SLEEP
JOURNAL OF SLEEP AND SLEEP DISORDERS RESEARCH
Volume 39, 2016 | Abstract Supplement

Official publication of the Associated Professional Sleep Societies, LLC. A joint venture of the American Academy of Sleep Medicine and the Sleep Research Society.

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ANNUAL SUBSCRIPTION RATES: Subscription rates for Volume 39, 2016: Individual Online (US and International): $225.00; Institutional Online (US and International): $425.00. Prorated subscriptions are not available. Subscriptions begin with the January issue of the current year. Renewals should be secured as early in the year as possible to avoid uninterrupted service. Questions about subscriptions (including payments, billing procedures, or policy matters) should be directed to the ASPS office at (630) 737-9700.

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EDITORIAL

Welcome to your first glimpse of SLEEP 2016, the 30th Anniversary Meeting of the Associated Professional Sleep Societies, which will be held in Denver, Colorado on June 11–15, 2016. This year marks 30 years of the SLEEP meeting—the largest gathering of sleep medicine physicians, sleep researchers, and allied sleep professionals. The field of sleep medicine has come a long way in 30 years; this publication shows not only what we’ve accomplished, but where we are headed.

This abstract supplement unites SLEEP, and the science of SLEEP 2016. All abstracts presented at SLEEP 2016 held June 11–15, 2016, in Denver, Colorado are included in this special issue. This year, 1,149 abstracts will be presented at the meeting. 196 will be presented in an oral presentation format, and the remainder will be presented in a poster format. New this year, many of the authors of oral presentations will also be presenting their science in the poster hall, providing additional dedicated time to network with the authors of these important studies. In addition, this abstract supplement contains case reports submitted by individuals in training programs. At the meeting, trainees will also be presenting their latest research in the poster hall, however, the abstracts for those presentations are not included in this supplement.

Abstracts in this supplement are divided between basic and clinical sleep science and then assigned to one of 24 subcategories. Each abstract has a unique four-digit number to facilitate identification and location both within this issue and at SLEEP 2016. The four-digit number in the abstract supplement matches the four-digit code published in the SLEEP 2016 Mobile App, available in May 2016.

The SLEEP meeting fosters an environment in which members and attendees obtain education on the latest basic, translational and clinical science and technologies, which will further promote the continued growth of the field through the dissemination of new knowledge. We look forward to sharing in the success of this pivotal event and hope you consider joining the American Academy of Sleep Medicine and Sleep Research Society in Denver, Colorado in June!

Ronald Szymusiak, PhD
Editor-in-Chief
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A. Basic Sleep Science

0001
SLEEP ARCHITECTURE PREDICTS LIFESPAN AND BIOLOGICAL DIFFERENCES IN DROSOPHILA
Fiebelman C, Olbricht G, Wang L, Samaranayake V, Thimgan M
Missouri S&T, Rolla, MO

Introduction: Sleep architecture has been associated with health outcomes. Consolidated sleep typically predicts better health while fragmented sleep is associated with health problems. To determine if sleep architecture relates to health in Drosophila, we monitored sleep and wake transitions over the flies’ lifetime and developed a statistical model that describes the lifespan of the fly solely from sleep characteristics.

Methods: Drosophila activity was monitored using the Trikinetics system and converted to sleep using a custom made program. Both regression and artificial neural network statistical models to estimate lifespan were generated from solely from 19 daily sleep architecture variables. Furthermore, data were then truncated at 30 days to see if the regression-based models could predict lifespan in flies. Glutathione levels were determined using high pressure liquid chromatography.

Results: Statistical models derived from a lifetime of sleep and wake transitions were used to estimate lifespan in multiple genotypes and genders. Estimated lifespan correlated to actual lifespan with an R² between 0.6 and 0.8 depending on genotype and gender. We focused on wild-type males, which exhibited an R² = 0.72. We then determined if we could predict lifespan using only the first 30 days’ worth of sleep data. Regression-based models accurately identified short-lived and long-lived flies at 30 days of age as there was no misclassification between the two groups. We then found a biological difference in which the antioxidant, glutathione, was increased in the bodies of long-lived flies compared to short-lived flies.

Conclusion: These results demonstrate that we can use sleep-wake transitions to estimate and predict lifespan in flies. We have found that glutathione levels are lower in the bodies of predicted shorter lived flies. Moreover, we can use this technique to test for markers of biologically aged animals that are the same chronological age.

0002
THE NAD+ PRODRUG NMN INCREASES SLEEP TIME IN CLOCK MUTANT AND WILD-TYPE MICE
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Introduction: Previous studies in our laboratory on mice with the mutant-induced D19 mutation of the Clock gene revealed a significant reduction of sleep time, particularly in NREM sleep (Naylor et al., 2000). Subsequent studies have revealed significant alterations in metabolism including the NAD+ pathway and amplitude of molecular circadian clocks arising from this mutation. To assess whether NAD+-sirtuin pathways may represent a common link among these phenotypes, we tested whether the NAD+ increasing drug, nicotinamide mononucleotide (NMN) could affect sleep in mice.

Methods: C57BL/6J homozygous Clock D19 mutant and wild-type male mice were produced at Northwestern University from heterozygote X heterozygote breeding. Mice were maintained on a 12:12 Light:Dark cycle with regular Chow (6% calories from fat) available ad libitum. At 12 weeks of age, Clock mutant and wild-type mice were surgically implanted, under ketamine/xylazine anesthesia, with electroencephalogram (EEG) and electromyogram (EMG) electrodes for recording of sleep-wake states. Ten days post-surgery, a 48-hour baseline period was recorded. Vehicle or NMN was injected (500mg/kg) daily for five days, and a second undisturbed 48-hour period was recorded. Sleep-wake states and EEG power spectrum were scored and quantified as described previously (Jiang et al., 2015).

Results: NMN increased NREM sleep time and reduced wake time by over two hours in both genotypes. No significant alterations in EEG power spectrum, REM time, or sleep fragmentation measures were observed in either genotype.

Conclusion: These findings suggest a role for NAD+ in the regulation of sleep. NAD+ amplitude may represent a molecular link between sleep and metabolic disturbances in the Clock mutant mouse. Additional studies will evaluate the role of NAD+ in sleep homeostasis.

Support (If Any): V.D.G. is supported by NIH T32 HL 007909. F.W.T., J.T.B. and M.H.V. are supported by NIH P01 11412.

I. Molecular Biology and Genetics

0003
NONINVASIVE SLEEP MONITORING IN LARGE SCALE SCREENING OF MOUSE KNOCKOUTS (KOMP2) PRODUCES HIGH HIT RATE WITH IMPLICATIONS FOR SLEEP AND BEHAVIORAL STUDIES
Sethi M1, Joshi SS1, Striz M1, Cole N1, Ryan J1, Lhamon ME1, Agarwal A1, Sukoff Rizzo SJ1, Denegre JM1, Braun RE1, Fardo DW1, Donohue KD1, Chesler EJ1, Svenson KL1, O’Hara BF1
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Introduction: Genomic manipulations can aid in identifying genes that influence sleep and hence may provide insight into functions and regulation of sleep. Our current study employs a non-invasive, high throughput piezoelectric system to characterize sleep-wake phenotypes in a large population of control and single-gene knockout mice; recorded as part of the Knockout Mouse Phenotype Program (KOMP2) at the Jackson Laboratory (JAX).

Methods: Knockout mice (15 weeks) generated on a C57BL6/NJ (BL6/NJ) background were phenotyped for sleep-wake parameters as part of the phenotyping pipeline at JAX for 5 days under 12:12 LD conditions using a non-invasive Piezoelectric system and compared to control BL6/NJ. The system consists of a sensor pad on the bottom of the mouse cage that records gross body movements. The pressure signals thus generated are classified by an automated classifier into sleep and wake. The system characterizes traits that range from sleep time over 24 hours, as well as during the light and dark phase, and distribution of sleep bout lengths. The piezoelectric system has been validated with EEG and human observations, and demonstrates a classification accuracy of over 90%. Thus far, we have recorded over 5000 mice representing 300 knockout lines, and more than 1200 controls, both males and females. The number of animals in each of the 300 knockout mouse groups ranges from 4-17. Breath rate was also assessed utilizing the piezoelectric system.

Results: More than 40 of the 300 knockout lines compared to control mice demonstrated altered sleep phenotypes. Additionally, sex differences were also found for many of the knockout mouse strains and control mice. C57BL6/NJ female mice exhibited shorter bout length and less total sleep compared to males. Several genes were also found that alter the breathing rate.

Conclusion: A number of novel genes influencing multiple sleep traits have been identified thus far, and these data will also be compared and correlated with non-sleep traits.

Support (If Any): NIH Grant OD011185 and NIH Grant HG006332
**0004**

**CORRELATING GENE EXPRESSION WITH COGNITIVE IMPAIRMENT DURING TOTAL SLEEP DEPRIVATION**

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**Introduction:** No reliable method is available to rapidly assess impairment from sleep loss. Gene expression levels responding to sleep deprivation may provide a useful diagnostic. We hypothesized that we could associate gene expression with cognitive impairment during sleep deprivation.

**Methods:** Healthy young adults (7 females, 10 males; 22-40 y) remained in a sleep laboratory for 6 days. They received two nights of baseline sleep (10 h time in bed; TIB). This was followed by 62 h total sleep deprivation (n = 8) or equivalent control (10 h TIB each night; n = 6). Finally, subjects received two nights of recovery sleep (10 h TIB).

**Results:** On average, PVT lapses in individuals subjected to total sleep deprivation more than tripled during hours 24-36 of extended wakefulness relative to baseline and relative to controls. Total sleep deprivation, as compared to control, was associated with differential expression of over 200 genes. Approximately 30 genes had expression levels that tracked PVT scores, with most decreasing their expression as performance declined. Differential expression and weighted gene co-expression network analyses revealed an association of cell cycle regulators with PVT performance. Many genes involved in the immune response also responded to sleep deprivation, including immunoglobulins and cytokine receptors.

**Conclusion:** We found new candidate biomarkers for tracking cognitive impairment resulting from total sleep deprivation. We also discovered gene expression networks affected by total sleep deprivation. Important future steps will include accounting for circadian rhythm.

**Support (If Any):** Research was supported by FAA grant DTFAAC-11-A-00003 and NIH grant R01HL105768.

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**0005**

**T CELL RECEPTOR SEQUENCING IN NARCOLEPSY**


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**Introduction:** Narcolepsy is a neurological disorder, which causes sleepiness, cataplexy and abnormalities in sleep-wake regulation. The cause of narcolepsy is loss of hypocretin producing neurons. There are strong indications of an autoimmune basis of narcolepsy. After association to HLA DQBI 06:02, strongest known genetic association to narcolepsy is rs1483979, a nonsynonymous SNP affecting the structure of the peptide binding groove of T cell receptor (TCR). Our aim was to study the effect of the TCR repertoire on narcolepsy and flu response.

**Methods:** We performed next generation RNA sequencing using Illumina HiSeq2000 platform in various T cell populations in narcolepsy cases and HLA DQBI*06:02 positive controls. The effect of seasonal flu vaccine on TCR repertoire before vaccination and after vaccination was studied in vivo.

**Results:** We detected that the TCR repertoire was shaped by the genetic risk background of the subject. Individuals carrying rs1483979 F allele had less unique CD4+ TCR clones than those carrying rs1483979 L (P < 0.001).

**Conclusion:** These findings suggest that the polymorphisms that predispose to narcolepsy alter the TCR repertoire, which may lead to increased narcolepsy susceptibility.

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**0006**

**GENOME-WIDE ASSOCIATION STUDY IDENTIFIES NOVEL GENETIC LOCI IN NARCOLEPSY**

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**Introduction:** Type 1 Narcolepsy is characterized by sleepiness, REM sleep abnormalities and loss of muscle tone triggered by positive emotions (cataplexy). The cause of type 1 narcolepsy is a loss of neurons producing the hypocretin/orexin peptide of likely autoimmune origin. Narcolepsy is strongly associated with Human leukocyte antigen (HLA) DQBI*06:02, with 98 percent of narcoleptics carrying this allele. Our aim was to further study genetic predisposition to narcolepsy and to determine if other HLA alleles also affect predisposition for narcolepsy.

**Methods:** We performed GWAS in Asian, African American and Caucasian samples including 5,000 cases and 30,000 controls. Regulatory effects of the top findings were examined using data from the ENCODE and GTEx consortiums. In addition, direct (subsample) genotyping and HLA imputation at high resolution (8-digit) was performed using HIBAG. Case control matching and conditional analyses were performed.

**Results:** In addition to well-known DQB1 effects, HLA-DPA1*01:03~DPB1*04:02 was highly protective, while other alleles at DPB1 and HLA-Class I increased susceptibility. We confirmed existing risk associations and also found significant SNP associations with eight novel genetic loci that predisposed to narcolepsy: CLEC4F/CD207, SIRPG, PPR2R2C, ZFAND2A, ZNF385C, LPP, LOC105373646 and PRF1. Interestingly, PRF1 is expressed in cytotoxic T cells and natural killer cells that may regulate hypocretin cell death. Also, the majority of other novel loci are either shared with other autoimmune diseases or are known regulators of immune responses. Functional studies suggest that the signals from CD207, SIRPG and PRF1 were mediated by direct nonsynonymous mutations changing protein function. In addition, risk variants had additional regulatory effects for gene expression.

**Conclusion:** The results highlight both the importance of HLA in narcolepsy and the effect of individual risk variants. The novel loci may explain how hypocretin cells are destroyed and support a T cell mediated autoimmune attack in narcolepsy susceptibility.
SINGLE AND MULTI-TRAIT GWAS IN THE UK BIOBANK IDENTIFY NOVEL LOCI FOR SLEEP QUANTITY, DISRUPTION AND SLEEPINESS, HIGHLIGHTING SHARED BIOLOGY WITH NEUROPSYCHIATRIC TRAITS


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Introduction: Sleep disturbances chronically affect 50-70 million US adults and are associated with higher risk for cardiometabolic diseases, mood disorders, and all-cause mortality. A wide range of variation exists in sleep duration, timing and quality that could be explained by genetic differences in sleep or circadian regulation, environmental factors, age, sex, ethnicity and/or co-morbidities. Identifying the genetic basis for differences in self-reported habitual sleep quantity and quality should lead to better understanding of sleep function and causal relationships linking sleep to disease with clinical translation.

Methods: We performed genome-wide association analyses of self-reported sleep duration, sleep disruption and daytime sleepiness in >100,000 subjects of European ancestry in the UKBiobank. We measured heritability and performed association tests adjusting for age, sex, ancestry and genotyping array (> 39 million variants). A multi-trait GWAS of correlated sleep duration, timing and quality traits was performed to enhance power. Gene-based association tests, follow-up gene-set analysis, heritability partitioning across tissues and functional classes and pair-wise genetic correlation analyses to 19 traits were also performed.

Results: We identified genome-wide significant (p < 5x10-8) and suggestive (p < 5x10-7) loci associated with sleep quantity (5 loci, including replication of PAX-8) and disruption (5 loci including MEIS1), daytime sleepiness (7 loci). Six genome-wide significant loci were discovered by multi-trait analyses, 2 of which were not found by single-trait analysis (near INADL and HCRTR2). Loci were enriched for transcription factor binding sites, including MEIS1 binding sites (6 fold enrichment in sleep duration, p = 0.0096). Significant genetic correlation was observed between long sleep duration and schizophrenia (r2 = 0.29, p = 1.90x10-13) and between daytime sleepiness and metabolic disorders (BMI r2 = 0.199, p = 3.12x10-09; waist circumference r2 = 0.199, p = 2.12x10-07).

Conclusion: These results provide novel biological insights into regulation of sleep quantity and quality, reveal shared underlying biology with health and disease, and offer potential new therapeutic avenues for sleep disorders and co-morbid conditions.

Support (If Any): This work was supported by NIH grants R21HL121728 (RS), F32DK102323 (JML), R01HL113338 (JML, SR, and RS), The University of Manchester (Regional Innovation Funding) and UK Medical Research Council MC_UU_12013/5 (DAL).

TRANS-ETHNIC META-ANALYSIS IDENTIFIES SEX AND SLEEP STATE-SPECIFIC GENETIC ASSOCIATIONS WITH OBSTRUCTIVE SLEEP APNEA SEVERITY


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Introduction: Obstructive sleep apnea (OSA) is a common disorder with significant heritability. The apnea hypopnea index (AHI) displays heterogeneity across ethnicity and sex. There has not been a multi-ethnic genome-wide association analysis to identify variants for the AHI, which includes differential physiological components within NREM and REM. We performed trans-ethnic meta-analyses to identify genetic associations with the AHI, considering REM-, NREM-, and sex-specific indices.

Methods: Genome-wide genotypes from as many as 19,733 participants of African-, Asian-, European-, and Hispanic/Latino-American ancestry from seven studies were tested for association with each trait and results were meta-analyzed. We adjusted for age, sex (when appropriate), BMI, population structure, and relatedness. Genotypes were imputed using a 1000 Genomes Project template excluding MAF < 1% and poorly-called genotypes. Additive genetic model tests using inverse-normal rank-normalized AHI values were performed using mixed linear model programs. A fixed effect, inverse variance weighted meta-analysis was performed using METAL with genomic control applied. European-American analyses were performed to identify associations that are heterogeneous across populations. Gene expression data were obtained from GTEx, Geuvadis, and a seven-cohort consortium (Westra, 2013).

Results: Two regions included polymorphisms that reached genome-wide significance: rs12936587 (Retinoic Acid-Induced 1; AHI in NREM in male-specific traits-ethnic analyses, p = 1.66x10-8, I2 = 0, p [sex interaction] = 1.51x10-5), and rs11690925 (Crystallin Gamma-E Pseudogene; AHI in REM in European-American females, p = 2.37x10-8, p [sex interaction] = 3.94x10-4, I2 = 45.5). 71 polymorphisms with p < 1x10-6 were associated with mRNA expression levels differences of 29 genes. rs12936587, previously associated with coronary artery disease, was associated with mRNA expression levels differences of nearby genes implicated in Potocki-Lupski Syndrome, Smith-Magenis Syndrome, and lipid metabolism effects of intermittent hypoxia.

Conclusion: These findings identify a SNP previously associated with an OSA comorbid disorder as a candidate for functional studies.

Support (If Any): R01-HL113338-04, T32-HL007901-16
PHARYNGEAL CONSTRICTOR MUSCLE FATTY CHANGE MAY CONTRIBUTE TO OBSTRUCTIVE SLEEP APNEA-HYPOPNEA SYNDROME: A PROSPECTIVE OBSERVATIONAL STUDY
The first affiliated hospital of Dalian Medical University, Dalian, China

Introduction: Obstructive sleep apnea-hypopnea syndrome (OSAHS) is a respiratory disorder caused by upper airway obstruction during sleep which contributes to the development of apnea and hypopnea. Increased fat tissue surrounding the upper airway can affect airway muscle activity. Obese individuals have a tendency to develop airway collapse. Zohar et al. suggested that excessive pharyngeal fatty infiltration plays a role in upper airway obstruction in patients with OSAHS, and that such infiltration can be associated with the development of apnea. Deposition of adipose tissue in the upper airway contributes to the collapsibility of the retropalatal and retroglossal airways. The primary objectives of this study were to determine the ultrastructural characteristics of the pharyngeal constrictor muscles in patients with OSAHS and evaluate the role of pharyngeal constrictor muscle injury in the pathogenesis of OSAHS. We hypothesized that: 1) pharyngeal fat deposition in muscle cells (internal pharyngeal muscle fat) would be higher in skeletal muscle of patients with OSAHS; 2) the degree of steatosis in pharyngeal muscle would be as positively correlated with the severity of OSAHS. We employed electron microscopy to study the ultrastructure of skeletal muscle cells. Increased lipid droplet accumulation was observed in the skeletal muscle cells of the upper airway in patients with OSAHS. The findings of this study provide a new structural basis for future clarification of the pathogenesis of OSAHS.

Methods: A pharyngeal constrictor muscle specimen was collected from all subjects. The muscle cell ultrastructure was observed under electron microscopy.

Results: Eighteen male patients with OSAHS (OSAHS group) and 10 male body mass index-matched patients with chronic tonsillitis (control group) were enrolled in this study. All patients were obese adults. The apnea-hypopnea index (41.22 ± 17.29 vs. 2.30 ± 1.10 events/h) was significantly higher and the lowest arterial oxygen saturation (76.00 ± 8.57% vs. 97.00 ± 2.00%) was significantly lower in the OSAHS group than in the control group (both p < 0.001). Myofibril disorder, mitochondrial edema, and intramyocellular lipid droplets were observed in patients with OSAHS. There was a significant correlation between the number of lipid droplets and the apnea-hypopnea index.

Conclusion: Pharyngeal constrictor muscle injury and fatty changes may play important roles in the pathogenesis of OSAHS.


CYSTEINE-GLUTAMATE ANTIPORTER XCT KNOCKOUT CORRELATES TO CHANGES FROM BASELINE IN RESPIRATORY PATTERN DURING SLEEP IN MICE
Walsh RW, Topchiy I, Carley D, Featherstone D

Introduction: XCT is a glial transport protein responsible for most ambient extracellular glutamate in the brain. Increasing evidence suggests that ambient extracellular glutamate functions as a powerful regulator of glutamatergic synaptic transmission. However, the conditions under which this regulation occurs remain poorly understood. One possibility is that XCT function is particularly important during sleep, when there is increased infusion of XCT-derived glutamate from cerebrospinal fluid into the brain parenchyma.

Methods: To determine whether XCT plays an important role in regulation of sleep, 8 adult male xCT -/- and 9 control (C57BL/6J) mice were instrumented for chronic sleep monitoring. Cortical EEG, nuchal EMG and respiration were recorded during sessions with a minimum time of 6 hours. Respiration was registered by whole-body plethysmography. Signals were amplified, filtered (EEG: 1-100 Hz, EMG: 10-100 Hz; respiration: 1-15 Hz) and digitized (256/s). Apneas were assessed as two or more “missed” breaths. Data were pooled and unpaired T-tests were performed to compare xCT -/- and control mice.

Results: Sleep architecture was equivalent between the 2 strains in terms of total sleep time, sleep efficiency, sleep–stage percentages and number of NREM and REM sleep bouts (p > 0.20 for each). In contrast, the xCT mice demonstrated far greater sleep disordered breathing than did the wild type controls, with apnea indexes of: 69.4 ± 10.2 versus 6.3 ± 3.0 (p = 0.0002) overall; 71.3 ± 10.7 versus 8.9 ± 3.2 (p = 0.0002) in NREM; and 48.3 ± 13.1 versus 0.8 ± 0.5 (p = 0.06) in REM.

Conclusion: We conclude that XCT regulates respiratory pattern variability during sleep and suppresses sleep apnea, presumably by regulating glutamatergic synaptic transmission.

EXTRACELLULAR SIGNAL-REGULATED KINASE (ERK) SIGNALING IN THE PEDUNCULOPONTINE TEGUMENTUM (PPT) AND HOMEOSTATIC REGULATION OF REM SLEEP
Datta S, Garner J, Koul-Tiwari R, Barnes A

Introduction: Recently we have shown that homeostatic regulation of REM sleep involves increased BDNF signaling in the pedunculopontine tegmentum (PPT). We have also shown that the activation of extracellular signal-regulated kinase (ERK) signaling in the PPT suppresses wakefulness, and is therefore involved in the maintenance of sleep. It is also known that activation of intracellular ERK increases BDNF signaling in the brain through a positive feedback loop. Therefore, in this study we have tested the hypothesis that the ERK signaling in the PPT is involved in the homeostatic regulation of REM sleep.

Methods: 30 adult male Sprague-Dawley rats (5 groups; 6 animals/group) were implanted with sleep-wake recording electrodes and bilateral guide tubes for local microinjection of ERK antagonist (U0126)
### A. Basic Sleep Science

**Multivariate Analysis of Insomnia Symptoms in Children with Autism Spectrum Disorder Reveals Connection with Constipation and Attention Deficit Disorder**

Veatch OJ, Sutcliffe JS, Warren ZE, Potter MH, Malow BA

1. Molecular Biology and Genetics

**Introduction:** Insomnia is common in individuals with autism spectrum disorder (ASD), indicating a connection between genes increasing risk for ASD and those involved in sleep regulation. Overwhelming evidence suggests genetic susceptibility factors underlying ASD, and that the wide variability in symptomatology is explained by genetic heterogeneity. Identifying individuals with co-occurring insomnia may detect clinically relevant genetic mechanisms in ASD. Conducting multivariate analyses of sleep in individuals with ASD could identify subgroups expressing insomnia and reveal genetically meaningful connections between insomnia symptoms and ASD.

**Methods:** Cluster analysis was conducted on five questions specific to insomnia included in the medical histories of 2,708 children with ASD. Input variables included responses related to whether the child had difficulty going to bed, falling asleep, frequent or prolonged night wakings, sleepwalking or nightmares, and/or needed a parent in order to sleep. Differences between mean sleep durations reported for individuals assigned to distinct clusters were then determined. In experiment 2, the level of phosphorylated ERK (pERK) expression and ERK activity in the PPT was measured.

**Results:** The results of this study demonstrated that the levels of pERK expression and ERK activity in the PPT were increased with increased REM sleep homeostatic drive. Microinjection of ERK antagonist attenuated RSD-induced pERK expression and ERK activity in the PPT, and suppressed REM sleep homeostatic drive.

**Conclusion:** These results suggest that activation of the ERK signaling pathway in the PPT plays a critical role in the development of homeostatic drive for REM sleep.

**Support (If Any):** NIH Grant MH59839 (SD).

### I. Molecular Biology and Genetics

**0012**

#### Multivariate Analysis of Insomnia Symptoms in Children with Autism Spectrum Disorder Reveals Connection with Constipation and Attention Deficit Disorder

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**Introduction:**

Insomnia is common in individuals with autism spectrum disorder (ASD), indicating a connection between genes increasing risk for ASD and those involved in sleep regulation. Overwhelming evidence suggests genetic susceptibility factors underlying ASD, and that the wide variability in symptomatology is explained by genetic heterogeneity. Identifying individuals with co-occurring insomnia may detect clinically relevant genetic mechanisms in ASD. Conducting multivariate analyses of sleep in individuals with ASD could identify subgroups expressing insomnia and reveal genetically meaningful connections between insomnia symptoms and ASD.

**Methods:**

Cluster analysis was conducted on five questions specific to insomnia included in the medical histories of 2,708 children with ASD. Input variables included responses related to whether the child had difficulty going to bed, falling asleep, frequent or prolonged night wakings, sleepwalking or nightmares, and/or needed a parent in order to sleep. Differences between mean sleep durations reported for individuals assigned to distinct clusters were then determined. In addition, the proportion of individuals with sleep problems, and other comorbidities were compared between clusters. Finally, the proportion of individuals with exonic mutations in two melatonin pathway genes (ASMT and CYP1A2), implicated in risk for both ASD and insomnia, was compared between clusters.

**Results:**

Clustering identified two distinct groups of individuals with ASD. Cluster 1 included 1,898 individuals and Cluster 2 included 810 individuals. The largest difference between the clusters was related to difficulty falling asleep, followed by whether or not the child needed a parent in order to fall asleep, difficulty going to bed, and frequent or prolonged awakenings. The presence of sleepwalking or nightmares also defined some of the cluster differences; however substantially less than other questions of interest to insomnia. Individuals in Cluster 2 had more sleep problems and shorter sleep durations than those in Cluster 1. Interestingly, more individuals in Cluster 2 had constipation and/or attention deficit disorder (ADD). There was no difference between the proportions of individuals with mutations in either candidate gene between clusters.

**Conclusion:**

Presence of insomnia was related to the presence of two other genetically meaningful comorbidities in ASD, ADD and constipation. While we did not observe a difference in mutations in the two candidate genes assessed, it is possible that these clusters represent genetically distinct ASD subsets. We are currently evaluating potential genetic differences between insomnia and non-insomnia clusters in more genes known to affect sleep patterns.

**Support (If Any):** The Simon’s Foundation and the Burry family endowment.

**0013**

#### Genome-Wide Analysis Identifies Novel Loci for Chronotype and a Causal Relationship with Educational Attainment


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**Introduction:** Our chronotype is a natural manifestation of our internal biological clock and is influenced by age, sex, environment, genetics, and other biological factors. Chronotype is associated with sleep disorders, cognitive and physical performance, chronic metabolic and neurologic disease, particularly when there is circadian desynchrony between internal and external timing. Although chronotype is highly heritable, there have been few large scale studies that have examined the genetic and environmental variants that influence inter-individual variation in human chronotype and which have interrogated causal pathways.

**Methods:**

Using self-reported sleep timing preference (chronotype) and genetic information from 100,420 subjects of European ancestry from the UK Biobank, we performed a genome-wide association study. Chronotype was reported as “definite morning”, “more morning than evening”; “more evening than morning” and “definite evening” preference. We measured heritability and performed single variant association tests adjusting for age, sex, principal components and genotyping array (n = 39,025,120 variants). Follow up analyses included gene-based association tests, gene-set analysis, heritability partitioning across tissues and functional classes, pair-wise genetic correlation to 19 traits.

**Results:**

We identified 12 genetic loci, of which 9 are novel and 5 are in or near a gene with an established role in circadian rhythms. The 12 loci account for 4.3% of chronotype variation, and genome-wide
This work was supported by NIH grants R21HL121728 (RS), F32DK102323 (JML), R01HL113338 (JML, SR, and RS), The University of Manchester (Regional Innovation Funding) and UK Medical Research Council MC_UU_12013/5 (DAL).

0014
GENETIC LOCI IN PERIODIC HYPERSOMNIA/KLLEIN-LEVIN SYNDROME TYPE

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Introduction: Kleine-Levin Syndrome (KLS) is a rare sleep disorder that affects ~1 person in a million and has been suggested to be more frequent in Ashkenazi Jewish. The disorder typically strikes adolescent males and improves with age, often resolving by age 30. KLS, patients have recurrent episodes sometimes lasting up to several weeks where they sleep nearly 24 hours per day. While awake, patients during episodes experience apathy, cognitive disturbances and occasionally hyperphagia and/or hypersexuality. Between episodes, patients are totally normal. Our aim was to identify genetic variants that contribute to KLS predisposition.

Methods: As a part of an international collaboration we performed GWAS on 650 KLS cases and 30,000 controls. The sample comprised KLS cases and matched controls from United States, Europe and Asia and additional controls from the GERA consortium. Genotyping was done using Affy 6.0 and Affymetrix Axiom World Array with ethnicity specific platforms that were imputed to 1000 genomes. Analyses were controlled for population stratification and ethnicity (Caucasian, Ashkenazi Jewish, Asians, other).

Results: Genome-wide significant loci were found near TRANK1. Most interestingly, the leading TRANK1 variant is also reported in other GWAS for bipolar disorder.

Conclusion: The findings give the first biological evidence for disease mechanisms in KLS. Importantly, these results suggest a partially overlapping genetic composition for schizophrenia and KLS. That these patients are not primarily depressed or psychotic during episodes and they completely reverse to normality between episodes could suggest important pathophysiological clues linking sleep and episodic psychiatric conditions.

0015
EXOME SEQUENCING STUDY ON RARE SLEEP PHENOTYPES

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Introduction: Sleep is a highly heritable trait. Indeed, mutations in the DEC2 and PER2 genes were successfully identified in families of short sleep and advanced sleep phase, respectively. Exome sequencing offers a new approach to help identify high effect genetic mutations which contribute to sleep phenotypes. We collected DNA samples from individuals with several sleep traits and performed exome sequencing to look for potential mutations in novel and existing sleep and circadian related gene loci.

Methods: We performed exome sequencing using the Illumina NGS platform on individuals with rare sleep phenotypes, which include hypersomnia with long sleep time, high delta power on PSG, and very short sleepers on weekend. We sequenced 3 unrelated individuals with each of these phenotypes. Exome sequencing data were then analyzed focusing on variants with a low minor allele frequency (<0.01 in the normal population) to help search for potential genetic mutations associated with these phenotypes.

Results: Preliminary analysis identified candidate genetic mutations/variants in each of the sleep phenotypes. The 3 individuals with hypersomnia with long sleep time share missense SNPs in the TLN2 and protocadherin alpha 1 (PCDH1A1) genes. For the 3 individuals with high PSG delta power, missense SNPs in the MUC4 and ZAN genes were identified. In addition, for the 3 individuals with very short weekend sleeper duration, missense SNPs in the CPD gene were identified. The significance of these results is uncertain. No mutations in known sleep and circadian genes were identified.

Conclusion: In this pilot exome sequencing work, we identified possible candidate genetic variants that are associated with 3 sleep phenotypes. It is unclear which, or any, of these candidate variants play a role in the associated phenotypes. Further studies on these candidate variants in a larger sample size will be required to confirm their relevant effects.

Support (If Any): Sleep and Genetics NIH T32 Grant NIH P50 Center For Narcolepsy And Related Disorders grant 5P50NS023724

0016
SYSTEMS BIOLOGY OF OBSTRUCTIVE SLEEP APNEA


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Introduction: Although obstructive sleep apnea (OSA) is known to occur more frequently among patients with metabolic syndrome (MS), the functional relationship between OSA and MS remains unclear. Therefore, we aimed to traverse the genetic-association between OSA and MS using A systems biology approach.

Methods: Candidate genes for OSA and MS were extracted from Comparative Toxicogenomics Database (http://ctdbase.org/help/goDisease). Overlapping genes associated with OSA and MS were then assembled by Functional Enrichment analysis tool (FunRich), and their biological functions were identified using the Gene Ontology (GO) approach with the Protein ANalysis THrough Evolutionary Relationships (PANTHER) tool. GO uses structured controlled vocabularies (ontologies)
to describe key characteristics of a gene product, including: (1) molecular function/activity, (2) biological processes it is involved in, and (3) cellular components where it is located.

Results: Of the genes associated OSA (6,586) and MS (15,228), 5,322 (81%) OSA genes overlapped between the conditions. GO analyses revealed that these genes were often associated with metabolic diseases (25.3%), inflammation/oxidative stress (13.6%), neurotransmitter regulation (12.8%), behavior/cognitive function (8.9%), and neurodegenerative diseases (4.8%). The remaining 34.7% were associated with other biological functions (i.e., cellular processes, homeostasis and reproduction, etc.).

Conclusion: The vast majority of OSA-related genes were also associated with MS, supporting the practice of screening for OSA among individuals with MS. Future lifestyle intervention programs for chronic care management should also focus on sleep as an interventional component to attain maximum benefits.

Support (If Any): This is supported by the NIH (5R01NR008792 and R01MD007716)

0017 DETERMINANTS OF THE VARIABILITY IN THE HYPOXIC AND HYPERCAPNIC VENTILATORY RESPONSES
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Introduction: A number of genes associated with the retrotrapezoid nucleus (RTN) and carotid bodies contribute to the chemoautonomic response to hypercarbia and hypoxia. However, a recent study revealed a potential association of the human leukocyte antigen (HLA) allele DQB1*06:02 with the hypoxic ventilatory response (HVR), but not the hypercapnic ventilatory response (HCVR) in an Asian population. This study sought to explore what factors influence variation in HVR and HCVR in a population of Caucasians and Asians.

Methods: 551 young adults (38.7% male; mean age 24 ± 7) had HVR and HCVR assessments via a re-breathing system. HLA-DQB1*06:02 and tagged polymorphisms/coding variants in genes participating in breathing (PHOX2B, HIF1A, GPR4, and TASK2/KCNK5) were analyzed for associations with HVR and HCVR variability. Gender associations were assessed using ANOVA. Genetic associations were assessed with SNPTEST v2.5 using frequentist testing.

Results: HVR (0.276 ± 0.168 in women vs 0.429 ± 0.266 L/min/%SpO2 in men; p < 0.001), but not HCVR, showed a strong correlation with gender. Women also had lower baseline minute ventilation (8.98 ± 2.36 vs. 10.00 ± 3.43 L/m, p < 0.001), higher SpO2 (98.0 ± 1.3% vs. 96.6 ± 1.7%, p < 0.001), and lower EtCO2 (4.65 ± 0.68 vs. 4.82 ± 1.02, p = 0.025). No association was seen between HLA-DQB1*06:02 and HVR or HCVR. Preliminary genetic analysis suggested a pointwise association between two TASK2/KCNK5 variants (rs2815118 and rs150380866) and HCVR.

Conclusion: This is the largest study to date reporting the relationship between gender and HVR/HCVR and the first study assessing the association between genetic polymorphisms in humans and HVR/HCVR. The data suggest gender has a large effect on HVR. Preliminary, focused genetic investigations did not achieve significance, presumably due to allelic frequency (only 5 of the 98-subject Asian subgroup were HLA DQB1*06:02 positive). The genome-wide association study followed by pathway analysis on imputed genotype data will help confirm the suspected genetic associations and biochemical mechanisms of the variability in chemoautonomy.

Support (If Any): 5T32HL110952-03 multi-institutional training in genetic/genomic approaches to sleep disorders
A. Basic Sleep Science

0018
DIETARY PREBIOTICS AND BIOACTIVE MILK FRACTIONS SUPPORTS EARLY-LIFE NREM SLEEP QUALITY, REM REBOUND SLEEP RECOVERY FOLLOWING ACUTE STRESS AND AMELIORATES STRESS-INDUCED DECREASES IN ALPHA DIVERSITY IN THE RAT
Thompson RS1, Roller R1, Greenwood BN2, Knight R3, Chichlowski M4, Berg BM4, Fleshner M1
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Introduction: Stressor exposure produces anxiety/depression-like behaviors; disruptions in the sleep/wake cycle and gut microbial dysbiosis. Prebiotics, a form of non-digestible dietary fiber, can promote the expansion of specific microbial species in the mammalian gut that prevent stress-evoked anxiety and depression. In addition, bioactive milk fractions provide a variety of nutritional and immunological benefits. Thus we tested the hypothesis that a diet rich in prebiotics and bioactive milk fractions will produce an umbrella of stress resistance that includes maintaining of the normal sleep/wake cycle and gut microbial dysbiosis following stressor exposure.

Methods: Male F344 rats were placed on either a test diet or a control diet post weaning on postnatal day 24 (PND 24). On PND 59, biotelemetry devices were implanted to enable undisturbed, continuous sleep/wake EEG recordings. Fecal samples were collected on PND’s 35, 71 and 91. To determine if test diet protected stress-induced disruptions of the sleep/wake cycle, rats were exposed to an acute stressor on PND 87 and biotelemetric recordings continued to PND 94.

Results: Prior to stressor exposure, rats fed the test diet spent more time in NREM sleep and had greater NREM sleep consolidation in early adulthood (PND 71, 72) when compared to those on the control diet. In addition, rats fed the test diet also had more REM rebound recovery sleep during the first dark cycle following stressor exposure (PND 87) when compared to rats fed the control diet. Four days after stressor exposure (PND 91), rats fed control diet had reductions in fecal microbial alpha diversity (observed species, Shannon entropy and PD whole tree) and test diet prevented this effect. Finally, results from a stepwise multiple regression analysis revealed a significant relationship between Deferribacteres (PND 35) in early-life and longer NREM sleep episodes (PND 71, 72) later in life. These results demonstrate that the test diet improved NREM sleep, which may be dependent in part on reduced levels of early-life Deferribacteres; increased REM rebound recovery sleep and protected alpha diversity following stress exposure.

Conclusion: Our results suggest that dietary prebiotics and bioactive milk fractions improves early-life sleep quality that is related to changes in specific gut bacteria. In addition, early-life dietary prebiotics and bioactive milk fractions reduce stress-induced disruptions to the sleep/wake cycle and gut microbial dysbiosis. Thus early-life dietary factors can promote resistance to a broad spectrum of negative consequences of stress.

Support (If Any): Mead Johnson Pediatric Nutrition Institute

0019
DEVELOPMENTAL SLEEP FRAGMENTATION IMPAIRS SOCIAL DEVELOPMENT IN MALE, BUT NOT FEMALE, PRAIRIE VOLES
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Introduction: Consolidated sleep periods during development are critical for synaptic pruning of dendritic spines, a neuropathology observed in autism. Our hypothesis is that sleep modulates the development of social behavior. Prairie voles (Microtus ochrogaster) are a highly social rodent species that form lifelong pair bonds with other individuals, thus providing an ideal model organism to study the role of sleep in shaping social behavior and brain development.

Methods: We applied a unique method of chronic sleep fragmentation to prairie vole pups in their home cages with both parents during the third postnatal week of age, a sensitive period approximating the human infant period. Following developmental sleep fragmentation, adult voles underwent testing for social investigation, social memory, partner preference, circadian wheel running, and locomotor activity. Brains were extracted and processed for dendritic spine counting and parvalbumin immunoreactivity.

Results: Sleep-fragmented male prairie voles showed profoundly impaired pair bond formation as assessed by the partner preference test (p < 0.05) and hyperactive behavior (p < 0.05). Sleep fragmentation did not significantly alter social behavior in female prairie voles. This male bias is consistent with an increased prevalence of autism in males. However, as this method also affects the sleep of the parents, sleep-fragmented pups could have received different parental care compared to control subjects. To investigate this potential confound further, we quantified the parental behavior of both parents towards their pups during sleep fragmentation compared to control conditions. There were no significant differences between sleep-fragmented and control groups in the total amounts of parental care received by pups (p > 0.05).

Conclusion: These data suggest that consolidated sleep during a sensitive period of development is critical for normal social development in males. Ongoing studies are examining dendritic spine counting using Golgi staining and parvalbumin immunoreactive neuron counts. Results from these studies will enhance our understanding of modifiable risk factors, such as sleep, that may contribute to atypical development of the brain and social behavior.

Support (If Any): VA CDA # IK2 BX002712, the American Sleep Medicine Foundation, the Brain & Behavior Foundation (NARSAD), and the Portland VA Research Foundation

0020
EFFECTS OF NAPPING ON READING COMPREHENSION IN ADOLESCENTS EXPOSED TO SLEEP RESTRICTION
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Introduction: Sleep restriction impairs vigilance, working memory, and cognitive processing speed in adolescents. Few studies have examined the effects of short sleep on reading comprehension, which is a critical skill for academic success. We therefore assessed reading comprehension in adolescents before and after exposure to sleep restriction.

Methods: Participants aged 15-19 years (n = 57) completed a reading comprehension task after 2 nights of baseline sleep with 9h of time in bed (TIB), and after 4 nights of sleep restriction with 5h of TIB. During sleep restriction, subjects were randomly assigned to a 1-hour
daytime nap opportunity (n = 29) or remained awake throughout the daytime (n = 28). The reading comprehension task comprised 4 different types of sentences (20 sentences in each condition) that differed in their clause structure and syntactic ambiguity. Each sentence was immediately followed by a comprehension question that required a yes-or-no answer.

**Results:** During sleep restriction, comprehension accuracy for the two sentence types with higher or lower levels of syntactic ambiguity showed similar impairment in the nap and no-nap groups (mean ± SEM: nap group, -14.1% ± 5.4% and -3.1% ± 1.8%; no-nap group, -14.0% ± 5.4% and -3.9% ± 1.7%; P > 0.05 for main effect of group). For the two sentence types that were syntactically unambiguous, a significant main effect of napping was found (F = 12.3, P < 0.001); comprehension scores improved across test sessions for the nap group (+5.7% ± 1.5% and +4.9% ± 1.7%), but not for the no-nap group (-0.2% ± 1.3% and -1.4% ± 1.6%).

**Conclusion:** The improved accuracy in processing sentences with unambiguous syntax occurred only in sleep-restricted adolescents who napped during the daytime. These results suggest that obtaining adequate sleep is important for reading comprehension performance.

**Support (If Any):** National Medical Research Council, Singapore (NMRC/StaR/015/2013) and The Far East Organization

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**0021**

**GENETIC AND ENVIRONMENTAL INFLUENCES ON CHILDHOOD SLEEP AND SIBLING CONFLICT IN YOUNG TWINS**

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**Introduction:** Early sleep dysregulation has been shown to impact later sleep behavior, as well as cognitive and behavioral functioning. Important familial psychosocial factors, such as sibling relationships, may also contribute to sleep outcomes in childhood. Twin studies provide an optimal opportunity to estimate genetic and environmental contributions to family relationships and child sleep independently, as well as genetic and environmental covariance in the association between traits. As such, we examined (i) whether the heritability of sleep duration, sleep dysregulation, and daytime sleepiness changed over time (at 12 months, 30 months, and five years), and (2) whether there were concurrent phenotypic and behavior genetic associations between sibling conflict and child sleep duration and daytime sleepiness at five years in a longitudinal sample of 406 young twins.

**Methods:** Parents reported on all child sleep parameters at each assessment and sibling conflict at five years. Mixed model regression analyses and quantitative behavior genetic models (univariate and bivariate) were conducted to determine heritability of sleep parameters and estimate genetic and environmental contributions to sibling conflict and child sleep.

**Results:** Heritability of sleep duration and sleep regulation showed increases over time, which is consistent with research showing heritability of traits increase with age. Phenotypic associations showed greater sibling conflict at five years was associated with shorter concurrent child sleep duration ($β = -.41$, $p = .05$) and greater daytime sleepiness ($β = 1.02$, $p < .001$). Shared environmental factors also accounted for the greatest proportion of the covariance between sibling conflict and sleep duration and daytime sleepiness at five years.

**Conclusion:** These findings hold promise for sleep and sibling interaction interventions, including educating parents about fostering positive sibling relations and teaching caregivers to utilize specific parenting behaviors that may encourage better child sleep behaviors (e.g., establishing bedtime routines).

**Support (If Any):** NA

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**0022**

**A SLEEP STUDY BY TEENS FOR TEENS: EXPLORING SLEEP HYGIENE, SLEEP PATTERNS AND PRACTICES IN ADOLESCENTS**

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**Introduction:** The decline in optimal sleep duration among adolescents is well documented. Many factors may contribute to poor sleep duration, so it is important to understand the knowledge, patterns, and behavior about sleep among this population. This study investigated the (1) sleep patterns of adolescents on school days and weekends, (2) sleep knowledge and the extent of knowledge on sleep duration and (3) technology use.

**Methods:** 345 adolescents (age range: 13-18) attending a local high school in grades 9 and 11 were invited to participate in the study. Data collection was conducted from May 2015-June 2015 via an online survey platform. A subset of adolescents participated in a focus group (n = 6).

**Results:** 43% 9th grade males and 57% females and 47% 11th grade males and 53% females completed the survey. Participants completed the knowledge questions with 88% accuracy. Over one-third of 9th and 11th grade adolescents reported engaging in technology use before bed (39% and 36% respectively). 9th and 11th graders reported in short sleep duration during school days (86% and 84% respectively) and long sleep (< 10 hours) during the weekends (53% and 43% respectively). There were no significant differences between 9th and 11th graders. Using a semi-structured interview guide major themes in the focus group revealed that short sleep duration was related to fulfilling school assignments, preparation for college, and social media use. Finally, participants reported that sleep duration declined as they became older.

**Conclusion:** These findings suggest that adolescents engage in both short and long sleep. There is sufficient knowledge about sleep, but poor sleep practices and hygiene are prevalent. Sleep education in schools should take into consideration the varying degrees of sleep practices and hygiene and technology use.

**Support (If Any):** This work was supported by funding from NIH (K23HL125939)

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**0023**

**THE BENEFIT OF TESTING ON DECLARATIVE MEMORY PERFORMANCE IN ADOLESCENTS EXPOSED TO SLEEP RESTRICTION**

Yeo S, Lo JC, Lee S, Chee M, Gooley JJ
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**Introduction:** Sleep after learning facilitates consolidation of declarative memories. However, few studies have examined whether exposure to sleep restriction increases forgetting after items are learned. Here, we examined the potential benefits of napping and testing on declarative memory in adolescents who underwent sleep restriction.

**Methods:** In a between-subjects study, adolescents aged 15-19 years studied 40 photographs of animals that were paired with the names of different human diseases (e.g., bear:mumps). Following a night of 9h of time in bed (TIB; 11pm-8am), a cued-recall test was given for 20 of the items. This was followed by 5 nights of sleep restriction (5h TIB; 1am-6am) with either a 1-hour daytime nap opportunity (n = 29), or continuous daytime wakefulness (n = 28). After 2 nights of recovery sleep with 9h of TIB, cued-recall performance was assessed for all 40
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Introduction: For ethics reasons, most sleep manipulation protocols for adolescents have either focused on very short-term sleep deprivation (e.g., one night) or multi-night sleep restriction during the summer months. We recently reported that it is feasible to conduct an ethically-grounded experimental trial during the school year in which habitual short-sleepers systematically extend their time in bed for two consecutive weeks. Here we report on the behavioral effects of such extension.

Methods: Forty-seven healthy 14-18-year-olds who regularly slept 5-7 hours on school nights were enrolled in a 5-week protocol. Week 1 was a baseline to confirm typical sleep. Participants then entered a 2-week sleep condition in a randomly counterbalanced order: Prescribed Typical Sleep (TYP; school-night schedule matching baseline) versus Sleep Extension (EXT; 1.5 hours longer in bed on school nights). Teens self-selected their weekend bedtimes. On the Friday afternoons of weeks 1, 3, and 5, parents and teens reported on the teens’ behaviors and mood using validated questionnaires.

Results: Per actigraphy, school night sleep averaged 6.1-6.2 hours in the TYP condition, similar to baseline (6.4 hours), p > .05. Teens averaged 1.1-1.2 hours longer sleep during the EXT condition (7.4 hours both weeks), p < .001. Compared to TYP, parents and teens alike reported reduced teen sleepiness (p < .01) and better metacognitive skills (e.g., planning, organization, p < .01) during EXT. Teens also self-reported less tension (p < .05), anger, confusion, and fatigue (p < .01) during the EXT condition than the TYP condition.

Conclusion: Whereas previous research has shown that experimentally shortening adolescents’ sleep causes deterioration in mood and metacognitive skills, this study was the first to show that lengthening the sleep of “naturally” short-sleeping adolescents can alleviate these symptoms during the school year. Future analyses will incorporate a larger sample to allow for analysis of whether this effect was moderated by sex or chronotype.

Support (If Any): National Medical Research Council, Singapore (NMRC/STaR/015/2013) and The Far East Organization

SLEEP ONSET TIME IN LATE-SLEEPING TEENS: THE IMPACT OF AFTER-SCHOOL TIME USE
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Introduction: Endogenous sleep-wake regulatory mechanisms contribute to late sleep timing as adolescents age; however, external factors also displace sleep and likely contribute to this common delayed sleep pattern. We examined how adolescents spend their time after school and what activities are associated with sleep onset.

Methods: Twenty-two late-sleeping adolescents (7 males) aged 14.3-18.0 years (mean = 16.2, SD = 1.1 years) completed a 14-day protocol in which they wore a wrist actigraph, completed daily sleep logs, and tracked their activities from school dismissal to bedtime. Participants tracked their activities continuously on a mobile device using a commercially available application. Participants assigned their activities to one of 18 pre-defined categories (e.g., socializing in person, using technology, school work, etc.). Sleep onset time, the main outcome measure, was derived from actigraphy. Associations between sleep onset and percent time engaged in an activity category was examined using a linear regression model. This analysis focuses on school days only.
II. Sleep and Development

**BASIC SLEEP SCIENCE**

**Results:** School-night sleep onset times ranged from 19:41 to 05:17 (mean = 00:28, SD = 1.5 h). Average school-day wake time was 06:32 (SD = 0.89 h) and total sleep time was 5.2 h (SD = 1.4 h). More time in the hours after school were associated with later sleep onset times.

**Conclusion:** These preliminary data of adolescents with late and restricted sleep suggest that technology use may be displacing sleep in the evening thereby driving sleep onset later or these teens are using technology for a longer period of time because they are not ready to fall asleep at an earlier clock time. Napping after school is likely recuperative, but may also reduce homeostatic sleep pressure thereby driving sleep onset later into the night. Technology use and napping may be relevant targets for interventions to shift bedtimes earlier in late-sleeping adolescents.

**Support (If Any):** R01 HL112756 to SJC

**MATHEMATICAL MODELING OF SLEEP ARCHITECTURE IN ADOLESCENCE**

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**Introduction:** Sleep in adolescents is characterized by longer sleep durations and delayed timing of sleep compared to adults. However, other features of sleep architecture may also be altered during this developmental period. In adults, rapid eye movement (REM) sleep occurs in cycles throughout the night with a peak propensity near the trough of the circadian body temperature rhythm. Although adolescents show similar patterns of REM sleep, there is evidence that REM sleep propensity may be shifted later in the circadian cycle in adolescents compared to adults.

**Methods:** To investigate mechanisms for altered sleep architecture in adolescence, we adapted a physiologically-based mathematical model of the adult sleep/wake regulatory network to describe adolescent wake, non-REM sleep, and REM sleep. The homeostatic time constants were chosen to reflect values estimated for adolescents, and potential alterations in circadian modulation of the sleep/wake network were considered. We fit the model to measures of total sleep time and circadian phase, and then we analyzed model predictions for simulated REM sleep behavior and timing. We also simulated perturbations to normal, entrained sleep/wake behavior to investigate the predicted responses.

**Results:** Simulated sleep reflected key features of adolescent sleep/wake behavior including the amount, timing, and architecture of sleep. In the 3-state model, REM sleep occurred as part of ultradian NREM-REM cycles, the duration of REM episodes increased across the night, and the propensity for REM sleep in the early morning was higher for the adolescent compared to the adult.

**Conclusion:** We have used a 3-state mathematical model to describe adolescent sleep/wake dynamics. Analysis of the model suggests that the delayed timing of sleep in adolescents is accompanied by a delay in the propensity for REM sleep. This may have implications for high school students subjected to early school start times and adolescents with REM sleep abnormalities as may occur in depression and other psychopathological disorders.

**Support (If Any):** NSF DMS 1412571 (CDB), DMS 1412119 (VB), and Children's Hospital Colorado/Colorado School of Mines Collaborative Pilot Award (CDB and Dr. Stacey Simon, Co-PIs).

**IMPACT OF SLEEP EXTENSION ON SLUGGISH COGNITIVE TEMPO SYMPTOMS AND DRIVING BEHAVIOR AMONG CHRONICALLY SLEEP DEPRIVED ADOLESCENTS**

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**Introduction:** Sluggish cognitive tempo (SCT) symptoms (e.g., inconsistent alertness and drowsiness), which are distinct from other mental disorders in children and adolescents, are associated with psychosocial and educational impairments. However, the relation between SCT and sleep has not been adequately studied, and no study has examined the impact of experimental sleep manipulation on SCT symptoms. We examined whether sleep extension alleviates SCT symptoms in a sample of chronically sleep-deprived adolescents. Given the role of drowsiness in driving-related fatalities, we also examined interaction between chronic sleep restriction and SCT on driving behavior in this at-risk population.

**Methods:** Twenty-five licensed 16-18-year-old adolescents (36% male) who regularly obtain 5-7 hours of sleep participated in the study. Each completed a 5-week at-home experimental protocol: a baseline week to determine typical sleep (TYP), followed in counterbalanced order by 2-week spans in which school-night bedtimes and rise times are (a) matched to the TYP or (b) modified to increase time in bed by >1.5 hours/night, extended sleep (EXT). Self-reported symptoms of inattention, SCT and driving problems were obtained following each condition.

**Results:** Actigraphy confirmed an average of 1 hour longer sleep during EXT than TYP, p < .001. Adolescents reported fewer SCT symptoms during EXT than TYP (Cohen’s d = .93; p < .001). Two SCT groups were created using median split: No Improvement and Improvement. Repeated measures analysis of covariance was conducted to test the effects of sleep condition (within-subjects factor) on self-reported driving problems with SCT group as the between subjects factor, covarying for relevant baseline demographic variables. The Sleep X SCT group interaction was significant [F(1,21) = 5.99, p = .024]. Adolescents whose SCT improved during EXT also showed reduced driving problems during TYP.

**Conclusion:** Preliminary findings suggest that alleviating chronic sleep restriction during the school year reduces symptoms of SCT and some driving related problems in adolescents.

**Support (If Any):** State of Ohio Emergency Medical Services fund

**NEIGHBORHOOD WALKABILITY AND PHYSICAL ACTIVITY ARE ASSOCIATED WITH NIGHTTIME SLEEP IN ADOLESCENTS**

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**Introduction:** Sleep deprivation in adolescence is of growing national and international concern, and therefore it is important to identify factors that facilitate sleep. There is mounting evidence that neighborhood context and physical activity are associated with sleep and that greater neighborhood walkability in particular promotes activity. However, these links are inconsistent and research with adolescents is scarce. This study examined neighborhood walkability and physical activity...
as predictors of sleep and explored physical activity as a mediator of the relationship between walkability and sleep.

**Methods:** Participants were 236 adolescents (55% female, Mage = 16.75 years). The sample was 68% European American and 32% African American, with median family income between $50-75,000. Adolescents wore a Motionlogger Octagonal Basic actigraph (Ambulatory Monitoring Inc.) for seven nights, from which mean nighttime sleep minutes were derived using Sadeh’s algorithm. They completed the well-established Neighborhood Environment Walkability Scale-Youth, which measures access to recreation facilities and land-use diversity (i.e., variety of resources available such as a grocery store, library). Weekly physical activity was assessed via self-report on the Physical Activity Questionnaire.

**Results:** Access to recreation facilities, land-use diversity, and physical activity were associated with more sleep minutes, β's = .16, .17, .22, p's < .05. Physical activity fully mediated the association between access to recreation facilities and sleep, t = 2.00, p < .05 and partially mediated the link between land-use diversity and sleep, t = 1.68, p < .10. Analyses controlled for race, sex, and socioeconomic status. BMI was considered as a control but was not associated with any variables.

**Conclusion:** The findings implicate physical activity as one potential mechanism linking neighborhood context to adolescent sleep. Access to recreation facilities and greater land-use diversity may encourage physical activity, which in turn is linked to longer nighttime sleep. Future research should assess these linkages longitudinally and incorporate objective walkability measures in order to further explicate this pathway.

**Support (If Any):** NIH R01-HD046795-06 to MES

**0030**

**LONGITUDINAL ASSOCIATIONS BETWEEN OBJECTIVE AND SUBJECTIVE SLEEP PROBLEMS, INTERNALIZING SYMPTOMS, AND BODY MASS INDEX IN YOUNG ADULTHOOD**

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**Introduction:** Incidence of being overweight or obese during adolescence has increased in the last decade and may confer high risk for dysregulated sleep. Additionally, psychological factors may exacerbate associations between sleep problems and obesity. We examined whether anxiety and depressive symptoms moderated associations between objective and subjective sleep problems and body mass index (BMI) over two years in 71 college students.

**Methods:** Participants were assessed in their first and third year of college. Wrist-based accelerometers measured objective sleep duration, sleep start time variability (SSV), and sleep onset latency (SOL) across four nights at the first time point and eight nights at the second time point. Participants self-reported sleep quality, anxiety and depressive symptoms, and BMI at T1. Researchers measured BMI at T2. Covariates included demographic variables, T1 BMI, and T2 predictor and moderator variables.

**Results:** Greater SSV at T1 predicted greater BMI at T2 (β = .70, p = .02), and the interaction between SSV and anxiety at T1 predicted greater T2 BMI (β = .17, p = .002), showing significant associations between SSV and BMI at high (β = 1.97, p = .01) and average anxiety levels (β = .74, p = .04), but not low levels (β = .50, ns). The interaction between SSV and depressive symptoms also predicted T2 BMI (β = .06, p = .01), with a significant association between SSV and BMI at high depression levels (β = .96, p = .02), but not at average (β = .31, ns) or low levels (β = -.34, ns). There were no main effects or interactions between sleep duration, SOL, or sleep quality at T1 and T2 BMI.

**Conclusion:** Overall, when experiencing poor sleep, anxiety and depression may be psychological stressors that stimulate overeating and lead to weight gain over time in young adults.

**0031**

**PHYSICALLY ABUSED ADOLESCENTS DEMONSTRATED POORER SLEEP QUALITY: EVIDENCE FROM A PROPENSITY SCORE MATCHED SAMPLE**

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**Introduction:** Increasing evidence has shown the association between childhood adverse experiences and poor sleep in adulthood. It also has been found that child sexual abuse is related to sleep problems in children. However, few studies have investigated the relationship between physical abuse and sleep quality in adolescent population.

**Methods:** As part of China Jintan Child Cohort Study, we collected cross-sectional data in 814 adolescents aged 13-15 years old in 2013. Physical abuse was measured by the items in Parent-Child Conflict Tactics Scale regarding parental violent behavior toward children, including slapping the child’s face, hitting body parts besides the bottom with an object, hitting with a fist, kicking, beating up, choking, burning, or threatening with a weapon. Sleep quality was assessed by the Pittsburgh Sleep Quality Index. We matched abused children with non-abused children using propensity score derived from 18 covariates including age, sex, being the only child in the household or not, sleep problems in preschool, co-sleep status, grade, maternal education and occupation, paternal education and occupation, maternal health problems, paternal health problems, marital marital status, house size, noise level around house, neighborhood condition, person raising child up, and birth complication. Propensity score matching method enables to tease out the measured bias.

**Results:** About 30% adolescents had experienced physical abuse in the preceding 12 months. After propensity score matching, we obtained balance on measured covariates. Wilcoxon signed rank sum test showed that physically abused adolescents reported significantly worse sleep quality than their matched non-abused counterparts (p < 0.001).

**Conclusion:** To our knowledge, this is one of the first findings that abused adolescents demonstrated poorer sleep quality in a matched community based sample using an approach of propensity score matching. The findings provide implications for practice and research.

**0032**

**THE INFLUENCE OF AGE ON SLEEPINESS, SLEEP-INDUCED DEPRESSED MOOD AND SLEEP-WAKE BEHAVIOR PROBLEMS OF IN-SCHOOL ADOLESCENTS IN NIGERIA**

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**Introduction:** In-school adolescents in Nigeria often complain of sleepiness and moodiness when woken out of sleep during school hours. Sleepiness and sleep induced depressed mood has often led to these students being inattentive and dozing off during classes. When woken up or told to stand up in class, these sleepy adolescents often manifest depressed mood and sleep-wake behavior problems throughout school hours. We investigated these variables in comparison with their age.

**Methods:** One thousand four hundred and seventy three (1473) secondary school adolescents (754 males and 719 females) aged between 12 to 19 years (M = 15.21; SD = 1.48) participated in this study. They responded to the School Sleep Habits Survey (SSHS) and their age.
binned into three equal groups. The data was subjected to Multivariate Analysis of Variance (MANOVA) and Analysis of Variance (ANOVA).

**Results:** The results revealed a significant age difference in the manifestation of sleepiness, sleep-induced depressed mood and sleep-wake behaviour problems among in-school adolescents in Nigeria, F (3, 3418) = 3.20, p = 0.01; Pillai’s Trace = 0.01, partial eta squared = 0.01. Further ANOVA with the dependent variables showed that age significantly affected students manifestation of sleepiness (F (2, 1469) = 3.61, p = 0.01), affected their mood (F (2, 1469) = 5.54, p = 0.01) and their sleep-wake behaviour problems (F (2, 1469) = 7.81, p = 0.01). Adolescents between ages 15 to 16 had higher mean scores in all the dependent variables. Adolescents sampled reported nocturnal awakening of 1 to 10 times per night and a sleep latency of 1 to 3 hours per night.

**Conclusion:** Results suggests the need to pay attention to the sleep behaviors of adolescents in Nigeria. Suggestions on how to improve the sleep behaviors of these adolescents through psychoeducation were made.

### 0034

**SHORT SLEEP INDUCES VARIABLE MOOD IN ADOLESCENTS**

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**Introduction:** Increased variability in mood has been associated with psychopathology and poor coping behaviors in adolescents. Research has established a relation between sleep duration and overall mood but little is known about the impact of sleep on variability in mood. Further, most studies examining these constructs use nonexperimental designs and correlational analyses that preclude confident cause-effect conclusions. This study examines the impact that experimentally manipulated sleep has on day-to-day variability in mood reported by adolescents. It was hypothesized that adolescents would report increased variability in mood when sleep restricted compared to when obtaining more optimal sleep.

**Methods:** Ninety-seven healthy adolescents aged 14-17 (64.9% female, 46.9% European American) completed 5 consecutive nights of sleep restriction (i.e., 6.5 hours in bed) and 5 nights of extended sleep (i.e., 10 hours in bed) in a randomized, counterbalanced cross-over experimental design, with a 2-night washout between conditions. Adolescents reported on feelings of nervousness, sadness, anger, energy, fatigue, ability to concentrate, and sleepiness each day of the study. Variability in mood was measured by the standard deviation of these daily mood scores across each condition.

**Results:** Based on within-subject ANOVA analyses, adolescents showed increased variability in sadness (p = .03, d = .23), anger (p < .001, d = .41), and sleepiness (p < .001, d = .40) when sleep was restricted compared to when sleep was extended. This effect was not moderated by age, sex, race, or the order in which participants underwent the sleep conditions.

**Conclusion:** During a time in development when emotion dysregulation is already heightened, results suggest that obtaining an insufficient amount of sleep increases variability in sadness, anger, and feelings of sleepiness. This is significant given that variability in mood and emotional dysregulation may contribute to psychopathology. Promoting healthy sleep in adolescents is important to decrease emotional variability and potentially prevent the development and/or maintenance of more severe psychopathology.

**Support (If Any):** National Institutes of Health (R01 HL092149).
Methods: Seventy seven children, age 9.9 to 14.0 years (mean = 12.2, SD = 1.2) at the time of first recording, were studied in the first year of this longitudinal study. A laboratory day of performance and sleepiness testing follows four nights with TIB restricted to 7, 8.5 or 10 hours. Each participant completed all three sleep schedules. Laboratory days entail 4 test sessions, every 2 hours starting at 0900. Each test session includes two subjective sleepiness ratings on the Karolinska Sleepiness Scale (KSS) and a multiple sleep latency test (MSLT).

Results: Survival analysis of the MSLT shows that the likelihood of falling asleep increased with decreasing TIB (p < 0.0001) and increased with increasing age (p = 0.0035). A significant (p < 0.0001) TIB by age interaction demonstrates that in older children sleep restriction had a smaller effect on already elevated sleep likelihood. Mixed effect analysis shows that subjective sleepiness ratings increased with decreasing TIB (p < 0.0001) but not with increasing age (p = 0.62) and that there was no TIB by age interaction (p = 0.97).

Conclusion: On the 10 hour TIB schedule, the youngest participants rarely sleep during the MSLT because their elevated waking brain activity precludes daytime sleepiness. Sleep restriction depresses arousal levels, allowing sleep during the MSLT. In the oldest group, waking brain activity has declined so that napping is possible even with sufficient nighttime sleep. Why an age effect on daytime sleepiness is present in the MSLT but not in the subjective sleepiness ratings may become apparent as the study progresses.

Support (If Any): R01HL116490

0036
LONGITUDINAL STUDY OF THE EFFECT OF SLEEP DURATION AND AGE ON PSYCHOMOTOR VIGILANCE TEST PERFORMANCE OF YOUNG ADOLESCENTS: FIRST YEAR RESULTS
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Introduction: In previous reports we documented longitudinally the maturational trajectories of sleep duration and NREM EEG frequencies. We found that ages 12-16.5 years is a period of rapid maturation. Our current longitudinal study varies time in bed (TIB) to determine changes in sleep need across adolescence. Here we present Year-1 results for TIB and age effects on psychomotor vigilance test (PVT) performance.

Methods: Seventy seven children, age 9.9 to 14.0 years (mean = 12.2, SD = 1.2) at the time of their first recording, are enrolled in this multiyear longitudinal study. A laboratory day of performance and sleepiness testing follows four nights with TIB restricted to 7, 8.5 or 10 hours. Annually, each study participant completes all three sleep schedules. Laboratory days entail 4 performance test sessions, every 2 hours starting at 0900. Each test session includes a 10 minute PVT.

Results: We divided participants into 3 age groups and constructed probability distribution functions of PVT response times for each age group and TIB condition. Mixed-effects regression analysis showed effects of both age and TIB (p < 0.01). Regardless of age, shorter TIB was associated with increased skewing of the response time distribution to the right, reflecting greater performance instability. In the oldest of the 3 age groups, the response time distribution as a whole was also shifted to the left by more than 30 ms, indicating faster responses overall.

Conclusion: Four nights of sleep restriction to 7 hours TIB, and even to 8.5 hours TIB, degraded PVT performance in children aged 9.9 to 14.0 years, indicating, for this age range, sleep insufficiency relative to 10 hours TIB. We hypothesize that the faster PVT responses in the older participants reflect maturation of the underlying neural circuitry.

Support (If Any): R01HL116490

0037
CONSEQUENCES OF PRETERM BIRTH AND FETAL GROWTH RESTRICTION ON SLEEP AND CARDIOVASCULAR PARAMETERS IN CHILDHOOD
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Introduction: Fetal growth restriction (FGR) and preterm birth have been associated with altered sleep, neurodevelopmental impairment and increased risk of hypertension in adulthood. Currently, we do not know how these pathologies evolve over time or how early they begin. Accordingly, we investigated the long-term consequences of FGR and prematurity on sleep, blood pressure (BP) and heart rate (HR) in children aged 5-12y.

Methods: Overnight polysomnography was performed in three groups: 18 preterm FGR children, 14 preterm children with appropriate weights for their gestational age (AGA) and 20 control term-born children. FGR was identified by evidence of absent/reversed end-diastolic flow of the umbilical artery on their fetal Doppler ultrasounds, indicating placental insufficiency. BP was measured continuously throughout the night using photoplethysmography. Sleep was scored as N1, N2, N3 and REM. Total sleep time (TST), wake after sleep onset (WASO%), sleep efficiency (SE%) and no differences for gestational age between groups 1 and 2. Compared to term and preterm AGA children, FGR children had a higher amount of N2 sleep (p < 0.05). Preterm AGA children had reduced SE% (p < 0.05), TST (p < 0.05) and higher WASO% (p < 0.05) compared to term children. For BP and HR there were no differences between groups during any of the sleep stages.

Conclusion: Preterm birth and FGR had long-lasting effects on the quantity and quality of sleep in children, but did not affect HR or BP. Thus, in FGR and preterm individuals, changes in BP may develop after childhood. As poor sleep is associated with impaired neurocognition in childhood, sleep disturbance and its impact on neurodevelopment in preterm children warrants further investigation.

Support (If Any): This work is supported by project grant funding from the National Health and Medical Research Council (NHMRC) of Australia (Project No. 1045559) and by the Victorian Government’s Operational Infrastructure Support Program.

0038
SLEEP PHENOTYPE CHARACTERIZATION OF MUSCLEBLIND-LIKE 2 KNOCKOUT MOUSE, A CENTRAL MODEL OF MYOTONIC DYSTROPHY
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Introduction: Excessive daytime sleepiness and associated alterations in REM sleep patterns are one of the most prominent CNS symptoms of myotonic dystrophy (DM). Major pathological changes in the DM brain are attributable to muscleblind-like protein 2 (MBNL2) seques-
II. Sleep and Development

A. Basic Sleep Science

Introduction: Accumulating evidence indicates midday naps enhance learning in early childhood. However, less is known of the underlying mechanisms that drive these benefits. A portable, unobtrusive device that could provide an accurate estimate of sleep would be an asset to this research. The aim of the current study is to determine whether sleep measures from Beddit are comparable to polysomnography (PSG). In addition to focusing on reliability of the device in young children, we were specifically interested in whether the device was valid in 25 day olds or 6, 9, and 12 month olds.

Methods: Two sets of Wild (WT) and KOs of Mbnl2 were implanted with EEG/EMG electrodes at 22 days or 6 months. Data acquisition was performed for 24 hr in 25 day olds or 6, 9, and 12 month olds.

Results: The most profound sleep phenotypes observed in adult Mbnl2 KOs were an increase in REM sleep amounts, associated with increased numbers of REM sleep episodes and increased EEG theta power, while no changes in wake/NREM sleep were observed. REM sleep changes in adult Mbnl2 KO mice were not progressive, and similar changes in REM sleep were also observed in 9 and 12 month olds. We therefore focused on the earlier development period and carried out sleep recordings in WT and KO mice at 25 day olds. KOs at 25 day olds showed an increased amount of REM sleep as in adults. In addition, they showed a decreased amount of NREMPy sleep with a shorter bout length, implying that the development in sleep pattern was immature and delayed for the age compared to WTs.

Conclusion: The results support our hypothesis that REM sleep abnormalities in DM is a residual of infant-type REM sleep, as infants of altricial species spend a large majority of their time in REM sleep. To further confirm the hypothesis, sleep phenotype characterization in younger developing KOs is currently in progress. This model is likely to be useful to study cellular and genetic mechanisms of ontogenic changes in REM sleep associated with brain maturation during the early developmental period.

TO NAP OR NOT TO NAP? EXAMINING SLEEP BEHAVIORS IN PRESCHOOL CHILDREN UNDER TYPICAL AND NAP-PROMOTED CONDITIONS


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Introduction: It has been suggested that the transition out of napping behavior in early childhood is flexible and reflects brain maturation. Others advocate rigid age cut-offs (age 2) as naps may reduce overnight sleep past this point. The current study sought to characterize typical sleep patterns in children who frequently, sometimes, or rarely nap and determine what factors predict when the transition from biphasic to monophasic sleep should occur.

Methods: 133 preschool-aged children (M = 53 mos, 50% F) wore actigraph watches for 5-16 days while parents completed questionnaires related to child’s behavior. On one study day children were nap-promoted by experimenters.

Results: Frequent nappers slept less at night than rare nappers. However, total 24-hr sleep duration and overall sleep quality did not differ across nap frequency groups. Effortful control was marginally greater in rare nappers, compared to frequent nappers (p = 0.058). On the nap-promoted day, nap promotion success was 91%. When typical sleep was compared to sleep following nap promotion, frequent nappers slept more on the nap-promoted night, whereas sometimes and rare nappers slept less. However total 24-hr sleep was greater for all groups on the nap promotion day. Moreover sleep quality on the nap-promoted day did not differ between nap groups.

Conclusion: Although overnight sleep decreased with napping, total 24-hr sleep increased. Furthermore, sleep quality did not differ between groups suggesting naps do not negatively impact sleep in early childhood. Likewise, the possible emergence of self-regulatory behaviors may predict when napping ceases supporting the view that transitioning out of naps reflects brain maturation. Given observed increases in 24-hr sleep and nap promotion success, and previously reported cognitive benefits of naps, ceasing naps at an early age may be premature.

Support (If Any): This research was supported by NIH R01 HL111695 (R.M.C. Spencer)
DIMENSIONS OF TEMPERAMENT IN PRESCHOOLERS WITH SLEEP PROBLEMS
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Introduction: Dimensions of temperament provide insight into children’s ability to respond to threatening stimuli, recover from arousal, and regulate behavioral responses; all critical processes for achieving optimum sleep health.

Methods: Data were obtained from a community sample of children aged 30-71 months as part of a randomized trial. The 136 preschoolers (70 boys) met criteria for sleep problems based on Children’s Sleep Habits Questionnaire (CSHQ) scores, with the absence of physiological sleep disturbances. The Children’s Behavior Questionnaire (CBQ) provided measures of specific dimensions of temperament: fear, soothability, and inhibitory control. Child Sleep Wake Scale (CSWS) total scores provided a measure of overall sleep problems; Going to Bed and Reinitiating Sleep subscale scores highlighted specific areas of impairment. Both measures were obtained via parent-report at baseline before intervention began. Separate regression analyses controlling for age and gender, assessed the relationships between CBQ temperament dimensions, looking at the highest quartile for negatively valenced (fear) and the lowest quartile for positively valenced (soothability and inhibitory control) temperament constructs compared to the rest of the sample, and CSWS total and subscale scores.

Results: Low soothability temperament predicted better success Reinitiating Sleep, t(133) = 2.01, p = 0.05. Low soothability temperament showed a trend toward significance for greater difficulty Going to Bed, t(135) = 1.78, p = 0.08. No significant associations were found between the fear or inhibitory control temperaments and the CSWS subscale or total scores.

Conclusion: These results speak to parents’ perceptions of their child’s sleep problems and when a low soothability temperament may influence greater behavioral problems and parental stress. Considering the relationship between dimensions of temperament and sleep problems may prove useful to the dynamic understanding of when children’s sleep struggles cause greater difficulty for parents and what temperamental deficits should be treated to achieve better sleep quality for both parent and child.

Support (If Any): R01HD071937-01A1

SLEEP-DEPENDENT EFFECTS ON THE ASSOCIATION BETWEEN STRESS REACTIVITY AND FACIAL EMOTION EXPRESSION IN PRESCHOOL CHILDREN
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Introduction: Although associations between stress physiology and emotion processing can influence children’s adaptation to environmental opportunities and stressors, research examining the extent to which sleep may alter such links is scarce. The aim of this study was to determine whether experimental sleep loss moderated the association between stress reactivity and facial emotion expressions in preschool children.

Methods: Healthy children (n = 23; 10 males; 45.9 ± 2.3 months) followed a stabilization sleep schedule for ≥3 days before completing two counterbalanced morning behavior assessments: one after habitual nap and nighttime sleep (Baseline) and another after a missed nap and a 3h bedtime delay (Sleep Restriction). Assessments included a 30min task with varying levels of “cognitive load” followed by a task designed to elicit positive emotion. For each condition, we also obtained 3 saliva samples: 1) 2h after morning wake time by parents (~09:00); 2) just before the cognitive task; and 3) immediately after the cognitive task, which occurred ~15min after the point of highest cognitive load and preceded the positive emotion eliciting task. Saliva was assayed for cortisol (μg/dl) to examine total stress reactivity (area under the curve; AUC). Behavior assessments were videotaped and facial emotion expressions were later quantified using our published coding system. For this analysis, we focused on the % time children expressed positive emotions (i.e. composite including measures of joy, pride, excitement). Pearson correlations (two-tailed) were computed between stress reactivity (AUC) and % time expressing positive emotion within each condition.

Results: Actigraphy data during the stabilization phase showed that children slept 2.4 ± 0.5 hours less in the Sleep Restriction than the Baseline condition. We observed a linear negative correlation between cortisol secretion (AUC) and positive emotion responses during the Baseline condition. That is, children exhibiting a larger stress response before starting the solvable puzzle task showed less positive emotion (r = -0.44, p = 0.04); however, we found no relationship between stress reactivity and positive emotion following Sleep Restriction (r = 0.02, p = 0.93).

Conclusion: When well rested, positive emotion expression and stress reactivity were closely linked, which suggests that children with lower stress responses during the cognitive challenge benefited more from the positive context of the puzzle task. Because sleep restriction decoupled this relationship, our data also indicate that children who experience sleep loss, regardless of their level of stress reactivity, may not be able to take full advantage of positive experiences after being cognitively challenged.

Support (If Any): R01-MH086566 to MKL; K01-MH066139 to ALM

PRESCHOOL NOCTURNAL SLEEP QUALITY IS UNAFFECTED BY MID-DAY NAPS
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Introduction: Sleep patterns change drastically throughout development. Children transition from biphasic to monophasic sleep typically during the preschool years (~3-5yrs). However, recent research has suggested that napping after 2 years of age may be detrimental through the reduction of overnight sleep time and quality. This study examined nocturnal sleep changes following a day with and without a nap in preschool-aged children.

Methods: Twenty children (10 female, Mean age = 52.32 ± 7.96 months) participated in two conditions separated by ~1 week. In the nap condition, children took a mid-day nap in the lab; in the wake condition, they were kept awake during the day. In both conditions, children also slept overnight in the lab. Polysomnography was recorded for the nap and overnight sleep bouts.

Results: Following a nap, nocturnal sleep was reduced by 39 min (t(15) = -3.17, p = 0.006) and nocturnal SWS was reduced by 27 min (t(15) = -4.175, p = 0.001). However, nap promotion resulted in a significant increase in 24-hr sleep time (nap + overnight sleep; t(15) = 2.25, p = 0.04) and no change in SWS time (t(14) = 1.48, p = 0.161). There were no differences in spectral measures, including SWA, slow oscillation power, theta power, or sigma power for frontal, central, or occipital electrodes for overnight sleep in the nap and wake conditions. Further, SWA in the nap was significantly positively correlated with
SWA during the night for both frontal and central electrodes. Similarly, nap sigma power was significantly positively correlated with overnight sigma power across the scalp.

**Conclusion:** Napping lead to an increase in sleep across a day. However, there were no other differences in sleep microstructure or macrostructure following a day with and without a nap. These results indicate that overnight sleep is not compromised by a nap. Given that naps have been shown to convey cognitive benefits, nap promotion may be an asset in early childhood.

**Support (If Any):** NIH R01 HL111695-01A1

**0044**

**ACUTE SLEEP RESTRICTION REDUCES INHIBITORY CONTROL IN PRESCHOOL CHILDREN**

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**Introduction:** The preschool years are characterized by rapid changes in the regulation of behavior and emotion, as well as in sleep, which is reportedly insufficient in ~30% of young children. Although correlational findings show that sleep loss is associated with decrements in self-regulation, few experimental studies exist. In this study, we employed an objective assessment of self-regulation and tested the hypothesis that children would exhibit less inhibitory control following Sleep Restriction than Baseline sleep.

**Methods:** 26 healthy children (11 males, 45.68 ± 2.55 months) followed a strict sleep schedule for ≥ 5 days before completing behavioral assessments in the morning after two counterbalanced sleep conditions: Baseline (regular nap and night sleep) and Sleep Restriction (missed nap and a 3-hour bedtime delay). Inhibitory control was assessed via a “forbidden toy” task. Children were presented with an exciting toy (i.e., air hockey table or pinball machine) and briefly taught how to play with it. They were then instructed not to touch or play with the toy before the experimenter left the room for 3 minutes. Whether or not the child touched or played with the toy and the latency to these behaviors were coded from assessment videotapes and used to quantify inhibitory control. McNemar chi-squared tests (one-tailed) compared the proportion of children who interacted with the toy and paired t-tests (one-tailed) compared the latencies to touch or play with the toy between Baseline and Sleep Restriction conditions.

**Results:** Children were more likely to touch (77% vs. 50%, χ² = 5.4, p = 0.03) or play (46% vs. 23%, χ² = 4.5, p = 0.02) with the toy in the Sleep Restriction than the Baseline condition. Also, the latency to touch (82.5 ± 65.4 vs. 109.5 ± 76.1 seconds, t = 2.0, d = 0.38; p = 0.02) or play (123.2 ± 67.2 vs. 149.1 ± 61.9 seconds, t = 2.1, d = 0.40, p = 0.04) with the toy was shorter in the Sleep Restriction compared to the Baseline condition.

**Conclusion:** Our findings indicate that acute sleep restriction during childhood leads to decreased inhibitory control in preschool children. These findings suggest that sleep plays an important role in learning how to resist impulses, which is necessary for social compliance and academic success. We propose that over time chronic sleep restriction may increase risk for behavioral and emotional problems that involve decrements in inhibitory control. Future research should examine the time course of self-regulatory behaviors during children’s recovery after sleep restriction.

**Support (If Any):** R01-MH086566 to MKL; K01-MH066139 to ALM; HHMI Grant to SDW.

**0045**

**DOCUMENTING TYPICAL SLEEP PATTERNS IN SCHOOL-AGED CHILDREN**

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**Introduction:** Most current developmental sleep research focuses on the sleep patterns of typically developing infants and adolescents or on atypical populations, such as the relationship between developmental disabilities and sleep disorders. We do know that children who are less physically active have shorter sleep durations, which puts them at risk for increased weight gain. Children who have shorter sleep durations during weekdays have lower physical activity levels on weekends, suggesting a complex relationship between sleep, physical activity, and health. Our aim was to address the dearth of literature on the typical sleep of school-aged children.

**Methods:** To assess sleep and activity, we used actigraphy. An actigraph is a small watch-like device that objectively measures activity levels. We examined the relationship between waking activity and nighttime sleep efficiency (percent of total time sleeping) and whether that relationship shifted depending on whether it was a school day. Thus far, three healthy school-aged children, aged 9-10-years-old have each worn an actigraph for 22 days.

**Results:** Whether children were in school did not predict overall activity level during the day. However, there was more variability in activity level on school days. Similarly, mean sleep duration and sleep efficiency did not seem to differ depending on school day, but were more variable on school days. Because quality of sleep can predict functioning the following day, we also examined the relationship between night-time sleep and activity level the next day. Sleep efficiency was positively correlated with next day’s activity: the better the nighttime sleep, the higher the activity level the next day.

**Conclusion:** Preliminary findings suggest possible links between sleep patterns and demands associated with school, such as learning, routines, and formal and informal opportunities for movement. Ultimately, this study lays the groundwork for developmental research on the relationship between sleep and the daily activities of school-aged children.

**Support (If Any):** Undergraduate Research Stipend, College of Staten Island, City University of New York

**0046**

**THE EFFECT OF SOCIOECONOMIC STATUS ON SLEEP AMONG PRESCHOOL-AGED CHILDREN**

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**Introduction:** Social economic status (SES) alters sleep quality throughout development. Specifically, higher SES predicts increased sleep quality (i.e., sleep duration, latency, efficiency, and disturbances) and increased sleep duration in school-aged children and adults. Provided the accumulating evidence outlining the importance of sleep on learning and behavior during early development, we examined the interaction between SES and sleep among preschool-aged children.

**Methods:** The sample included 221 preschool-aged children (106 females, M = 52.00 months, SD = 10.21 months). Sleep was assessed using actigraphy and sleep diaries completed by the caregiver. SES was measured by caregiver-report of total household income, financial difficulty, and need for financial assistance.

**Results:** Income and financial difficulty were negatively correlated (r(221) = -0.457, p < 0.05), such that greater income was associated with less caregiver-reported financial difficulty. Financial difficulty
and financial assistance were positively correlated (r(231) = 0.529, p < 0.05), such that caregivers who reported greater financial difficulty also reported greater need for financial assistance. Of interest, higher household income was associated with greater night sleep duration (r(218) = 0.323, p < 0.05), earlier night sleep onset (r(218) = -0.372, p < 0.05), greater sleep onset latency (r(218) = 0.226, p = 0.001), greater wake after sleep onset (WASO) (r(218) = 0.154, p = 0.023), and decreased sleep efficiency (r(218) = -0.156, p = 0.020). Financial difficulty and need for financial assistance were not significantly related to any of these sleep measures (p’s > 0.165).

Conclusion: Consistent with previous reports in older children, these findings indicate that sleep quality and duration are reduced among preschool-aged children of lower SES households. Interestingly, there were no significant relationships between child sleep parameters and the caregiver-reported financial difficulty or perceived need for financial assistance. Given that poor sleep is associated with behavioral problems, children in lower SES households may be at greater risk for behavioral deficits, and should be targeted with interventions to improve sleep habits.

Support (If Any): This study was supported by NIH R01 HL11695-01A1 (R.M.C. Spencer).

0048
PARENTAL RELATIONSHIP DISSOLUTION DECREASES CHILDREN’S SLEEP QUALITY
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Introduction: Mannerin and colleagues (2011) conducted the only evaluation of parental relationship dissolution (PRD) on sleep in children with a sample of married, middle class parents and their adopted children. They found that PRD increased bedtime resistance. The current study expands this work to evaluate whether PRD negatively impacts children’s sleep quality among a diverse group of married and unmarried parents.

Methods: Three waves of data from the Fragile Families Study (FFS; Teitler et al., 2001) were used. When children participated were three, mothers reported on their PRD (e.g., did the mother experience a breakup) in the previous two years, and their children’s sleep. The same information was gathered when the children were 5 and 9. We fit a cross-lagged model to assess the link between: 1) PRD (0 = no PRD; 1 = one or more PRDs) between 3 and 5, on a latent factor of sleep quality (e.g., child’s sleep duration, trouble sleeping) at age 5, controlling for sleep quality at age 3; and 2) PRD between 5 and 9, on sleep quality at age 9, controlling for sleep quality at age 5. All analyses controlled for mother’s age and education at childbearing, mother’s race, child gender, and low birth weight.

Results: Mothers who experienced PRD between their child’s 3rd and 5th birthday reported their child’s sleep quality at age 5 to be .13 standard deviations lower than mothers who did not experience PRD (b = -.13, SE = .05, p < .01), controlling for previous sleep quality. Mothers who experienced PRD between their child’s 5th and 9th birthday reported their child’s sleep quality at age 9 to be .10 standard deviations lower than mothers who did not experience PRD (b = -.10, SE = .04, p < .01), controlling for previous sleep quality.

Conclusion: PRD broadly, not just marital instability, is associated with lower sleep quality in children, independent of previous sleep quality.

Support (If Any): NIH R01HD36916, R01HD39135, R01HD40421, T32HD07475, NSF GSRF DGE1342962, as well as a consortium of private foundations.

0049
EARLY CHILDHOOD EDUCATOR’S EXPERIENCES WITH SLEEP
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Introduction: Over 80% of children in developed countries attend childcare at some point before school entry. The childcare environment very often provides for sleep/rest. This early environment therefore plays an important role in the shaping of children’s sleep behaviours. The aim of this study was to understand the beliefs and experiences of educators working in Early Childhood Education services regarding children’s sleep.

Methods: 250 educators working within Australian childcare settings completed an on-line survey, with items assessing beliefs, attitudes, practices, and understanding around sleep for young children. This
sample included educators from long day care (50%), kindergarten (30%) and family day care (10%). The average age of children attending these services was between 2.2-4.9 years.

**Results:** Of the educators, 208 (83%) indicated that their service currently had a scheduled sleep or rest time during the day (range = 15-180 minutes; M = 89 minutes, SD = 43 minutes). 73% of educators indicated that catering for children’s individual sleep needs were a little challenging (42%), somewhat challenging (22%) or very/extremely challenging (9%). The educators reported that they had received varying amounts of information/formal education regarding the sleep needs of children. 58% of educators indicated that they had received ‘a lot of information’ about safe sleeping guidelines (i.e. SIDS/SUDI), with 7% indicating they had received ‘no information’ at all. Approximately 32% of respondents indicated that they had received ‘no information’ about the typical sleep patterns for children. 84% of educators indicated that they would be interested in receiving more information about sleep and sleep practices for children.

**Conclusion:** These data demonstrate the need for more training and information for childcare educators about sleep and sleep practices for young children. Childcare provides a point of opportunity for the promotion of good sleep, and it is vital that we improve our education and training of the childcare workforce.

**Support (If Any):** This research was conducted with the support of the Queensland Government’s Department of Education and Training.

**0050**

**NAP TIME PRACTICES IN CHILDCARE IS ASSOCIATED WITH BODY MASS OF PRESCHOOL CHILDREN**

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**Introduction:** Sleep and napping undergo substantial transitions in the early childhood period due to a range of genetic and environmental influences. Childcare settings are one environment which has shown significant potential for impact and intervention on children sleep patterns. Many childcare environments feature a nap time as part of their curriculum and mandated nap periods, in which children are required to lie on their beds without alternative activities are a feature in the majority of these services. This study aimed to determine the effects of childcare nap time practices (flexible vs mandatory) on children’s body mass and activity.

**Methods:** 62 children (30 females; mean age = 4.76 years ± .49; ages 3.28-6.18 years) were recruited from six childcare services in Brisbane, Australia. Children’s sleep, activity and light exposure were measured via Actigraphy for 14 days. Each child’s height (cm) and weight (kg) were measured objectively for BMI z-score calculations according to the World Health Organization growth charts. Services were classified as either having flexible (< 45mins of time spent on bed without alternative activity; n = 19 children attended these centres) or mandated (> 45mins spent without alternative activity; n = 43 children attended these centres) nap practices.

**Results:** Preliminary data analyses indicated that mandated nap time practices were associated with increased napping (r = -4.09, p = .005) and increased body mass index (r = -2.68, p = .035). Day-to-day variability calculated as the mean referenced variation in sleep duration and wake after sleep onset will also be discussed.

**Conclusion:** Though preliminary, these findings suggest that mandated childcare nap time practices are associated with increased body mass. This finding indicates an impetus to further investigate the effect of childcare nap time practices on children’s sleep and health.

**Support (If Any):** Financial Markets Foundation for Children Grant (2012-213)

**0051**

**SLEEP DURATION AND DIFFICULTIES IN CHILDREN OF ALCOHOLICS AND CONTROLS**

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**Introduction:** Recent studies indicate that sleep difficulties may preclude and represent a marker of risk for the development of alcohol use disorders (Brover, 2001; Wong et al., 2004, 2010). However, there is little research comparing sleep habits and patterns of children of biological alcohol-dependent parents (COAs) and controls. In this study, we compared sleep duration and difficulties in young COAs and controls, as measured by actigraphy and parental report.

**Methods:** Participants were 75 children (61% COAs; 53% girls; mean age = 10.21(1.41)) in a study designed to understand the longitudinal relationship between sleep characteristics and substance use. Time 1 data were presented here. Parental ratings of sleep problems were collected by the Child Behavior Checklist (Achenbach, 1991). Additionally, sleep data were collected by actigraphy. Participants were asked to wear an actigraphy watch for one week.

**Results:** Controlling for age and gender, COAs did not differ from controls on parental ratings of overtiredness (Odds ratio (OR) = 5.41, p = .13) and having trouble sleeping (OR) = .62, p = .40). Moreover, there was no difference between COAs and controls on average sleep duration (b = -.02, p = .85), sleep efficiency (b = .06, p = .63), onset latency (b = .09, p = .44) and wake time after sleep onset (b = .04, p = .72).

**Conclusion:** COAs did not seem to differ from controls on sleep variables. We discussed the implications of these findings on the understanding of sleep problems as a risk factor for alcohol use and alcohol-related problems.

**Support (If Any):** Supported by NIH Grant R01 AA020364

**0052**

**CHANGES IN MOTOR SKILL OVER INITIAL SLEEP ARE UNRELATED TO LONG-TERM SKILL LEVELS IN CHILDREN**

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**Introduction:** Sleep supports the formation of skill memory. In juvenile song birds learning a tutor’s song, a stronger initial deterioration of song performance over night-sleep predicts better song performance in the long run. This and similar observations have stimulated the view of sleep supporting skill formation during development in an unsupervised off-line learning process that, in the absence of external feedback, can initially also enhance inaccuracies in skill performance.

**Methods:** Here we explored if in children learning a motor sequence task, like in song-learning juvenile birds, changes across sleep after initial practice predict performance levels achieved in the long run. The task was a serial reaction time task (SRTT) where subjects had to press buttons which were lighted up in a repeating 8-element sequence as fast as possible. Twenty-five children (8-12 yrs) practiced the task in the evening before nocturnal sleep which was recorded polysomnographically. Retrieval was tested the first time on the following morning and a second time one week later after daily training on the SRTT.

**Results:** As expected changes in response speed over the initial night of sleep were negatively correlated with speed of performance after the
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one-week training. However, unlike in song birds, this correlation was driven by the baseline level of speed achieved before sleep. Baseline-corrected changes in speed or variability over the initial sleep period did not predict final performance on the trained SRTT sequence, or on different sequences introduced to assess generalization of the trained behaviour.

Conclusion: The lack of correlation between initial sleep-dependent changes and long-term performance might reflect that the children were too experienced for the simple SRTT. A consistent association found between sleep spindle activity and explicit sequence knowledge alternatively suggests that such correlation was masked by explicit memory systems interacting with skill memory formation.

Support (If Any): This study was supported by a grant from the Deutsche Forschungsgemeinschaft (SFB 654 - Plasticity and Sleep).

0053 WITHDRAWN

0054

ABNORMAL GROWTH AND ENERGY METABOLISM INDUCED BY CHRONIC UPPER AIRWAY OBSTRUCTION IS ASSOCIATED WITH IMPAIRMENT OF SOMATOTROPIC AXIS IN RATS

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Introduction: Children with sleep-disordered breathing (SDB) often exhibit growth retardation, and the upper airway obstruction (AO) rat model mimics many of the features of human SDB including the abnormal sleep and growth retardation. The mechanisms linking AO-induced sleep, growth impediment, and energy metabolism abnormalities are poorly understood. Here, we investigated the role of somatotropic hormonal profile and energy metabolism during sleep/wake cycle in unrestrained juvenile rats.

Methods: The trachea of 22-day-old rats were narrowed; AO and sham-control animals were monitored for 7 weeks. Slow wave activity (SWA) power, body temperature (Tb), food intake, serum growth hormone (GH), ghrelin, leptin, and corticosterone were measured. After euthanasia, hypothalamic related mediators were analyzed.

Results: The time course of SWA in AO decreased and was unchanged across the day compared with controls; Tb decreased by 0.5°C. The AO group gained 40% less body weight compared to the controls, despite 20% elevation of food intake; ghrelin (GH secretagogue) level increased by 250% while leptin level decreased by 45%. The elevation of food intake was associated with 160% upregulation of hypothalamic somatotropin (GH), ghrelin, leptin, and corticosterone were measured. After euthanasia, hypothalamic related mediators were analyzed.

Conclusion: Abnormal growth and energy metabolism in AO are associated with alteration in circulating anabolic hormones. Our findings suggest that upregulation of ghrelin fails to stimulate GHRH level and GH secretion, while at the same time it stimulates appetite. These results provide evidence of altered hormonal regulation at the level of the hypothalamus and implicate suppression of anabolic hormones leading to abnormal sleep and energy metabolism, and growth retardation during chronic upper airway obstruction.

Support (If Any): Supported by the Israel Science Foundation grant No. 31/14.

0055

SLEEPING PILLS AND DEPRESSION: A COMMON CONCOCTION

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Introduction: Insomnia and depression are intrinsically linked—so much so that treatment of one alleviates the symptoms of the other. Upwards of 40% of individuals suffering from insomnia will self-medicate with sleeping pills or alcohol. Previous research has demonstrated that use of sleeping pills is higher among individuals with likely depression than those not depressed, particularly among older adults. The current study aims to better understand the links between depression and use of medicinal sleep aids on difficulty sleeping among adults.

Methods: Data were collected from 3,122 adults as part of the Midlife in the United States (MIDUS-I) study. Participants disclosed sleeping pill use over the last month, any diagnosis of depression, and age which was coded into young(20-40), midlife(41-65), and late-life(66+). Participants reported having trouble sleeping every night(1), several times/week(2), once/week(3), several times/month(4), once/month(5), or never(6). The sample was 100% female and ranged in age from 20 to 98 (M = 46.8, SD = 13.0).

Results: Multiple regression analysis was used to examine if depression, sleeping pill use, and age predicted trouble sleeping. Results indicated that these predictors explained 8.3% of the variance (R2 = .083,F(3,3116) = 93.776,p < .001), and that age(β = -.06,p = .000), depression(β = -.04,p = .015), and sleeping pill use(β = .27,p = .000) predicted trouble sleeping.

Conclusion: In line with previous research, those reporting more trouble sleeping were more likely to use sleeping pills, were more likely to report a depression diagnosis, and were more likely to be middle-aged or older-adults. Each of these variables independently predicted trouble sleeping thought the model only accounted for 8% of the variance in trouble sleeping, indicating that more research is needed the relation of sleep medication use, which is often done without medical supervision, particularly among those middle-aged and older adults suffering from depression.

Support (If Any): Data from MIDUS-I study funded by the John D. and Catherine T. MacArthur Foundation’s Research Network on Successful Midlife Development.

0056

REGIONAL BRAIN TISSUE INTEGRITY ASSESSMENT IN PEDIATRIC PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Pediatric subjects with long-standing OSA show evidence of neural injury and functional deficits in neuropsychologic and cognitive control sites. However, the nature and whole-brain tissue integrity in pediatric OSA subjects is unclear, but can be examined by tis-
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sue texture in high-resolution T1-weighted images through measures of local changes in intensity patterns/gray levels. A texture feature, “entropy”, measures the extent of homogeneity/randomness in tissue; this value increases in chronic and decreases in acute tissue damage. Our aim was to examine regional brain entropy values, using high-resolution T1-weighted images, in pediatric OSA compared to controls, and to determine the extent and nature of tissue pathology.

Methods: We collected high-resolution T1-weighted images from 13 pediatric OSA (age, 7.7 ± 1.0 years; AHI, 10.5 ± 6.2 events/hour; BMI, 20 ± 6.0 kg/m^2; 7 male) and 9 healthy controls (age, 9.1 ± 1.6 years; BMI, 18.8 ± 5.8 kg/m^2; 5 female), using a 3.0-Tesla MRI scanner. T1-weighted images were bias-corrected and entropy values were calculated. We normalized whole-brain entropy maps to a common space, smoothed, and compared between groups (ANCOVA; covariates: age, gender; SPM12, uncorrected-threshold p < 0.005, cluster-size 10 voxels).

Results: Significant differences in age (p = 0.02) emerged between groups. However, no significant differences in gender (p = 0.66) or BMI (p = 0.68) appeared between groups. Several brain sites in OSA subjects showed increased entropy values, including the bilateral insular regions, superior frontal, medial pre-frontal, right basal forebrain, bilateral mid and inferior temporal lobe regions, the amygdala, and the right occipital regions.

Conclusion: Regional brain entropy values are significantly increased in multiple sites in pediatric OSA, suggesting predominantly chronic tissue pathology in those areas. These regions are principally localized in critical autonomic, respiratory, cognitive, and neuropsychologic control sites, functions that are vulnerable and functionally deficient in the condition. A range of OSA-related alterations, including episodic hypoxia, repeated arousals, and hypercarbia, can contribute to the chronic tissue changes.

Support (If Any): This work was supported by the Herbert T. Abelson Chair in Pediatrics.

0057
THE DEVELOPMENTAL CHANGES OF OBSTRUCTIVE SLEEP APEAN IN INFANTS WITH CONGENITAL LARYNGOMALACIA
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Introduction: Obstructive sleep apnea (OSA) is common in infants with laryngomalacia. There is limited information on the developmental changes of OSA in this population. The purposes of this study are to determine the natural course of OSA in infants with laryngomalacia and the effect of supraglottoplasty.

Methods: Data of infants with congenital laryngomalacia who had at least two diagnostic polysomnogram performed during 2005-2015 were retrospectively reviewed. Only infants who had obstructive sleep apnea index (OA) > 1 on the initial study were included. Split-night studies were excluded. Comparison of OI was done between various age groups (0-6, > 6-12 and > 12-18 months old) by paired t-test and post hoc analysis; and between supraglottoplasty (SGP) and non-supraglottoplasty (non-SGP) group by independent t-test. The time of OSA improvement were analyzed by survival analysis.

Results: 102 infants met criteria for entry into analysis, comprising of 64 infants underwent SGP and 38 infants without SGP. The median age of surgery was 3.7 months. There was a significant decline in OI with increasing ages in both groups ([15.24 ± 14.40 [0-6 months] vs 2.04 ± 1.86 [ > 6-12 months], n = 29, p < 0.01), (6.48 ± 7.28 [ > 6-12 months] vs 3.13 ± 6.17 [ > 12-18 months], n = 9, p = 0.01)) in SGP group and (11.63 ± 9.64 [0-6 months] vs 3.24 ± 3.17 [ > 6-12 months], n = 10, p = 0.03) in non-SGP group. The decline in OI with increasing ages was not different between the two groups but sleep efficiency improved significantly in SGP group (p = 0.04). The survival analysis showed median age that OI decline to below 5 was 5.33 months old in SGP group and 6.33 months old in non-SGP group (p = 0.29).

Conclusion: Developmental changes with improving OSA in infants with congenital laryngomalacia occur with increasing ages irrespective of supraglottoplasty. The mechanism underlying these changes may involve airway growth and maturation of respiratory control. Further studies are needed to confirm these findings and to evaluate long term outcomes in this population.
0058  
DEGENERATION OF WHITE MATTER PATHWAYS IN OLDER ADULTS EXPLAINS THE FAILURE OF SLEEP SPINDLES TO PROMOTE MOTOR MEMORY CONSOLIDATION  
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Introduction: Frontal sleep spindles are associated with the consolidation of motor skills in young adults. However, why this spindle-related motor memory benefit is not observed in older adults remains unknown. Combining diffusion tensor imaging (DTI) and whole-head EEG recordings, here we demonstrate that the degree of white matter degeneration in select pathways of the human brain explains the failure of sleep spindles to facilitate motor memory consolidation in older adults.

Methods: DTI scans indexing whole-brain, voxelwise white-matter integrity (mean diffusivity; MD), calculated using tract-based spatial statistics, were obtained in 51 participants: 31 older (73.5 ± 5.2 years) and 20 young (20.4 ± 2.0 years) adults. Additionally, both groups had sleep recorded with full-head EEG polysomnography, with motor memory consolidation assessed overnight. An additional 14 older (74.1 ± 7.1 years) and 20 young (21.7 ± 2.9 years) adults served as wake controls.

Results: While young adults exhibited normal sleep-dependent motor memory consolidation overnight (relative to young controls; P = 0.013 FDR corrected), older adults showed no such sleep benefit relative to older controls (P = 0.258). Furthermore, frontal sleep spindles predicted motor memory consolidation in young (r = 0.48, P = 0.033) but not older (r = 0.08, P = 0.679) adults. Frontal sleep spindles were reduced in older relative to young adults (P < 0.05 FDR corrected), with white matter deterioration in select fiber tracts predicting the degree of spindle impairment. Critically, white matter within corpus callosum fiber tracts statistically moderated the influence of sleep spindles on motor memory consolidation (P = 0.027 FDR corrected, controlling for age), such that greater white matter degeneration significantly diminished the normally beneficial influence of sleep spindles on overnight motor memory consolidation.

Conclusion: The degeneration of white matter fiber tracts within the aging brain explains both impairments in the physiological expression of sleep spindles, and their corresponding failure to transact memory consolidation benefits. Structural brain integrity may therefore represent an underappreciated factor constraining the efficacy of sleep interventions in the elderly.

Support (If Any): Supported by National Institutes of Health; NIH NIA [R01AG031664] (MPW), [R01AG034570] (WJ), [R01AG08415] (SA), [F32AG039170] (BAM)

0059  
DATA MINING OF MULTIPLE MOUSE AND HUMAN DATASETS UNCOVERS KEY GENE NETWORKS AND REGULATORS UNDERLYING PARKINSON’S DISEASE AND COMORBID SLEEP DISRUPTIONS  
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Introduction: Sleep disruptions are common non-motor symptoms of Parkinson’s disease (PD), and are often prelude motor symptoms. However, molecular pathways and networks underlying such comorbidities remain largely unknown. Our previous work has established cellular and functional specific gene coexpression networks in mouse striatum underlying a large set of sleep phenotypes, providing an ideal platform for joint analysis elucidating how PD pathology impinges sleep gene networks and disrupts sleep.

Methods: We performed a meta-analysis of 5 PD striatal gene expression datasets in humans to establish a differential expression signature of PD. We also established a PD susceptibility signature by combining a large meta-GWAS dataset and a human striatal eQTL mouse. Striatal gene coexpression network modules relevant for sleep phenotypes were then compared to these PD gene signatures to identify modules shared by both sleep and PD.

Results: Five sleep gene modules were found down-regulated in PD, including a module highly relevant to sleep fragmentation, which represents the most common nocturnal complaint in PD. Interestingly, gene modules affected by PD susceptibility signature are distinct from those affected by the differential expression signature, and the top-affected modules are not relevant to sleep fragmentation. Instead, they are associated with EEG beta and theta power during wake and REM sleep, abnormalities in which are hallmarks of REM-sleep behavior disorder, a strong risk indicator of developing PD later in life. Furthermore, we identified key upstream regulators of these sleep/PD coexpression modules by reconstructing Bayesian regulatory networks. Querying drug signature databases using these regulator genes uncovered a number of drugs that are used for PD treatment.

Conclusion: Our findings suggest the shared gene networks underlie comorbidities between PD and specific aspects of sleep disturbance. Our data may also shed light on novel treatment strategies that alleviates PD pathology by restoring proper sleep gene networks.

Support (If Any): This work was supported by the Defense Advanced Research Projects Agency, the U.S. Army Research Laboratory and the U.S. Army Research Office (government contract/grant number DAAD190210038 and W911NF101006).

0060  
CORTICAL SOURCE IMAGING OF LOCAL SLEEP CHANGES IN OBSTRUCTIVE SLEEP APNEA  
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Introduction: It is now widely recognized that sleep is not a global phenomenon, but can occur on a local level in an otherwise wakeful brain. Similarly, sleep disruption might also occur in local cortical areas despite the rest of the brain being asleip. In support of this, we have recently demonstrated a local sleep deficit in posterior brain regions of asymptomatic, healthy middle-aged subjects with obstructive sleep apnea (OSA) relative to control subjects. Here we sought to extend this finding by localizing the neural sources contributing to this deficit using source localization of high-density polysomnography (hdPSG).
Methods: Healthy adults (n = 16, ages 35-66) with OSA (apnea hypopnea index (AHI) > 10) and controls without OSA (AHI < 5) underwent hdPSG (256 channel) recordings. Five minute segments of continuous sleep free from respiratory events and arousals were taken from the all-night sleep data of subjects in each group for cortical source imaging (sLORETA) and spectral analysis. A within-subject analysis of sleep segments with and without respiratory events in the OSA subjects was also conducted. Topographic differences in spectral density were assessed using statistical non-parametric mapping.

Results: Between-group analyses of respiratory event-free sleep fragments confirmed, in ostensibly normal sleep, the presence of the posterior reduction in electroencephalographic power previously reported in the OSA group compared to controls. Source modeling of these sleep segments localized this reduction to the cingulate, particularly posterior regions, bilaterally. A within-subject analysis of sleep with and without respiratory events in the OSA subjects revealed that, despite the unsurprising occurrence of more high frequency activity (> 14 Hz) in all cortical areas suggestive of globally disrupted sleep during respiratory events, slow waves were preserved in a circumscribed region of the fronto-medial cortex.

Conclusion: Our data indicate that sleep in OSA subjects fails to adequately involve the posterior cingulate. Importantly, sleep is known to play a critical role in the regulation of amyloid and the posterior cingulate is thought to be a region of early amyloid deposition. These data therefore suggest a mechanism by which sleep disruption in OSA might contribute to Alzheimer’s disease progression and could provide a target for early treatment during a potentially reversible stage of Alzheimer’s neuropathology.

Support (If Any): Data for this study was collected with support from the National Center for Complementary and Alternative Medicine (NCCAM) P01AT004952 to GT.

0061 INSOMNIA SYMPTOMS AND RESTING-STATE NETWORK CONNECTIVITY IN OLDER ADULTS WITH DEPRESSION

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Introduction: Disturbed sleep is commonly associated with poor executive function in older adults with depression. Age-related and depression-related sleep disturbances, such as increased insomnia symptomatology, may negatively influence executive function through connectivity of the executive control network (ECN). Alternatively, insomnia symptoms may indirectly affect executive function through sleep’s role in attention and the underlying anterior salience network (ASN), which initiates switching between the ECN and default mode network (DMN).

Methods: In a sample of 42 older adults with depression (mean age = 68.86), we tested the hypothesis that insomnia symptoms are associated with lower functional connectivity in the ECN. Insomnia symptoms were assessed with the Hamilton Depression Rating Scale. Connectivity of the bilateral ECN, DMN, and ASN were assessed using functional magnetic resonance imaging. We tested bivariate relationships between insomnia symptoms and each resting-state network. Additionally, the mediating role of the ASN in the relationship between insomnia symptoms and the ECN was tested through statistical mediation analysis and through inter-network connectivity of the ECN and ASN. Covariates included age, sex, and depressive symptoms.

Results: Greater insomnia symptoms were associated with lower connectivity in the left ECN, rho = -0.35, p = 0.02, and the DMN rho = -0.24, p = 0.02. The relationship in the ECN remained significant after controlling for covariates. Insomnia symptoms were not significantly associated with the right ECN or the ASN. ASN connectivity did not statistically mediate the relationship between insomnia symptoms and the ECN, nor was inter-network connectivity between the ASN and ECN associated with insomnia symptoms.

Conclusion: Insomnia symptoms of older adults with depression are associated with lower connectivity in networks commonly associated with executive function. Future work will investigate whether more specific and objective sleep features, such as slow-wave sleep, may further explain the relationship between insomnia symptoms and executive network connectivity.

Support (If Any): This work was supported by R01 MH076079. KAW was supported by T32 MH019986. DBK was supported by T32 HL082610.

0062 EFFECTS OF APOE GENOTYPE ON SLEEP AND OVERNIGHT CONSOLIDATION OF SPATIAL NAVIGATIONAL MEMORY

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Introduction: The ApoE4 allele is a major risk factor for development of Alzheimer Disease (AD). Symptoms of AD include early deficits in spatial orientation and alterations in sleep. The effects of ApoE4 on sleep architecture and sleep-dependent memory consolidation are less known, particularly at earlier time points before clinical manifestations are apparent. We investigated the effects of ApoE4 allele on sleep architecture and overnight spatial navigational memory consolidation in cognitively normal elderly individuals.

Methods: We recruited 29 cognitively normal elderly subjects (age = 67 ± 9 years) who underwent one night of standard polysomnography. Subjects performed training and 3 timed trials before and after sleep on the same computer-generated 3D spatial maze. Improvement in average completion time after sleep was calculated. A 20-minute psychomotor vigilance test (PVT) was performed in the morning prior to the maze trials. ApoE genotype was determined from serum. Individuals with at least 1 ApoE4 were considered at risk carriers.

Results: Of 29 subjects, 17 were control and 12 had at least one ApoE4 allele. Both groups were similar in age, total sleep time, sleep efficiency, sleep architecture, severity of sleep disordered breathing, PVT performance, and pre-sleep baseline maze performance. The control group had significant improvements in maze performance after sleep (390 ± 135 sec vs 302 ± 121 sec, p < 0.002) while ApoE4 carriers had no significant change in performance (349 ± 159 sec vs 358 ± 178 sec, p = 0.82). We observed a trend toward a difference in the median of individual changes in overnight performance between groups (28.8% vs -11.8% respectively, p = 0.066).

Conclusion: Cognitively normal subjects with at least one ApoE4 allele showed a decreased ability to consolidate spatial navigational memory during sleep. Sleep-dependent spatial memory deficits observed may represent an endophenotype of ApoE4 genotype or may help establish risk for development of subsequent AD.

Support (If Any): This work was supported by the philanthropy of the James Kuhn Friends of Sleep Medicine, the American Sleep Medicine Foundation Junior Faculty Award and Bridge to Success Award (A.W.V.), NHLBI K24 grant HL109156 (I.A.), and by NHLBI R01 118624 (R.S.O.)
A LONGITUDINAL EXAMINATION OF THE IMPACT OF DELTA ACTIVITY AT SLEEP ONSET ON COGNITIVE AND AFFECTIVE FUNCTION IN COMMUNITY-DWELLING OLDER ADULTS

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Introduction: The investigation sought to determine whether delta activity at sleep onset (DASO), also known as anterior bradycardia or sleep onset frontal intermittent rhythmic delta activity, in the Sleep EEGs of older adults is normal variation or could be associated with clinical pathology. Our previous report showed cross-sectional findings of no significant associations between DASO and cognition. The question remains, however, whether DASO captured by nocturnal PSG in healthy individuals is associated with long-term decline in cognition. To this end, we examined its longitudinal associations with cognitive and affective function in older adults without dementia.

Methods: Participants were 153 community-dwelling older adults without dementia. We evaluated polysonomography (PSG), cognitive performance, and affective function at four time points: baseline, 12, 24, and 36 months. Data collection occurred from 2005 to 2011. All participants were administered PSG and measures of global cognition, delayed verbal memory, information processing speed, attention, inhibition, verbal naming, visuospatial ability, as well as anxiety and depression. DASO was defined as sequences of rhythmic anterior delta activity on PSG in the transition from awake to sleep during the baseline assessment. We employed linear mixed effects modeling to model trajectories of cognitive and affective function measurements across the four time points.

Results: At the baseline, 83 women and 70 men, mean age 71.3 ± 0.6 years participated and 19.6% of participants exhibited DASO on PSG. Age, years of education, gender and BMI did not differ based on the presence of DASO. The linear mixed model showed no significant correlation with DASO and trajectory of cognitive decline. Further, participants with DASO, versus those without DASO, performed better on cognitive tests, although none of these associations reached statistical significance. In the analyses with affective measures linear mixed modeling showed that lower depressive symptoms (The Geriatric Depression Scale) and lower trait anxiety (Spielberger Anxiety/Trait) was associated with presence of DASO at baseline (p < 0.05). Somatic anxiety (Beck Anxiety Inventory) was lower in the DASO (+) group relative to the DASO (-) group, but this was not statistically significant.

Conclusion: Whereas DASO was associated with better affective function, no association was found between DASO and cognitive performance or change over time. These longitudinal findings support the notion that the presence of DASO in healthy older adults represents normal variation.

Support (If Any): National Institute of Health Grants MH 070886, AG 18784 and AG17824 and Advanced Fellowship Program in Mental Illness Research and Treatment, Department of Veterans Affairs.
RELATIONSHIP BETWEEN FARMING HABIT AND DEPRESSIVE SYMPTOMS: A CROSS-SECTIONAL STUDY OF THE HEIJO-KYO COHORT

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Introduction: Previous randomized controlled trials revealed that bright light and exercise interventions improve depressive symptoms. Although farming habit may increase physical activity and light exposure during daytime, the relationship between farming habit and depressive symptoms remains unclear. The purpose of this study was to clarify the relationship between daily farming habit and depressive symptoms in a general elderly population.

Methods: This study included home-dwelling 1027 men and women aged over 60 years in the HEIJO-KYO cohort (mean age, 71.5 years). Farming habit and depressive symptoms were assessed using self-administrated questionnaires. Depressed mood was defined as the Geriatric Depression Scale score of ≥ 6. Physical activity and light exposure during daytime were measured using an actigraph (Actiwatch 2, Respiromics) worn on the non-dominant wrist in two days.

Results: 680 participants (66.2%) were included in the farm work group, containing pastime farmers, part-time farmers, and full-time farmers. The farm work group showed significantly higher average physical activity and light exposure during daytime (305.6 vs. 289.3 counts/min, P < 0.001; 6.01 vs. 5.56 log lux, P < 0.01; respectively) than the non-farm work group. Logistic regression analysis revealed that crude odds ratio (OR) for depressed mood among the farm work group was significantly lower than the non-farm work group (OR, 0.59, 95% confidence interval, 0.41 to 0.84, P = 0.003). Also, adjusted OR for depressed mood among the farm work group was significantly lower than the non-farm work group (OR, 0.62, 95% confidence interval, 0.44 to 0.90, P = 0.01), independently of potential confounding factors, such as age, gender, drinking habit, body mass index, antidepressant use, education, and household income.

Conclusion: We found independent and significant association between farming habit and depressive symptoms in a general elderly population. This may be mediated by increased physical activity and light exposure during daytime.
0066
ADAR-MEDIATED RNA EDITING SUPPRESSES SLEEP BY ACTING AS A BRAKE ON GLUTAMATERGIC SYNAPTIC PLASTICITY

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Introduction: It has been postulated that synaptic potentiation during waking is offset by a homeostatic reduction in net synaptic strength during sleep. However, molecular mechanisms to support such a process are lacking.

Methods: RNA editing was reduced by knockdown of Adar expression in the CNS of Drosophila. Sleep was measured using DAMS from Trikinetics. Changes in the vesicular glutamate transporter (VGLUT) were measured in whole brains by western blotting. Changes in synaptic activity were measured as spontaneous and evoked EPSPs at the neuromuscular junction.

Results: Deficiencies in the RNA editing gene Adar increase sleep due to synaptic dysfunction in glutamatergic neurons in Drosophila. Specifically, VGLUT is upregulated, leading to over-activation of NMDA receptors, and the reserve pool of glutamatergic synaptic vesicles is selectively expanded.

Conclusion: These changes lead to sustained neurotransmitter release under conditions that would otherwise result in synaptic depression. We propose that a shift in the balance from synaptic depression toward synaptic potentiation in sleep-promoting neurons underlies the increased sleep pressure of Adar-deficient animals. Our findings provide a plausible molecular mechanism linking sleep and synaptic plasticity.

Support (If Any): NIH R01NS072431 (WJJ), Whitehall Foundation grant # WF20110560 (WJJ), National Science Foundation Graduate Research Fellowship Program grant # DGE-1144086 (JER), UCSD Graduate Training Program in Cellular and Molecular Pharmacology T32 GM007752 (JER).

0067
CALCIUM-BINDING PROTEIN PROFILE OF BASAL FOREBRAIN GLUTAMATERGIC NEURONS IN THE VGLUT2-TDTOMATO MOUSE

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Introduction: The basal forebrain (BF) plays a crucial role in cortical activation, and it was recently reported that optogenetic stimulation of BF glutamatergic neurons elicited a profound wake-promoting effect. Glutamatergic neurons are the least well understood of the three major BF neurotransmitter classes, due to difficulties in immunohistochemical identification. Thus, we established a mouse model that expresses a red fluorescent protein (tdTomato) in BF glutamatergic neurons, allowing investigation of their distribution and neuronal phenotype.

Methods: Vesicular glutamate transporter, subtype 2 (vGluT2)-tdTomato mice were generated by crossing vGluT2-Cre Recombinase mice with a Cre-reporter strain expressing tdTomato. Immunohistochemical staining was performed against choline acetyltransferase (ChAT), to confirm that tdTomato was not ectopically expressed in cholinergic BF neurons. vGluT2-ttdTomato mice were also crossed with GAD67-Green Fluorescent Protein (GFP) knock-in mice, to test for co-localization in GABAergic neurons. Lastly, immunohistochemistry was performed to profile the calcium binding protein content of these neurons (parvalbumin, calbindin, and calretinin).

Results: The distribution of tdTomato+ neurons was markedly different from that of GABAergic neurons, and resembled that identified by in situ hybridization. A very low level of tdTomato co-expression was observed in cholinergic, parvalbumin, or GABAergic neurons (<1%, N = 3 per group). 25.9 ± 3.3% (AVE ± SEM) of BF vGluT2-Tomato neurons contained calbindin (N = 3), whereas 41.0 ± 5.1% contained calretinin (N = 3). In vGluT2-ttdTomato/GAD67-GFP crossed animals, we also performed a blue ChAT stain, which confirmed that BF cholinergic, GABAergic, and glutamatergic neurons represent largely non-overlapping populations.

Conclusion: BF glutamatergic neurons may play a role in modulation of cortical activation, and investigation of the distribution and neuronal phenotype of these neurons is critical for our understanding of how they promote wakefulness. Our results suggest that several subpopulations of BF glutamatergic neurons exist which differ in their calcium binding protein content and may play distinct roles in the control of cortical activation and sleep-wake behavior.

Support (If Any): Department of Veterans Affairs, NHLBI P01 HL095491, NIMH R01 MH039683, NINDS R21 NS093000

0068
MAPPING HYPOCRETIN RECEPTORS IN HYPOTHALAMIC LOCAL CIRCUITS USING MICE GENETICALLY TARGETED IN HCRTR1 AND HCRTR2 GENES

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Introduction: Hypocretin (orexin) insufficiency or inactivation of its receptors HcrtR1 and HcrtR2 lead to narcolepsy with cataplexy in humans and mice. Breeds of dogs harboring single-gene lesions in HcrtR2 also manifest severe narcolepsy. HcrtR2’s site of action and mechanism in preventing cataplexy are unknown. Hcrt-neurons were reported to get excited by Hcrt-2, and to express HcrtR2. By contrast our novel mouse models support that the vast majority of Hcrt-neurons do not express HcrtR2 or HcrtR1, while neighboring intra-hypothalamic neurons do. Because we and others have shown that global Hcrt levels are normal in dogs and mice lacking functional HcrtR2, one hypothesis is that HcrtR2 is critical for control of Hcrt neuronal activity, Hcrt timely release or response, at the level of intra-hypothalamic networks. Therefore we characterized HcrtRs-expressing hypothalamic cell types, using gene-targeted mouse alleles that both report and conditionally inactivate HcrtR expression.

Methods: Two alleles were generated for each of the two HcrtR genes: one Cre-dependent-KO allele for cell-type, area, or time-specific gene inactivation and GFP reporting; and, using a germ-line Cre, a “whole-body-recombined” allele to report and inactivate receptor expression in all cells. Double and triple-immunostaining of hypothalamic sections from HcrtR2-del-Gfp and HcrtR1-del-Gfp heterozygous mice was performed and confocally imaged to test co-expression of GFP with MCH, GABA, HDC, TH and GFAP. Because our alleles express cytoplasmic GFP, cell somas and neurites are visualized, allowing in some cases to infer cell-cell interactions.

Results: Cell-type mapping of HcrtR distribution in local hypothalamic networks uncovered previously unknown patterns allowing elaboration of models to explain the failed neurotransmission at the basis of narcoleptic symptoms and other disorders of Hcrt deficit.

Conclusion: Models await electrophysiological-testing and subsequent validation using cell-type-specific HcrtR inactivation. Local injection of VGAT-Cre and MCH-Cre vectors will be assayed for Hcrt-neuron activity and cataplexy in the resulting mice.

Support (If Any): This work was supported by grants from the Swiss National Science Foundation to AV (144282).
IV. Neurobiology

0069

GPR139, AN ORPHAN RECEPTOR ACTIVATED BY L-TRYPTOPHAN AND L-PHENYLALANINE: EMERGING ROLE ON SLEEP MODULATION


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Introduction: GPR139 is an orphan GPCR expressed in the brain and pituitary gland, and highly enriched in circumventricular regions of the habenula and septum in rodents and humans. Amino acids L-tryptophan (L-Trp) and L-phenylalanine have recently been identified as physiological ligands for GPR139. Trp loading is reported to improve sleep in humans and some animal models. The aim of the present study was to investigate the potential role of GPR139 in sleep regulation in rat models using a recently developed selective agonist JNJ-63533054.

Methods: EEG sleep effects of the GPR139 agonist (3-30 mg/kg po), its 50-fold less active enantiomer and L-Trp (200 mg/kg po) as a comparison were evaluated in rats during the light or dark phase. In a separate group of rats, the sensitivity to the sleep response of JNJ-63533054 and L-Trp was tested after 18h food deprivation as compared to control conditions.

Results: When administered at the beginning of the light phase, JNJ-63533054, but not its less active enantiomer, dose-dependently decreased spontaneous locomotor activity, reduced NREM latency and increased NREM sleep duration for 2h post-dosing, whereas REM sleep was not affected. The lack of effect observed after dosing at dark onset indicated a phase-dependent sleep response. In contrast, sleep parameters were not altered following L-Trp administration. Interestingly, the GPR139 agonist decreased NREM power in the 10-30 Hz frequency range whereas L-Trp rather increased power in the 5-15 Hz frequency range, revealing a differential EEG pattern between the two compounds. The sleep response to activation of GPR139 was not affected by the 18h food deprivation suggesting that the sleep-promoting effect may not be directly related to metabolic activity.

Conclusion: These data indicate an emerging role of GPR139 in the modulation of sleep. Further pharmacological investigations are in progress and we are in the process of evaluating the sleep profile of GPR139 knockout mice.

0070

A NOVEL ROLE FOR PEDUNCULOPONTINE TEGMENTUM PPT) BDNF-TRKB SIGNALING: A MECHANISM OF HOMEOSTATIC REGULATION OF REM SLEEP IN RAT

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Introduction: Studies in laboratory animals and humans have shown that cholinergic neurons in the PPT are critically involved in the initiation and maintenance of spontaneously occurring REM sleep. Recently we have shown that there is increased expression of PPT BDNF with REM sleep homeostatic drive. The present study, tested the hypothesis that BDNF-TrkB receptor activation in the PPT is a causal factor for homeostatic regulation of REM sleep.

Methods: Adult male Sprague-Dawley rats were randomly divided into five groups (8 rats/group) and then chronically implanted with sleep-wake electrodes and PPT bilateral guide cannulae. In Experiment 1, Groups 1 and 2 were microinjected with vehicle (control), groups 3, 4 and 5 were microinjected with 20, 30 and 40 μmol of TrkB antagonist K252a. Group 1 was allowed undisturbed sleep-wake activity, while groups 2, 3, 4 and 5 were subjected to three hours of selective REM sleep deprivation (RSD). All animals were allowed undisturbed sleep-wake activity for the final three hours. Episodes of wakefulness, non-REM and REM sleep were scored, and percentage of time spent in each state was calculated. In experiment 2, the level of BDNF expression in the PPT was measured using ELISA. In a separate set of rats, ANA-12, another TrkB antagonist, was microinjected, followed by three hours of selective RSD. BDNF expression was analyzed by Western blotting.

Results: RSD progressively increased REM sleep homeostatic drive, REM sleep rebound, and increased BDNF expression in the PPT. Microinjection of the TrkB antagonists, K252a and ANA-12 blocked REM sleep homeostatic drive, and reduced PPT BDNF expression. There was a positive correlation between the level of BDNF expression and REM sleep homeostatic drive.

Conclusion: These findings suggest, for the first time, that activation of BDNF-TrkB receptor signaling in the PPT is a critical step for the homeostatic regulation of REM sleep.

Support (If Any): NIH Grant MH-59839 (SD)

0071

DEFAULT MODE ACTIVATION PREDICTS VULNERABILITY TO SLEEP DEPRIVATION IN THE DOMAINS OF MOOD, SLEEPINESS, AND VIGILANCE

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Introduction: There are consistent trait-like individual differences in vulnerability to the adverse effects of sleep deprivation (SD) but the underlying neural mechanisms of this trait are poorly understood. Furthermore, resistance to SD also differs across domains (e.g., psychomotor vigilance versus subjective sleepiness) within a given individual. Because sustained activation of the Default Mode Network (DMN) appears to play a critical role in attentional lapses, we hypothesized that individuals showing this tendency during non-SD cognitive performance might show greater subsequent vulnerability to SD even when tested several days later.

Methods: Forty-five healthy adults (23 male; Ages 20-43) underwent 3T functional magnetic resonance imaging (fMRI) while completing a numeric cognitive conflict task. Within the next 4 days, participants underwent a single overnight SD session, including hourly assessment of three domains of functioning, including the psychomotor vigilance task (PVT), visual analog mood scale (VAMS), and Karolinska Sleepiness Scale (KSS). Data were converted into three comparable metrics of percent decline in performance from baseline across the entire SD session and then combined as a global index of vulnerability. The metric was then correlated with fMRI within the medial DMN using SPM12, controlling for sex.

Results: Two clusters of activation significantly (p < .05, FWE corrected) predicted subsequent global vulnerability to SD, including anterior (ACC; r = -.59) and posterior (PCC; r = -.63) cingulate cortex. Stepwise multiple regression showed that ACC and PCC each contributed unique variance to predicting vulnerability globally (R2 = .51), and the individual domains of mood (R2 = .39) and sleepiness (R2 = .47), while only PCC accounted for vigilance (R2 = .10).

Conclusion: Reduced suppression of DMN response during a difficult cognitive task at rested baseline predicted greater subsequent global vulnerability to sleep deprivation, but was particularly predictive of degradation of subjective sleepiness and worsening mood, and to a lesser extent PVT performance. The medial DMN may be an important functional biomarker of vulnerability to SD.

**0072**
**EXPOSURE TO BLUE WAVELENGTH LIGHT IS ASSOCIATED WITH INCREASED DORSOLATERAL PREFRONTAL CORTEX RESPONSES, AND INCREASES IN RESPONSE TIMES DURING A WORKING MEMORY TASK**

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**Introduction:** Consistent long-term exposure to blue enriched white light has been associated with increases in self-reported alertness, concentration, work performance and decreases in fatigue and daytime sleepiness. Blue light has also been shown to lead to immediate functional brain changes during the light exposure, but the effects of blue light on functional brain responses during cognitive tasks after cessation of light exposure remain unclear.

**Methods:** Thirty-five healthy 18-32 year olds (18 females, mean age = 21.79) were randomized to receive a 30-minute exposure to either blue (active) (n = 17) or amber (placebo) light (n = 18), immediately followed by a working memory task (N-Back task) during functional magnetic resonance imaging (fMRI). All exposure was completed between 10:15-10:45 a.m., following normal sleep at home.

**Results:** In contrast to placebo, participants in the blue light group showed significantly greater activation within the dorsolateral prefrontal cortex (DLPFC) and the ventrolateral prefrontal cortex (VLPFC) with increases in working memory load. Participants in the blue group responded faster during conditions of high cognitive load than participants in the placebo group. In addition, with increases in activation within the VLPFC, participants showed faster reaction times (r = -.35, p = .04) and more efficient responding (i.e., answered more items correctly per second) (r = .40, p = .01) during conditions of greater cognitive load.

**Conclusion:** The results suggest that a short single exposure to blue light is sufficient to produce measurable changes within the DLPFC and VLPFC, brain areas recruited during heavy cognitive load. This may explain why previous studies have reported increases in subjective alertness and performance after long-term blue light exposure. These findings may have important implications for using blue light as a tool to increase alertness, and response times in a variety of work settings that require alertness, and quick decision-making.

**Support (If Any):** Department of Defense Award No. W81XWH-14-1-0571

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**0073**
**DYNAMIC CONSISTENCY BETWEEN EEG SPECTRAL POWER AND REGIONAL CONNECTIVITY ACROSS SLEEP-WAKE CONDITIONS**

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**Introduction:** EEG has been widely adopted and regarded as the gold standard for sleep investigations. Literature majorly reported based on topological changes of spectral power. Recently, another supplemental perspective from functional connectivity (FC) arises to benefit on the explanation of the brain activities; however, such FC viewpoint was rarely reported in the sleep field. Therefore, to explore the functional-ity of EEG signal propagations in Non-REM (NREM) sleep, we compared the changes between regional FC and spectral power of EEG signals across five conditions (from wakefulness to NREM stages).

**Methods:** Around midnight, we asked 24 healthy young volunteers to sleep for up to 2 hours inside a 3T Tim Trio MRI scanner using simultaneous EEG-fMRI recordings (BrainProduct 32-channel MR-compatible EEG system). The EEG signals underwent the gradient correction and ballistocardiogram correction using the Analyzer software. The sleep scoring was performed according to preprocessed EEG signal, and 13 out of 24 participants with N3 sleep were used for following analysis. Subsequently, we segmented all 13 EEG signals into five conditions (pre-sleep, N1, N2, N3 and Awakening, each condition was with 5-min duration). For spectral power analysis, we isolated the delta, theta, alpha and beta bands using band-pass filters. For regional connectivity analysis, we segmented the brain into 3 parts for both transverse (frontal, central and occipital) and longitudinal (left, right and midline) connectivity patterns. The connectivity index was performed by temporal correlations between channel pairs and averaged in each brain segregation.

**Results:** Results denoted that delta power kept increasing along with sleep stages and fell back to presleep level, where the frontal regions are especially significant. However, other frequency bands did not show significant changes across conditions. In delta band FC, all the transverse connectivity increased along with NREM stages, whereas the longitudinal connectivity decreased along NREM stages, expressing the dynamic consistency across conditions. Only the midline region did not show significant changes.

**Conclusion:** We observed the consistency across spectral power changes and FC changes in the delta band. As the transverse connectivity increased along with deep sleep stages, the longitudinal connectivity decreased in the opposite way. Such finding suggested that the enhanced delta spectral power during sleep was used as the expenditure on constructing inter-hemisphere connectivity, especially significant in the frontal regions. This phenomenon might be the indication of dynamic brain reorganization during NREM sleep.

**Support (If Any):** This study was supported by Ministry of Science and Technology, Taiwan (MOST 104-2221-E-008-123-)

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**0074**
**BRAIN-SPECIFIC ROLE OF HOMER PROTEINS IN DROSOPHILA SLEEP**

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**Introduction:** Homer proteins are a component of the postsynaptic density of neurons that are necessary for the maintenance and consolidation of behavioral state in both vertebrates and invertebrates. Drosophila melanogaster carries a single Homer gene that encodes for D-Homer protein whose global genetic loss leads to disruption and fragmentation of sleep and wake states. In the following study, we investigated the brain-specific role of Homer in Drosophila sleep-wake behavior.

**Methods:** We employed the Drosophila UAS/GAL4 GeneSwitch system to conditionally express Homer RNAi in neurons and a subset of wake-promoting mushroom body cells in the brain. Flies were administered RU486 or vehicle at 7 days of age to minimize any developmental effects caused by transgene expression. Quantitative PCR was conducted to confirm knockdown of Homer following RU486 treatment.

**Results:** Transgenic flies expressing RU486-activated Homer RNAi in a subset of mushroom body cells display a 39% increase in nighttime sleep (P < .001) following RU486 administration relative to vehicle control flies. Sleep bout duration and sleep bout numbers were...
not significantly altered following Homer knockdown. Wake time was concurrently decreased by 38% (P < .001) at night with no significant change in number of wake bouts during the day or night. Expression of Homer RNAi in neurons led to variable changes in sleep that did not produce a statistically significant directional effect.

**Conclusion:** Our results suggest that within a select subset of wake-promoting cells, Homer proteins modulate sleep and wakefulness in Drosophila melanogaster. The data provides evidence that there may be distinct brain-region specific effects of Homer signaling on sleep. This has important implications for our understanding of the molecular mechanisms underlying sleep regulation and provides insight into the biology of processes such as synaptic plasticity and cell signaling that are dependent on Homer signaling.

**Support (If Any):** 5-T32-HL-007953-15; P01 AG017628

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**0075**

**BASEAL FOREBRAIN GLUTAMATERGIC AND GABAERGIC NEURONS: INTRINSIC PROPERTIES AND MODULATION BY CHOLINERGIC INPUTS AND HYPNOTIC AGENTS**

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**Introduction:** Recent optogenetic and pharmacogenetic studies in vivo have suggested that basal forebrain (BF) glutamatergic and GABAergic neurons play a key role in promoting cortical low voltage fast activity and wakefulness. Here, we use mice expressing a red fluorescent protein (tdTomato) in the major group of BF glutamatergic neurons (those expressing the vesicular glutamate transporter, type 2, vGluT2), and verified GAD67-GFP knock-in mice which express green fluorescent protein (GFP) in GABA neurons to study the ion channels and neurotransmitter receptors which regulate their activity in vitro.

**Methods:** Whole-cell patch-clamp recordings were performed on coronal slices prepared from young (13-22d) mice. GABAergic and glutamatergic (vGluT2) neurons were identified based on their expression of GFP (green fluorescence) and tdTomato (red fluorescence) respectively. Drugs were bath-applied.

**Results:** BF vGluT2 neurons were small/medium-sized (15.2 ± 0.7 μm, n = 39) with a more hyperpolarized resting membrane potential than large (> 20 μm) BF GABAergic neurons, and a lower maximum firing frequency (47.9 ± 3.5 Hz). They displayed rebound spikes at the offset of hyperpolarizing current steps, which were blocked by the T-type calcium channel antagonist TTA-P2 (3 μM). Different from the excitatory effect on BF GABAergic neurons, the cholinergic agonist carbachol (50 μM) hyperpolarized vGluT2 neurons located in the ventromedial BF (-15.6 ± 2.9 mV, n = 6/6). The hypnotic, zolpidem (1 μM) increased the decay time of inhibitory currents in BF GABAergic and vGluT2 neurons (decay Tau, control vs. zolpidem, GABA: 6.6 ± 1.1 vs.11.9 ± 2.2 ms, p = 0.0057, n = 7; vGluT2: 6.5 ± 1.8 vs. 12.8 ± 2.6 ms, n = 4).

**Conclusion:** BF glutamatergic neurons have T-type calcium channels which may allow them to discharge in bursts. Unlike BF GABAergic neurons, whose tonic firing is increased by cholinergic inputs, BF glutamatergic neurons are hyperpolarized, which may facilitate burst firing by de-inactivating the T-type channel. Hypnotic agents acting on GABA-A receptors may facilitate sleep, in part, by increasing the inhibition of BF GABAergic and glutamatergic neurons.

**Support (If Any):** VA; NINDS R21 NS093000; NIMH R01 MH039683; NHLBI HL095491; NINDS R21 NS079866

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**0076**

**NEUROCHEMICAL MECHANISMS RESPONSIBLE FOR ATONIA DURING REM SLEEP**

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**Introduction:** Which neurochemical mechanisms are responsible for atonia during REM sleep? For decades the consensus, based primarily on data obtained by recording intracellularly, was that muscle atonia during REM sleep was due to the postsynaptic inhibition of motoneurons. However, extracellular recording studies during the last 15 years have indicated that REM atonia is the result of disfacilitatory processes. Funk (2008) suggested that “a detailed intracellular analysis of XII motoneuron properties across natural sleep-wake cycles combined with the local application of antagonists as performed for V motoneurons would likely resolve this debate very quickly”. These data, which are now available, provide the foundation for resolving the conflicting results emanating from extracellular and intracellular recording studies.

**Methods:** The extracellular activity of motoneurons and motor nerves was recorded during REM sleep following the volume application of neurotransmitter agonists and antagonists, e.g., by reverse dialysis (see Chase, 2013). Intracellular records from motoneurons were obtained during spontaneously-occurring sleep and waking states in conjunction with the juxtacellular microiontophoresis of neurotransmitter agonists and antagonists (ibid.).

**Results:** Extracellular studies of motor nerves and motoneurons revealed that the disfacilitation of motoneurons is responsible for REM sleep atonia. In these studies, hypoxia/hypercapnia was produced by vagotomy and other procedures to enhance the signal-to-noise ratio. These procedures are not necessary when recording Intracellularly. Intracellular recording studies in normoxic animals demonstrate that atonia during REM sleep occurs as the result of postsynaptic inhibition.

**Conclusion:** We conclude that glycnergic postsynaptic inhibition is responsible for REM atonia under normal (i.e., normoxic) conditions. During pathological states, such as Obstructive Sleep Apnea, that are accompanied by periods of low oxygenation (hypoxia) and/or elevated CO2 (hypercapnia), both disfacilitation and postsynaptic inhibition promote atonia during REM sleep.

**Support (If Any):** 1R01NS094062-01 and 1| 01BX00819

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**0077**

**MEDULLARY TARGETS OF AXON TERMINALS ORIGINATING IN THE DORSAL MEDULLARY CATECHOLAMINERGIC A2/C2 NEURONS**

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**Introduction:** Our measurements based on c-Fos immunohistochemistry suggested that dorsomedial medullary catecholaminergic neurons of the A2/C2 group have reduced or abolished activity during rapid eye movement sleep. As such, they could contribute to state-dependent regulations. While long-range projections from A2/C2 cells to the forebrain and spinal cord are well established, information about projections within the brainstem is conflicting. Study of such projections may offer clues about the role of A2/C2 neurons.

**Methods:** We injected 50-100 nl of adenovirus-associated virus (AAV9) carrying Cre-dependent DNA sequences for enhanced yellow fluorescent protein (eYFP) and channelrhodopsin-2 into the caudal nucleus of the solitary tract (NTS) in 4 rats engineered to produce these exogenous proteins exclusively in tyrosine hydroxylase (TH)-synthesizing neurons. After 42-47 survival days, rats were perfused and brainstems
A. Basic Sleep Science

IV. Neurobiology

Anch M, Larsen N, Catich E, Albers J

Results: Injections resulted in labeling of 4-10 cell bodies per series whose distribution within the NTS was consistent with the established catecholaminergic cell locations in this region. In HRP-labeled sections, the majority of medullary axon terminals emerging from A2/C2 neurons targeted the reticular formation area located ventral to the nucleus ambiguus that corresponded to the rostral and caudal ventrolateral medulla and the paragigantocellular region. Additional axons coursing towards the forebrain or spinal cord also were present. Importantly, all medullary projections were located almost exclusively ipsilateral to the injection site.

Conclusion: The medullary targets of efferent projections from catecholaminergic A2/C2 neurons overlap with regions previously considered as important for generation of sleep-wake states. However, the absence of significant bilateral projections is not consistent with a major role of A2/C2 neurons in the regulation of brain activity in a state-dependent manner.

Support (If Any): NIH grant HL047600.

0078

DOPAMINE D2 RECEPTORS OF THE DORSOLATERAL STRIATUM EXERT CONTROL OVER SLEEP BEHAVIOR

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Introduction: Parkinson’s disease (PD) is a neurodegenerative disorder that results in profound loss of dopaminergic nerve terminals in the dorsolateral striatum. Interestingly, more than 90% of PD patients suffer from significant concomitant sleep disturbance, the etiology of which is likely multifactorial. Recent evidence suggests that the basal ganglia may play a direct role in sleep governance as a central sleep regulator. It is possible that alterations of dopaminergic signaling in this region may induce parallel sleep changes, according to neuroanatomical and neurophysiological predictions.

Methods: Rats were implanted with bilateral parietal electrodes and dorsolateral striatal guide cannulas for electrocorticography (ECoG) and drug infusion. ECoG was recorded for 12 hours during No Infusion, Saline, 2nM/20nM Quinpirole, and 60nM L-741,626 infusions. Open Field Activity was recorded following each infusion period. Rats were evaluated for cannula placement in the dorsolateral striatum via methylene blue infusion.

Results: Infusion of quinpirole (2nM and 20nM) decreased high-voltage sleep in a dose-dependent fashion. This effect was mitigated by the infusion of L-741,626. Alone, L-741,626 also decreased high-voltage sleep to durations similar to 2nM quinpirole conditions. 2nM quinpirole increased, while 20nM quinpirole and L-741,626 decreased, activity in the open field.

Conclusion: It is possible that a proper balance of dopaminergic signaling in the striatum is necessary for the maintenance of sleep. Although more experimentation is needed to disentangle the motor and sleep responsibilities of the basal ganglia, the dopamine D2R has been shown to be at least partially responsible for sleep behavior in a rat model.

0079

THE EFFECTS OF CHRONIC PARTIAL SLEEP DEPRIVATION ON ALCOHOL CONSUMPTION AND DELTA FOS B ACCUMULATION

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Introduction: Alcohol is one of the most common psychoactive drugs. Research has focused on the effects of alcohol on sleep, however recent trends in the literature have taken a more bidirectional approach to the relationship between alcohol and sleep. Research on transcription factors involved in chronic alcohol consumption suggests a maladaptive alteration of these proteins. The research on transcription factors (specifically Delta Fos B) and chronic sleep deprivation has been sparse. This research investigates the effects of chronic, partial sleep deprivation on alcohol consumption.

Methods: Twelve Sprague Dawley rats had free access to two bottles, one containing water and one containing a 7% alcohol solution. Sleep deprivation was achieved by using a forced exercise wheel. Rats were sleep restricted 18, 20, or 22 hours every day for one week. There were three total weeks of chronic partial sleep deprivation with one recovery week in between each deprivation week. Five rats had no access to alcohol, three rats experienced an alcohol only condition and three rats had no sleep deprivation or alcohol.

Results: There was a significant effect of sleep condition on voluntary alcohol consumption, F (4, 44) = 9.191, p < .001, n2 = .455. Thus, 45.5% of the variance in error associated with alcohol consumption can be explained by sleep condition. Preliminary histology results reveal that alcohol, only after sleep deprivation, accounted for 34% of the variance in transcription factor accumulation in the nucleus accumbens core.

Conclusion: It was found that sleep deprivation increased alcohol consumption. Histology was performed on all rats to stain for differences in Delta Fos B levels in areas involved with reward and sleep. Preliminary results indicate that sleep deprivation increases the buildup of chronic alcohol related Delta Fos B.

0080

SLEEP PHENOTYPE OF PRADER-WILLI SYNDROME IS PARTIALLY RECAPITULATED IN MAGEL2 NULL MICE

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Introduction: Daytime sleepiness, disrupted sleep, and cataplexy-like falling episodes are common in Prader-Willi Syndrome (PWS), but the cause of these symptoms is unknown.

Methods: Using EEG, EMG, and video recordings, we have examined sleep/wake behavior in MAGEL2 null mice, a model of PWS.

Results: These mice have normal total amounts of wake (W), Non-REM sleep (NR), and REM sleep (R) when housed on a 12:12 light:dark cycle. However, compared to their wild type littermates, MAGEL2 null mice have shorter NR bouts during the dark and light phases. Additionally, MAGEL2 null mice have more bouts of W and NR during the dark and light phase. These short bouts and frequent state transitions indicate that MAGEL2 null mice lack the ability to maintain sleep for long periods.

Conclusion: These findings in MAGEL2 null mice are similar to the sleepiness and disrupted sleep common in PWS. Further research with these mice should provide helpful insights into the nighttime awakenings and daytime sleepiness people with PWS experience.

Support (If Any): Foundation for Prader-Willi Research
A. Basic Sleep Science

0081 DIFFERENTIAL SLEEP RESPONSES TO IMMUNE CHALLENGE IN MICE WITH THE TNF 55 KD RECEPTOR EXPRESSED SELECTIVELY ON NEURONS VS ASTROCYTES

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Introduction: Tumor necrosis factor alpha (TNF) has a role in sleep regulation in health and disease. The TNF 55 kD receptor (TNFR1) is required for normal NREMS and REMS; mice lacking TNFR1 have less NREMS and REMS than control mice. TNFR1 is found on multiple brain cell types including neurons and astrocytes.

Methods: Mice expressing TNFR1 only on neurons (NSE2 mice) or only on astrocytes (GFAP5 mice) were developed from mice lacking endogenous TNFR1. Mice were implanted with EEG/EMG electrodes for sleep studies or an intracerebroventricular (ICV) cannula and Mini-Mitter transmitter for temperature recordings. After 24 h undisturbed baseline recordings, mice were infected with influenza virus intranasally (12.5 TCID50; mouse-adapted A/ Puerto Rico/8/34 H1N1). In a separate study, NSE2, GFAP5, and TNF double receptor knockout (TNFR1/2 KO) mice received human TNF ICV (50 ng; 2 µl), or saline as control, and body temperature determined for 24 hours.

Results: NREMS baseline values were similar among genotypes. In contrast, REMS duration was significantly less during the dark period (ZT12-24) in GFAP5 mice compared to NSE2 mice. Both strains displayed typical day/night variations in NREMS and REMS. On day 6 post-influenza challenge, NREMS duration increased in both strains during the dark period. During the light period (ZT0-12), NREMS increased in NSE2 mice, but not GFAP5 mice. Influenza infection suppressed REMS in GFAP5 mice during the light period, but not in NSE2 mice. In response to TNF, NSE2 mice exhibited a fever for ~4 hours whereas GFAP5 and TNFR1/2 KO mice did not.

Conclusion: Previous studies demonstrated a role for TNFR1 in REMS during the dark period. This study confirms those prior reports and extends them by demonstrating that it is TNFR1 on neurons that mediates these TNF actions. We also conclude that neuronal TNFR1 is sufficient for sleep responses to influenza challenge and febrile responses to TNF.

Support (If Any): This work was supported by NIH grants HD036520 to JMK and AG041287 to MRO.

0082 NEUROCHEMICAL SIGNALING CHANGES ASSOCIATED WITH SLEEP PROMOTION BY OREXIN RECEPTOR ANTAGONISTS RELATIVE TO STANDARD OF CARE


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Introduction: Orexin receptor antagonism is an emerging therapy for the treatment of insomnia. The rationale for this mechanism is based on the hypsomnolence exhibited by narcoleptic patients lacking orexin neurons, as well as mouse and dog genetic models lacking orexin receptors. Besides sleep, downstream neurochemical and behavioral changes due to orexin antagonism relative to genetic constitutive loss of orexin signalling associated with narcolepsy are unknown.

Methods: In vivo microdialysis was used to assess histamine (HA) and acetylcholine (Ach) levels in the lateral hypothalamus (LH), prefrontal cortex (PFC), and hippocampus (HIP) following administra-

tion of DORA-22, OX1- or OX2- selective antagonists, and eszopiclone. Also, two conditioning paradigms in mice were evaluated: 1) a super- therapeutic treatment to mimic constitutive orexin signaling loss: 100 mg/kg DORA-12 QID (4 times daily) for 7 days and 2) a high dose therapeutic regimen: 200 mg/kg DORA-12 QD (once daily) for 14 days. In dogs, 5 mg/kg DORA-12 was administered twice daily for 14 days. Each conditioning paradigm was followed with a challenge with DORA-12, in mice and dogs, and also physostigmine, in mice only, at 1 and 2 weeks. PSG and qEEG were evaluated throughout the conditioning regimens and subsequent challenge.

Results: DORA-22 lowered HA in the LH dose-dependently, and in the PFC to levels observed during normal sleep. Eszopiclone transiently lowered HA. DORA-22 did not reduce Ach. In contrast, eszopiclone produced significant decreases in Ach. Following the supertherapeutic dosing regimen, no SOREM (direct Wake-REM transitions) were observed following DORA-12 challenge.

Conclusion: The differential effect on Ach release could explain the lack of inhibition of cognition and REM suppression observed with OXR antagonism. Although constitutive DORA receptor occupancy was accompanied by marginal changes in neurochemistry and physostigmine responses in mice, longer term loss of orexin signaling, perhaps during development, appears necessary for altered neuropathway changes involved in cataplexy.

Support (If Any): This research was funded by Merck & Co., Inc.

0083 BEHAVIORAL STIMULATION OF TONGUE USE UPREGULATES IMMUNOSTAINING FOR 5-HT2A, BUT NOT 5-HT2C, RECEPTORS IN THE HYPOGLOSSAL MOTOR NUCLEUS

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Introduction: Excitations mediated by serotonin (5-HT) type 2A and 2C receptors enhances activity of hypoglossal (XII) motoneurons during wakefulness. This is especially relevant in obstructive sleep apnea patients in whom the muscles of the tongue (innervated by the XII nerve) help maintain upper airway patency. We previously found that mRNA and protein for 5-HT2A, but not 5-HT2C, receptors have higher levels in the XII nucleus at active period onset than at rest onset. The difference for 5-HT2A receptors could represent endogenous circadian variation or be secondary to the daily rhythm of tongue use.

Methods: Four groups of 3 Sprague-Dawley rats were subjected to behavioral conditions leading to different intensities of tongue use: W-water ad lib; S+s-water with sucrose (100mM) and saccharine (6mM) to increase drinking; S+s+O-water with sucrose+saccharine and peanut oil applied to fur to increase licking/grooming. Licks of bottle and total motor activity (TMA) were detected from 7pm to 7am using infrared technology after which rats were perfused and brainstem slices were subjected to immunohistochemistry. Immunostaining intensity for 5-HT2A and 5-HT2C receptors minus background was measured in the XII nucleus at four antero-posterior levels.

Results: Both S+s and S+s+O rats had elevated lick counts during the test night when compared to the previous water night, whereas TMA did not differ among the treatments. Immunostaining for 5-HT2A receptors was significantly higher in S+s+O rats than in W rats (65 ± 9 (SD) vs. 58 ± 9 arbitrary units; p = 0.04). S+s group did not differ from the other two. There was no difference among the treatments for 5-HT2A receptors.

Conclusion: 5-HT2C, but not 5-HT2A, receptor staining intensity in the XII nucleus is use-dependent; increased immunostaining may indicate an elevated turnover or synthesis of 5-HT2C receptors. No effect of behavioral stimulation on 5-HT2A receptor immunoreactivity suggests
that the previously reported day-night difference is driven by endogenous circadian oscillators.  

Support (If Any): NIH grant HL116508.

0084  
THE NEUROPHYSIOLOGICAL BASIS OF CONSCIOUSNESS TRANSITION DURING SLEEP ONSET PERIOD: A FMRI STUDY  
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Introduction: Previous studies have shown that the sleep onset period is characterized by a gradual decrease of perceptual experience, followed by alterations in and reductions of thought processes. The subjective perception of sleep was found to be determined primarily by a reduction of thought process. The aim of the study is to further explore the neurophysiological basis of the transition in states of consciousness during the sleep onset process.

Methods: Twenty-four healthy adults (19-35 yo, 14 female) participate in the study. Simultaneous EEG and fMRI recordings were conducted while the participants were trying to fall asleep in a MRI scanner. They were awakened after going into stable stage N1 or N2 sleep, or after 90 minutes without getting into stable sleep. They were then interviewed to recall their conscious experience, such as perceptual experience, thought process, and self-control, immediately prior to having been awakened.

Results: Forty-three awakenings were included in the analyses. Sleep perception was found to correlated significantly with decreased functional connectivities between the left dorsal anterior cingulate cortex (dACC) and thalamus (left: rho = -0.358, p = 0.020; right: rho = -0.342, p = 0.027). The awakenings with perception of sleep, comparing to those without sleep perception, showed less connectivities between the dACC and thalamus (left: Z = -2.323, p = 0.020; right: Z = -2.139, p = 0.032). Visual image correlated significantly with the connectivities between DLPFC and different areas (supplementary motor area: p = -0.321; p = 0.038; insula: p = -0.401; p = 0.009; rolandic operculum: p = -0.400; p = 0.009).

Conclusion: The results suggest that decreased thalamo-cortical connectivities may be related to the fading-away of our consciousness while falling asleep. The dorsal anterior cingulate cortex which is thought to be associated with selective attention and self-monitoring may also play an important role in the perception of sleep onset.

Support (If Any): Department of Defense Award No. W81XWH-14-1-0571

0085  
EXPOSURE TO BLUE WAVELENGTH LIGHT REDUCES ACTIVATION WITHIN THE ANTERIOR CINGULATE CORTEX DURING ANTICIPATION OF CERTAIN REWARD STIMULI  
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Introduction: Blue wavelength light represents the peak sensitivity for input to the circadian system; as such this wavelength is optimal for entrainment of circadian rhythms. It is also an effective treatment for seasonal and nonseasonal depression and is associated with increased arousal and reduced fatigue, presumably through circadian mechanisms. The neurobiological pathways that link circadian entrainment to light with affective responses remain unclear. We aimed to investigate how 30 minutes of blue light exposure affects subsequent functional brain responses during an emotional anticipation task.

Methods: Thirty-five healthy adults (18 females, mean age = 21.58) were randomized to receive a thirty-minute exposure to either blue (active) or amber (placebo) light at 10:15 a.m. Within a half hour following cessation of the light, participants completed an emotional anticipation task (EAT) during fMRI at 3T. The EAT included conditions during which participants were anticipating certain reward, certain threat, and uncertain reward/threat. Data were analyzed using SPM12.

Results: In contrast to the amber placebo light, participants in the blue light group showed significantly reduced activation within the rostral anterior cingulate cortex (ACC) during uncertain versus certain anticipation of reward (p < 0.05, false discovery rate corrected).

Conclusion: The ACC is involved in many high level cognitive and affective processes, including error detection, decision-making, and reward anticipation, as well as autonomic functions such as heart rate and blood pressure. Blue wavelength light, in addition to its effects on alertness, fatigue, and sleep, also has the potential to enhance emotional activation within the ACC during anticipation of rewarding stimuli, possibly due to an increase in norepinephrine and its effects on dopaminergic reward prediction-error signals. Future work should examine the effects of blue light on emotional processing during periods of insufficient sleep.

Support (If Any): Department of Defense Award No. W81XWH-14-1-0571

0086  
LONG-TERM BRAIN INJURY ACCOMPANIES ANXIETY IN OBSTRUCTIVE SLEEP APNEA  
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Introduction: Obstructive sleep apnea (OSA) subjects show anxiety symptoms, as well as brain injury in areas mediating those symptoms. However, the relationships between extent and duration of tissue injury and anxiety symptoms in OSA subjects are unclear. Tissue injury can be examined with texture analysis using high-resolution T1-weighted images, a measure of local changes in intensity patterns/gray levels. A texture feature, “entropy,” measures the extent of homogeneity/randomness in tissue; values increase in chronic, and decrease in acute tissue injury, and thus, may be useful to examine associations between brain tissue integrity and anxiety scores. Our aim was to examine correlations between regional brain entropy values and anxiety scores in OSA subjects, using high-resolution T1-weighted images.

Methods: We collected high-resolution T1-weighted images from 56 OSA subjects (age, 48.7 ± 8.7 years; AH1, 35.3 ± 21 events/hour; BMI, 30.6 ± 5.8 kg/m²; 40 male) using a 3.0-Tesla MRI scanner. The anxiety symptoms were examined with the Beck Anxiety Inventory
A. Basic Sleep Science

IV. Neurobiology

(AI). T1-weighted images were bias-corrected, and entropy maps were calculated. We normalized entropy maps to a common space and smoothed; correlations between entropy values and BAI scores were computed using partial correlation analysis (covariates: age, gender, BMI; SPM12, uncorrected-threshold p < 0.005).

Results: Several brain sites in OSA showed positive correlations with BAI scores, including the bilateral insulae, inferior frontal, medial pre-frontal, genu and splenium of corpus callosum, anterior, mid, and posterior cingulate cortex, basal forebrain, thalamus, extending to pallidum, bilateral cerebellar cortices, bilateral mid and ventral temporal, bilateral hippocampus, ventro-lateral medulla, and bilateral occipital regions.

Conclusion: Significant positive correlations appeared between regional brain integrity and BAI scores in multiple sites, suggesting significant associations between chronic tissue pathology and the presence of long-term anxiety symptoms in OSA. These relationships appeared in critical anxiety regulatory areas, along with autonomic, respiratory, and cognitive control sites, and suggest that prolonged brain injury in multiple sites accompanies anxiety in OSA.

Support (If Any): This research work was supported by National Institutes of Health R01 HL-113251 and R01 NR-015038.

ASSOCIATIONS BETWEEN REGIONAL BRAIN INJURY AND DEPRESSIVE SYMPTOMS IN OBLITERATIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) subjects show depressive symptoms and neural injury in areas classically associated with regulation of those symptoms. However, whether that injury has been chronic or short lasting is unknown. Neural tissue can be evaluated by texture analysis using high-resolution T1-weighted images; this procedure assesses local signal intensity patterns, and is more sensitive to injury than voxel-based morphometry. A texture feature, “entropy”, evaluates the extent of local homogeneity/randomness in neural tissue; values increase in chronic, and decrease in acute neural damage. Our aim was to assess correlations between regional entropy values, derived from high-resolution T1-weighted images and depression scores in OSA subjects, to determine whether the injury associated with depression is long standing.

Methods: We collected high-resolution T1-weighted image series from 56 OSA subjects (age, 48.7 ± 8.7 years; AHI, 35.3 ± 21 events/hour; BMI, 30.6 ± 5.8 kg/m2; 40 male), using a 3.0-Tesla MRI scanner. The depressive symptoms were examined with the Beck Depression Inventory II (BDI-II). T1-weighted images were bias corrected and entropy maps were generated. We normalized entropy maps to a common space, smoothed, and calculated correlations between entropy values and BDI-II scores (partial correlation, covariates: age, gender, BMI; SPM12, uncorrected-threshold p < 0.005, cluster-size 10 voxels).

Results: Multiple brain areas showed positive correlations between entropy values and BDI-II scores, including the bilateral pallidum, extending to the putamen, inferior and medial frontal cortices, genu of corpus callosum, anterior and posterior cingulate cortices, and the cingulum bundle, cerebellar cortex, basal forebrain, bilateral mid and inferior temporal areas, and bilateral parietal and occipital regions.

Conclusion: Regional brain entropy values showed significant positive correlations with BDI-II scores in areas normally associated with depression, indicating that the injury was of a long-standing nature, despite the image collection being shortly after diagnosis in most OSA subjects. The origin of the long-term injury remains to be revealed, but these findings argue for examination of mechanisms that contribute to both depression and disordered breathing long before initial detection.

Support (If Any): This research work was supported by National Institutes of Health R01 HL-113251 and R01 NR-015038.
0088
ENERGY BALANCE PREDICTORS OF BASELINE SLEEP ARCHITECTURE
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Introduction: Extensive evidence indicates short sleep duration leads to hyperphagia and weight gain; however, very few studies have examined the relationship between energy balance parameters and sleep architecture. The current study investigated whether body composition, resting energy expenditure or caloric intake variables predicted time spent in specific sleep stages (rapid eye movement [REM], non-REM stages 1, 2, and slow-wave sleep [non-REM stages 3 & 4]).

Methods: N = 36 healthy adults (32.9 ± 8.9 y, 24.6 ± 3.9 BMI, 16 females, 19 African Americans) participated in a protocol involving two consecutive nights (BL1-2, 10h time-in-bed/night, 2200h-0800h) in the laboratory. Polysomnography was recorded on BL2 and scored using standard criteria. Sleep stage duration was calculated as a percentage of total sleep time. Weight was measured at protocol admittance. Body composition and resting energy expenditure were assessed in a subset of subjects (n = 22) in the morning following BL1. Food/drink consumption was ad libitum and was objectively measured during the protocol; macronutrient intake was calculated as a percentage of daily caloric intake. Multiple regression and multivariate ANOVA were used for statistical analyses.

Results: BMI, body fat percentage and resting energy expenditure were not significant predictors of sleep stage duration when controlling for age, gender and race. However, overweight adults (n = 19, BMI 25-30) exhibited more REM sleep than normal-weight adults (n = 17, BMI < 25; 27.6 ± 3.4% vs. 24.2 ± 3.7%, p = 0.007). When examining the relationship between daily caloric intake and subsequent sleep variables, increased protein intake predicted less stage 2 sleep (β = -0.54, p = 0.003) and more REM sleep (β = 0.41, p = 0.038), when controlling for BMI, age, gender and race. Total caloric, carbohydrate and fat intake did not predict baseline sleep architecture.

Conclusion: Weight status and protein intake may influence baseline sleep architecture in healthy adults. Future research is needed to examine if manipulating protein intake affects REM sleep duration and to identify the biological mechanisms underlying this relationship.

Support (If Any): NIH R01 NR004281, F31 AG044102: CTRC UL1RR024134; Department of the Navy, Office of Naval Research (Award No. N00014-11-1-0361).

0089
ACTIVATION OF THE VENTRAL TEGMENTAL AREA INCREASED WAKEFULNESS IN MICE
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Introduction: The ventral tegmental area (VTA) is crucial for brain functions, such as voluntary movement, cognition, emotion, reward, and motivation. However, the role of VTA in sleep-wake regulation when it is directly activated remains unknown.

Methods: The 129 male mice were bilaterally microinjected with CMV-hM3Dq-AAV10 into VTA. After 2 weeks of postoperative recovery, the animals were implanted with electrodes for electroencephalograph (EEG) and electromyography (EMG) recording. One week later, the animals were transferred to the recording room and habituated to the recording cables and conditions for 2 days. Then, 48-h EEG/EMG was recorded, in which saline was given by intraperitoneal injection as control on the first day, while hM3Dq ligand clozapine-N-oxide (CNO) 1 mg/kg was given on the second day. EEG recordings were automatically scored offline by 10-sec epochs as wake, non-rapid eye movement (NREM) and rapid eye movement (REM) sleep. Immunohistochemistry staining was conducted to confirm the microinjection sites and examine whether the VTA neurons were activated.

Results: The neurons in VTA were excited by CNO after microinjection of CMV-hM3Dq-mCherry-AAV10 confirmed by induction of c-fos expression in the virus-infected VTA neurons. The activated VTA neurons during inactive period following 5 hours after CNO administration produced 120.1% increase in total wakefulness amount compared with control, whereas NREM and REM sleep respectively decreased 62.5% and 92.2%. Similarly, when VTA neurons were excited during active period during the subsequent 8 hours after CNO treatment, the total wakefulness amount increased 81.5%, while NREM and REM sleep decreased 64.6% and 93.8%, respectively.

Conclusion: These results indicated that the activated VTA neurons with a pharmacogenetic approach played important roles in promoting wakefulness.

Support (If Any): This study was supported by grants from National Natural Science Foundation of China (31530035, 81571296) and Shanghai Leading Academic Discipline Project (B119).
A. Basic Sleep Science

Conclusion: The sleep-promoting medications zaleplon and zolpidem (especially 10mg zolpidem) resulted in more severe deficits in cognitive performance than sleep inertia (placebo), 10mg zaleplon, and 5mg zolpidem, when emergent awakening occurred near the expected Tmax of plasma concentrations and at terminal awakening. Astronaut performance may be adversely affected during emergent awakenings, necessitating the development of an evidence-based personalized medicine approach to the use of sleep medications in astronauts.

Support (If Any): This study was funded by the National Aeronautics and Space Administration (NASA).

0091

SLEEP ONSET AND MAINTENANCE CONFERRED BY OPTIMIZED OREXIN RECEPTOR BINDING KINETICS OF DUAL SELECTIVE AND OX2R-SINGLE ANTAGONISTS

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Introduction: Ideally, insomnia therapeutics promote sleep throughout the inactive period, while avoiding residual effects upon waking. The onset and duration of sleep promoting efficacy is dependent upon optimized pharmacokinetic properties and receptor binding kinetics under physiological conditions. Here we evaluate the temperature dependence of dual orexin receptor antagonists (DORAs) selective for OX1R and OX2R and OX2R-single receptor antagonists (2-SORAs) contributing to effective receptor occupancy to mediate appropriate sleep efficacy timing.

Methods: Binding affinity for OX1R relative to OX2R was evaluated by radio-labeled antagonist displacement for DORAs including suvorexant, filorexant, SB-649868, almorexant, DORA-12, and DORA-22, and 2-SORAs including MK-1064, MK-3697, MK-8133, 2-SORA-18 and 2-SORA-7. Kinetics of binding to OX2R was evaluated at room temperature and 37°C for select 2-SORAs and DORAs. Sleep responses measured by polysomnography in telemeterized rats was correlated with compound exposure and ex vivo OX2R occupancy across doses and time after treatment.

Results: While DORAs exhibit similar binding affinity for OX1R and OX2R, exquisite OX2R/OX1R selectivity of 2-SORAs was observed, including MK-1064 and MK-3697 which favor OX2R by over 2,500-fold. Overall, 2-SORAs trended toward faster binding kinetics relative to DORAs. Strikingly however, binding kinetics of key DORAs was 4 to 8 fold more rapid at 37°C relative to that seen room temperature, while overall binding Kd was relatively unaffected. Effective sleep promoting efficacy occurs at OX2R occupancies > 65% in a time-dependent manner for DORAs while 2-SORAs appear to require higher OX2R occupancies for active wake reduction and NREM and REM promotion.

Conclusion: Previous estimations of On and Off rates of DORAs dramatically underestimated binding kinetics occurring at physiological temperature, which is more closely associated with observed sleep onset and cessation. Optimized binding kinetics and optimized pharmacodynamic properties contributing to effective OX2R occupancy enable ORAs such as suvorexant to induce sleep onset and appropriate maintenance timing.

Support (If Any): This research was funded by Merck & Co., Inc.

0092

WITHDRAWN

0093

HABITUAL POOR SLEEP EFFICIENCY IS ASSOCIATED WITH INCREASED CARDIOVASCULAR AND CORTISOL RESPONSES TO PSYCHOSOCIAL STRESS

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Introduction: Poor sleep has profound effects on mood and emotional processes. Several studies have shown that experimentally induced acute sleep deprivation leads to increased expression of physiological and neuroendocrine stress markers, and well as exaggerated stress responses. In this study we examined whether sleeping less by choice would have similar effects in stress reactivity sleep.

Methods: Fifty-eight healthy male participants were recruited. Sleep patterns were monitored at home for seven days by actigraphy. Stress reactivity was assessed in laboratory by means of the Trier Social Stress Test. Cardiovascular responses and salivary cortisol were measured at baseline, during stress, and during recovery.

Results: Average sleep efficiency ([total sleep time/time in bed] × 100%) during the week before stress induction ranged from 64% to 96%. Sleep efficiency was negatively associated with stress-related elevation of blood pressure. This finding extended into the recovery period. Stress induced increases in salivary cortisol were negatively correlated with sleep efficiency. In contrast, there was no significant association between sleep efficiency and subjective stress (state anxiety) reactivity. Sleep duration and stress reactivity were not significantly correlated. Lastly, sleep efficiency was positively correlated with vigilance, however no association between vigilance and stress reactivity was found.

Conclusion: These findings indicate that the physiological and neuroendocrine effects of psychosocial stress may be exaggerated by poor habitual sleep. As such, sleep quality may accelerate the development of stress related disorders.

Support (If Any): This work was supported by a grant awarded to Dr. Michael Chee from the national medical Research Council Singapore (NMRC/STaR/015/2013).

0094

AUTONOMIC NERVE MODULATION BY NOISY ENVIRONMENT AND ITS EFFECT ON SLEEP INITIATION

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Introduction: Environment sound is problematic when sleep is about to start. However, it is unknown how environment sound affect physiological state in this situation. In this study, we examined how autonomic nervous state changes at the sleep initiation in three different sound environments.

Methods: 12 healthy adult volunteers (12 males 20.69±0.27 years old) participated in the study. Each participant underwent three PSG session each of which had different sound condition; No noise [NN], City noise(40dB) [CN] and City noise(40dB) with Calming music(45dB) [CC]. PSG data were later analyzed by trained scorer. Autonomic nerve activities were estimated by heart rate variability, which was calculated from ECG data track of PSG. The analysis was conducted using ECG during 10 minutes before and 5 minutes after sleep onset. The autonomic nerve activities were presented as %LF/HF, which was LF/HF normalized individually to that at sleep onset. Data values are pre-
sent as mean +/- SEM. For statistical analysis, One-way ANOVA with post-hoc Tukey’s multiple comparisons test were used. **Results:** Average sleep latency was 38.13 +/-11.96 minutes in NN, and comparable sleep latency were found for other conditions (CN: 35.83 +/- 12.56 minutes and CC: 21.04 +/-6.58 minutes). However, in CN condition %LF/HF at 10 minutes before sleep onset was significantly higher than other conditions (386.94 +/-150.19% in CN, 163.23 +/-49.35% in NN, 146.41 +/-35.60% in CC). %LF/HF decreased toward the sleep onset in all conditions, and they were constantly comparable after sleep onset. **Conclusion:** Current results showed that sympathetic nerve activities were reduced prior to sleep in the city noise condition. Also of note is that the effect by city noise could be cancelled by concurrent play of comfortable music. The autonomic nerve activities were remianed constant after sleep onset in all conditions, suggesting environment sound effects to autonomic nerve activities were more substantial in awake state. Thus environmental sounds were suggested to have differential effect on autonomic nerve activity at sleep onset, if not the effect was not evident in sleep latency. **Support (If Any):** This study was supported by Grant-in-Aid from the Japan Society for the Promotion of Science (grant no. 15K16565), and funding from YAMAHA corporation.

**0095**

**DUAL AND 2-SELECTIVE OREXIN ANTAGONISTS DO NOT DISRUPT NORMAL SPECTRAL POWER WITHIN VIGILANT STATE COMPARED TO STANDARD-OF-CARE INSOMNIA THERAPIES**


**Introduction:** Dual OX1R/OX2R and OX2R-single orexin receptor antagonists (DORAs and 2-SORAs, respectively) are currently being examined in both pre-clinical and clinical studies for the treatment of insomnia. It is hypothesized that these antagonists may offer a benefit over standard-of-care therapies due to the selectivity of the compounds as compared to those that engage more widely diffuse receptors. Differientazing orexin receptor antagonists from standard-of-care pharmaco-therapies is important in understanding the potential benefit of this new class of drugs, as well as understanding the differences between DORAs and 2-SORAs.

**Methods:** Male Sprague-Dawley rats were implanted with wireless telemetry (Data Sciences International, St. Paul, MN, USA) for EEG, EMG, and generalized activity. Automated sleep scoring software (Embla/Natus, Pleasanton, CA, USA) along with custom developed analysis algorithms in Matlab (Mathworks, Natick, MA, USA) and R (R Foundation for Statistical Computing, Vienna, AUT) were used to create power spectral density ratios within sleep/wake states over a 24h circadian phase for each pharmacological treatment and compared to within-subject vehicle controls.

**Results:** Doses of all pharmacological compounds were selected based on suppression of Active Wake as these compounds modulate sleep architecture differently. Standard-of-care treatments showed a marked disruption of spectral power across frequencies in all sleep stages relative to vehicle controls suggesting they modulate the EEG spectral frequencies differently than normal vehicle controls. Neither DORAs nor 2-SORAs showed a marked change in spectral frequencies while still promoting sleep as a function of decreased Active Wake to the same extent as standard of care.

**Conclusion:** These results indicate that, orexin receptor antagonism via DORA and 2-SORAs do not disrupt neuronal activity within specific stages of sleep unlike GABA receptor modulator standard of care. These results are consistent with prior studies indicating that sleep architecture induced by DORAs is qualitatively similar to that observed during normal inactive phase sleep. **Support (If Any):** This research was funded by Merck & Co., Inc.

**0096**

**OREXIN RECEPTOR ANTAGONISTS FOR THE TREATMENT OF INSOMNIA - SETTING A NEW STANDARD**


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**Introduction:** As a key modulator of wakefulness conserved across species, the orexin/hypocretin system offers a new approach for treating insomnia. Innovative translational studies enabled the discovery, informed development plans and contributed to regulatory approval of the first-in-class orexin receptor antagonist (ORA) for insomnia. Continued preclinical studies have expanded our understanding of orexin signaling and demonstrated unique distinctions from other types of insomnia therapies.

**Methods:** The results from a series of in vitro and in vivo nonclinical pharmacology studies with ORAs will be presented. Studies were conducted to assess roles of individual orexin receptors in modulating sleep/wake dynamics as well as to compare with GABA receptor modulators. The results of these studies will be placed in context with clinical characterization of suvorexant and other orexin receptor antagonists.

**Results:** Potent, selective and reversible orexin receptor antagonists including suvorexant proportionally increase NREM and REM sleep in rodents, dogs, monkeys and patients with insomnia. Orexin receptor antagonists have been shown to differentiate from GABA receptor modulators in their effects on sleep architecture, qEEG spectra, arousability and cognitive performance. We have expanded this nonclinical work to look at effectiveness of ORAs following REM deprivation and after chronic treatment with GABAergic modulators. Additionally, we have demonstrated that antagonism of OX2R alone also increases NREM and REM sleep across species, and have further examined effects on qEEG across sleep stages.

**Conclusion:** Pharmacological antagonism of orexin signaling reduces wake and promotes sleep across species in a manner distinct from GABAergic receptor modulation. As the first approved orexin receptor antagonist, Belsomra® (suvorexant) offers a novel approach for the treatment of insomnia. **Support (If Any):** This work was supported by Merck & Co., Inc.

**0097**

**SLEEP, PERFORMANCE AND SLEEPINESS IN TRUCK DRIVERS: COMPARISON OF EARLY STARTERS VERSUS NIGHT DRIVERS IN A NATURALISTIC FIELD STUDY**

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**Introduction:** Shift workers commonly experience sleep loss and circadian misalignment, resulting in performance deficits and elevated accident risk. We investigated sleep, performance, and sleepiness in truck drivers who began their duty periods either in the early morning or in the early evening.
Methods: N = 21 truck drivers (ages 27-65; 2 females) participated in a naturalistic field study. They were 10 early starters with duty starting between 00:00 and 04:00, and 11 night drivers with duty starting between 17:00 and 20:00. Sleep, performance, and sleepiness were measured each duty period across two duty cycles. Sleep was measured by means of wrist actigraphy. Performance was measured with lapses (RTs > 355ms) on a 3min Psychomotor Vigilance Test (PVT). Sleepiness was self-reported on the Karolinska Sleepiness Scale (KSS). The PVT and KSS were administered three times per duty period: at duty start (session 1), midway (session 2), and at duty end (session 3). Data were compared between groups using mixed-effects ANOVA.

Results: Average duty start time was 02:52 for early starters and 17:59 for night drivers. There was no effect of group in overall sleep duration (F = 0.2, P = 0.64), which averaged 6.6h per 24h. However, there was an effect of time of day (F = 5.1, P < 0.001) and a group by time of day interaction (F = 31.8, P < 0.001). Early starters slept primarily during the early night and night drivers slept primarily during the early day. There was no significant effect or interaction of group for PVT lapses (F0.31), but a significant effect of session (F = 4.1, P = 0.018) indicated that performance degraded across duty periods in both groups. There was no significant effect of group for sleepiness (F = 1.6, P = 0.21), but a significant effect of session (F = 155.7, P < 0.001) showed that sleepiness degraded across duty periods. An interaction of group by session (F = 8.6, P < 0.001) revealed that night drivers showed a sharper increase in sleepiness toward the end of their duty periods.

Conclusion: In this sample of truck drivers, sleep restriction was observed in night drivers as well as early starters. Despite the difference in the circadian timing of duty and sleep periods, both groups showed increasing performance impairment and subjective sleepiness across their duty periods.

Support (If Any): FMCSA award DTMC75-07-D-00006

0098
FLIGHTY EMOTIONS, POOR SLEEP: NEUROTICISM, LOW AFFECT, AND HYPERAROUSAL PREDICT POOR SLEEP QUALITY
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Introduction: Considering that a large proportion of the population experiences poor sleep quality, the need to understand whether and how individual differences predict poor sleep is timely. Recently, personality traits have arisen as important predictors of self-reported sleep. However, whether personality predicts sleep quality independent of other predictors such as affect, emotion regulation, and hyperarousal it still unclear.

Methods: In a sample of 420 Italian adults (26.7 ± 7.0 years, 117 Male), multiple regressions were used to evaluate the independent and joint relationships personality traits, affect, emotion regulation strategies, hyperarousal, and sleep quality.

Results: Consistent with studies from United States, Korea, Australia, Finland, and Turkey, neuroticism was the best personality predictor of sleep quality also in this Italian sample. We also observed an interaction between conscientiousness and neuroticism, such that individuals high on both traits reported significantly worst sleep quality. When the predictors were examined in separate models, personality traits explained the most variance in sleep quality (12.4%), followed by hyperarousal (10.5%), affect (9.6%), and emotion regulation strategies (1.4%). When combined into the same model, these individual difference measures explained a combined 15.3% of the variance in sleep quality, with only personality traits (agreeableness and the interaction of conscientiousness and neuroticism), positive affect, and hyperarousal remaining significant.

Conclusion: Our results replicate the association between personality and self-reported sleep quality in an Italian sample, and suggest that perceived sleep quality depends on the interplay between personality traits, hyperarousal and affect.

0099
HEMISPHERIC ASYMMETRY IN RESPONSIVENESS FROM SLOW-WAVE SLEEP IN ASSOCIATION WITH THE FIRST-NIGHT EFFECT IN HUMAN
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Introduction: We experience poor sleep in a novel environment, which is called the first-night effect (FNE) in human sleep research. The FNE has been regarded as a typical sleep disturbance due to temporary inhabitation to a novel and unfamiliar environment. Some animal studies have shown that increased vigilance during sleep works as protective mechanisms. Does this sleep disturbance on the first night also have positive effects? Here we found that the FNE involves a half-awake half-asleep state where one brain hemisphere being vigilant as a night watch to respond efficiently to unfamiliar surroundings while the other hemisphere sleeps. We examined how fast each brain hemisphere could respond to external stimuli from slow-wave sleep with and without the FNE. If the FNE involves interhemispheric half-awake-half-asleep state, humans should be able to respond to deviant stimuli faster in one hemisphere than the other specifically on Day 1 when the FNE occurs, and not on Day 2 when the FNE does not occur.

Methods: Two types of auditory stimuli, deviant (10%, 2000 Hz) and standard (90%, 1000 Hz) beep tones, were presented to one brain hemisphere randomly while participants showed slow-wave sleep, which was determined polysomnographically. Participants were instructed to tap their fingers when they heard any beep tones.

Results: The result showed that deviant tones presented to the left hemisphere induced awakenings and tapping responses significantly faster than those presented to the right hemisphere specifically on Day 1. This hemispheric asymmetry in responsiveness was specific to the deviant tones, and vanished on Day 2.

Conclusion: Our results suggest that the human brain involves an interhemispheric half-awake-half-asleep under the FNE as night watch where it may be advantageous for humans to keep some degree of alertness to detect unfamiliar surroundings in a new environment.

0100
SLEEP ARCHITECTURE MODELING USING PROBABILISTIC MARKOV MODELS: HOME BASED STUDY
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Introduction: Sleep architecture quantification has clinical importance as it enables the detection of abnormalities related to sleep disorders. The standard for sleep architecture assessment is in-lab polysomnography (PSG) but this is often limited to a single night because of financial, scheduling, or comfort considerations. Home-based PSG is a cost effective alternative to collect sleep data throughout several nights with high ecological validity. This research aims at modeling sleep architecture from a generative probabilistic perspective. The dataset used for this purpose was collected on 5 male volunteers (age
range 26 to 50) who performed 10 recordings at home using a custom
made system able to record 2 EOG and 1 EEG (FPz location) signals
referenced to the right mastoid.

Methods: The time dependent probabilities of N1, N2, N3, REM
and WASO were estimated relative to sleep onset. Considering each sleep
stage as state in a Markov chain, transition matrices were estimated for
each half of the night. The distribution of the duration of uninterrupted
bouts of sleep stages NREM, REM, and WASO was analyzed using
exponentially decaying functions. In the Markov framework each ex-
ponential distribution maps to a state.

Results: The time dependent REM and N3 probabilities exhibit 109.7
minute long cyclic periodicities. WASO randomly distributes through-
out the night without cyclic dynamics. Markedly different transition
dynamics between stages were found for the night’s first and second
part. Fitting exponentially decaying distributions to NREM bout-du-
rations resulted in two states with fast (NREMf) and slow (NREMf)
exit rates. Estimating conditional bout-duration distributions enabled
the calculation of exit rates between (NREMf, NREMs, WASO, and
REM). EEG analysis of NREMf and NREMf shows that these cor-
respond to shallow and deep sleep respectively.

Conclusion: Multiple probabilistic models were applied to sleep architec-
ture and revealed time dependent stage probabilities, transition dynamics,
and exit rates. EEG analysis was used to relate sleep depth to exit rates.

0101
SLOW-WAVE SLEEP DURATION PREDICTS NEXT-DAY
RESTING HIPPOCAMPAL FUNCTION
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Introduction: Recent evidence indicates a key role of slow-wave sleep
(SWS) in memory consolidation. However, very few studies have ex-
amined the relationship between sleep architecture and subsequent brain
function. The current study used arterial spin labeling (ASL)
fourth sequence in a Siemens 3T Trio scanner at rest (subjects were
awake but not completing a task). A pseudo-continuous ASL sequence
was used to quantify regional cerebral blood flow (CBF) in the brain. Imaging data were ana-
yzed using SPM8 and the Marsbar toolbox. Multiple regressions were
used for statistical analyses.

Results: Whole brain voxel wise analysis revealed that SWS duration
negatively correlated with resting CBF in bilateral hippocampus (small
volume corrected, p < 0.05, total sleep time entered as a covariate). Us-
ing anatomically defined hippocampus as the regions-of-interest (ROI),
independent ROI analysis further confirmed that SWS duration nega-
tively predicted resting hippocampal CBF when controlling for global
CBF, age, gender, and total sleep time (Left hippocampus, β = -0.39,
p = 0.001; Right hippocampus, β = -0.40, p = 0.001).

Conclusion: Greater slow-wave sleep at baseline was associated with
lower resting-state hippocampal CBF. Previous studies suggest that
SWS plays a role in transferring temporary memories in the hippoc-
campus to long-term memories in the neocortex. Longer slow-wave
sleep duration may provide more time for memory consolidation and
promote more efficient hippocampal function the following day. Fu-
ture studies are needed to determine the neural basis for individual
differences in slow-wave sleep duration.

Support (If Any): NIH R01 HL102119 and R01 NR004281, CTRC
UL1RR024134, P30 NS045839, National Space Biomedical Research
Institute through NASA NCC 9-58, and the PENN ITMAT-TBIC Pilot
Project.

0102
RESILIENCE AND SLEEP QUALITY AMONG COLLEGE
STUDENTS: MEDIATING EFFECTS OF PERCEIVED STRESS
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Introduction: Resilience refers as the capacity for successful adap-
tation despite challenging or stressful circumstances. Previous stud-
ies have showed a negative correlation between perceived stress and
resilience. Recent research found that resilience could predict sleep
quality among college students. Resilience might increase sleep qual-
ity through the reduction of the perception of stress. Thus, our study
aimed to examine whether stress mediates the relationship between
resilience and sleep quality among college students.

Methods: 71 college students (51 women, 20 men; Mean age = 19.92
years, SD = 1.21) recruited from a college campus participated in this
study. All participants completed a package of questionnaires that in-
cluded the Pittsburgh Sleep Quality Index (PSQI), Resilience Scale
(RS) and Perceived Stress Scale (PSS). Hierarchical linear regression
analysis was used to test the mediation model.

Results: The results showed that resilience could predict sleep quality
(t = -2.976, p = 0.004,β = -0.337) and perceived stress (t = -6.760,
p < 0.001,β = -0.631), while perceived stress could predict sleep quality
(t = 4.307, p < 0.001,β = 0.631), while perceived stress could predict sleep quality
(t = 4.307, p < 0.001,β = 0.631). After controlling for the perceived
stress, the relation between resilience and sleep quality was no longer
statistically significant. 19% of the variance in sleep quality (adjusted
R2 = 0.192) could be explained by resilience through the mediation
effect of perceived stress. When we further examined PSQI compo-
ients, perceived stress were found to completely mediate the associa-
tion between resilience and two components of PSQI, subjective sleep
quality (t = -1.19, p = -0.905,β = 0.017) and daytime dysfunction (t = -0.93,
p = -0.926,β = -0.012).

Conclusion: Our results support a complete mediation effect of per-
cieved stress on the relation of resilience and sleep quality (especially
subjective sleep quality component and daytime dysfunction compo-
nent of PSQI). The finding indicated that resilience could decrease the
level of perceived stress among the college students and further affect
their sleep quality and daytime function.

0103
NO CHANGE IN SLEEP ARCHITECTURE FOLLOWING AN
EXPERIMENTAL NAPPING INTERVENTION
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Introduction: Compared with nappers, non-nappers have more SWS
during a nap and complain of post-nap sleep inertia (McDevitt et al.,
2012). However, it is unclear whether these differences in sleep architecture are due to a history of frequent napping. We examined whether four weeks of “nap practice” would change sleep architecture during a nap.

**Methods:** Fifty healthy participants (age = 21.7 ± 3; 19 male), categorized as nappers and non-nappers via self-report and actigraphy measures, were randomly assigned to four weeks of Nap Practice (at least 3 naps/week outside the lab) or Nap Restriction (no naps outside the lab). During weeks 0, 2, and 4, participants took a 90-minute, polysomnographically-recorded nap. Latent growth curve models were used to examine the variance in level (intercept) and slope (change across time) for percentage of Stage 2, Stage 3, and REM across these three visits.

**Results:** During the baseline week, there were no differences in the percentage of Stage 2 (p = .94), Stage 3 (p = .34), or REM (p = .40) due to habitual napping habits, but this may be due to a slight restriction of range. For Stage 2, Stage 3, and REM, latent growth curve modeling revealed the best-fitting model was an unconditional means model, which describes and partitions variation in the percentage of each stage across people without regard to time; nap architecture remained consistent across all 3 visits.

**Conclusion:** We were unable to replicate differences in the percentage of Stage 3 sleep due to habitual/non-habitual napping. Furthermore, there was no change in the percentage of each sleep stage during a nap across the 4-week intervention. In conclusion, sleep architecture during a nap appears to be a relatively stable, individual difference measure of sleep.

**Support (If Any):** R01AG046646 to S. C. Mednick

0105

**EFFECT OF T-TYPE CALCIUM CHANNEL INHIBITION IN THALAMIC RETICULAR NUCLEUS ON SLEEP AND SLEEP SPINDLES: A DOSE RESPONSE STUDY WITH INITIAL RESULTS**


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**Introduction:** Cav3.3 T-type calcium channels are expressed in parvalbumin (PV)-containing GABA thalamic reticular neurons (TRN) and are thought to generate burst firing necessary for sleep spindle generation. Cav3.3 is also a risk gene for schizophrenia, where spindle abnormalities are present. The role of Cav3.3 T-type channels in the control of sleep and/or spindles has been examined using Cav3.3 knockout mice but not with acute, local pharmacological blockade. Therefore, here we examined the inhibitory effect of a selective T-type inhibitor, TTA-P2, in TRN.

**Methods:** In vitro, whole-cell patch-clamp recordings of identified PV neurons were made in slices from young (13-22d) PV-tTomato mice. In vivo, mice were implanted with bilateral microdialysis cannulae targeting TRN (AP = -0.7, ML = 1.3, DV = -4.0) and EEG/EMG electrodes. Experiments were as follows: Day 1, aCSF from ZT 2-ZT 6 (BL). Day 2, TTA-P2 (1, 10, 30, or 100 μM) from ZT2-6 when mice mostly sleep. The dose-dependent effect on NREM sleep and spindle density (spindles/min NREM sleep) was determined by comparing with the BL values and further related to the histological location of the probe.

**Results:** TRN-PV neurons exhibited rebound spikes/inward currents after removal of hyperpolarizing currents/voltage steps, which were blocked by TTA-P2 (3 μM, n = 4, 2). In vivo, we observed a reciprocal relationship between the drug-dose and its inhibitory effects on spindle density in two mice, with probe locations either within (T) or partly (P) within TRN. Compared to time matched BL controls, TTA-P2 at 1μM led to the highest (-55.64%) spindle-selective inhibition in ‘T’ mouse followed by -15.27% in ‘P’ mouse. NREM sleep was not appreciably altered.

**Conclusion:** TRN-PV neurons express T-type calcium channels whose activation is blocked by TTA-P2. In contrast to constitutive, global, knockout of Cav3.3, which reduces spindles and fragments NREM sleep, localized pharmacological blockade of T-type channels in TRN inhibits spindle density without affecting NREM.

**Support (If Any):** Department of Veterans Affairs Medical Research Service Awards (RB & RWM), a VA career development award (JMM), NINDS R21 NS079866-01 (RB), NINDS R21 NS093000 (REB), NIMH R01MH039683 (RWM)

0104

**ASSOCIATION BETWEEN NOISE-INDUCED AWAKENINGS AND AWAKENINGS DURING NOISE-FREE PERIODS**

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**Introduction:** When estimating the effect of single noise events (e.g., aircraft noise) on sleep, time windows are usually screened for arousals (e.g., transitions from sleep to wake). The underlying cause for the awakening though cannot be explicitly determined; whether it was due to the noise or other external or internal factors. It is unclear whether individuals that awaken more often to noise also awaken more often spontaneously during noise-free periods. As noise protection concepts are usually based on those awakenings attributable to noise (i.e., noise minus spontaneous), it is important to determine whether both types of awakening correlate.

**Methods:** Analyses are based on 94 healthy adults (age range 18-68 years, 40 male) who participated in polysomnographic field studies on the effects of aircraft (N = 61) or rail (N = 33) noise on sleep. Reactions to road noise were also measured within both studies. Ninety second time windows since noise event onset (or virtual noise event onset for spontaneous reactions; virtual noise events were randomly placed between noise-events) were monitored for a change from Rechtschaffen and Kales sleep stages REM, S4, S3, and S2 to S1, awake or movement time (defined here as an awakening). Logistic regression models with indicator variables for each subject, and adjusted for time from sleep onset, prior sleep stage, and indoor maximum noise level and the noise source (noise model only) were estimated for the probability of awakening.

**Results:** The correlation between the subject specific coefficients for spontaneous and noise induced awakenings was calculated. Both Spearman (r = 0.33, p = 0.002) and Pearson correlation coefficients (r = 0.35, p < 0.001) were positive and significant, but of small effect size.

**Conclusion:** The results indicate that subjects with more fragmented sleep may also be more susceptible to noise-induced sleep disturbance. This information could be used to improve noise protection concepts.

**Support (If Any):** This study was internally funded by the German Aerospace Center (DLR).
0106  
EFFECT OF CONTINUOUS NICOTINE INFUSION ON SLEEP PATTERNS IN RATS  
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**Introduction:** Smoking has been shown to cause various disruptions in the sleep of humans. However, these effects have yet to be extensively modeled in rodents. In the present experiment, a well validated model of nicotine dependence was utilized to examine the effects of nicotine administration on sleep.

**Methods:** Sprague Dawley rats (n=6) were implanted with EEG and EMG using standard procedures. Following recovery, polysomnography was recorded for a baseline day. Then, an osmotic mini-pump was implanted subcutaneously to administer nicotine bitartrate (9mg/kg/day) over 5 days. This infusion rate has been shown to produce blood levels of nicotine similar to those in heavy smokers. Sleep/Wake behavior during baseline and administration days 1, 3, and 5 were scored using SleepSign for Animals.

**Results:** The administration of nicotine resulted in an increase in wakefulness. During the light cycle, there was a peak in wake on Day 1 (p=.035) that returned toward baseline by Day 5; however, during the dark cycle, there was a constant trend of increasing wake over the 5 days (p=.001). NREM sleep was decreased in comparison to baseline throughout the 5 days in both the light (p<.001) and dark cycle (p<.001). Nicotine resulted in an increase in REM sleep. During the light cycle there was a trend toward increasing REM over all 5 days (p<.001), while during the dark cycle, there was a peak on Day 1 (p=.004) and a return to baseline by Day 5. Average wake bout duration significantly increased on Day 1 (p=.037) of nicotine administration and then returned to baseline, but no changes were noted during the dark cycle. Average NREM bout duration decreased over the 5 days of nicotine administration in both light (p=.002) and dark cycles (p=.043). Average REM duration was not affected.

**Conclusion:** Overall, NREM sleep was negatively impacted by nicotine in both time and average duration. Wakefulness and REM were increased with nicotine administration, though the temporal pattern of change differed based on rats being in their active or inactive period. This suggests that although certain sleep disruptions diminish as habituation to nicotine occurs, other patterns persist even after initial administration. This has implications for broader models of nicotine’s effects over time.

**Support (If Any):** Funding was provided by Acadia Pharmaceuticals
A. Basic Sleep Science

0107
SELECTIVE KNOCKOUT OF BMAL1 IN SKELETAL MUSCLE AND BRAIN HAS DIFFERENTIAL EFFECTS ON SLEEP AND CIRCADIAN PROCESSES
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Introduction: The Bmal1 knockout mouse is a useful tool to examine circadian and sleep processes. However, whole-body Bmal1 knockout has pleiotropic effects on inflammatory and metabolic processes. In lieu of this, we aimed to pinpoint where Bmal1 is acting to alter circadian and sleep processes. We focused our attention on selective knockout of Bmal1 expression in the brain and periphery: skeletal muscle.

Methods: These experiments utilized an inducible Cre recombinase mouse expressing with a Nestin (brain) or α-skeletal actin (muscle) promoter. In experiment 1, wheel running rhythms were measured across 2 wk of a 12:12 light-dark cycle (LD) and constant darkness (DD). In experiment 2, a 24 h recording of sleep/wake was undertaken three weeks after implantation of EEG/EMG electrodes.

Results: Under LD, there were no differences in nighttime activity onset and duration (alpha) between each flox/cre strain and respective flox/wt mice (p > 0.05, all). Under DD, flox/cre-muscle mice had a significantly shorter free-running rhythm (23.2 ± 0.1 h) compared to flox/wt mice (23.7 ± 0.2; p0.05; n = 8/strain). Flox/cre-muscle mice were awake for ~1 h less than flox/wt mice during the dark-phase of LD (p = 0.02; n = 6/strain). Daily amounts of NREM sleep showed a trend towards increase in flox/cre-brain versus flox/wt mice but further analyses are required (p = 0.05; n = 4).

Conclusion: This study demonstrates robust tissue-specific effects of Bmal1 knockout on circadian processes and modest effects for sleep processes. Most notably, molecular manipulation in the periphery and not the brain produces the most significant changes in circadian and sleep processes.

Support (If Any): F32HL116077 to AJB, R01NS078410 to KNP, U54NS060659 to KNP, P50HL117929 to KNP

0108
METABOLIC DYSREGULATION IN SKELETAL MUSCLE AND ADIPOSE TISSUE FOLLOWING ACUTE SLEEP LOSS IN HEALTHY YOUNG MEN
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Introduction: Sleep loss promotes peripheral insulin resistance and increases the risk of type-2 diabetes. As the molecular mechanisms remain largely unknown, we analyzed the response of two key metabolic peripheral tissues to a one night of total sleep deprivation (TSD).

Methods: Fifteen normal-weight young males participated in a cross-over within-subject design, in which they were subjected to both one night of TSD and normal sleep (8.5 hours), followed by morning skeletal muscle (SM) and subcutaneous adipose tissue (SAT) biopsies. Blood was collected before and after a post-biopsy oral glucose tolerance test. Protein and metabolite changes were analyzed with western blotting, proteomics and metabolomics.

Results: TSD induced a significant downregulation of the glycolysis pathway in SM (P < 0.001) as assessed by proteomics, in which the key glycolytic protein phosphofructokinase-1 was validated to be downregulated (~24%, P < 0.01) by western blotting. Instead, changes were indicative of increased glycolysis and adipocyte differentiation in SAT, whereas expression of the core clock protein BMAL1 was upregulated only in SM (P = 0.02) after TSD vs. sleep. Metabolomic data also supported a catabolic state with increased oxidative metabolism with elevated ketone bodies in both muscle and serum samples, with increased levels of insulin resistance-promoting saturated fatty acids.

Conclusion: Acute sleep loss induces perturbations at several molecular levels in peripheral metabolic tissues, with more pronounced effects in skeletal muscle. These changes might account for the impaired insulin sensitivity in response to sleep loss. Opposite effects in metabolic tissues might reflect a sleep loss-induced change in fuel utilization that may increase the risk of developing type-2 diabetes under conditions of chronic sleep restriction.

Support (If Any): Work from the authors’ laboratory is supported by the Swedish Brain Foundation, Thuring’s Foundation, Åke Wiberg Foundation, NovoNordisk Foundation, Swedish Society of Medicine and the Swedish Research Council.

0109
INTER-INDIVIDUAL DIFFERENCES IN WAKING AND SLEEP ENERGY EXPENDITURE
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Introduction: Knowledge of energy expenditure is important for research and clinical settings to determine caloric needs for energy balance and weight management, and to understand physiological changes in response to metabolic challenges such as sleep loss and circadian disruption. The aim of this investigation was to determine whether inter-individual differences in wake, sleep, and 24 h energy expenditure are stable across repeated 24 h assessments.

Methods: Fifteen participants (8 males and 7 females, aged 23.3 ± 3.4 years, ± SD) were studied. Participants were healthy, free of medical disorders, medications, and illicit drugs. Participants maintained a consistent 8 h per night sleep schedule for one week as an outpatient prior to the study (verified by wrist actigraphy, sleep diaries, and calls to a time stamped recorder). Participants consumed an outpatient energy balanced research diet for three days prior to the study. The inpatient protocol consisted of an initial sleep disorder screening night followed by three standard days with 16 h scheduled wakefulness and 8 h scheduled sleep each. Energy expenditure was measured during the three standard days using whole-room indirect calorimetry. During this time, constant posture bedrest conditions were maintained to control for energy expenditure associated with activity and energy balanced diet was continued with the same exact meals across days to control for thermic effects of food. Systematic inter-individual variability in energy expenditure was quantified using the intraclass correlation coefficient (ICC).

Results: We found ICCs to be in the almost perfect range for the consistency in wake energy expenditure (ICC = 0.94), sleep energy expenditure (ICC = 0.96) and 24 h energy expenditure (ICC = 0.96) across the three standard days of the study. The average absolute difference in 24 h energy expenditure between days was small at ~27 kcal/d.

Conclusion: We demonstrate robust and stable trait-like individual differences in whole body energy expenditure across repeated assessments of wake and sleep, and across 24 h.

Support (If Any): Philips, Inc
VI. Physiology

0110 TIMING OF DAILY ENERGY INTAKE DISTRIBUTION DIFFERS WITH TIME AWAKE IN OBESE ADOLESCENTS: PRELIMINARY RESULTS FROM FORCED DESYNCHRONY

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Introduction: Research in adults has demonstrated a role for the timing of energy distribution in weight management and obesity, with more favorable outcomes when a greater proportion of energy is consumed earlier in the day. We examined the timing of energy distribution in adolescents with 28-h forced desynchrony (FD), hypothesizing an association of overweight (OW) and obesity (O) with lower proportion of daily energy consumed early in the day and greater consumption later in the day compared to adolescents who were normal weight (NW).

Methods: Twenty-six (15 m) adolescents (12 to 15 yr) completed 7 full cycles of FD; 17.5 h awake each cycle. Foods were selected about 1 h before each of 6 meals every cycle; Meal 1 began 1.7h after waking, Meal 2 was 2 h after Meal 1, and Meals 3-6 followed at 3-h intervals. Food was weighed before and after each meal. Proportion of daily energy intake was computed for each meal based on the total energy consumed in that cycle. Weight categorization used BMI percentiles (CDC): Normal Weight (NW); > 5 < 85; n = 14), Overweight (OW; ≥ 85 < 95; n = 6), or Obese (O; ≥ 95; n = 6). Analyses were performed using mixed effect models.

Results: A main effect of meal time (F = 49.49; p < .001) showed greatest proportion (22.3%) of energy consumed in Meal 1 and least (13.0%) in Meal 6. A significant interaction (F = 2.40; p = .005) of meal by weight group showed lower proportion of energy (20.0%) at Meal 1 in OW than both NW (22.7%) and OW (24.2%). Furthermore, OW consumed more daily energy at Meal 6 (15.0%) than NW (12.9%) and OW (11.1%). The OW participants, however, had a significantly higher proportion of energy intake at Meal 1 than NW and lower proportion of energy intake at Meals 4 (14.1% vs. 17.4%) and 6 than NW.

Conclusion: Regardless of circadian phase at waking, proportion of daily energy intake was greatest close to waking. In comparing proportion of energy intake in the earliest and latest meals, we found a decrease of only 5% in the O group, whereas the NW showed nearly 10% decline and OW over 13%. These data support the hypothesis, but only for the adolescents who were obese. With a larger sample, we plan to examine circadian phase impact, the interactions of phase with time awake, and the distribution of nutrients at each meal.

Support (If Any): R01DK101046

0111 LOGNORMAL DISTRIBUTION AND SLEEP HOMEOSTATIC PROPERTIES OF SLOW WAVES

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Introduction: Although sleep slow-waves (delta band, 0.5-4 Hz, 75 uV) are known to be a measure of sleep homeostasis, little is known about the role of lower amplitude slow waves. Our objective was to characterize the distribution of slow-waves of any amplitude and examine their role in sleep homeostasis.

Methods: Fifteen subjects (6 female, age median 44.5 years (range 23-74) underwent polysomnography during a baseline, followed by sleep deprivation for 24 hours, and then polysomnography during recovery sleep. We used a MatLab code to identify the negative value of electroencephalographic slow-waves (0.5-4.0 Hz, no amplitude threshold) during non-rapid eye movement (NREM) sleep and determine the amplitude, slope, and inter-peak interval of the negative half-waves during both baseline and recovery sleep. Absolute power in the delta frequency band during NREM sleep was calculated via direct Fourier transform.

Results: The logarithmic transformation of the amplitude, slope and duration between negative slow-wave peaks were Gaussian distributed. The mean logs of the amplitude, slope, and inter-peak interval at baseline were 2.75, 4.08, and -0.469 respectively, and increased to 2.96, 4.25, and -0.453 during recovery sleep, respectively (p < 10^-23 for all measures). Individual subject’s mean slow-wave amplitude, slope, and inter-peak interval at baseline were each highly correlated with that of the recovery night (r = 0.93, p < 0.0001 for amplitude). Although absolute power across the night increased during recovery compared to baseline, there was no significant correlation between the slow-wave power of the baseline and recovery nights.

Conclusion: Sleep slow-waves of all amplitudes during NREM are lognormally distributed and increase with sleep deprivation, suggesting that their distribution may be a valid measure of sleep homeostasis. Furthermore, it may be more sensitive to change than standard measures of sleep homeostasis. Further studies are needed to validate these measures and examine their clinical implications.

Support (If Any): This research was supported by the Dixon Translational Research Grant, UL1TR000150, and P01AG11412.

0112 PROXIMITY TO SLEEP ALTERS THE AFFECTIVE PROCESSING OF EMOTIONAL AND NEUTRAL STIMULI

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Introduction: Research investigating sleep’s role in modulating affective reactivity has remains equivocal, with studies suggesting that sleep may increase, decrease, or maintain affectivity. A variety of factors, such as context or quality of sleep, may impact affective processing. We investigated whether the proximity of sleep to the encoding event alters long-term processing of emotional and neutral stimuli. We predicted that sleeping soon after encoding would lead to greater affective processing of events, prohibiting increased visceral reactions.

Methods: Participants encoded 80 negative and 80 neutral scenes at 9am (wake-first) or 9pm (sleep-first). They were tested both 12hrs and 1wk later, where half of the originally viewed scenes were re-presented along with 40 novel scenes of each valence. Skin conductance response (SCR) was collected during each session and reactivity at each session was calculated as the number of scenes eliciting a response divided by total number viewed.

Results: At encoding, SCRs were similar between sleep- and wake-first groups to negative, t(25) = 1.0, p = 0.3, and neutral scenes, t(25) = 1.4, p = 0.17, reducing concern about circadian effects. A 3x2x2 mixed ANOVA revealed a significant session-group interaction, F(2,24) = 6.5, p = 0.003. The wake-first group demonstrated an increase in reactivity to old negative scenes, t(13) = 4.1, p = 0.001, after the 12hr day. A week later, however, reactivity to previously presented negative scenes was reduced, t(13) = 2.3, p = 0.036. Reactivity to neutral scenes followed a similar overall pattern. Critically, in the sleep-first group, reactivity to both negative and neutral information remained equivalent across all three sessions, with no initial spike in early processing.

Conclusion: The proximity of sleep may play an important role in the processing of emotional experiences. When sleep occurs close to an encoding event, information may be processed and integrated into the neocortex, resulting in consistent emotional responses across time.
Without sleep, however, the brain may rely more on limbic regions, leading to potentiated reactivity when re-encountered.

0113
EFFECTS OF PRECEDING SLEEP ON PHYSIOLOGICAL RESPONSES TO A LABORATORY STRESS INDUCTION
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Introduction: Sleep continuity and quality have important implications for adaptive stress response, other physiological processes, and well-being. While various aspects of these multi-directional relationships have been explored in prior research, the implications of sleep on subsequent daytime stress physiology are not well elucidated.

Methods: Eighteen healthy young adults (14 female; age 19.9 ± 2.3 years) wore an Actiwatch 2 wrist actigraphy device and completed online daily sleep logs for up to one week. Then, participants underwent a daytime laboratory visit that involved the Maastricht Acute Stress Test (MAST), employing physical and psychosocial stressors including ice water hand immersion and a serial subtraction task. Subjective ratings of pain/discomfort and distress were obtained throughout the laboratory visit, along with hand surface temperature, respiration, and EKG recordings.

Results: Participants reported a significant increase from baseline to post-MAST in both pain/discomfort (0.6 ± 1.4 vs. 5.3 ± 2.8, p < .001) and distress (0.9 ± 1.5 vs. 4.9 ± 3.0, p < .001), both returning to baseline levels 30 minutes after completion of the MAST. Starting at a baseline of 31.5 ± 2.2°C, hand surface temperature decreased 56.4 ± 4.8% following the first ice water immersion, and recovered by 40.4 ± 10.2% from 8.7 ± 0.9°C after the final immersion, corresponding to 25.1 ± 3.8°C following the 30 minute recovery period. Sleep efficiency via sleep log was 91.2 ± 7.0%. Higher sleep efficiency on the night preceding the lab visit predicted greater recovery in hand temperature (r = 0.69, p = .002), despite no significant correlations between sleep parameters and subjective measures of stress. Actigraphy and other psychophysiological analyses are forthcoming.

Conclusion: These results corroborate and extend prior research of direct associations between sleep patterns and subsequent stress physiology. The impact of sleep continuity on peripheral thermoregulation under conditions of stress may have critical implications for health (e.g. acute medical care), public safety (e.g. outdoor service workers), and quality of life (e.g. chronic pain).

Support (If Any): This research was funded by a Mind and Life Institute Varela Award and National Science Foundation Graduate Research Fellowship (MRG).

0114
SLEEP’S INFLUENCE ON EMOTIONAL DIFFERENTIATION IN THE LATE POSITIVE POTENTIAL
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Introduction: Sleep leads to preferential consolidation of emotional memory, but how does it affect the emotional tone associated with a memory? Differences in the late positive potential (LPP) of the EEG in response to negative versus neutral stimuli provide an interesting opportunity to explore sleep’s influence on the emotional tone of a memory as it is represented within the central nervous system.

Methods: Participants viewed 80 negative and 80 neutral photos in either the morning (wake group) or the evening (sleep group). Sleep participants then slept in the lab and wake participants went about their normal daily routine. One week later, participants returned for a surprise recognition session in which half of the old scenes from the viewing session were mixed with 40 novel scenes of each valence. Event-related EEG was used to measure LPPs to the old negative, old neutral, new negative, and new neutral photos. To assess how sleep influences the emotional tone associated with a memory, the difference between the area under the curve for negative and neutral LPPs was calculated for both old and new images.

Results: A preliminary analysis revealed an interaction between sleep and emotional differentiation (F(1,19) = 4.05 p = 0.014) during the recognition session. Post hoc analysis revealed a trend (t(9) = 1.9, p = 0.079) in which sleep appears to lead to a larger emotional differentiation compared to wake. Within the sleep group, a trend (t(9) = 2.03, p = 0.072) suggests emotional differentiation may be larger for old compared to new stimuli.

Conclusion: Though these results are preliminary, it appears sleep could lead to differential processing of emotional stimuli. An increased emotional differentiation between old negative and neutral stimuli compared to new negative and neutral stimuli suggests sleep might increase the emotional tone associated with emotional memories.

Support (If Any): SFB

0115
RELATIONSHIP BETWEEN SLOW-WAVE ACTIVITY AND CEREBRAL BLOOD FLOW IN FREELY MOVING MICE
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Introduction: Numerous studies have demonstrated that cerebral blood flow (CBF) is generally higher during wakefulness and rapid eye movement (REM) sleep than non-REM (NREM) sleep. The relationship between slow-wave activity (SWA; 1-4 Hz) and CBF is not well understood.

Methods: In the present study, we recorded CBF in the cerebral cortex in freely moving mice and correlated it with SWA and other sleep parameters. Simultaneous recordings of electroencephalogram (EEG), electromyogram (EMG) and CBF were performed in C57BL/6J adult male mice using our new system that allows optical and electrical connections in mice without the need of a commutator or fiber optic rotary joint. Mice were implanted with EEG/EMG electrodes, and a cannula was placed above the parietal cerebral cortex. After a seven-day recovery period, spontaneous sleep/wake patterns and locomotor activity were recorded in these mice for a 24-hour period. Then, the optical fiber was connected to the mouse via the implanted cannula, and recordings were continued for a 24-hour period. EEG, EMG, and activity counts were recorded by a radio-telemetric system (Dataquest ART Gold 4.1, Data Sciences International, New Brighton, MN). CBF was recorded by Perimed laser-Doppler flowmeter (Jarfalla, Sweden). CB1 was recorded with cerebrovascular activity.

Results: We observed positive correlation between SWA and CBF during NREM sleep when the data were averaged within 4-hour or 2-hour intervals. However, when the CBF and SWA data were averaged within 10-second intervals and correlated within each NREM sleep bout, the correlation between CBF and SWA was not statistically significant (r = -0.22).

Conclusion: Our data suggest that relationship between SWA and CBF in the cerebral cortex is regulated differently on the short time scale (seconds or minutes) and long time scale (hours) in mice.

Support (If Any): Supported by NIH grants R01NS064193, R21NS092926
0116
LOCAL INHIBITORY CONTROL OF OREXIN NEURONS
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Introduction: The basal forebrain (BF) is critically involved in maintaining EEG and behavioral wakefulness. Recent work has shown that selective activation of BF GABAergic (BFGABA) neurons produced sustained wake and fast cortical rhythms in behaving mice (Anaclet et al., 2015 and Xu et al., 2015). The downstream circuits engaged by BFGABA neurons to produce this wakefulness remain unresolved. We hypothesized that BFGABA neurons might produce wakefulness by inhibiting GABAergic neurons in the lateral hypothalamus (LH), resulting in disinhibition, and hence activation, of wake-promoting orexin neurons. To first demonstrate that orexin neurons are under inhibitory control by local LH GABAergic neurons we used a ChR2-assisted-circuit-mapping approach in brain slices.

Methods: To test the functional connectivity between GABAergic neurons in the perifornical region and orexin neurons, we stereotaxically injected vGAT-eCre mice with a mixture (1:1) of cre-dependent AAV-Chr2 and AAV-h-orexin-tdTomato (Saito et al, 2013), which resulted in expression of Chr2 in GABAergic neurons and tdTomato in orexin neurons. We then performed whole-cell recordings from orexin neurons (td-Tomato positive) while photostimulating local GABAergic neurons.

Results: Photostimulation of LH GABAergic neurons (somata/axons/terminals) expressing ChR2 evoked inhibitory postsynaptic currents (IPSCs) in 10 out of 20 recorded orexin neurons. Application of 20uM bicuculline abolished these photoevoked IPSCs, indicating that they were mediated by the release of GABA and activation of GABAA postsynaptic receptors.

Conclusion: GABAergic neurons in the LH inhibit orexin neurons through the release of GABA and activation of postsynaptic GABAA receptors. We propose that local GABAergic neurons provide inhibitory tone to orexin neurons during sleep. During wakefulness LH GABAergic neurons are inhibited by a wake-on inhibitory input such as that from BFGABA neurons, which results in dis-inhibition of orexin neurons.

Support (If Any): 1R01NS091126, R01NS024736

0117
PROBABILISTIC MODELING OF SLEEP ARCHITECTURE
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Introduction: The extended two process model of sleep posits that the length and sequence of sleep stages relies on three dynamic processes, 1) the periodic circadian cycle (dependent on the time of day), 2) exponential sleep homeostat function (a function of time spent awake), and 3) the periodic ultradian cycle (regulating the sequence and duration of Rapid Eye Movement (REM) and Non-REM stages). These models, and others, take a holistic view of sleep architecture, combining stage 1, 2, 3 & 4 into non-REM, thereby only giving a coarse prediction of sleep architecture. Moreover, they do not include health measures such as Body Mass Index (BMI) and gender which play a role in sleep architecture. Here, we test assumptions of the extended two process model and the relationship between sleep architecture (Wake, 1, 2, Slow Wave Sleep and REM), time of day, and other subject factors using a probabilistic graphical model framework.

Methods: Various Bayesian networks representing different variable independence assumptions were fit to 483 sleep episodes from 404 subjects taken from morning and afternoon naps as well as partial nights of sleep.

Results: The best fitting model (BIC = -107096) suggests that previous stage, but not its duration is predictive of the current stage (ΔBIC = -1279) and the duration of the current stage to be independent of the previous stage and duration (ΔBIC = -1310). In agreement with the two process model, time of day influences sleep architecture (ΔBIC = 1200), but BMI and gender do not.

Conclusion: This work demonstrates the promise of probabilistic graphical models in sleep science and represents the first steps towards a model able to predict sleep architecture from a set of known priors. Further development of this model may serve to quantify variation in sleep architecture to the benefit of disease detection.

0118
K-COMPLEXES: A CARDIAC PERSPECTIVE
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Introduction: K-complexes (KC) are specific patterns of electrical brain activity that occur during stable sleep; they can occur spontaneously or be evoked by external stimuli. While the KC itself has been extensively studied, associated changes in peripheral physiology have received less attention. We investigated heart rate (HR) fluctuations associated with spontaneous and evoked KCs in male and female adolescents to achieve new insight into the functional significance of the KC.

Methods: Inter-beat intervals (IBIs) were derived from continuous electrocardiographic recordings of 40 healthy adolescents 16-22 years old (19 female) on two nights, one when sleep was undisturbed and another when auditory stimuli designed to elicit KC were presented.

Results: Participants showed a clear biphasic cardiac response to both spontaneous and evoked KCs, with an initial acceleration in HR followed by a deceleration (p < 0.001). The cardiac response was similar for both spontaneous and evoked KCs but was absent or minimal following a tone that did not trigger a KC (p < 0.001). The cardiac response to KCs began sooner when tones were presented in the first part compared with the second and third parts of the cardiac cycle (p < 0.05). Sex differences were evident in that pre-tone baseline HR was higher and the peak in HR acceleration in response to KCs was blunted and delayed, in girls compared to boys (p < 0.001). Interestingly, pre-tone baseline HR was lower when a tone elicited a KC compared to when it did not (p < 0.001), suggesting that KCs are more likely to be elicited by external stimuli in states of reduced cardiac activation.

Conclusion: Our results show a strict dependency between electroencephalographic sleep events and cardiac control suggesting a potential functional role of KCs in modulating the cardiovascular system during sleep. Differences in KC-cardiac response between male and female adolescents suggest sex differences in autonomic cardiac control during sleep.

Support (If Any): This study was supported by the National Consortium on Alcohol and NeuroDevelopment in Adolescence (NCANDA); grants: AA021690 (DBC), and AA021696 (IMC+FCB).
Changes in Heart Rate Variability Due to Light Exposure Predict Frontoparietal Connectivity
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Introduction: Acute exposure to blue light increases alertness and performance on the Psychomotor Vigilance Task (PVT). Preliminary data from our lab has also shown that smaller changes in heart rate variability (HRV), a measure of cardiac reactivity, can predict PVT performance during bright light exposure. We hypothesized that individuals who show smaller increases in HRV during light exposure (presumably reflecting greater alertness and associated sympathetic tone) would have greater post-exposure frontoparietal connectivity.

Methods: Twenty healthy 18-30 year olds underwent a half-hour acclimation period at 9:45 a.m. in low amber light (baseline), followed by a half-hour exposure to bright light (blue or amber) at 10:15 a.m. Participants then underwent a six-minute resting state functional magnetic resonance imaging (fMRI) scan at 3T within 10 minutes of cessation of light exposure. Regions of interest were placed in frontal and parietal areas of the cortex as defined by the Automated Anatomical Labeling Atlas. Functional connectivity was analyzed utilizing the CONN toolbox and SPM12, with p < .05, FDR corrected.

Results: Smaller change in HRV from baseline in response to the bright light exposure, and better PVT performance, correlated positively with increased functional connectivity between the Left Angular Gyrus, and Left Middle Frontal Gyrus; in contrast, it was associated with greater negative functional connectivity between the Left Middle Frontal Gyrus and Right Superior Frontal Orbital Gyrus.

Conclusion: During light exposure, attenuated change in HRV was associated with increased functional connectivity within the left frontoparietal attention network, and better vigilance performance. Findings suggest a link between sympathetic vagal tone as measured by HRV and brain function that is directly associated with faster response times. The HRV response to light exposure might potentially serve as a trait marker of vulnerability to cognitive decline during sleepiness or fatigue.

The Effects of Light Exposure on Heart Rate Variability Predict Sleepiness and Vigilance
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Introduction: Heart Rate Variability (HRV) has been shown to increase at the onset of sleep. Interestingly, exposure to blue wavelength light prior to sleep can inhibit this increase, suggesting a possible biomarker of increased alertness. In addition, acute exposure to blue light has been demonstrated to increase alertness, reduce sleepiness, and increase performance on the Psychomotor Vigilance Test (PVT), but this has not been directly associated with HRV. We hypothesized that blue light exposure would decrease HRV and increase performance on the PVT.

Methods: Twenty healthy 18-30 year olds underwent a half-hour baseline acclimation period in low amber light at 9:45 a.m., followed by a half-hour exposure to bright blue light (469 nm; n = 10) or bright amber light (578 nm; n = 10). HRV was assessed during a 5 minute resting condition at baseline and during bright light exposure. A change score was calculated between these two resting periods. As a measure of sustained attention, the PVT was administered during the final 10 minutes of the bright light exposure.

Results: There was no significant difference in baseline HRV, performance on the PVT, or sleepiness between the two light conditions. Both groups showed an increase in HRV between baseline and the bright light exposure (p = .001). However, smaller HRV change scores were associated with fewer lapses in vigilance (p = .003) and faster reaction time (p = .001) on the PVT.

Conclusion: Contrary to expectations HRV increased for both wavelengths of bright light. However, consistent with our hypotheses, individuals with inhibited HRV increases during light exposure, regardless of wavelength, had better performance on the PVT. Findings suggest that smaller increases in HRV during bright light exposure, regardless of wavelength, may be associated with better sustained attention. Future work may focus on the role of individual differences in HRV during exposure to light on performance during various cognitive tasks.

Effects of Sympathetic Denervation of Brown Adipose Tissue on Sleep
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Introduction: In previous experiments, using uncoupling protein 1 knockout mice - in which brown adipose tissue (BAT) thermogenic processes are turned off - we have shown that BAT thermogenesis is required for normal sleep-wake activity and for recovery sleep after sleep deprivation. BAT is activated by norepinephrine, which is released by postganglionic sympathetic neurons and BAT-resident M2 macrophages. The current project investigates the effects of chemical denervation of the sympathetic outflow to BAT on sleep, body temperature, and activity under baseline conditions and during cold exposure.

Methods: Male C57BL/6 mice, instrumented for sleep recording, were treated with 20 microinjections of 6-hydroxydopamine (6-OHDA, 2 µl each) (n = 8), or vehicle (n = 6) delivered to their interscapular BAT pads to induce chemical lesion of the sympathetic terminals. Efficacy of lesions was determined by detecting TH-immunoreactivity in BAT pads at the conclusion of the experiments. Sleep-wake activity, body temperature, and motor activity were measured to determine the acute effects of sympathetic denervation. One month after denervation, the effects of cold exposure (10°C) were measured.

Results: Administration of vehicle had no acute effect on body temperature or activity rhythms. 6-OHDA administration significantly increased body temperature during the light phase. Motor activity and the total amount of sleep did not change after either treatment. Cold exposure induced significant changes in NREMS, REMS, body temperature, and activity in vehicle-treated mice. NREMS was decreased (12%) during the light phase, while REMS was significantly reduced (60%) throughout the cold exposure. These changes were significantly attenuated (ΔNREMS of 4%; ΔREMS of 35%) in 6-OHDA-treated mice.

Conclusion: These findings suggest that 6-OHDA-induced BAT lesioning might be transient or that it might induce activation of other BAT reserves in the mouse to compensate for the loss of BAT function. M2 macrophages might also compensate for the lowered sympathetic tone to BAT by increasing norepinephrine release.

Support (If Any): Supported by the National Institutes of Health R01HL122390 to ES.
0122
SEX DIFFERENCES AND TIME OF DAY EFFECTS ON 24-HOUR FREE FATTY ACID PROFILES
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Introduction: Free fatty acids (FFA) are a primary fuel source for heart and skeletal muscle, particularly during fasting. Time of day alterations in FFA play a role in the regulation of metabolic physiology. However, findings from such studies have been limited by a focus on male subjects. Growth hormone (GH), an important regulator of FFA, shows sex differences in 24-hour profiles with males releasing GH primarily at night and females throughout the day and night. We therefore examined potential sex differences in circulating 24-hour FFA profiles under energy balanced and controlled sleep-wake conditions.

Methods: Healthy adults (six females: 24.0 ± 2.8y, BMI 21.8 ± 1.5 kg/m²; seven males: 25.3 ± 4.8y, BMI 22.2 ± 1.0 kg/m²; mean ± SD) were studied after two inpatient days consisting of 9h scheduled sleep per night at habitual bedtime. Blood was sampled hourly beginning one hour after scheduled wake-time for 24 hours. Plasma FFA were analyzed using a colorimetric assay and 2h post meal area under the curve (AUC) for FFA was determined. Participants consumed energy balanced research diets composed of 30% fat, 55% carbohydrate and 15% protein for 5 days prior to assessments.

Results: Males showed higher average FFA levels during scheduled sleep versus scheduled wakefulness (p < 0.05), whereas females showed a non-significant trend for higher FFA levels during scheduled sleep (p = 0.08). Females showed a more robust daytime FFA feeding pattern with larger meal-related FFA AUC following lunch (p < 0.05), versus men. 24-hour and daytime FFA levels were positively associated with body fat percentage (p < 0.05).

Conclusion: We provide evidence of sex differences in 24-hour FFA profiles, which were related to body fat. The functional significance of these differences and how they may affect responses to metabolic perturbations is unknown. Future studies are necessary to determine whether differences in FFA may be related to sex differences in day-time GH, and/or catecholamines, cortisol and metabolic parameters.

Support (If Any): NIH-HL109706, TR001082, and DK048520 and Society in Science, The Branco Weiss Fellowship, administered by the ETH Zürich.

0123
THE ROLE OF ALTERNATIVELY ACTIVATED (M2) MACROPHAGES IN SLEEP REGULATION
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Introduction: Brown adipose tissue (BAT) plays a fundamental role in metabolism and thermoregulation. It is specialized for regulated heat production and has a significant role in cold- and diet-induced thermogenesis. The ability of BAT to produce heat is due to the tissue-specific presence of the uncoupling protein 1 (UCP-1) in the mitochondria. We have previously shown that BAT heat production is sonomgenic and required for normal sleep-wake activity and sleep deprivation-induced recovery sleep. BAT is activated by norepinephrine released from postganglionic sympathetic neurons. Additionally, BAT activation can occur from a recently recognized macrophage population, the alternatively activated (M2) macrophages. The heat-producing capacity of BAT is severely impaired in the absence of M2 macrophages. The aim of the present experiments were to determine the role of M2 macrophages in sleep regulation. We studied spontaneous sleep and sleep responses to sleep deprivation and cold ambient temperature in interleukin 4 α-receptor knockout (IL4-Rα KO) mice that lack M2 macrophages.

Methods: Male IL4-Rα KO and Balb/c mice (n = 8, each) were used. After baseline body temperature, motor activity and sleep recordings, we studied the effects of 6 h sleep deprivation by gentle handling at thermoneutral (30°C) temperature. In the second experiment, we determined the effects of cold exposure (10°C) for 24-h on sleep and metabolism determined by indirect calorimetry.

Results: Under baseline conditions, non-rapid-eye movement sleep (NREMS) of IL4-Rα KO mice did not differ from control mice. However, IL4Rα KO mice had significantly more rapid-eye movement sleep (REMS) during the light phase and during the last 4 hour of the dark period as compared to controls. The increase in REMS was due to the higher number of REMS episodes in the KO mice. NREMS rebound after sleep deprivation was significantly attenuated by ~50% in the KO animals. There was no difference in the EEG slow-wave activity responses to sleep deprivation between genotypes. Exposure to cold ambient temperature induced decreases in NREMS and REMS in both groups but the changes were significantly more pronounced in the KO mice. Cold exposure increased VO2, suppressed respiratory exchange ratio and body temperature. These changes were significantly elevated in IL4-Rα KO mice.

Conclusion: Present findings support the hypothesis that intact M2 macrophage function in BAT is required for compensatory sleep after sleep loss as well as for normal sleep and metabolic responses during cold exposure.

Support (If Any): Supported by the National Institutes of Health R01HL122390 to ES.

0124
BOTH SUBJECTIVE AND OBJECTIVE MEASURES OF RISK FOR SLEEP DISORDERED BREATHING DISTINGUISH BETWEEN UNIVERSITY FOOTBALL AND TRACK TEAM MEMBERS
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Introduction: Despite their young age and physical fitness, professional football players are at greater risk for sleep disordered breathing (SDB) than the general population due to greater upper body mass. Although larger upper body mass is valuable to these athletes (line-men, in particular), this often includes greater neck mass, which may increase risk for developing SDB. This may subsequently increase downstream risk for cardiovascular and metabolic disease. In order to explore whether these risk factors are also evident among college athletes, the present study examined subjective and objective risk factors for SDB in college level football players relative to athletes with lower body mass.

Methods: Offensive/defensive linemen (males) and track and field team members currently enrolled at a DI university in the SE United States were asked to complete a survey that assessed risk factors of SDB (Multivariable Apnea Prediction (MAP) index). Blood pressure, neck and waist circumferences, body mass index, modified Mallampati Index, and tonsil size were also measured.

Results: Both self-reported and physiological risk factors were significantly different. Football players had larger necks and waists, higher body mass index, larger tonsils, and higher systolic blood pressure. Measures generated by the MAP (roughly indicating risk for apnea...
and potential severity of apnea) were significantly higher among football players.

**Conclusion:** College level football players demonstrated significantly more risk factors associated with SDB than did track team members. These data suggest that the body characteristics valued among linemen that may predispose them to SDB are evident in college athletes. Our data suggest that simple assessments could be incorporated into the screening process of collegiate athletes to identify those at risk for developing SDB, which would allow early awareness of risk and intervention.

**Support (If Any):** Supported by the National Colligate Athletic Association (NCAA) Graduate Student Research Grant (Peck, PI).

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**0125**

**EFFECTS OF CARBACHOL ON HYPOGLOSSAL MOTOR NEURONS IN ADULT MICE**

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**Introduction:** In REM sleep, cranial respiratory muscles undergo a suppression of activity, with the genioglossus (GG) muscle showing the most dramatic suppression. Work by several groups have concluded that the reduction of activity in hypoglossal neurons is mediated by the combination of 1) noradrenergic and glutamatergic disinhibition and 2) a direct cholinergic inhibition of hypoglossal motor neurons. Interestingly, blocking the cholinergic transmission in the hypoglossal motor nucleus fully restores REM sleep GG activity to levels seen during NREM and wakefulness (Grace et al., 2013), suggesting that a cholinergic-mediated inhibition of hypoglossal motor neurons is largely responsible for the REM sleep suppression of GG activity. Previous in vitro electrophysiological work has found that hypoglossal motor neurons are excited by the cholinergic agonist carbachol via nicotinic receptors (Chamberlin et al., 2002). This work was conducted in neonatal rats, whereas, all the in vivo work has been done in adult animals. In this study we tested the effects of carbachol on hypoglossal motor neurons in brain slices of adult mice.

**Methods:** We recorded from hypoglossal motor neurons in brain slices of 6-8 week-old mice using whole-cell voltage-clamp mode.

**Results:** We found that bath application of carbachol (at -60mV) induced an inward current (excitatory response) in all hypoglossal motor neurons tested. In 70% of these neurons, carbachol also produced an initial outward current (inhibitory response). Both responses were found.

**Conclusion:** Our results confirmed that as in neonatal animals, the main effect of carbachol in adult mice is the excitation of hypoglossal motor neurons. A subpopulation of hypoglossal motor neurons is inhibited by carbachol. This inhibitory response appears to be mediated by muscarinic receptors, and suggests a mechanism by which a REM-On cholinergic input could reduce the activity of hypoglossal neurons in REM sleep.

**Support (If Any):** 2P01HL095491

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**0126**

**POST-EXERCISE BLOOD PRESSURE RESPONSE IN HYPERTENSIVE PATIENTS WITH OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** Obstructive sleep apnea (OSA) is strongly associated with hypertension (HT). Exercise promotes benefits and is considered as a strategy to prevent and treat HT and sleep disorders. However, blood pressure (BP) behavior during exercise recovery is not clear in hypertensive patients with OSA.

**Methods:** Eight hypertensive men without OSA (HT group) and eleven hypertensive men with moderate/severe OSA (HT + OSA group) were matched for age, BMI and BP. The patients were underwent an exercise (treadmill, duration: 45 min, intensity: 60% maximal heart rate) and a control (sitting rest) session. Measurements [mean arterial pressure (MAP, systolic blood pressure (SBP) and diastolic blood pressure (DBP)] were taken pre- and post-intervention (55-60min after exercise) in all the sessions.

**Results:** HAS and HT + OSA groups had similar pre-intervention MAP (HT: 97 ± 6mmHg vs. HT + AOS: 95 ± 9mmHg), SBP (HT: 139 ± 12mmHg vs. HAS+ AOS: 135 ± 13mmHg) and DBP (HT: 75 ± 4mmHg vs. HT+ AOS: 75 ± 9mmHg). After 55-60min (post-intervention period), [MAP (89 ± 6mmHg), SBP (130 ± 10mmHg) and DBP (69 ± 5mmHg)] were decreased in HT group and increased in HT + OSA group [MAP (99 ± 8mmHg), SBP (142 ± 15mmHg) and DBP (78 ± 7mmHg)], compared with pre-intervention values, respectively.

In the HT group, exercise session promoted a reduction in the magnitude of MAP (-7.2mmHg), SBP (-9.6mmHg) and DBP (-5.9mmHg) response. When HT + OSA group was analysed, an increase in the magnitude of MAP (3.6mmHg), SBP (4.6mmHg) and DBP (2.0mmHg) responses was found.

**Conclusion:** The results suggest that OSA can affect the post exercise blood pressure response in hypertensive individuals.

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**0127**

**CONTROL OF HYPOGLOSSAL MOTONEURON EXCITABILITY BY NORADRENERGIC NEURONS IS NOT DIRECT**

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**Introduction:** Antagonism of α1-adrenergic and serotonin receptors in the hypoglossal nucleus abolished depression of hypoglossal nerve activity that occurred during carbachol-induced REM sleep-like state in anesthetized rats. Since the effects of antagonists were delayed, we have hypothesized that antagonists had to diffuse outside the hypoglossal nucleus to abolish the motoneuron depression. To test this hypothesis, we compared effects of prazosin, α1-adrenergic antagonist, injected at different locations within the hypoglossal nucleus using the same animal preparations.

**Methods:** Four adult Sprague-Dawley rats were anesthetized with urethane, vagotomized, paralyzed and artificially ventilated. Spontaneous hypoglossal nerve activity was recorded using the cuff electrode. In
two rats, three injections (40 nl each) of 0.2 mM prazosin were placed within the hypoglossal nucleus at caudal, central and rostral levels: 0.5 mm caudal, 0.15 mm rostral and 0.8 mm rostral, to the obex respectively. In two other rats, single injections (100 nl) of 0.2 mM prazosin were made into the central level (0.15 mm rostral to the obex). We measured the amplitude of moving-time average (time constant 100 ms) of inspiratory hypoglossal nerve activity, respiratory rate and mean blood pressure before (baseline) and 40 min following, the prazosin injection onset.

Results: The three injections of prazosin (40 nl each) gradually decreased the hypoglossal nerve activity to 35.8% and 38.8% relative to baseline. However, the single (100 nl) injections of prazosin made into the center of hypoglossal nucleus did not affect the activity of hypoglossal nerve (92% and 108%, relative to baseline). In all rats, prazosin did not affect either blood pressure or respiratory rate.

Conclusion: These results support our hypothesis that injections of prazosin at the three rostro-caudal levels within the hypoglossal nucleus yield a specific pattern of prazosin diffusion to its targets, which most likely are located outside the hypoglossal nucleus and mediate noradrenergic drive to hypoglossal motoneurons.

Support (If Any): NIH grant ROI HL116845.
0128
CHICAGO TO JAPAN: CIRCADIAN PERIOD AND PHASE SHIFTS IN AFRICAN AND EUROPEAN AMERICANS
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Introduction: Our previous studies showed that African-Americans (Blacks) have shorter free-running circadian periods than European-Americans (Whites). This ongoing study measures circadian period and how it relates to phase shifts in response to a large and abrupt delay of zeitgebers.

Methods: So far, 15 Black and 9 White healthy young adults (14 males) ages 21-44 (median = 32.5) lived in the lab for 14 days. They spent 3 days on an ultradian light/dark (LD) cycle (LD 3:2) forced desynchrony protocol. The dim light melatonin onset (DLMO) was determined before and after the ultradian LD cycles to yield circadian period. Then, subjects were put on a baseline sleep schedule similar to their home sleep schedule for 4 days. Finally, their sleep and meal schedules were delayed 9 h for 3 days, like flying from Chicago to Japan. The DLMO was determined after the 4 baseline days and after the 3 delayed days to determine the phase shift.

Results: In this preliminary analysis, the DLMO delayed for all subjects after the delay of zeitgebers, but Blacks had smaller phase delay shifts (mean ± SD: 2.1 ± 1.1 h vs. 3.7 ± 0.6 h, p < 0.001). As in the previous studies, the free-running period of Blacks was shorter than Whites (24.03 ± 0.19 h vs. 24.29 ± 0.19 h, p < 0.005). Shorter periods were associated with smaller phase delay shifts and longer periods were associated with larger phase delay shifts (r = -.62, p < 0.001).

Conclusion: These data suggest that longer circadian periods, characteristic of White young adults, may facilitate adaptation to flying west or working night shifts more quickly than having shorter circadian periods, which are characteristic of Black young adults. By contrast, the shorter circadian periods of Blacks may protect these young adults from circadian misalignment after a typical weekend delay of sleep.

Support (If Any): Funded by NIH grant R01NR007677 to CIE.

0130
EVENING BRIGHT LIGHT SUPPRESSES MELATONIN IN PRESCHOOL AGE CHILDREN
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Introduction: Evening light exposure influences human circadian physiology, including suppression of the pineal hormone melatonin and promotion of brain arousal. Although light-induced melatonin suppression has been investigated among adolescents and adults, we know of no published data in early childhood. Therefore, our aim was to quantify the magnitude of melatonin suppression in response to evening bright-light exposure in preschool children.

Methods: Children aged 3-5 years (n = 10; 4.3 ± 1.1y; 8 females) participated in a 7-day protocol. On days 1-5, children followed a stable sleep schedule, verified with actigraphy. On day 6, children entered a dim-light environment (i.e. < 10 lux in the angle of gaze) for 1-h before providing salivary samples every 20-30min from the afternoon until 50min after scheduled bedtime (baseline condition). On day 7, subjects remained in dim-light conditions until 1-h before bedtime, after which they were exposed to a bright-light stimulus for 1-h (1033.8 ± 158.1 lux; light condition) and then re-entered dim-light conditions. Saliva samples were obtained before, during, and after bright-light exposure and were time-anchored to baseline samples. Percent melatonin suppression was computed and salivary melatonin levels (pg/ml) were compared between baseline and light conditions at each time point using paired t-tests (Bonferroni correction for multiple comparisons; alpha = p < 0.008).

Results: Baseline dim-light melatonin onset was 19:47 ± 00:34, which was 39.8 ± 29min before the start of bright-light exposure on day 7. Average melatonin suppression was 87.6 ± 10.0%. Melatonin levels 20min before bright-light exposure were similar between conditions (d = 0.02, p = 0.65); whereas melatonin levels during bright-light exposure were lower at 10min (d = 0.70, p = 0.004), 30min (d = 1.56, p = 0.003), and 50min (d = 1.86, p < 0.001). The melatonin suppression effects between baseline and light conditions persisted 20min (d = 2.07, p < 0.001) and 50min (d = 1.43, p < 0.001) after children returned to dim-light.

Conclusion: Our findings demonstrate that young children are sensitive to the melatonin suppression effects of light in the evening, which persisted after the end of bright-light exposure. Future studies are needed to determine the impact of such light-induced melatonin suppression on sleep timing and bedtime resistance in young children.
well as to examine melatonin suppression in response to evening electronic device exposure.

Support (If Any): Community Funded through the University of Colorado Boulder

0131

UNRESTRICTED USE OF LIGHT-EMITTING TABLET COMPUTERS IN THE EVENING DELAYS SELF-SELECTED BEDTIME AND DISRUPTS CIRCADIAN SIGNALING AND MORNING ALERTNESS

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Introduction: In a previous study, we showed negative effects on sleep latency, circadian rhythms, and morning alertness after five consecutive evenings reading on light-emitting-tablet computers (LE-tablet) compared with reading books. In that study, strict bedtimes were imposed and LE-tablet use was restricted to reading e-books. However in real-world settings people freely choose their bedtimes and computer activities. Here, we carried out a similar study, but did not impose restrictions on bedtimes or LE-tablet activities.

Methods: Prior to the 14-day inpatient study, the 9 healthy participants (3 women, 25.7 ± 3.0y; mean ± SD) maintained 22:00-06:00 sleep schedules for one week. For five consecutive study evenings, participants continuously read printed books or used LE-tablets in dim ambient light (~3lux) beginning at 18:00. At 21:00 participants were instructed they could self-select when to go to bed. Conditions (printed book, LE-tablet) were randomized and counterbalanced, and participants had knowledge of clock-time. Hourly blood samples were collected at baseline, during the fifth night of each condition, and the following night to assess melatonin suppression and phase (DLMO25%). PSG was recorded on those nights, and subjective sleepiness was assessed five times in the hour after awakening (06:00 each morning).

Results: Compared to print nights, on LE-tablet nights participants self-selected later bedtimes [22:03 ± 0.08 vs. 21:32 ± 0.04 (mean ± SEM); p < 0.0001], had suppressed melatonin [54.2% ± 6.4 vs. 9.8% ± 8.0; p = 0.0007], and were less alert in the hour after awakening (p < 0.0001). Circadian phase was later following the LE-tablet condition [20:23 ± 0.22 vs. 19:35 ± 0.20; p = 0.0004]. Total sleep time and sleep latency did not differ between conditions (p > 0.10).

Conclusion: Unrestricted evening LE-tablet use led to selection of later bedtimes, and was associated with suppressed evening melatonin, delayed circadian timing, and reduced morning alertness. These results have implications for understanding the impact of evening exposure to light-emitting devices on sleep and circadian rhythms.

Support (If Any): The study was supported by NIH grant R01HL094654, and was carried out in the Brigham and Women’s Hospital Center for Clinical Investigation, part of Harvard Catalyst (Harvard Clinical and Translational Science Center), supported by NIH Award UL1 TR001102 and financial contributions from the Brigham and Women’s Hospital and from Harvard University and its affiliated academic health care centers; EDC was supported by a fellowship from NIH T32HL007901.

0132

ASSOCIATIONS BETWEEN SLEEP AND CIRCADIAN TIMING WITH MEASURES OF OBESITY, DIET AND EXERCISE AMONG HEALTHY ADULTS

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Introduction: Previous studies have reported that late sleep timing is associated with higher BMI, poorer diet and lower physical activity. However, few studies have included biological markers of circadian timing or matched participants on sleep duration. The goal of this study was to determine the associations between measures of circadian and sleep timing with body mass index, body fat and diet and exercise behaviors among healthy adults.

Methods: Participants included adults aged 18-50 with sleep duration > 6.5 hours who completed 7 days of wrist actigraphy to measure sleep, food diaries to measure caloric intake and dietary patterns and SenseWear arm band monitoring to measure physical activity. DLMO was evaluated in the clinical research unit. Body fat was evaluated using dual axis absorptiometry (DXA). Data were analyzed using correlation and regression analyses controlling for age, sex, sleep duration and sleep efficiency.

Results: Participants included 96 adults (61 F, age 26.8 ± 7.3 years) with an average sleep duration 443.7 (SD = 50.4) minutes. Average DLMO was (22:36 ±1:27) and average BMI and % body fat were in the normal range (24.0 ±4.6 kg/m2, 30.4 ±8.4%). Later timing (sleep onset, offset and DLMO) were not associated with BMI, % body fat, caloric intake or physical activity. Sleep onset time and DLMO were significantly related to fast food intake (p values < .05). Later sleep offset time was associated with fewer servings of vegetables (p < .04). The relationships between timing variables with fast food and vegetable intake were stronger among males than females.

Conclusion: These results suggest that among healthy adults with habitual sleep duration > 6.5 hours, timing of sleep and DLMO is not associated with higher BMI or body fat, caloric intake, or physical activity but remains associated with diet quality, particularly fast food intake.

Support (If Any): 1K23HL109110-01, ULITR000150

0133

THE TIMING OF FOOD INTAKE RELATIVE TO THE ONSET OF MELATONIN PREDICTS BODY FAT PERCENTAGE IN COLLEGE UNDERGRADUATES

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Introduction: Obesity has reached alarming levels throughout the developed world. College-aged individuals, as compared to the general population, have an increased prevalence of weight gain and obesity rates. Eating during the night is a novel risk factor for weight gain, yet it is unknown how the timing of food consumption relative to circadian phase (e.g., dim-light melatonin onset [DLMO]), is associated with body composition. We examined relationships among meal timing, sleep, and DLMO with the percentage of body fat in college undergraduates.

Methods: 78 undergraduates (46 males), ages (mean, range; 19.2y, 18-22y), BMI (23.0kg/m2, 15.9-42.8kg/m2), fat percentage (22.1%, 6.4-55.1%) participated in a month-long protocol. Sleep timing was monitored for 30-days using actigraphy. Meal content and timing were documented for 1-week using a photographic time-stamped cellular...
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phone application (MealLogger™). Circadian phase (n = 41) was determined via salivary DLMO (5pg/ml threshold) during an overnight laboratory stay (< 4lux). Body composition was determined via bioelectrical impedance. Associations were calculated using Pearson correlations.

Results: Average DLMO was at 23:24h (range 20:06-3:36h). There was a significant negative association between the weekly average time of a student’s last meal each day relative to DLMO and a higher percent body fat (r = -0.55, p < 0.001). There were no significant associations between the average clock time of last meal and percent body fat (r = 0.14, p = 0.23), number of meals overall for the 7-day monitoring period and percent body fat (r = 0.11, p = 0.35), average total sleep time per 24h and percent body fat (r = 0.16, p = 0.18), or number of meals after 2000h and BMI (r = -0.1, p = 0.4).

Conclusion: The timing of food relative to circadian phase (assessed using DLMO), and not the clock time of meals or sleep duration, may be an important risk factor for increased body fat during the college years. Experiments investigating the timing of meals should include circadian phase rather than only clock time in their assessments.

Support (If Any): R01HL114088, R01GM105018, P01AG009975, K24HL105664 (EBK), T32HL007901 (AWM) and ULITR001102, and the Harvard Catalyst

0134

FASTING DURING NIGHT SHIFT: A STRATEGY TO REDUCE THE METABOLIC IMPACT OF SHIFT-WORK
Grant C1, Coates A2, Dorrian J1, Kennaway D3, Wittwer G3, Heilbronn L1, Pajcin M4, Della Vedova C5, Gupta C6, Banks S7
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Introduction: Shift-work impairs glucose metabolism and increases the risk for obesity and type 2 diabetes. In rodents, the adverse metabolic effects of simulated shift-work can be reversed by withholding feeding during the ‘nightshift’, when they would normally be asleep. We investigated the effects of night-time eating as compared to night-time fasting on glucose metabolism during simulated shift-work in men.

Methods: Healthy, males were randomly assigned to either a night-time eating (n = 4, 24.5 ± 5.4y, 22.1 ± 1.4kg/m2) or night-time fasting condition (n = 7, 25.6 ± 5.8y, 22.4 ± 1.9kg/m2). The protocol included an 8h night-time baseline sleep, followed by 4 consecutive nights of simulated shift-work (sleep opportunity 10:00h-16:00h each day), and an 8h night-time recovery sleep. Meal timing and composition were strictly controlled throughout the study. During simulated shift-work, meals were consumed at 07:00h, 19:00h and 01:30h (night-time eating condition); or at 07:00h, 09:30h, 14:10h and 19:00h (night-time fasting condition). Energy content was calculated using the Harris Benedict equation with a light/sedentary activity level. Blood samples for glucose and insulin analysis were collected at baseline, and 15, 30, 60, 90 and 120 minutes post-breakfast on days 1 (baseline), day 4 (following simulated shift-work) and day 6 (return to daytime schedule after night-time recovery sleep). Mixed effect ANOVAs were used with fixed effects of conditions, day and time, and their interactions, and a random effect of subject ID on the intercept.

Results: Insulin was elevated across the simulated shift-work in both groups (p < 0.001). Glucose was differentially affected dependent on condition. Compared to baseline, area under the curve (AUC) glucose responses to breakfast following simulated shift-work were increased by 27% in the night-time eating condition. Whereas in the night-time fasting condition, the increase was only 12%. After returning to a day work/night sleep schedule, glucose AUC responses to breakfast increased by 69% from baseline in the night-time eating condition. While in the night-time fasting condition the increase was only 2%.

Conclusion: Our preliminary data suggests that night-time eating compared to night-time fasting, impairs glucose metabolism in response to a standard breakfast. In the night-time fasting condition the increased insulin stabilized glucose levels; however night-time eating resulted in elevated glucose levels despite increased insulin. Thus, altering meal timing, and reducing the amount of food consumed on night-shift could be an intervention to reduce the burden of metabolic disease in shift-workers.

0135

DINNER TIMING INTERACTS WITH MTNR1B SNP TO INFLUENCE GLUCOSE TOLERANCE IN NATURAL LATE EATERS
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Introduction: Glucose metabolism exhibits diurnal variation, and eating in misalignment with the biological clock is associated with increased risk for diabetes. We identified the novel type 2 diabetes (T2D) risk gene MTNR1B that encodes the high-affinity melatonin receptor 1B. This common MTNR1B risk SNP (rs10830963; MAF: 30%) confers one of the strongest effects on decreased oral disposition index out of over 80 common variants identified for T2D.

Aims: To test the hypothesis that: a) chronic concurrence of meal timing with elevated endogenous melatonin concentrations associates with adverse glycemic changes in natural late-night eaters including decreased glucose tolerance; and b) that this association is stronger in MTNR1B risk allele carriers versus non-carriers.

Methods: A randomized, cross-over study was carried out in 20 carriers (GG) and 20 non-carriers (CC) of the MTNR1B risk variant who were naturally late-eating, overweight women (BMI: 28.43 ± 4.04 kg/m2). Each subject was tested under two dinner conditions for 1 day each in a randomized cross-over design: a) Late-Eating (LE) with dinner 1 hour before their usual bed time (“Spanish-schedule”); or b) Early-Eating (EE), with dinner 4 hours before bed time (“North-European-schedule”). A 2h Glucose Tolerance Test (2hGTT) was performed after each dinner condition.

Results: In carriers of the risk allele G, late dinner impaired glucose tolerance relative to the early dinner (EE: AUC = 270.9 ± 30 mg/dlxh and LE: AUC = 292.2 ± 33.8 mg/dlxh, P = 0.006). Differences were significant at 60, 90 and 120 minutes after dinner (paired t-test, P < 0.05). However, among non-risk carriers (CC) the dinner timing condition (early vs. late) did not differentially affect postprandial glucose tolerance (EE: AUC = 268.2 ± 38.2 and LE: AUC = 277.3 ± 30.5, P = 0.122). As expected, endogenous melatonin levels were higher in the LE than in the EE condition (20.89 ± 8.07 Pg/mL versus 10.29 ± 3.99 Pg/mL) independent of genotype.

Conclusion: Dinner timing interacts with MTNR1B risk SNP to influence glucose tolerance in natural late-eaters recruited from the Spanish study population.
A POSSIBLE NON-PHOTIC PRIMARY ZEITGEBER SEASONALLY ENTRAINING DUAL-PHASING IN THE ARABIAN ORYX

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Introduction: The Arabian oryx, a large mammal, successfully inhabits the Arabian deserts where climate undergoes extreme shifts seasonally. It is known the oryx employ multiple physiological and behavioural adaptions in order to survive; however, it is currently unknown whether such harsh conditions have led to the evolution of any neural adaptations within the sleep system neuroanatomy or have any effects on inactivity and sleep patterns.

Methods: Sleep/inactivity throughout the summer and winter season was examined by fine-grain actigraphy in free-roaming oryx (n = 9). Sleep neuroanatomy was examined by immunohistochemistry of the cholinergic, catecholaminergic, serotonergic and orexinergic systems within the basal forebrain, hypothalamus and pons (n = 3). Inactivity/sleep variations and core body temperature (Tc) were determined in relation to ambient temperature and light levels in the Mahazat as-Sayd Protected Area, Saudi Arabia.

Results: The sleep system neuroanatomy follows the typical mammalian organization with only minor differences. The oryx show typical diurnal Artiodactyl patterns of inactivity/sleep during winter with the major sleep/inactivity occurring pre-dawn. In contrast, during the hotter summer month the oryx shift to a crepuscular activity pattern with the major sleep/inactive bouts now split between pre-dawn hours (coldest part of night) and the afternoon (hottest part of day). No seasonal differences were observed for daily rhythm of Tc alongside sleep/inactivity patterns.

Conclusion: Through dual-phasing between seasons, the oryx appear able to employ standard sleep thermoregulatory processes to circumvent major Tc increases. This possibly represents a novel thermoregulatory mechanism considering the sleep neuroanatomy appears typical and unspecialized in contrast to the unique sleep/inactivity patterns. The results present a desynchronization of circadian rhythms (Tc, sleep timing and daily activity patterns) during summer and it seems indicative of more than one primary zeitgeber (light & temperature). The summer-based natural desynchronization of circadian rhythms and seasonal dual-phasing seen in free-roaming Arabian oryx appears novel and unreported thus far.

Support (If Any): Funding by the National Plan for Science, Technology and Innovation, Deanship of Scientific Research at the King Saud University, Vice Deanship of Research Chairs, the South African National Research Foundation (NRF) and German Academic Exchange Service (DAAD) and lastly the South Africa Research Chair for Mammal Behavioural Ecology.

0137 IMPACT OF WEEKEND EXPOSURE TO THE MODERN VERSUS NATURAL LIGHT-DARK CYCLE ON CIRCADIAN TIMING IN HUMANS

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Introduction: Living in modern society is associated with reduced exposure to sunlight and increased exposure to electrical lighting, the latter especially after sunset. This pattern of light exposure, as well as later sleep timing on the weekend, has been shown to delay the timing of the circadian clock. Late sleep timing is associated with a number of poor health outcomes. We have previously shown that after one week of exposure to only natural light, circadian timing advances by ~2h. However, the time course required to achieve this change is unknown. Therefore, we tested the impact of a weekend with exposure to only natural light on the human circadian clock as compared to a typical weekend in the modern environment.

Methods: Eleven physically active participants (6 female) aged 25.3 ± 6.8y (± SD) completed the 8 day study. The study consisted of 3 days of wrist actigraphy and light exposure monitoring in the subject’s habitual work-school-home environment, a 24h in-laboratory dim-light melatonin assessment and then either 2 days camping in the Rocky Mountains of Colorado with no exposure to electrical lighting (n = 8), or continued exposure to the habitual modern lighting environment on the weekend, immediately followed by a repeated 24h in-laboratory dim-light melatonin assessment. Results: After the weekend of exposure to the natural light-dark cycle, the melatonin rhythm was shifted earlier (e.g., melatonin onset was ~1.37h earlier; p < 0.05) whereas after the weekend of living in the modern environment the circadian melatonin rhythm was delayed (p < 0.05, main effect of condition).

Conclusion: Two days of natural light exposure achieved 69% of the phase-shifting response we previously reported after a week of natural light exposure suggesting a fast resetting response to only natural light exposure. These findings have implications for preventing delays in circadian timing in modern society.

0138 EFFECTS OF LIGHT EXPOSURE ON SLEEP AND CIRCADIAN RHYTHMS IN THE REAL WORLD: A MODELLING APPROACH

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Introduction: Preferred sleep timing changes across the human lifespan and differs between individuals. This can be particularly problematic for adolescents/young adults, whose preferred sleep timing often conflicts with the social constraints of school/work. This has led to the concept of social jetlag. While it is believed that preferred sleep-timing is underpinned by physiology, recent work has suggested that individual differences are exacerbated by modern lifestyles that have resulted in changes to our light environment. There have been few attempts to simulate sleep timing using real world light profiles: a simulation approach can explore the relative importance of physiology versus light exposure in a way that is not practical in human studies.

Methods: We consider over 750 days of light data collected using a Cambridge Neurotechnology AWL Actiwatch from 21 adolescents (14M, 7F; ages 18 to 20) following their normal daily schedules. These data include 6 weeks of recordings (3 spring, 3 winter) in Guildford,
Surrey, UK. By combining the light data with the Phillips-Robinson mathematical model we predict sleep-wake timing. Predicted sleep timings are then compared with timings derived from Actiwatches/sleep diaries.

Results: We find considerable intra- and inter-individual and seasonal differences in light exposure. In the winter, light levels of above 1000 (500) lux were recorded for an average of only 15 (40) minutes a day, increasing to 75 (125) minutes a day during the spring. Comparisons between model predictions and data on sleep timing suggested days where some participants were primarily driven by zeitgebers other than light, such as social cues.

Conclusion: Using light data with mathematical models to predict ‘physiological’ sleep timing and comparing with timings derived from diaries/actigraphy could indicate cases where modification of self-selected light exposure may be effective in managing sleep regulation problems.

Support (If Any): Royal Society Wolfson Research Merit Award (DJD), Surrey Sleep Research Centre.

0139

BRIGHT LIGHT AT NIGHT CAN SHIFT THE CIRCADIAN RHYTHM OF DISTAL BODY TEMPERATURE DURING SIMULATED NIGHT SHIFT

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Introduction: Body temperature is known to vary with circadian phase and is influenced by central and distal mechanisms. Prior studies have shown that bright light exposure at night can shift the core body temperature (CBT) rhythm. The aim of the present study was to test whether this was also the case for skin temperature rhythms during a simulated night shift protocol.

Methods: Eighteen healthy subjects (23.7 ± 4.2 years old; 2 women) were enrolled in a 6-day simulated night shift experiment. They were assigned to either a control or bright light group (n = 9/group). Using rectal probes and skin temperature sensors, CBT (n = 9/group) and skin temperature (control: n = 9; bright light: n = 4), respectively, were continuously recorded from each participant kept in constant posture over 24 h under a baseline day-oriented schedule and after 3 days under a night-oriented schedule. In the bright light group, participants were exposed to 10,000 lux for 8 h at night, while the control group remained in dim light conditions (< 10 lux).

Results: We found significant circadian rhythms for CBT and skin temperature at baseline for both groups (P < 0.0001 for all). The time of CBT minimum occurred at 5:07 ± 0:15 and 4:40 ± 0:13 in the control and bright light groups, respectively, while the time of skin temperature maximum preceded it by few hours (e.g. hands: 2:52 ± 0:02 and 3:12 ± 0:02, respectively). In the control group, there was no phase shift for CBT and skin temperature rhythms following night shift, while these rhythms were significantly phase delayed by about 9 h (P < 0.01) in response to bright light exposure.

Conclusion: The present study shows that light effects lead to a desynchronization of core and skin temperature rhythms and that both rhythms can be shifted in response to bright light exposure at night. These results have potential applications for the determination of circadian phase in field conditions.

Support (If Any): Canadian Institutes of Health Research

0140

AMBIENT LIGHT EXPOSURE IS POSITIVELY ASSOCIATED WITH CALMNESS IN MENTAL HEALTH CARE PROVIDERS

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Introduction: Lower levels of ambient light exposure are associated with higher levels of depression, lower quality of life, and decreased social and emotional functioning. Light exposure appears to improve worker productivity, potentially via an increase in mood and alertness. In addition, higher levels of happiness are positively correlated with job performance. This study examined light exposure in mental health care providers, a group of individuals who rely upon their own emotional health to perform their job well.

Methods: We recruited 18 mental health care providers (56% Female) between the ages of 21 and 65 from University of Arizona Medical Center. Mean age was 33.23 years (SD = 9.36). Subjects were instructed to wear Actiwatches with light monitors for 7 days and complete Visual Analogue Scales to rate the intensity of 7 separate emotions (calm, energetic, fatigued, stressed, optimistic, interested, irritable) at the end of their work day. Mixed linear models were employed to examine daily relationships between ambient light exposure (mean and minutes > 1000 lux) and each of the 7 emotions.

Results: Mental health care providers experienced higher levels of calmness at the end of their work day when they were exposed to more overall light (B = 0.032, SE = 0.0006, p < 0.05) and more minutes of intense ambient light (B = 0.048, SE = 0.006, p < 0.05). There was also a trend indicating that exposure to intense light was associated with experiencing more energy at the end of the work day (B = 0.092, SE = 0.006, p < 0.10). Descriptive analyses suggest that ambient light may have a greater impact on positive versus negative emotions in mental health providers.

Conclusion: The results from this study suggest that mental health providers may emotionally benefit from increased exposure to ambient light. They also suggest a potential role for both industrial hygiene and occupational health interventions to increase exposure to ambient light. Calmness has been described as a particularly important emotion for successful therapy in the aftermath of crisis. Future research may examine whether light exposure improves patient mental health outcomes and productivity.

Support (If Any): University of Arizona Honor’s College

0141

A SINGLE DOSE OF ALCOHOL DOES NOT CONSISTENTLY CHANGE CIRCADIAN PHASE SHIFTS TO BRIGHT LIGHT IN HUMANS

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Introduction: Central circadian timing influences mental and physical health. Research in nocturnal rodents has demonstrated that single doses of alcohol can alter circadian phase shifts to light, presumably by altering GABA and glutamate within the central circadian pacemaker. Here, for the first time, we examined the effects of a single dose of alcohol on circadian phase advances and phase delays to light in humans.

Methods: Two 23-day within-subjects counterbalanced design studies were conducted. Both consisted of 6 days of fixed baseline sleep to stabilize circadian timing, a 2-day laboratory session, a 6-day break, and a repeat 6 days of fixed sleep and 2-day laboratory session. In the Phase Advance study (n = 10 healthy light drinkers), the laboratory sessions consisted of a baseline dim light phase assessment, 5-hour sleep episode, alcohol (0.6g/kg) or placebo, 2-hour morning bright light pulse,
and next day final phase assessment. In the Phase Delay study (n = 14 healthy light drinkers), the laboratory sessions consisted of a baseline phase assessment, alcohol (0.8g/kg) or placebo, 2-hour late night bright light pulse, 8-hour sleep episode and next day final phase assessment. 

Results: In the Phase Advance study, 2 subjects showed larger phase advances in the dim light melatonin onset (DLMO) to light with alcohol, whereas 8 subjects showed smaller phase advances in DLMO with alcohol (interaction p = 0.74). In the Phase Delay study, 7 subjects showed larger phase delays in DLMO to light with alcohol, whereas 7 subjects showed smaller phase delays in DLMO to light with alcohol (interaction p = 0.46).

Conclusion: No consistent effects of a single dose of alcohol (versus placebo) on circadian phase shifts to bright light were observed. It is still possible that multiple doses of alcohol may alter phase shifts to light in humans. We are now studying phase shifts to light in habitual light and heavy drinkers.

Support (If Any): R21 AA021762 to HJB.

0142
DAYLIGHT EXPOSURE AND THE RELATION TO SLEEP AND DEPRESSIVE SYMPTOMS
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Introduction: Daylight exposure is essential for regulation of circadian rhythms, mood and sleep.

Methods: To investigate this on an epidemiological level, the Swedish Longitudinal Occupational Survey of Health (SLOSH) of 2012 was analysed. The database included workers studied 2012 (N = 7324) and 2014 (N = 15359).

Results: On workdays outdoor daylight exposure was ≤ 1 h in 62 % of indoor workers, exposure being longer in males and increasing with age. Low exposures decreased on free days (≤ 1 h = 18%). At work, 86% worked within 5 m of a window. Those having problems with lowered mood, fatigue and lack of energy in autumn/winter amounted to 50% and 22% reported marked/severe problems. A multivariate analysis showed increased sleep problems were related (p < 0.001) to lack of light exposure in connection to work (and leisure) and distance to the window. The relationship was most pronounced for difficulties to initiate sleep, repeated awakenings, not being restored and mental and physical exhaustion. Light exposure was associated with an earlier onset of sleep (p < 0.001) as well as an earlier time of rising (p < 0.001). Self-rated health was lowest in the group with low daily exposures (< 30 min). A regression analysis demonstrated that an increase of ½ hour of natural daily exposure seems protective and reduces lowered mood in winter by 33%. In a longitudinal analysis including subjects participating in both studies (N = 4470) new cases (N = 340) of moderate depression in 2014 were predicted by combined low daylight exposure in connection to work and days off (p = 0.038) and exercise (p < 0.001) in 2012. However, when controlling for age the light effect was reduced.

Conclusion: In summary, data indicates that lowered exposure to natural daylight among in-door workers negatively affects sleep, possible daytime functioning, and could be involved in the development of depressive states.

0143
BLUE WAVELENGTH LIGHT THERAPY REDUCES DAYTIME SLEEPINESS FOLLOWING MILD TRAUMATIC BRAIN INJURY
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Introduction: Excessive daytime sleepiness and fatigue are some of the most common symptoms of mild traumatic brain injury (mTBI), affecting approximately 50% of patients with recent concussions. Emerging evidence suggests that exposure to blue wavelength light in the morning hours may provide an effective treatment for fatigue problems in many mTBI patients, but it is unclear whether this also affects self-reported sleepiness. Here we tested the effectiveness of a six-week regimen of morning blue wavelength light therapy on daytime sleepiness in individuals with mTBI.

Methods: Thirty participants (15 female; aged 18-45 years) with a history of mTBI during the previous 18 months completed the Epworth Sleepiness Scale (ESS) and several other questionnaires at baseline and again following 6 consecutive weeks of 30-minute daily treatment with either a blue-wavelength (active; n = 15) or amber-wavelength (placebo; n = 15) light device at home, within 2 hours of awakening each morning.

Results: Mixed ANOVA, with covariation for the number of days of light used, presence of baseline sleep disturbance, and total sleep obtained on the baseline night, showed a significant reduction in ESS scores for the blue compared to the amber light group (p = .04). Furthermore, 86% of those exposed to blue light showed a decline in sleepiness whereas only 40% of those exposed to amber light showed a decline (p = .008).

Conclusion: Among individuals with mTBI, six weeks of daily treatment with morning blue wavelength light led to a significant improvement in daytime sleepiness relative to placebo. Because morning exposure to blue light suppresses melatonin and phase advances the circadian rhythm, it is likely that these effects are due to improvement in sleep and daytime alertness due to entrainment of the circadian system. These preliminary findings suggest that blue wavelength light therapy may be an effective treatment for reducing sleepiness in patients with mTBI.

0144
BLUE WAVELENGTH LIGHT THERAPY IMPROVES BALANCE FOLLOWING MILD TRAUMATIC BRAIN INJURY
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Introduction: Individuals with mild traumatic brain injury (mTBI) often complain of several common cognitive and psychomotor symptoms, including persistent difficulties with balance and stance stability. Furthermore, up to 50% of people with an mTBI report sleep problems and fatigue. Blue wavelength light therapy has previously shown to improve fatigue in mTBI patients. We hypothesized that blue light exposure therapy may re-entrain the circadian rhythm and improve overall sleep quality, potentially enhancing brain repair and therefore be associated with improvement in balance problems following mTBI.

Methods: Twenty-eight individuals (15 female; aged 18-48 years) who experienced an mTBI during the preceding 18 months underwent balance and stance-stability (BSS) testing while standing on a platform with feet together, eyes open, arms extended, and palms up. In
a double-blind design, participants were randomly assigned to daily morning exposure with a blue-wavelength (active; n = 14) or amber-wavelength (placebo; n = 14) light device for 6 weeks at home (30-minutes daily, prior to 11:00am). Following treatment, participants again returned to the lab to undergo the BSS test.

Results: After 6 weeks of treatment, the active blue light group decreased body sway movement by 9.89% while the amber placebo light placebo group increased by 23.98%, F(1,25) = 4.31, p = .048. Moreover, the improvement in balance/stability was found to be significantly correlated with the change in subjective sleepiness from baseline to post-treatment, but only among those in the active light group (r = .58, p = .03), but not for the placebo light condition (r = -.31, p = .31).

Conclusion: Daily morning exposure to blue light for 6 weeks led to an improvement in balance and stance stability compared to a matched light placebo and this improvement corresponded directly to the reduction in daytime sleepiness. These preliminary findings suggest that morning blue light therapy may be an effective treatment for balance problems following mTBI by improving sleep and thereby enhancing potential brain repair.

0145
SLEEP-RELATED DIFFERENCES IN SHIFTWORK AND DAYTIME WORK ACROSS TWO SEASONS
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Introduction: Light is important for the regulation of circadian rhythms, however, light is known about seasonal differences related to daylight exposure. The aim of the study was to test how daylight exposure influences how shift workers and daytime workers adapt to working hours and how it affects sleep and health. We saw a unique opportunity to examine the scarcity of light in the northern town of Kiruna, above the Arctic Circle (latitude 67°86’), with little daylight during winter months.

Methods: 1800 miners working both above and underground were invited to participate in a questionnaire study in winter (N = 1291) and summer (N = 909).

Results: The results showed that shift workers (3-shift and 2-shift) but not daytime workers consistently followed the same sleep patterns (sleep timing and sleep length) regardless of season. Daytime workers but not shift workers showed an earlier time of rising on days off in summer which was mainly explained by delayed sleep onset (winter 22:37 hr ± 0.49; summer 23:26 hr ± 0.59; p < 0.001). Both shift workers and daytime workers reported sleep in winter more often being interrupted by awakenings (p < 0.016), containing more premature awakenings and workers felt less refreshed by sleep (p < 0.001). More sleepiness, fatigue and lack of energy during work were reported in winter (p < 0.01).

Conclusion: Data demonstrate that shift workers had a more stable annual sleep pattern than daytime workers and sleep quality was lowered in winter independent of work hours. Most likely the daylight influence in summer support sleep quality and daytime alertness that compensates for sleep loss for daytime workers. A distinctive feature is the early wake-up time in connection to summer which causes a shortening of sleep.

Support (If Any): FORTE 2011-0488

0146
THE ASSOCIATION OF CHRONOTYPE AND FOOD INTAKE AFTER SELECTIVE SLEEP RESTRICTION
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Introduction: Evening chronotypes have often been linked to increased food and energy intake (EI), and to higher body mass index (BMI). The objective of the present study was to investigate the impact of partial sleep deprivation (PSD) in evening and morning chronotypes on EI during the following days.

Methods: We first measured BMI and chronotype (Morningness-Eveningness Questionnaire-MEQ) of 17 subjects (11men-6 women; 18-33y). Then, ad libitum EI for 36h was measured after a “normal” night of sleep (NS), and two 50% sleep restriction nights: one with a late sleep onset (LS) and one with an early awakening (EA). For each PSD condition, the difference in EI (Eld) was calculated (LS-NS and EA-NS). Pearson product moment correlations between Eld, MEQ score and BMI were computed in each PSD condition. Subjects were then separated in two groups based on their MEQ scores (evening and morning chronotypes), and t-tests were calculated between groups to compare Eld in each PSD condition.

Results: For LS, no relationship was found between Eld and the MEQ score (r = .264, p = .306) and BMI (r = -.044, p = .867). For EA, Eld was negatively associated with MEQ score (lower score means greater evening chronotype) (r = -.625, p < 0.01), but not with BMI (r = .077, p = .768). A significant difference was found in Eld between morning and evening chronotypes in the EA condition (mean Eld evening type = 373.23 kcal ± 295.66; mean Eld morning type = -54.78 kcal ± 467.66; t(15) = 3.589, p < 0.01), but not in the LS condition (mean Eld evening type = 513.07kcal ± 711.53; mean Eld morning type = 433.22kcal ± 937.09; t(15) = .196, p = .847).

Conclusion: These results suggest that for the same amount of sleep restriction, the timing of the sleep deprivation may have an important impact on EI, especially in those with an evening chronotype.

0147
MEAL AND SLEEP TIMING INTERACT TO AFFECT TOTAL CALORIC INTAKE
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Introduction: Sleep and meal timing may influence cardio-metabolic health, although it is unclear if this occurs independent of sleep duration. Our goal was to evaluate the impact of meal and sleep timing on food intake regulation.

Methods: Participants were tested as inpatients under controlled sleep and feeding conditions differing in the timing of sleep and meals: either normal (Ns: 0000-0800 h) or late sleep (Ls: 0330-1130 h) and normal (Nm: 1, 5, 11, 12.5 h after awakening) or late meals (Lm: 4.5, 8.5, 14.5, 16 h after awakening). Participants underwent 4 separate intervention periods in randomized, crossover design: Ns/Nm, Ns/Lm, Ls/Nm, Ls/Lm, with a 2-3 week washout period between phases. Participants were given $25 to freely purchase foods on day 5, but were restricted to eat at their scheduled meal and snack times. All foods were dispensed by research personnel, weighed pre and post consumption, and analyzed using University of Minnesota Nutrition Data System for Research (NDSR). Data were analyzed using linear mixed-model analyses with energy and macronutrients as outcomes and sleep, meal, and sleep-meal interaction as independent variables and sex and weight as covariate.
Results: Participants were tested as inpatients under controlled sleep and feeding conditions differing in the timing of sleep and meals: either normal (Ns: 0000-0800 h) or late sleep (Ls: 0330-1130 h) and normal (Nm: 1, 5, 11, 12.5 h after awakening) or late meals (Lm: 4.5, 8.5, 14.5, 16 h after awakening). Participants underwent 4 separate intervention periods in randomized, crossover design: Ns/Nm, Ns/Lm, Ls/Nm, Ls/Lm, with a 2-3 week washout period between phases. Participants were given $25 to freely purchase foods on day 5, but were restricted to eat at their scheduled meal and snack times. All foods were dispensed by research personnel, weighed pre and post consumption, and analyzed using University of Minnesota Nutrition Data System for Research (NDSR). Data were analyzed using linear mixed-model analyses with energy and macronutrients as outcomes and sleep, meal, and sleep-by-meal interaction as independent variables and sex and weight as covariate.

Conclusion: Our data suggest that sleep and meal times influence food intake and may have implications for metabolic complications and obesity risk.

Support (If Any): National Institutes of Health (R56HL119945)

0148 DECREASED INSULIN SENSITIVITY IN EVENING-TYPES WHO ARE CARRIERS OF THE RISK ALLELE AT MTNR1B RS10830963 RELATIVE TO NON-CARRIERS IN TWO INDEPENDENT POPULATIONS: MEDITERRANEAN AND NORTH AMERICAN

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Introduction: MTNR1B is a type 2 diabetes (T2D) risk gene encoding the high-affinity melatonin receptor 1B. The mechanism underlying the association between genetic variation in MTNR1B and increased diabetes risk is unknown and the path to clinical translation is therefore unclear. Here we test the hypothesis that evening chronotype interacts with the MTNR1B diabetes risk variant to worsen the impact of the MTNR1B risk allele on glucose-related traits.

Methods: We tested for interactions between MTNR1B rs10830963 and evening chronotype on four glucose-related traits in two independent populations of European ancestry: a Mediterranean from Spain (1,204 subjects; 80% women) age: 40(12) years; BMI = 31(5) kg/m2 and a North American from the USA 3,428 subjects; 80% women; age: 60(8) years; BMI: 28(5) kg/m2, In addition, a meta-analysis of both cohorts was performed.

Results: Eveningness was associated with increased HOMA-IR in the North American population (P = 0.03) but not in the Mediterranean Population. We identified a novel interaction between the MTNR1B diabetes risk variant and chronotype on HOMA-IR. Specifically, the risk allele was associated with elevated HOMA-IR in evening type participants (beta (SE) = 0.313 (0.190) units/allele) but not in morning type participants (beta (SE) = -0.0225 (0.180) units/allele), and this effect was consistent in both populations (meta-analysis P interaction = 0.007).

Conclusion: This work adds new knowledge around the impact of melatonin receptor variation on glucose tolerance and can aid in the design of novel strategies in the prevention and treatment of T2D, especially in night eaters, shift workers, and MTNR1B risk allele carriers.

Support (If Any): This study was supported by grants from Spanish Government of Economy and Competitiveness (SAF2014-52480-R), and European Regional Development Fund (ERDF) to Marta Garaulet, and NIH grants R21DK089378, R01 DK102696, R01 DK999512 and R01 HL118601 to Frank AJL Scheer, and NIH grants R21DK089378 and R01 DK102696 to Richa Saxena, National Heart, Lung, and Blood Institute grants HL-54776, National Institute of Diabetes and Digestive and Kidney Diseases, Grant Number DK075030 and by contracts 53-K06-5-10 and 58-1950-9-001 from the US Department of Agriculture Research to José M Ordovás.

0149 HUMAN ADIPOSE TISSUE EXPRESSES INTRINSIC CIRCADIAN RHYTHM IN INSULIN SENSITIVITY

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Introduction: In humans, insulin sensitivity varies with the time of day with decreased values in the evening. Mechanism(s) responsible for diurnal variation in insulin-sensitivity are not clear. We investigated whether human adipose tissue (AT) expresses intrinsic circadian rhythms in insulin sensitivity that could contribute to this phenomenon.

Methods: Subcutaneous and visceral AT biopsies were obtained from extreme-obese subjects (BMI: 41.8 ± 6.3 kg/m2; 46 ± 11y), including 9 diabetic and 9 non-diabetic, during gastric-bypass surgery. To assess the rhythm in insulin signaling, AKT phosphorylation was determined every 4h across 24h in vitro in response to insulin concentrations (0, 1, 10 and 100 nM).

Results: Data revealed that subcutaneous AT exhibited robust circadian rhythms in insulin signaling (p < 0.00001) with no difference in rhythmicity between diabetic and non-diabetic subjects. Insulin sensitivity reached its maximum (acrophase) around noon, being 54% higher than during midnight (p = 0.009). The amplitude of the rhythm was negatively correlated with in vivo bed time (p = 0.020; i.e., smaller amplitude with later bedtime) and positively with in vivo sleep duration (p = 0.023; i.e., larger amplitude with longer self-reported sleep duration). No circadian rhythms were detected in visceral AT (p = 0.643).

Conclusion: Here we demonstrate the relevance of the “time of the day” in how sensitive adipose tissue is to the effects of insulin. Subcutaneous AT shows an endogenous circadian rhythm in insulin sensitivity that could provide an underlying mechanism of the daily rhythm in systemic insulin sensitivity.

Support (If Any): This study was supported by grants from Spanish Government of Economy and Competitiveness (SAF2014-52480-R), and European Regional Development Fund (ERDF) to Marta Garaulet, and SAF2011-22812 to Olga Martinez-Augustin, Seneca Foundation from the Government of Murcia (15123/PI/10) to Marta Garaulet, and NIH grants R01 DK999512 and R01 HL118601 to Frank AJL Scheer.
A150

**GLUCOSE TOLERANCE IN NOCTURNAL ANIMALS EXPERIENCING LIGHT-DARK STIMULUS PATTERNS LIKE THOSE MEASURED FROM DAYSHIFT AND ROTATING SHIFT WORKERS**

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**Introduction:** Light-induced circadian disruption experienced by rotating shift workers has been associated with increased risk for Type II diabetes.

**Methods:** Using light-dark exposures data collected from nurses, we investigated how glucose tolerance in mice was affected by exposure to patterns simulating dayshift (12L:12D) and rotating-shift workers working one night per week (RSS1) and three nights per week (RSS3). An oral glucose tolerance test was administered 3 h before the start of the dark phase on the same day of the third week of each session. Circadian disruption was quantified for mice and with phasor magnitudes based upon mouse-specific 24-h light-dark patterns and 24-h activity-rest wheel-running patterns.

**Results:** Glucose levels were significantly lower 30 min after glucose administration than 15 min after glucose administration when animals had experienced the 12L:12D pattern (t = 5.0; p = 0.001), but not when they had experienced the RSS1 or the RSS3 lighting patterns (t = 0.3; p = 0.8 and t = 0.6; p = 0.6). Glucose area-under-the-curve after animals experienced the 12L:12D lighting pattern was significantly less than after animals experienced the RSS1 and the RSS3 lighting patterns (t = 13.8; p < 0.0001 and t = 11.8; p < 0.0001, respectively). Phasor magnitudes measured when animals experienced the 12L:12D lighting pattern was significantly greater than after animals experienced the RSS1 and the RSS3 lighting patterns (t = 20.6; p < 0.0001, t = 24.7; p < 0.0001, respectively). Glucose tolerance in mice was directly related to phasor magnitude.

**Conclusion:** The present study showed that even one night of shift work reduces glucose tolerance. Human circadian disruption was directly related to glucose tolerance in mice, a nocturnal animal model for onset of Type II diabetes.

**Support (If Any):** The Swedish Energy Agency and Office of Naval Research

A151

**SLEEP AND MEAL TIME MISALIGNMENT ALTERS INTRINSIC FUNCTIONAL CONNECTIVITY: A PILOT RESTING STATE STUDY**

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**Introduction:** Delayed sleep and meal timing promote metabolic dysregulation and obesity. Altered coordination of sleep and eating may impact food reward valuation in the brain; yet the independent and collective contribution of sleep and meal times remains unknown. This pilot, randomized crossover study manipulates both sleep and meal times while preserving normal sleep duration (8 h time in bed for 5 nights) to test how misalignment of sleeping and eating behaviors affects intrinsic functional connectivity (iFC) across reward and interoception-related brain circuitry.

**Methods:** Resting state functional MRI scans (3T Siemens Skyra; TR = 2.55s; 2 x ~5-minute runs) were obtained for 4 participants (3 males; 25.3 ± 4.6 years) who completed all 4 phases (normal sleep/normal meal; late sleep/normal meal; normal sleep/late meal; late sleep/late meal). Normal meal times were 1, 5, 11, and 12.5 h after awakening and late meal times were 4.5, 8.5, 14.5 and 16 h after awakening.

**Results:** These pilot findings provide support that misalignment of sleep and food timing alters iFC in regions relevant to food reward and interoception, motivating examination in a larger sample.

**Support (If Any):** NIH Grant R56HL119945

0152

**PHASE ANGLE IS ASSOCIATED WITH GLUCOSE METABOLISM AMONG HEALTHY, OVERWEIGHT ADULTS**

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**Introduction:** Circadian misalignment has been associated with insulin resistance in human and animal experimental protocols. Phase angle between dim light melatonin onset (DLMO) and sleep has been evaluated as a measure of circadian alignment, and has been associated with depressed mood and caloric intake. The goal of this study was to test associations between phase angle and metabolic function among healthy overweight adults.

**Methods:** Participants included healthy overweight and obese adults (BMI > 25) aged 18-50 with sleep duration > 6.5 hours who completed 7 days of wrist actigraphy and a fasting blood draw to measure glucose and insulin. Homeostatic model of assessment- insulin resistance (HOMA-IR), was calculated from the fasting glucose and insulin values. DLMO was calculated as duration between DLMO and sleep onset. BMI was calculated from measured height and weight and body fat was evaluated using dual axis absorptiometry (DXA). Data were analyzed using correlation and regression analyses controlling for age and sex.

**Results:** Participants included 18 adults (7 F, age 29.6 ± 6.9 years) with an average sleep duration was 444 ± 46 minutes). Average DLMO was 22:03 ± 1:45 and average phase angle was 2:14 ± 0:47. Phase angle was significantly associated with fasting glucose (r = -0.43, p = .08) and % body fat (r = -0.45, p = .06). Phase angle was not associated with sleep duration, sleep timing or DLMO. In multivariable models, shorter phase angle was associated with higher insulin (B(SE) = -5.2 (1.9), p = .018) and HOMA (B(SE) = -1.3 (0.45), p = .015). Phase angle was not associated with fasting glucose.

**Conclusion:** These data demonstrate that phase angle, even among healthy overweight adults with at least 6.5 hours sleep duration, is associated with metabolic measures.

**Support (If Any):** 1K23HL099110-01, ULITR000150
ADULT HEIGHT IS REDUCED IN NON-24-HOUR SLEEP-WAKE RHYTHM DISORDER PATIENTS COMPARED TO HEALTHY CONTROLS
Xiao C, Lockley SW, Cho Y, Heitman A, Licamele L, Dressman MM

Introduction: Previous studies reported that blind people have reduced height and that those with no perception of light (NPL) are shorter than those with light perception (LP). No previous study examined whether height is related to non-24-hour rhythms, or Non-24-Hour Sleep-Wake Rhythm Disorder (Non-24).

Methods: Height was assessed in three populations: Non-24 NPL patients (n = 110), Entrained NPL patients (n = 54), and matched sighted controls (n = 324). Demographic data including height, gender, age, and race for US NPL patients was collected during screening of the tasimelteon SET Study. Non-24-hour rhythms were defined as a circa period > 24.10 h (95% CI > 24.0), assessed from urinary 6-sulfatoxymelatonin. Control data were sampled from the National Health and Nutritional Examination Survey (2013-2014) matched for age, gender, and race. Difference of least squares means was analyzed controlling for gender, race, age, and significant interactions.

Results: Non-24 NPL patients were shorter than controls (2.6cm, p < 0.0001). There was no height difference between entrained NPL patients and controls (0.03cm, p = 0.98). We also examined whether age of loss of LP was associated with height. Adults with Non-24 who lost LP prior to the age of the average peak growth rate (PGR; 12 years for girls, 14 for boys), were shorter than those with Non-24 who lost LP later (3.1cm, p = 0.032). For patients who lost LP before PGR, those with Non-24 were shorter than those with entrained rhythms (3.6cm, p = 0.042). There was no difference between Non-24 patients who lost LP after PGR and entrained people with NPL (regardless of age of LP loss).

Conclusion: Totally blind adults with Non-24 were shorter when controls and, if they lost LP prior to PGR, they were shorter than those who lost LP after PGR. These data suggest that having non-entrained circadian rhythms may limit the growth potential of adolescents.

Support (If Any): Vanda Pharmaceuticals Inc.

PLACE OF BIRTH AND HEALTHY SLEEP DURATION:
ANALYSIS OF THE NATIONAL HEALTH INTERVIEW SURVEY (2000-2013)

Introduction: Associations between place of birth and various health outcomes have been explored in recent studies. While sleep disturbance has been related to a number of negative health outcomes, few studies have examined the relationship between place of birth and sleep duration among individuals living in the United States.

Methods: We examined data for 416,152 adult participants in the 2000-2013 National Health Interview Survey (NHIS), who provided self-reported hours of sleep and place of birth. NHIS data emanated from face-to-face interviews with trained interviewers from the U.S. Census Bureau. We explored associations between healthy sleep (7-8hrs.), referenced to unhealthy sleep (8 hrs.), and place of birth among US adults using multivariate logistic regression analysis, adjusting for effects of socio-demographic factors, health risks, and physician-diagnosed medical conditions. We used SPSS 20.0 to conduct descriptive and inferential analyses.

Results: The mean age of the sample was 47.4 ± 0.03 years; 56% were female. Of the respondents, 61.5% reported experiencing healthy sleep, 81.5% reported being born in the United States and 18.5% were foreign-born adults. Descriptive statistics revealed that Indian Subcontinent-born respondents (71.7%) were more likely to report healthy sleep compared to US-born respondents (OR = 1.53, 95% CI = 1.37-1.71, p < 0.001), whereas African-born respondents (43.5%) were least likely to report healthy sleep (OR = 0.78, 95% CI = 0.70-0.87, p < 0.001).

Conclusion: These findings suggest that place of birth should be considered in the assessment of risk factors for unhealthy sleep. They add to the literature on sleep duration among racial and ethnic minorities in the U.S. This is useful when attempting to elucidate differences in sleep based on race/ethnicity and immigrant status.

Support (If Any): National Institutes of Health (R01MD007716)
**0156**

**“OF ISLANDS AND PANCAKES”: A NOVEL METHOD TO QUANTIFY AND VISUALIZE MISTIMED RHYTHMS**

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**Introduction:** Sleeping at the ‘wrong’ internal time can have consequences for health and safety, particularly apparent in shift work, occupations with frequent jet lag, and psychiatric disorders featuring disrupted sleep-wake cycles. Desynchrony between sleep, circadian physiology, and external (social) demands—often called circadian disruption—are argued to underlie these adverse outcomes. Studies investigating its causes and consequences need a good quantification. Here, we propose a novel method to quantify the mistiming of behavioral and physiological rhythms, and demonstrate its versatility on diverse data sets, ranging from shift workers to patients with schizophrenia and jetlagged mice.

**Methods:** Our approach calculates the distance between actual and ideal time series represented by a vector length using Pythagoras’ theorem. Actimetry and light data from rotational shift workers (n = 53, study period = 4 weeks), patients with schizophrenia and healthy controls (n = 36, 6 weeks) as well as breast-cancer prone mice in chronically altered or regular 12:12 light-dark conditions (n = 10, 10 weeks) were analyzed and compared with previously described measures of circadian disruption (i.e., Inter-diary Stability (IS) and ‘Behavioural Entrainment’ (BE)).

**Results:** Our method shows good congruence with IS and BE (bivariate correlations, r = -0.56 - 0.48, P < 0.001), but offers unique, additional information. We unveil a distinctive geometry (“Islands and Pancakes”) across subjects and study protocols allowing for evaluation of work schedules refining current shift work guidelines, visualization of activity-rest rhythms in psychiatric patients and controls, and detailed analyses of behavioral responses to environmental changes in mice.

**Conclusion:** In view of rising numbers of people exposed to disrupted sleep by unusual and early work hours altering daily routines and well-being, our method can help to systematically examine the role of mistimed rhythms in health and safety on an individual basis.

**Support (If Any):** DARPA-12-12-11-YFA11-FP029

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**0157**

**LATER WAKE UP TIME AND IMPULSIVITY**

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**Introduction:** Short sleep, sleep restriction, and total sleep deprivation have been shown to affect cognition, mood, and motor functions. However, excessive sleep or irregular sleep schedules can also affect some of these functions. We investigated the relationship between self-reported weekday wake up times and self-reported impulsiveness. We hypothesized that later wake up times would be associated with higher levels of impulsive behavior due to possible circadian disruption of prefrontal functioning.

**Methods:** Forty-seven participants (24 males and 23 females, mean age = 29.0) completed the Barratt Impulsiveness Scale-11 (BIS-11) and a self-report sleep questionnaire that included items about typical sleep, wake up, and bed times for weekdays and weekends. The BIS-11 is a 30 item self-report questionnaire that measures the personality trait of impulsiveness. The BIS-11 also has three subscales measuring Attentional, Motor, and Non-Planning aspects of impulsiveness. Participants also completed the Morningness-Eveningness Questionnaire (MEQ).

**Results:** Weekday wake up times were positively correlated with BIS-11 Total (r = .55, P < .001), suggesting greater impulsivity with later wake up times. These findings remained significant after controlling for typical weekday hours of sleep, MEQ scores, age, and gender (r = .45, P = .003). The effect was observed for two of three subscales, including Attentional (r = .33, P = .03) and Non-Planning (r = .55, P = .02), but not Motor (r = .30, P = .05). The association was generally not present for weekend sleep, with the exception of a positive correlation between later weekend wake up time and higher Non-Planning (r = .33, P = .03).

**Conclusion:** As hypothesized, later weekday wake up times were associated with higher impulsiveness, even after controlling for hours of sleep obtained, chronotype, age, and gender. This suggests that other circadian factors (e.g., social, occupational, activity, food, light, etc) may also contribute to the association between impulsive behavior and wake up time beyond insufficient sleep. Causal direction remains to be established and further work is needed to determine the behavioral significance of these findings.

**Support (If Any):** This research was funded by ThyssenKrupp Electrical Steel Europe and Siemens AG as well as a scholarship of Hanns-Seidel-Foundation to DF.

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**0158**

**CHRONOTYPE AND RISK-TAKING PROPENSITY**

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**Introduction:** Morning chronotype has been associated with lower risk-taking on self-report measures, but behavioral measures have shown inconsistent findings. Based on prior research, we hypothesized that under normally rested conditions, morning types would demonstrate lower risk-taking tendencies than evening types on a behavioral measure of risk-taking administered at 10:30 a.m.

**Methods:** Sixty-five participants completed the Morningness Eveningness Questionnaire (MEQ) as a measure of chronotype. Scores ranging between 0-41 indicate “evening type,” and scores ranging from 59 or greater indicate “morning type.” From this, 12 were classified as morning and 11 as evening type (14 males, M age = 30.6). Participants completed the 30-trial Balloon Analogue Risk Task, a behavioral measure of risk-taking to earn money by inflating a virtual balloon. The Adjusted Average Number of Pumps, which reflects risk taking, was quantified for each third (i.e., block) of the task.

**Results:** A mixed (2 chronotype x 3 block) ANOVA demonstrated a significant interaction, suggesting that morning types remained relatively stable in risk-taking propensity over the course of the task, while evening types increased in risk-taking behavior across the three blocks (F(1,53,32.2) = 3.83, P = .042). Moreover, when total money earned was considered, morning types earned more than evening types early in the game, but evening types showed a linear increase across blocks and earning more money in the final block of the game relative to morning types (F(2,42) = 3.81, P = .03).

**Conclusion:** Although there were no overall differences between morning and evening types in behavioral risk taking, temporal patterns were found, such that over time, morning types remained consistent at a moderate risk level, whereas evening types increased steadily...
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across trials. Thus, examination of differences in risk-taking profiles based on chronotype requires consideration of learning over time. Future studies should explore the neurobiological basis of the relationship between strategic thinking and chronotype and examine the potential role of sleep loss.

0159

CHRONOTYPE AND SLEEP HYGIENE DURING THE TRANSITION FROM HIGH SCHOOL TO 5-YEARS POST-COLLEGE GRADUATION

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Introduction: We examined longitudinal changes in chronotype and sleep hygiene across ten years (high school senior year through 5 years post-college graduation) and three environments (parental home, college campus, work world) and examined the relationship of these changes to sleepiness and BMI.

Methods: Testing occurred during the summer before college (high school: 17-20 years old), end of college freshman and senior years, and five years post-college graduation. Participants completed the Epworth Sleepiness Scale, Horne and Östberg Morningness-Eveningness Questionnaire, The Sleep Hygiene Index, the Pittsburgh Sleep Quality Index, and napping and demographic questions. Only participants completing questionnaires 3-4 times were included (N = 21, 17 female).

Results: High school students (M = 45.08, SD = 6.95) and college freshmen (M = 44.54, SD = 7.80) had more evening type chronotype, but shifted towards more morning through college (M = 48.85, SD = 8.81) and post-graduation (M = 56.62, SD = 9.90; F(3,36) = 14.08; p < .05). During college, this shift associated with less napping (r(22) = -.473; p < .05) which associated with less sleepiness, better sleep hygiene, and lower BMI (all p’s < .05). Greater shifts towards morningness across the entire time period correlated with better post-graduation sleep hygiene (r(12) = -.743; p < .05).

Sleep hygiene deteriorated during the transition from high school (M = 34.25, SD = 5.07) to college (freshmen: M = 37.75, SD = 6.08; seniors: M = 37.08, SD = 6.10) and only improved post-graduation (M = 32.08, SD = 4.94) (F(3,33) = 8.55; p < .05). Shifting to more mal-adaptive sleep hygiene in college was associated with more napping (r(22) = .343; p < .05) and more sleepiness (r(23) = .425; p < .05) which was associated with a greater increase in BMI (r(22) = .610; p < .05). Improving sleep hygiene by post-graduation was associated with less sleepiness and improved sleep quality, efficiency, and disturbance (all p’s < .05).

Conclusion: Chronotype and sleep hygiene changed from high school to post-college graduation. Shifting towards morningness and adaptive sleep hygiene was associated with better sleep outcomes. Understanding both the influence of the environment and the implications for sleep, sleepiness, and health could help improve behavioral choices.

0160

CHRONOTYPE EFFECTS ON INTERVAL TIME PRODUCTION

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Introduction: Estimates of Interval timing are crucial to maximal individual performance in sports, music, dance, and cognitive processing. The few studies investigating inherent interval-timing differences among circadian chronotypes were not conclusive, and warranted closer investigation.

Methods: Using MEQ and BALM scale chronotype assessments, 32 Evening-types (ETs) and 32 Morning-types (MTs) were selected. A computerized time-production task presented five target intervals during each session of 13, 27, 43, and 57 seconds, each interval repeated five times randomly. Each subject completed five test sessions, beginning within 60 minutes of their wake up time, 3.75 h apart, across 15 hours. To increase production accuracy, subjects counted with feedback. Outcomes included +/- proportional directional error from target values, and absolute error (1 - [directional error]) regardless of direction, transformed by square root for normality.

Results: Mixed-model ANOVAs were conducted on directional and absolute errors. Directional error showed a significant Chronotype x Time effect (F = 3.56, p = .007). During afternoon testing MTs underestimated and ETs overestimated intervals (p < .05), while at night ETs were least accurate and overestimated intervals, with MTs approximating the target values (p < .01). ET directional error varied over time significantly (p < .01), mostly from accurate evening values becoming large overproductions at night (p<0.05). A significant target-interval effect for directional error (F = 5.55, p = .001) indicated that the 27-s interval was overestimated most often (p<0.05), MTs were significantly more precise than ETs for 27-s interval production (p < .05). MTs were less precise at 13-s interval production as compared to their production of 27-s (p < .001), 43-s (p < .01), and 57-s intervals (p < .05).

Conclusion: Chronotype differences in interval timing apparently exist, and may contribute to chronotype performance differences independent of other circadian contributions.

0161

WEST COAST TEAMS OF THE NATIONAL FOOTBALL LEAGUE HAVE A CHRONOBIOLOGIC ADVANTAGE IN WINNING: ASSESSMENT OF GAME DAY TRAVEL, TURNOVERS, AND INJURIES

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Introduction: Previous studies have identified that teams of the National Football League playing two or more time zones away from home are more statistically likely to lose. East coast teams are at a further disadvantage. In order to assess the impact of circadian misalignment on game day performance beyond win-loss records, the present study examined relationships between time zone travel, errors in play, and in season injuries across the 2013 regular season of the NFL.

Methods: The number of sacks and interceptions (i.e. turnovers) for each of the 32 teams across 17 weeks of play was obtained from Pro-Football-Reference. Each team’s adjusted game lost (AGL) metric for injuries, which accounted for winning percentages based on in season injuries to starters and special teams, was obtained from Football Outsiders’. A lower AGL metric indicates greater weight to injuries impacting winning percentages.

Results: The 32 teams of the NFL traveled across 236 time zones. Fifty-nine wins were accounted for traveling eastward while only thirty-four wins were accounted for traveling westward. Average time zones traveled for teams in the Eastern versus Central versus Mountain versus Western teams did not vary despite the disproportionate number of teams in each time zone (p = 0.156; Mann-Whitney U). Average AGL metric varied even after controlling for disproportionate number of teams in each time zone (p = 0.020; Mann-Whitney U). West Coast teams had the highest AGL metric meaning lesser weight to injuries impacting winning percentages. There was also no difference between each team’s rank of total season travel against each team’s AGL metric rank (p = 0.186; Kruskal-Wallis test).
Conclusion: These results align with previous studies demonstrating that found West Coast teams of the NFL have a chronobiologic and ecological advantage for winning games. Future studies relevant to circadian misalignment and injury metrics ought to focus on injury type and biological underpinnings of injury prevention and risk.

0162
A 5-YEAR RETROSPECTIVE STUDY ON THE CIRCADIAN DISADVANTAGE IN THREE MAJOR SPORT LEAGUES IN NORTH AMERICA
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Introduction: The purpose of this study was to investigate the effects of a circadian disadvantage on the winning percentages in three major sport leagues in North America: the National Basketball Association (NBA), the National Football League (NFL) and the National Hockey League (NHL).

Methods: We reviewed the past 5 years of regular season games in the NBA, the NFL and the NHL and noted the winning percentage of the visiting team depending on the direction of travel (east vs west), and the number of time zones crossed for every game. T-tests and ANOVAs were performed to study the effect of the circadian disadvantage and its direction on winning percentage.

Results: The results showed an advantage, in all three leagues, for the teams travelling from west to east, but the effect was only significant in the NBA (F(2,594) = 6.82, p < .001). The effects for the NHL (F(2,563) = 1.73, p = 0.17) and the NFL (F(2,503) = 2.09, p = 0.12) were not significant, but the same tendencies were observed. In the NBA, teams travelling from west to east had a winning percentage of 45.38% compared to 36.23% for teams travelling from east to west. In the NHL, teams travelling from west to east had a winning percentage of 47.62% compared to 42.48% for teams travelling from east to west. In the NFL, teams travelling from west to east had a winning percentage of 46.54% compared to 37.98% for teams travelling from east to west.

Conclusion: These results highlight the importance of the direction of the circadian disadvantage on the probability of success. Teams, from the three sports studied, traveling from Western to Eastern time zones had a greater winning percentage than those travelling in the opposite direction. Evening scheduling may be part of this phenomenon and need to be addressed in further studies.

0163
TOY OR TOOL REDUX: A SECOND LOOK AT A CONSUMER BRAIN-COMPUTER INTERFACE EEG HEADSET
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Introduction: Circadian research shows that individuals experience a drop in energy levels (attention) and feel sleepier at around 3 PM. This low point is usually detectable by EEG, which records electrical brain activity. Our goal was to test whether a popular consumer brain-computer interface (MindWave Mobile portable EEG headset) would detect this drop in energy levels through its algorithms for “attention”, “meditation”, and “eye blink intensity”. We expected level of “attention” to decrease and level of “meditation” (a measure of relaxation) to increase around 3 PM. We had no hypothesis about “blink intensity.”

0164
MULTISCALE MATHEMATICAL MODELING OF VIGILANCE STATE EFFECTS ON THE CIRCADIAN CLOCK
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Introduction: The electrophysiology of neurons in the suprachiasmatic nucleus (SCN) varies with time of day. In addition to driving SCN outputs, this variable electrophysiology represents a mechanism by which the SCN may gate its inputs. Recent work has demonstrated a functional connection between the laterodorsal tegmental nucleus (LDT) and the SCN that may transmit information about vigilance states to the clock. To investigate the mechanisms by which LDT activity affects the molecular clock in SCN neurons, we simulated LDT inputs in a multiscale mathematical model representing the interaction between SCN per1 neuron electrophysiology and a simplified gene feedback network.

Methods: Using an integrated model introduced by Diekman and colleagues, we first considered the effects of general excitatory/inhibitory inputs on individual per1 SCN neurons at different times of day to identify the role of electrophysiology in gating the response of the SCN neuron. Then we simulated excitatory effects consistent with projections from LDT neurons. In this modeling framework, changes to SCN electrophysiology drove changes in intracellular calcium concentration thereby affecting gene regulation and the timing of the internal clock.

Results: Consistent with previous reports, we found that model SCN neurons demonstrated distinct electrophysiological properties at different circadian phases. These electrophysiological differences translated to altered time courses for intracellular calcium concentrations, which, in turn, advanced or delayed the phase of the gene network. Thus, the clock demonstrated phase-dependent responses to simulated LDT inputs.

Conclusion: This model suggests mechanisms by which variable electrophysiology of SCN neurons gates inputs from LDT. Since these inputs are vigilance state-dependent, these findings have implications for
the effects of waking and sleeping out of phase with the endogenous clock as may occur with jet lag or shift work.

Support (If Any): NSF DMS 1412571 (CDB), and DMS 1412119 (VB)

0165

NIGHT WORK DISTURBS MULTISCALE PHYSICAL ACTIVITY REGULATION IN HUMANS

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Introduction: Human motor activity possesses fractal activity fluctuations with similar temporal structure/correlations across different time scales from minutes to hours. Animal models showed a crucial role of the central circadian pacemaker in maintaining such fractal patterns. Here we tested whether fractal activity patterns are disrupted during night shifts that are known to disturb circadian rhythms.

Methods: We studied 16 chronic shift workers (25-50 years old, 8/8 females/males) and 9 controls without night shifts (24-49 years old, 5/4 females/males). Ambulatory activity was continuously monitored using Actiwatch for > 10 days. We analyzed data during working hours of night shifts, and compared the results with those of controls during the daytime and those of the same shift workers while awake during the daytime on free days. We performed the detrended fluctuation analysis (DFA) to quantify temporal correlations in activity at time scales from ~0.1-8h.

Results: Daytime activity fluctuations in controls showed strong correlations, as characterized by a DFA-derived exponent α~1.0 that was similar at different time scales, e.g., \(a_1 = 0.99 \pm 0.03\) (SE) at time scales < 1.5h and \(a_2 = 0.98 \pm 0.03\) at 2h (\(p > 0.1\)). Activity fluctuations of shift workers on free days displayed weaker correlations at 2h (\(a_2 = 0.90 \pm 0.04\)) as compared to those at < 1.5h (\(a_1 = 0.99 \pm 0.02\); \(p = 0.01\)). During night shifts, mean activity levels of shift workers (260 ± 28 arbitrary units) remained similar as those during the daytime on free days (240 ± 26; \(p > 0.1\)). However, correlations at both short and long time scales were significantly reduced (i.e., \(a_2 = 0.73 \pm 0.06\); \(a_1 = 0.89 \pm 0.01\)), leading to more random activity as compared to the same subjects during free days or to controls during the daytime (all p values < 0.002). These results are reminiscent of degraded fractal activity patterns in patients with dementia that are associated with circadian, mood and cognitive dysfunction.

Conclusion: Night shift work detrimentally impacts multiscale activity regulation, likely due to disrupted circadian regulation.

Support (If Any): R00-HL102241, R01AG048108-01A1 and P01AG009975 to K.H.; R01-HL118601 to F.A.J.L.S.

0166

LACK OF EXERCISE LEADS TO ALTERED ACTIVITY PATTERNS IN WILD-TYPE AND VIP-DEFICIENT MICE DURING LIGHT-DARK CYCLES

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Introduction: In mammals, locomotor activity displays daily/circadian rhythms that are controlled by the central circadian pacemaker (suprachiasmatic nucleus: SCN) in synchrony to day-night cycles. Disrupting the rhythms has many serious health consequences including sleep and metabolic disorders. Overwhelming evidence indicates that lack of exercise is detrimental to health. Here we tested how lack of exercise impacts activity rhythms in wild-type mice and mice with SCN dysfunction from deficit of vasoactive intestinal polypeptide (VIP).

Methods: We studied 9 VIP-deficient (VIP-/-), 6 wild-type (VIP+/+), and 6 heterozygous (VIP+/-) mice (age: 6-35 weeks). VIP +/- mice (congenic with C57BL, courtesy of Christopher Colwell, UCLA) were bred to produce the three genotypes. To monitor locomotion, animals were housed individually under 12h:12h light-dark cycles for ≥ 10 days with or without access to running-wheels. Locomotor activity was monitored continuously by infrared motion detectors, and data were stored over 1-min epochs. To quantify daily/circadian rhythms, we calculated interdaily stability (IS) and intradaily variability (IV) using the motion data resampled at multiple time scales (1-180min).

Results: As compared to VIP+/+ and VIP+/-, VIP-/- had lower IS (less stable rhythms) (\(p = 0.03\)) but similar IV (\(p > 0.05\)). Depiving the exercise opportunity (running wheels) reduced IS by ~35% (\(p < 0.0001\)), and increased IV by ~50% (\(p < 0.001\)). Interestingly, the effects of exercise were more pronounced in IS and IV at smaller time scales (e.g., IS, \(p = 0.001\) at 1-30min and \(p = 0.0006-0.02\) at 60-180min) while the genotype difference in IS was the most significant at 60-120min (\(p = 0.006-0.008\)). Additionally, aging had an independent effect, causing a decrease in IS (\(p < 0.0001\)).

Conclusion: Lack of exercise leads to less stable and more fragmented daily activity in both wild-type and VIP-deficient mice during light-dark cycles. The effects of exercise and of VIP deficit on activity timing can be better observed at certain but different time scales.

Support (If Any): This work was supported by NIH grants R00-HL102241, R01AG048108-01A1 and P01AG009975 to K.H.

0167

ROLE OF THE DORSAL MEDIAL HABENULA IN THE REGULATION OF CIRCADIAN RHYTHMS

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Introduction: The epithalamic habenula has been implicated in the regulation of behaviors including motor activity and sleep. Neurons in both the medial and lateral habenula exhibit spontaneous firing that is higher during the day than night, and the lateral habenula exhibits endogenous oscillations in gene expression and neuronal activity.

Methods: We use genetic lesions to specifically ablate neurons in the dorsomedial habenula (dMHb) in order to examine its role in the regulation of locomotor activity and circadian rhythms. Using the Cre-LoxP system, neurons in the dMHb were ablated by abolishing expression of Bmi1a without affecting other regions in the habenula.

Results: We show that developmental lesion of the dMHb reduces WRA under both a light-dark cycle and constant darkness, and increases the circadian period of WRA, but not of home cage activity, suggesting that the lengthening of period is a result of the decreased WRA in the mutant mice. Photoreponsiveness is intact in dMHbCKO mice but, compared to control animals, they re-entrain faster to a 6h abrupt phase delay protocol. Both the circadian expression of the clock genes PER1 and PER2 within the SCN and the 24h profiles of sleep stages are normal in the dMHb lesions mice.

Conclusion: Our results support a model in which the dMHb is part of the neural pathway encoding exercise motivation; according to this model, decreased dMHb activity may be involved in the manifestation of some of the symptoms of depression, such as decreased physical activity, which in turn leads to changes in the circadian system that may further exacerbate the depressive phenotype.

Support (If Any): NIH Grant F32MH098498 and NSF Grant EEC-1028725
**VIII. Behavior**

**0168**

**GAMING THE NIGHT AWAY: A LOOK AT VIDEO GAMERS AND THEIR BEDTIMES**

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**Introduction:** 72% of Americans play video games (NPD Group) while 90% of Americans do not sleep the recommended hours for their age (National Sleep Foundation). As such, video gaming may be taking precedence over a bedtime that allows for sufficient sleep. Presently, data are lacking that examine how gaming influences bedtime choices. We hypothesized that 1) gamers would evidence a high bedtime delay (BTdelay) prevalence rate and 2) gaming frequency and duration would predict BTdelay. Contributing factors to delay were also explored.

**Methods:** Participants were U.S. gamers ages 13+ (mean = 28.7 years) who played video games at least once the previous week. After providing consent or parental consent (under 18), gamers completed an online survey examining the extent gaming habits affected BTdelay frequency and duration. Questions asked about demographics, gaming consoles, game genres, and gaming frequency and duration (weekday/weekend). Gamers who delayed their bedtime ≥ 1 nights (delayers) answered questions regarding game modes(s), social interactions, next day tardiness, and gaming-related BTdelay reasons. ANCOVA and regression analyses were performed with SPSS (Version 20).

**Results:** In February 2015, 963 gamers completed surveys (females = 15%; white = 58%). During the previous week, they gamified 4.6 +/- 2 nights for weekdays = 192 +/- 158 minutes and weekends = 303 +/- 183 minutes. 67% of gamers delayed their bedtime on 1.7 +/- 2 nights for 102 +/- 70 minutes. Many were tardy at least once the next day to school (9.7%), work (12.9%), or other activities (18.5%). No significant differences in demographics were found (delayers versus nondelayers). ANCOVA analyses with age, relationship status, and living situation showed delayers gambled more frequently (4.9 vs 4 nights) and for longer durations (weekdays = 208 vs 159 minutes; weekends = 329 vs 249 minutes). Playing more genres predicted greater BTdelay frequency (P < 0.001) and duration (P = 0.027) while more consoles predicted greater BTdelay durations (P = 0.041). Nights (%) playing co-op (P < 0.001) and multi-player (P = 0.011) and in-game (P < 0.001) and cellphone (P = 0.001) socializing predicted longer BTdelay durations. Regression analyses showed addiction-type delay reasons (P = 0.001) and no save-point (P = 0.015) predicted BTdelay frequency while only no save-point predicted duration (P = 0.022).

**Conclusion:** These data show that gamers will push off obtaining an adequate sleep in order to continue video gaming. More broadly, while video game addiction is not an official DSM-5 disorder, these data show gaming contributes to bedtime delays and tardiness providing further evidence that, at least for some, gaming may be addictive.

**Support (If Any):** Internal funding support from UNT Health Science Center.

**0169**

**SLEEP, MOOD, AND NEUROBEHAVIORAL PERFORMANCE IN THE PERINATAL PERIOD**

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**Introduction:** Disturbed sleep in the perinatal period puts women at risk for neurobehavioral impairment and postpartum depression. Recent work has established a link between disturbed sleep and worse neurobehavioral performance in expectant/new mothers, but little attention has been paid to neurobehavioral capacity and depressive symptoms in this population. Our aim was to examine associations between neurobehavioral performance, maternal sleep, and depressed mood in at-risk perinatal women.

**Methods:** 21 women (age ± SD = 29.8 ± 4.5 years) with a history of major depression, but who were not in a mood episode at enrollment, had their average sleep onset, sleep offset, total sleep time, and sleep efficiency estimated over one week with wrist actigraphy at 33 weeks gestation and 2, 6 and 16 weeks postpartum. At the end of each monitoring week, mood was assessed with the 17-item Hamilton Rating Scale for Depression and participants completed a 6-minute visual psychomotor vigilance task (PVT, AMI). Generalized estimating equations were used to test for changes over time and assess associations between sleep, mood, and PVT measures.

**Results:** Time of sleep offset (33 wks: 7:41 ± 63.6 min, 2 wks: 8:13 ± 63.6 min, 6 wks: 8:05 ± 71.4 min, 16 wks: 7:04 ± 57.6 min; F = 5.66, p = 0.01) and sleep efficiency (33 wks: 82.0 ± 11.3%, 2 wks: 70.9 ± 7.1%, 6 wks: 75.1 ± 7.0%, 16 wks: 84.2 ± 6.3%; F = 31.8, p < 0.01) differed significantly across time, as did three mean PVT measures: slowest 10% reciprocal reaction time (RRT) (33 wks: 2.1 ± 0.7 s-1, 2 wks: 1.8 ± 0.8 s-1, 6 wks: 1.7 ± 0.7 s-1, 16 wks: 2.1 ± 0.7 s-1; F = 3.80, p = 0.03), mean reaction time (RT) (33 wks: 361.6 ± 202.5 s, 2 wks: 396.0 ± 220.9 s, 6 wks: 467.9 ± 467.0 s, 16 wks: 410.2 ± 436.2 s; F = 4.22, p = 0.02), and number of lapses (33 wks: 46.4 ± 9.5, 2 wks: 8.1 ± 17.4, 6 wks: 7.4 ± 10.4, 16 wks: 4.3 ± 9.8; F = 4.16, p = 0.03). More time awake at night was associated with worse neurobehavioral performance, with significant associations observed between wake minutes and mean slowest 10% RRT and false starts (F = 5.14, p = 0.03 and F = 6.76, p = 0.01, respectively). Finally, more depressive symptoms also were associated with worse performance, with significant associations between depressive symptoms and mean slowest 10% RRT, mean RT, and number of lapses (F = 19.33, p < 0.01; F = 13.11, p < 0.01; and F = 20.55, p < 0.01, respectively).

**Conclusion:** In our sample of perinatal women with a history of MDD, worse neurobehavioral performance was associated with more wakefulness at night and greater depressive symptomatology. These data indicate that both postpartum sleep disturbance and depressed mood impair daytime functioning in postpartum women.

**Support (If Any):** K23MH086689 (KMS) and T35HL094308 (JCS)

**0170**

**SLEEP DISRUPTION IS ASSOCIATED WITH FEARFUL BEHAVIOR IN A MOUSE MODEL OF POST-TRAUMATIC STRESS DISORDER**

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**Introduction:** Post-traumatic stress disorder (PTSD) often results in significant sleep disturbances, daytime sleepiness, depressed mood and hypervigilance. Little is known about the interactions between sleep and the other relevant neural circuits involved in chronic stress. We analyzed sleep staging, EEG coherence, and behavior in a mouse model of PTSD.

**Methods:** Mice were randomized to a control condition or Single Prolonged Stress (SPS), a well-validated protocol which comprises a series of stressors including restraint stress, a group forced swim, exposure to ether, and social isolation for 1 week (n = 7-9 per group). Following SPS, mice underwent behavior testing, including fear extinction and digital gait assessment, prior to surgical implantation of EEG/EMG electrodes. Baseline EEG/EMG signals were recorded from freely be-
having animals for one week, including a challenge task in which mice were placed into a novel environment. Epochs were scored offline as Wake, NREM, and REM sleep. EEG coherence (a normalized value that reflects the degree of coupling between EEG waveforms from 2 skull sites for a given frequency bin) was computed using MATLAB. Group and individual differences were analyzed using Student’s t-tests and linear regression.

**Results:** As expected, SPS mice showed significantly more freezing behavior during the fear extinction task (p = 0.038), while digital gait assessment was normal between groups. Mice in the SPS group showed significantly shorter average sleep bout lengths (p = 0.037) compared to controls, indicating an inability to maintain consolidated sleep. In the novel environment task, SPS mice showed significantly more sleep-wake transitions (p = 0.0016) and a shorter latency to fall asleep (p = 0.0088) compared to controls. SPS mice showed significantly decreased delta-band EEG coherence between hemispheres during NREM sleep (p = 0.03). Finally, individuals that showed the most severe sleep fragmentation also showed greater freezing behavior (R2 = 0.54, p = 0.004) and decreased exploration time (R2 = 0.52, p = 0.005) during fear extinction.

**Conclusion:** SPS shows validity in mice, and robustly recapitulates sleep and behavioral disturbances common to the human condition of PTSD. Quantitative EEG markers of sleep may represent a useful marker to further query brain circuit dysfunction and individual differences in PTSD symptomatology. Ongoing studies will examine patterns of neural activation across sleep and stress circuits, and relationships between EEG and behavior.

**Support (If Any):** VA CDA # IK2 BX002712, American Sleep Medicine Foundation, Portland VA Research Foundation

### 0171 DAILY STRESSORS AND TEMPORAL RESOURCES: INFLUENCE ON SLEEP

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**Introduction:** Sleep measures can be both predictors and outcomes of daily contextual factors. However, most research using a cross-sectional design lacks the ability to examine daily antecedents and consequences of sleep. Using a longitudinal daily diary design, this study examined the causal direction between nightly sleep and daily stressors and temporal resources.

**Methods:** Middle-aged parents employed in a U.S. IT firm (N = 102) provided 8 days’ diary data at baseline and one year later. Each evening, parents reported bed-time and wake-time, sleep latency, and sleep quality. They also reported daily work-to-family conflict (WTFC), and daily temporal resources assessed by perceptions of having enough time (i.e., time adequacy) for their child and themselves (to exercise). Multilevel models tested whether daily WTFC and time adequacy were affected by the previous nights’ sleep. The lagged variables of WTFC and time adequacy were also simultaneously included to test whether they were predictors of sleep that night. Analyses adjusted for sociodemographic and work characteristics, day-of-week, and previous nights’ sleep assessment.

**Results:** Results revealed that daily WTFC and time adequacy were more likely to be pulled by the previous nights’ sleep: On days following longer sleep duration or better sleep quality than usual, parents reported lower WTFC and greater time adequacy for their child and themselves. Daily WTFC and time adequacy, however, predicted sleep latency that night, not the converse. Parents reported longer sleep latencies on nights following days with greater work-to-family conflict or lower time adequacy for their child and themselves.

**Conclusion:** Sleep quantity and quality influence the next days’ experiences of WTFC and sense of time adequacy for child and themselves. In the other direction, daily exposure to greater WTFC and less temporal resources leads to difficulty falling asleep that night. Future work should examine how daily characteristics are linked with actigraphic measures of sleep.

**Support (If Any):** This research was conducted as part of the Work, Family, and Health Network, which is funded by a cooperative agreement through the National Institutes of Health: Eunice Kennedy Shriver National Institute of Child Health and Human Development (U01HD051217, U01HD051218, U01HD051256, U01HD051276), National Institute on Aging (U01AG027669), Office of Behavioral and Social Sciences Research, and National Institute for Occupational Safety and Health (U01OH08788, U01OH059773). Grants from the National Heart, Lung and Blood Institute (R01HL107240), the William T. Grant Foundation, Alfred P Sloan Foundation, and the Administration for Children and Families provided additional funding.

### 0172 A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED, CROSSOVER STUDY FOR EVALUATION OF HUMAN ABUSE LIABILITY OF JZP-110

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**Introduction:** JZP-110 is a second-generation wake-promoting agent and a dopamine and norepinephrine reuptake inhibitor. Given its mechanism of action, JZP-110 may have abuse potential and was compared to the Schedule IV stimulant phentermine as a positive control.

**Methods:** Adults with a recent history of recreational polydrug use, including stimulants, and who met criteria in a Qualification Phase were randomized to 1 of 6 sequences in a Test Phase. Each Test Phase sequence included a single administration of placebo, JZP-110 (300, 600, and 1200 mg), and phentermine (45 and 90 mg), with a 2-day washout between periods. The primary endpoint was peak rating of Liking at the Moment across the first 12 hours on a bipolar liking-disliking visual analog scale (VAS); key secondary endpoints were retrospective VAS ratings of Drug Liking, and how much the subject would like to Take the Drug Again. Safety also was assessed.

**Results:** Of 43 subjects (74.4% male; 67.4% African American; mean age 29.1 years), 37 completed the study. On the primary endpoint of peak liking, all doses of JZP-110 were significantly greater than placebo (P < 0.001) and significantly less than 90 mg of phentermine (P < 0.05). In addition, Overall Next Day Drug Liking for JZP-110 at 600 and 1200 mg was not significantly different from placebo and was significantly lower for all doses of JZP-110 relative to 90 mg of phentermine (P < 0.02). Ratings of willingness to Take the Drug Again for all doses of JZP-110 were significantly lower than both doses of phentermine (P < 0.05). Treatment-emergent adverse events (TEAEs) were dose-dependent for JZP-110 and phentermine and none were serious or severe. The most common TEAEs for JZP-110 included hypervigilance, elevated mood, dry mouth, hyperhidrosis, and insomnia.
Conclusions: On primary and key secondary endpoints, JZP-110 may have similar or lower abuse potential than Schedule IV stimulants.

Support (If Any): Jazz Pharmaceuticals.

0173

RODENT MODELS SHOW LOW ABUSE POTENTIAL OF JZP-110, A DOPAMINE-NOREPINEPHRINE REUPTAKE INHIBITOR WITH WAKE-PROMOTING EFFECTS

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Introduction: Several stimulant medications are FDA approved to treat general symptoms of narcolepsy; however, current medications are associated with limitations such as abuse potential. A phenylalanine-derived, second-generation wake-promoting agent, JZP-110, has shown efficacy for improving daytime sleepiness and wakefulness in patients with narcolepsy in two phase 2 trials. In contrast to traditional stimulants, JZP-110 is a low potency reuptake inhibitor at dopamine (IC50 = 2.9 µM) and norepinephrine (IC50 = 4.4 µM) transporters, does not promote norepinephrine release in rat brain synaptosomes, and does not produce rebound hypersomnia in mice.

Methods: The current studies examined the abuse-related effects of JZP-110, in comparison to traditional stimulants, using in vivo models.

Results: In Sprague-Dawley rats, and in contrast to amphetamine (2 mg/kg), JZP-110 did not produce conditioned place preference at doses of 10, 30, or 90 mg/kg. In contrast to cocaine (0.8 mg/kg/infusion), JZP-110 did not maintain self-administration (< 5 infusions/session) at doses of 0.25, 0.5, and 1.0 mg/kg/infusion under a fixed ratio schedule of reinforcement. Finally, only the highest dose of JZP-110 (90 mg/kg) that was tested increased locomotor activity, in contrast to the robust increases in locomotor activity that were observed with amphetamine.

Conclusion: Taken together, JZP-110 did not produce conditioned place preference, did not readily maintain self-administration, and had a smaller magnitude of effect on locomotor activity in rats, compared to traditional stimulants. In conclusion, JZP-110, a second-generation wake-promoting agent, does not appear to have the abuse-related effects of the traditional stimulants.

Support (If Any): Jazz Pharmaceuticals.

0174

BASELINE MEASURES OF PVT PERFORMANCE AND HEART RATE VARIABILITY ASSOCIATE WITH OBJECTIVE MEASURES OF DROWSY DRIVING

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Introduction: Laboratory studies have shown that some baseline measures of behavior and physiology associate with cognitive vulnerability to the effects of sleep deprivation. We tested whether baseline psychomotor vigilance task (PVT) performance and heart rate variability associate with drowsiness-related decrements in driving performance.

Methods: Adult male subjects (n = 44) completed a 4-hour driving test in the early afternoon. Prior to the driving test, participants completed a 5-minute PVT and performed a ~15-minute practice drive around the closed course with continuous ECG monitoring. During the driving test, eye closure events were recorded using an in-car camera, and vehicle position was monitored by a driving instructor. Based on a median split, participants were categorized as having either faster or slower PVT response times at baseline. Survival analyses were then performed for the first occurrence of a 2-second eye closure event (a measure of drowsiness), and the first occurrence of a half-lane deviation in vehicle position. Similar analyses were performed based on a median split of ECG-derived power spectral density in the 0.02-0.08 Hz frequency range of the RR-interval time series (RR-interval PSD).

Results: Subjects in the faster PVT response time group showed significantly longer survival times to the first 2-second eye closure event (P < 0.01), as compared to subjects with slower response times at baseline, whereas survival curves were similar for the first half-lane deviation in vehicle position (P = 0.15). Subjects with lower RR-interval PSD exhibited significantly longer survival times to eye closure and lane-deviation events relative to participants with higher RR-interval PSD (P < 0.05 for both survival analyses).

Conclusion: The onset of drowsy driving occurred earlier in subjects with slower PVT response times and higher RR-interval PSD. Baseline measures of PVT performance and heart rate variability may carry information about risk for falling asleep during long-duration driving tasks.

Support (If Any): DSO National Laboratories (DSOCL15007)

0175

EFFECTS OF SOCIAL STRESS ON BEHAVIOR ARE SLEEP-DEPENDENT

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Introduction: Sleep disturbances are among the core symptoms of affective disorders such as PTSD, but to date, there is no consensus about whether sleep impairments are a symptom or causative factor of affective disorders. However, evidence that sleep impairments contribute to susceptibility to affective disorders has increased in recent years. In the present study, we used social stress to induce social avoidance in a mouse model of PTSD to investigate the role of sleep in the regulation of behavior. Our hypothesis is that sleep changes contribute to the development and maintenance of social avoidance behavior.

Methods: We implanted C57Bl6/J mice with EEG/EMG electrodes, recorded baseline sleep and then subjected the implanted mice to 10 days of social defeat stress using a resident-intruder paradigm. Social avoidance testing and sleep recordings were then performed immediately and 3 weeks after social defeat.

Results: Both NREM and REM sleep amount prior to social defeat were predictive of susceptibility to social defeat. Immediately after defeat, we found that mice exhibiting increased social avoidance had significantly higher amounts of REM sleep and NREM delta power, indicating increased sleep pressure in these susceptible mice. Notably, we also found pronounced changes in sleep-wake architecture that persisted for the 3 weeks following stress.

Conclusion: To our knowledge, this is the first mouse model demonstrating sustained changes in sleep and behavior. We are currently investigating the effects of sleep manipulations in this model on behavioral responses to social defeat to determine if sleep changes are necessary for the development and maintenance of social avoidance. Understanding how sleep regulates the neural pathways responsible for social avoidance in our current model is likely to reveal new targets for the treatment of psychological disorders such as PTSD.

Support (If Any): This work was supported by grant numbers 8G12MD007602 from the National Institute of Minority Health and Health Disparities (NIMHD) to JCE and R01NS078410-01 (NIH) to KNP. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIMHD or the NIH.
0176
NAPPING IS ASSOCIATED TO POOR SLEEP QUALITY AND HARMFUL HEALTH RELATED BEHAVIORS IN A BRAZILIAN POPULATION-BASED STUDY
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Introduction: The number of studies about napping has been recently increasing in the literature, but there are still gaps and controversies about its relationship with sleep quality and health. Our objective is to verify the association between napping and sleep quality, as well as between napping and health related behaviors

Methods: It is a population-based, cross-sectional study, carried out with data from the Campinas Health Survey developed in 2014/2015. We studied a representative sample of 1998 individuals aged 20 years or more (mean age 45.0 years; 54.8% female). The dependent variable was the occurrence of daytime naps (“Do you nap during the day?”). Independent variables were age, gender, variables related to sleep quality (such as complaints about initiating and maintaining sleep and subjective evaluation of sleep quality) and health related behaviors (physical activity, alcohol consumption and smoking). Prevalence and confidence intervals for the dependent variable were estimated according to independent variables. Differences were tested by Chi-square test and, for those with p < 0.20, multiple Poisson regression was performed, adjusting for gender and age. The analyses were performed with svy commands of STATA 11.0

Results: The prevalence of daytime napping was 47.6%. Napping was significantly associated to regular (PR = 1.3) and poor sleep quality (PR = 1.3), difficult in staying awake during the day at least three times a week (PR = 1.9), never (PR = 1.8) or almost never (1.3) feeling well disposed after awaking, snoring (PR = 1.4) and reporting witnessed apneas (PR = 1.3). Furthermore, we found significant association between napping and some harmful habits, e.g., alcohol consumption for at least four times a week (PR = 1.4), current or previous smoking habit (PR = 1.4) and smoking 20 or more cigarettes a day (1.5)

Conclusion: Napping is associated to poor sleep quality and to harmful health related behaviors. Longitudinal studies are needed to help understanding if there is causal relationship in those associations

Support (If Any): FA FESP #2012/23324-3 and FA FESP #2013/19338-1

0177
EXPLORING POVERTY & SOCIOECONOMIC STATUS AS DETERMINANTS OF THE DISPROPORTIONATE SHORT SLEEP PREVALENCE AMONG BLACKS
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Introduction: Previous studies have indicated that race/ethnicity predicts insufficient sleep duration and that blacks bear a greater associated burden than individuals of other racial/ethnic group. We hypothesized that this disparity is likely due to greater poverty levels rather than race/ethnicity itself.

Methods: Data for the present analysis came from the National Health Interview Survey [2004 - 2013], (N = 911,773). The survey applies a multi-stage sample survey of the resident civilian non-institutionalized US population. Respondents provided sociodemographic and physician-diagnosed chronic conditions. Self-reported sleep data was used to determine insufficient sleep status (< 6 hours / night) as well as poverty status. Poisson regression and logistic regression analyses were used to analyze the NHIS data.

Results: Analysis showed that 54.7% of the sample were female; 77.8% were white and 15.6% black, (mean age = 46.68 ± 17.38) years. Blacks consistently had a significantly higher prevalence of insufficient sleep compared to whites for all years included in the analysis (36.35% (p < .001) versus 27.4% (p < .001). Prevalence estimates of insufficient sleepers living below the poverty level was consistently higher than those living above poverty line (OR = 1.28, 95% CI = 1.25 - 1.32 ) (p < .001). After adjusting for race/ethnicity, poverty index was found to be a more significant indicator of likelihood of reporting for insufficient sleep than was race/ethnicity.

Conclusion: Results support our hypothesis that poverty level was a stronger indicator of insufficient sleep than was race/ethnicity. Our findings confirm the importance for advocating for mitigation of the negative aspects of poverty such as poor housing and neighborhood quality and food deserts, all of which affecting sleep health, quality of life and eventually chronic disease risks.

Support (If Any): SUPPORT: This research was supporting by funding from the NIH (R01MD007716, RO1HL78566, and R01HL095799).

0178
PRIOR-NIGHT SLEEP DURATION IS NEGATIVELY ASSOCIATED WITH IMPULSIVITY IN WOMEN
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Introduction: Previous studies have found a correlation between shorter sleep duration and impulsivity in children and specific adult populations. While it is well established that men tend to be more impulsive on average than women, it is not known whether the association between reduced sleep and impulsivity is similar across sexes. Here, we examined the association between hours of sleep the previous night (SPN) before the assessment session and self-reported impulsivity in men and women.

Methods: Sixty healthy adults (30 women), ages 18-45 (M age = 30.25), completed the Barratt Impulsiveness Scale (BIS), a validated survey that measures self-reported tendencies toward impulsive behavior, including three subscales which measure Attentional, Motor, and Non-Planning aspects of impulsiveness. They also completed a questionnaire that asked questions pertaining to their sleep, including hours of sleep the previous night. A partial correlation analysis, adjusting for typical weekday and weekend sleep duration, was utilized to examine the relationship between scores on the BIS and SPN.

Results: Although there was no difference between sexes in terms of SPN (p = .45) or BIS (p = .57), BIS scores were negatively correlated with SPN for females (r = -.53, p = .004), but not for males (r = -.07, p = .73). The difference in the correlation strength between the two groups was non-significant (z = 1.92, p = .055). Furthermore, the significant association within the females was observed for all three subscales, Attentional (r = -.52, p = .005), Motor (r = -.38, p = .049), and Non-Planning (r = -.44, p = .018).

Conclusion: SPN was negatively associated with impulsivity, but only among females. While it is conceivable that impulsivity was the cause of reduced sleep, it seems more plausible that insufficient sleep led to greater impulsivity, as the association remained even after statistically controlling for typical sleep duration. Further work will be necessary to establish causality and to identify whether the underlying mechanisms are due to cognitive, socialization, or neurobiological differences between the sexes.
THE EFFECTS OF TRAIT GRATITUDE ON QUALITY OF SLEEP, INTRUSIVENESS OF PRE-SLEEP COGNITIONS, AND DAYTIME ENERGY IN HEALTHY INDIVIDUALS
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Introduction: Higher levels of trait gratitude are associated with greater psychological health. One aspect of health that may be affected by gratitude is the quality of sleep. We hypothesized that higher self-reported trait gratitude would be associated with better sleep quality, less intrusive pre-sleep cognitions, and lower daytime fatigue.

Methods: Ninety non-clinical 17-29 year old participants (43 females; Mage = 19.01) completed the Gratitude Resentment and Appreciation Test (GRAT) as a measure of trait gratitude. The Glasgow Content of Thoughts Inventory (GCTI) was used the measure the intrusiveness of cognitions in the moments prior to sleep onset within the last week. The Motivation and Energy Inventory (MEI) assessed daytime fatigue, and the Pittsburgh Sleep Quality Index (PSQI) was used to assess self-reported sleep quality.

Results: GRAT scores were negatively associated with intrusiveness of pre-sleep cognitions on the GCTI (r = -.21, p = .05), and positively correlated with higher daytime energy and motivation on the MEI (r = .51, p < .001). Finally, participants with higher trait gratitude reported sleeping longer on the PSQI (r = .30, p = .004), and individuals who rated their sleep as “good” to “fairly good” had higher levels of trait gratitude (M = 314.34, SD = 38.72) than individuals who rated their sleep as “fairly bad” to “bad” M = 287.90, SD = 50.36; t(88) = 2.51; p = .01).

Conclusion: Higher levels of trait gratitude were associated with fewer intrusive pre-sleep cognitions, longer sleep duration, better sleep quality, and greater energy. While the causal nature of these associations cannot be determined from the present study, we speculate that high levels of trait gratitude bias attention toward positive experiences, leading to fewer negative pre-sleep cognitions that could impair the quality of sleep. While further studies are needed to determine whether these results are applicable to individuals with clinical sleep disorders, the results suggest that gratitude interventions might be beneficial in the treatment of sleep problems.

MACHINE LEARNING OF SLEEP AND WAKE BEHAVIORS TO CLASSIFY SELF-REPORTED EVENING MOOD
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Introduction: Depression is a widespread problem, with no method to automatically predict downturns in mood. In this work we investigate the use of machine learning methods, using sleep and wake data, to predict mood.

Methods: We collected 30 days of data each from 68 college students (age: 18-25, 47 male). Throughout the study, participants wore a Q-sensor (Affectiva) on their dominant wrist to measure electrodermal activity, 3-axis acceleration, and skin temperature. Android phone software monitored location, receiver, sender and timing of calls and SMS, and screen on/off timings. Participants also kept morning and evening diaries about daily activities, social interactions, caffeine, alcohol, and drug intake, and overall mood (on a scale from sad(0) to happy(100)) each day upon awakening and at bedtime. We trained a machine learning algorithm to recognize mood using data from the wearable sensor, phone app, and self-reported activities. In order to accomplish this, we split each participant’s mood data into 3 groups labeling the top 30% as “happy”, the bottom 30% as “sad”, and discarding the middle. We computed over 700 features and used automated feature selection to identify the most informative features. After comparing six machine learning techniques, we found that a multi-task, multi-kernel learning algorithm performed the best at classifying happiness.

Results: The method achieved 74% accuracy for evening mood estimation on a hold-out test set. We found that skin conductance and mobile phone usage features between midnight and 8am were among the most informative in classifying evening mood. In particular, higher skin conductance activity and lower screen “on” durations were associated with “happy” evening mood.

Conclusion: Automated machine learning, applied to nightly data from sensors and smartphones, shows value for predicting college student’s mood the following evening. This work indicates the potential value of using objective sleep hygiene data for understanding mood progression.

BEDTIME-DELAYING ACTIVITIES, INSOMNIA, SLEEP DURATION, AND SLEEP QUALITY IN MIDDLE-AGED AND OLDER ADULTS
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Introduction: Time-use surveys suggest that many adults trade-off sleep for other activities, particularly in the hours before intended bedtimes. This study examines the prevalence of bedtime-delaying behaviors in a community-based cohort of middle age and older adults and how it changes over time as participants retire. The cross-sectional and longitudinal relations between bedtime-delaying activities and sleep duration, sleep quality, and insomnia symptoms are also examined.

Methods: Participants in the Retirement and Sleep Trajectories (REST) study (n = 1966, age 47-84 years, 52% female) were recruited from a working population of adults in 1988 (the sampling frame of the ongoing Wisconsin Sleep Cohort Study). Participants indicated whether they regularly engaged on specified pre-bedtime activities that resulted in a delay of their “intended bedtimes” (watching TV/movies, other screen activities involving computer or mobile devices, reading, and other). Outcomes included self-reported sleep quality, insomnia symptoms (difficulty getting or staying asleep, nighttime awakenings), and sleep duration. Age and gender-adjusted estimates were obtained using binary and ordinal logistic regression, and linear regression.

Results: In cross-sectional analyses, the adjusted odds ratios (95% confidence interval) of worse sleep quality were 1.4 (1.2-1.7) for TV watching, 1.2 (1.0-1.4) for other screen activities, and 1.2 (1.0-1.4) for reading. Each of these activities was also associated with shorter sleep duration (-7, -9, and -7 minutes, respectively, all p < 0.05). No consistent associations with insomnia symptoms were observed. Longitudinal changes in these activities were not significantly associated with changes in sleep quality or sleep symptoms over time. Participants who underwent retirement during follow-up increased the frequency of these pre bedtime activities, but this was not statistically significant.

Conclusion: Among middle-aged and older adults, leisure-related pre-bedtime activities (television watching, other screen activities and reading) are cross-sectionally but not longitudinally associated with
self-reported sleep quality and duration, which raises questions about the causal direction of these associations.

Support (If Any): University of Wisconsin Helfaer Endowed Chair and NIH grants IR01AG036838-01A1, R01HL62252, and 1UL1RR025011

0182
EVERYDAY PERCEIVED DISCRIMINATION AND SLEEP: MENTAL HEALTH SYMPTOMS AS A MEDIATOR
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Introduction: Growing literature has documented associations between experiences of perceived discrimination and physical and mental health problems. Sleep is a bioregulatory process essential to maintaining health. The objective of the study was to examine relations between everyday perceived discrimination and adults’ sleep, as well as to explore depressive and anxiety symptoms as potential mechanisms for this link.

Methods: Participants were 151 couples from a representative community sample (Mage = 36.2 years (men), 34.2 years (female)). The sample was ethnically and socioeconomically diverse (~24% African- and the rest mostly European-American; 66% lived near or below the poverty line). Partners self-reported on their sleep problems using the Pittsburgh Sleep Quality Index. Depression and anxiety symptoms were assessed through self-report on the Center for Epidemiological Study of Depression and the Beck Anxiety Inventory questionnaires. Partners reported on their own experiences of general everyday perceived discrimination using the well-established Everyday Discrimination Scale.

Results: Adults reported experiencing discrimination predominantly because of their ethnicity, physical appearance, and poverty. Everyday perceived discrimination, depression, and anxiety were associated with sleep problems for both men and women (men βs = .12, .27, .36, ps < .001; women βs = .17, .16, .24, ps < .001). For both men and women, depression and anxiety fully mediated the association between everyday perceived discrimination and sleep problems where pathways linking discrimination and sleep were reduced to non-significance when adding mental health symptom to the models. Analyses controlled for race, age, income-to-needs, medication use, season of sleep, cohabitation with partner, and shift work.

Conclusion: Findings implicate mental health symptoms as an important mechanism linking perceived discrimination to adult sleep. Experiences of everyday discrimination are associated with increased mental health symptoms, which in turn are linked to greater subjective sleep problems. Future research should assess these associations longitudinally, as well as include objective sleep assessments to further understand these pathways.

Support (If Any): NIH R01-HL093246 to MES.

0183
INFLUENCE OF SLEEP REGULARITY ON SELF-REPORTED MENTAL HEALTH AND WELLBEING
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Introduction: Irregular sleep-wake schedules are commonplace in modern society. Recent studies have suggested the importance of sleep regularity in addition to sleep duration in multiple aspects of health. We studied how sleep regularity affects mental health and wellbeing in college students.

Methods: 114 college students (age: 18-25, 76 male) participated in a 30-day field study. Sleep timing and duration were monitored using actigraphy and daily morning and evening diaries. Wellbeing (alertness, happiness, sluggishness, healthiness and calmness) was also collected using the daily diaries. Participants completed the 12-Item Short Form Survey to self-report their mental health (MCS) and stress (Perceived Stress Scale (PSS)) pre and post-study. Sleep regularity was calculated as the likelihood of being awake or asleep at the same time-points 24-hours apart. We defined regular/irregular sleepers in two ways to check robustness of results: (1) The 40% top and bottom regularity scores; (2) Above or below the average regularity. We used coarsened exact matching for estimating casual effects and controlled covariates (gender, average sleep duration, pre-study PSS). We controlled for long/short sleep duration with thresholds of 6 and 7 hours based on previous studies to test if results were sensitive to these values. T-tests or Mann-Whitney U tests (for non-Gaussian distributions) were used to compare the regular and irregular sleepers.

Results: Regular sleepers had significantly higher MCS and higher alertness and energy level in the morning than irregular sleepers (p < 0.05) for the different coarsening thresholds of sleep duration and regularity. These results held also after controlling for pre-study PSS.

Conclusion: Sleep irregularity appears to be associated with lower self-reported mental health and wellbeing (low energy and alertness in the morning), even when controlling for sleep duration and stress. This work underlines the necessity of considering sleep regularity, in addition to sleep duration, as a potential important factor for mental health and wellbeing.

Support (If Any): R01HL114088, R01GM105018, P01AG009975, K24HL105664 (EBK), T32HL007901 (AWM) and UL1TR001102, the Harvard Catalyst, Samsung Electronics, and MIT Media Lab consortium

0184
SPECIFIC PERSONALITY TRAITS ASSOCIATED WITH INCREASED FOOD CONSUMPTION AFTER 50% SLEEP RESTRICTION
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Introduction: Sleep restriction often leads to increased energy intake (EI). Psychological factors, such as personality, may also be related to heightened EI. The aim of this study was to explore the associations of personality traits previously associated with weight gain and EI following partial sleep deprivation (PSD).

Methods: Seventeen subjects completed the NEO-PI-3. Ad libitum EI was measured following 50% PSD held during the first (PSD1) or second part (PSD2) of the night, and a control session (CS). Spearman’s rho correlations were computed between the E5 (excitement-seeking), N5 (impulsiveness), C3 (achievement-striving), and C5 (order) NEO-PI-3 scales, and the differences in EI (Eld) between each PSD sessions and the control session (PSD-CS).

Results: E5 showed a significant negative relationship with Eld after PSD2, (r = -.59; p = .013) and a non significant trend after PSD1 (r = -.44; p = .077). None of the other 3 scales showed any relationship with Eld after both PSD conditions (N5: r = .15 and r = .27; C3: r = .10 and r = .17; C5: r = -.15 and r = .35 for PSD1 and PSD2 respectively).

Conclusion: These results suggest that following partial sleep deprivation, more specifically following the loss of the second part of their night’s sleep, individuals that are less prone to excitement-seeking and stimulation tend to increase food intake. This was somewhat contrary to what was expected since high scores on E5 are often associated with risk taking and addictions. Our results suggest that after partial sleep deprivation...
deprivation, it is rather people who tend to be generally more passive and quiet that increase their food consumption after sleep loss. This study highlights the fact that further research is needed to better understand how sleep loss interacts with personality to modulate EI.

0185 HABITUAL CAFFEINE USE AND MOTIVATION TO CONSUME CAFFEINE: ASSOCIATIONS WITH SLEEP DURATION, SLEEPINESS, FATIGUE, AND INSOMNIA SEVERITY


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Introduction: Caffeine is a commonly used countermeasure for sleepiness and fatigue, although it may lead to problems with sleep continuity and duration. In this investigation, we examined whether the desire to alleviate fatigue/sleepiness is associated with increased likelihood of caffeine consumption.

Methods: Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used. SHADES is a community-based study of adults in southeastern Pennsylvania (N = 1007). Participants recorded the “typical number of servings per day” of caffeine, and whether they felt that they “needed caffeine to get through the day” (yes or no). Sleep duration was assessed using the NHANES question (hours/weeknight). Insomnia was assessed with the Insomnia Severity Index and categorized as none (reference), mild, or moderate-severe. Fatigue was assessed with the Fatigue Severity Scale and sleepiness was assessed with the Epworth Sleepiness Scale. Relationship between these factors and servings of caffeine were evaluated using logistic regression, adjusted for age, sex, race/ethnicity, education, smoking, and binge drinking. Associations with “needing caffeine” were also adjusted for caffeine servings.

Results: There was no relationship between number of servings and sleep duration, however there were small but significant relationships with sleepiness (B = 0.07 servings/point; p < 0.0005), fatigue (B = 0.02 servings/point; p = 0.001), mild insomnia (B = 0.48 servings; p = 0.002), and moderate-severe (B = 0.53 servings; p = 0.001) insomnia. Although, desire (i.e., “needing”) to consume caffeine was not associated with sleep duration or sleepiness, it was associated with fatigue (OR = 1.03/point, p < 0.0005), mild insomnia (OR = 1.99, p < 0.0005) and moderate-severe (OR = 2.34, p < 0.0005) insomnia. An interaction of insomnia status on fatigue was seen, such that fatigue was associated with motivation for caffeine, but only in those without insomnia.

Conclusion: Sleepiness, but not sleep duration, was modestly but significantly associated with the amount of caffeine consumed. Fatigue and both mild and moderate-severe insomnia are associated with motivation to consume caffeine. The desire for caffeine consumption is neither associated with sleepiness nor sleep duration.

Support (If Any): The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216. Dr. Chakravorty is supported by VA grant IK2CX000855.

0186 CROSS-SECTIONAL ASSOCIATIONS BETWEEN SLEEP AND ENERGY INTAKE: THE CARDIA SLEEP STUDY

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Introduction: Experimental studies that restricted sleep observed increased appetite and food intake after sleep loss. Observational studies have also reported associations between self-reported sleep and dietary intake. The aim of this study was to determine whether sleep duration, quality or timing estimated from actigraphy was associated with energy intake.

Methods: The CARDIA Sleep Study recorded wrist actigraphy for 3 days twice, approximately one year apart in 2003-2005; 92% had 6 days of recording. The Berlin Questionnaire was used to estimate apnea risk. In 2005-2006, CARDIA participants underwent an interviewer-administered quantitative food frequency questionnaire to assess total energy intake (kcal) and amount (g) of the three macronutrients: protein, carbohydrates and lipids. Regression analyses were used to quantify associations between sleep measures and energy intake adjusting for age, race, sex, body mass index, education and, in the macronutrient analyses, energy intake.

Results: Participants with both sleep and dietary data (n = 602) were 37 to 55 years old (mean 45 years), 58% were women, 43% were African-American and 57% were white. Sleep duration was not significantly associated with energy intake: sleep percentage, (beta -2.19 kcal/percent, 95% CI -35.9, -8.0), sleep fragmentation (beta = 16.2 kcal/percent, 95% CI 6.6, 25.8) and wake after sleep onset (349.7 kcal/hour, 95% CI 168.6, 530.9). Sleep start time, midpoint of the sleep period and apnea risk were not associated with energy intake. No sleep measure was associated with any of the three macronutrients.

Conclusion: Among middle-aged adults, worse sleep quality was associated with greater energy intake, while sleep duration, timing and apnea risk were not.

Support (If Any): P01 AG01412, NO1-HC-48047, NO1-HC-48048, NO1-HC-48049, NO1-HC-48050, and NO1-HC-95095

0187 DELAY DISCOUNTING AND RESPONSE DISINHIBITION MODERATED ASSOCIATIONS BETWEEN ACTIGRAPHICALLY-MEASURED SLEEP AND BODY MASS INDEX (BMI)

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Introduction: Poor sleep is associated with greater risk of obesity. Prior studies suggest that this association is stronger in individuals who lack self-regulatory ability to mitigate the influence of poor sleep on eating. This study examined whether the associations between sleep and BMI would be moderated by delay-discounting, the tendency to choose immediate rewards and devalue delayed rewards, and response disinhibition, the difficulty withholding previously-rewarded responses, such that the associations would be stronger in individuals with greater delay-discounting tendencies or greater response disinhibition.

Methods: University students (N = 78) carried a wrist-worn actigraph for 7 days and completed the computerized delay-discounting task and go/no go (NGG) task. The false alarm rate in NGG was used to indicate response disinhibition. BMI was computed using measured height and weight.

Results: Regression analysis showed that sleep duration, bedtime, sleep latency, and sleep fragmentation were not significantly associated with BMI. However, the bedtime-by-delay-discounting interaction was significant (R = .30) indicating that later bedtime was associated with higher BMI only in individuals who had high delay-discounting. The sleep duration variability-by-delay-discounting interaction was also significant (R = .15) indicating that the association was stronger in individuals with high delay-discounting. Bedtime variability was significantly and positively associated with BMI (R = .22). The bedtime variability-by-delay-discounting interaction and the bedtime variability-
ty-by-GNG interaction were both significant (Rs = .18, .15) indicating that the association between bedtime variability and BMI was stronger in individuals with high delay-discounting and in those with higher false alarm rates in GNG.

**Conclusion:** Consistent with literature suggesting the association between poor sleep and obesity is stronger in individuals who lack self-regulatory ability, the present findings showed that individuals who have difficulty resisting immediate rewards and those who have the difficulty suppressing a previously-rewarded behavior might be especially vulnerable to the influence of late bedtime and irregular circadian rhythm on their eating and weight.

**Support (If Any):** This research was conducted at Indiana University. The author was funded by Indiana University.

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**0188**

**EFFECTS OF DISTRACTION AND DROWSINESS ON SIMULATED DRIVING PERFORMANCE IN POLICE OFFICERS**

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**Introduction:** Collisions are a leading cause of police officer on-duty deaths. Distracted driving is a major contributing factor in motor vehicle collisions among the general public. Within policing, fatigue associated with shift work is a well-established and pervasive problem that affects officer performance and safety. Although drowsy driving among post-shift workers is a well-established risk factor, no data are available about officer injuries and deaths due to drowsy driving. We assessed the impact of fatigue, distraction, and the interaction of distraction and fatigue on officers’ driving using laboratory experiments with high fidelity simulation.

**Methods:** Experienced police patrol officers (n = 80) from four shifts were tested using a within- and between-subjects design to assess the impact of fatigue and distraction on individual officers, as well as the impact of different work shifts, on driving performance. Officers drove high-fidelity driving simulators on two separate occasions: immediately following five consecutive 10:40-hour patrol shifts (fatigued condition) and again 72 hours after completing the last shift in a work cycle (rested condition).

**Results:** Experienced police patrol officers (n = 80) from four shifts were tested using a within- and between-subjects design to assess the impact of fatigue and distraction on individual officers, as well as the impact of different work shifts, on driving performance. Officers drove high-fidelity driving simulators on two separate occasions: immediately following five consecutive 10:40-hour patrol shifts (fatigued condition) and again 72 hours after completing the last shift in a work cycle (rested condition).

**Conclusion:** Fatigue, night shift work, and distracted driving are all common in policing and all impair driving performance. PVT reaction scores were found to predict impaired driving performance and could be used as early warning indicators. Breaking latency and lane deviation were also significant predictors of collisions, suggesting that these variables could also be used to alert officers of the dangers of drowsy and distracted driving.

**Support (If Any):** California Commission on Peace of Officer Standards and Training, US DOD Office of Naval Research

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**0189**

**SLEEP INERTIA IS GREATER FOLLOWING MORNING AWAKENINGS ON A SIMULATED 6H ON / 6H OFF SPLIT DUTY SCHEDULE**

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**Introduction:** Split duty schedules can offer an alternative to traditional shift scheduling by reducing shift length and providing nocturnal rest periods for all workers. However, such duty schedules introduce additional wake-ups and may therefore increase risk of sleep inertia. This study investigated sleep inertia across a 6h on / 6h off split duty schedule.

**Methods:** Sixteen participants (aged 21-36y; 10 females) completed a 9-day laboratory study with two baseline nights (10h time in bed, TIB), four 24h periods of a 6h on / 6h off split duty schedule (5h TIB each period; 10h TIB per 24h) and two recovery nights. Participants were randomly assigned to one of two complementary rosters: a 2am/2pm wake-up roster or an 8am/8pm wake-up roster. An 8min sleep inertia test bout, which included a 3min Psychomotor Vigilance Test (PVT-B) and the Karolinska Sleepiness Scale (KSS), was completed at 2min, 17min, 32min and 47min after scheduled awakening. Further testing occurred at 1.5h, 3.5h and 5.5h after scheduled awakening to capture background performance.

**Results:** Mixed-effects ANOVA revealed that PVT-B response times were slower and KSS ratings were higher during sleep inertia tests compared to background for all wake-up times (p < 0.01) except 8pm (p > 0.7). For both rosters, the difference in performance and alertness between the sleep inertia period and background was greater for am wake-ups compared to pm wake-ups (p < 0.001).

**Conclusion:** Morning wake-ups (2am and 8am) were associated with higher levels of sleep inertia than later wake-ups (2pm and 8pm). Our results suggest that split duty workers may experience sleep inertia more than once a day, with the effect being greatest during the morning hours.

**Support (If Any):** Bushfire Cooperative Research Council

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**0190**

**CORRELATES OF POOR SLEEP QUALITY AMONG ACTIVE-DUTY AIR FORCE CADETS IN AVIATION PHYSIOLOGICAL TRAINING**

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**Introduction:** There are significant consequences to human error and accidents caused by performance deficits due to sleep deprivation and poor sleep quality in active-duty jet fighter pilots. Yet little is known about correlates of poor sleep among a highly select group of young active-duty Air Force cadets in Taiwan. The objective of this study was to investigate the extent of poor sleep and its correlates in active-duty Air Force cadets during aviation physiological training in Taiwan.

**Methods:** This was a cross-sectional study conducted in 2015. Seventy four active-duty healthy Air Force cadets aged 22 to 24 years were recruited from the Taiwan Air Force Academy during their one week intense training period. Sleep quality was assessed with Pittsburgh Sleep Quality Index (PSQI). Potential risk factors included daily training duration, stress, trouble falling asleep, fatigue, smoking, depres-
sion, and sleepiness, caffeine intake, physical activity, work condition, and support based on self-report questionnaire. Multivariable logistic regression model was conducted to estimates odds ratios (OR) and its corresponding 95% confidence interval (95% CI).

**Results:** The proportions of poor sleep quality (global PSQI scores > 5), sleepiness (ESS scores ≥10), and self-reported trouble falling sleep were 45.8%, 31.1%, and 27%, respectively. Short sleep duration of < 8 hours (OR: 7.34, 95% CI: 1.84 - 29.35 ) trouble falling sleep at bedtime (OR: 18.05, 95% CI: 2.97 - 109.64 ) , and fatigue (OR: 1.57, 95% CI: 1.00 - 2.46 ) were significant predictors of poor sleep quality after adjusting for other covariates.

**Conclusion:** Sleep problems among young, healthy, Taiwanese active-duty Air Force cadets are common. Our study findings have significant implications for the health and safety concerns for Air Force cadets in Taiwan. A prospective cohort study with larger sample size is warranted to further investigate the correlates of poor sleep among active-duty Air Force cadets.

**0192 PILOTS’ SELF-REPORTED FATIGUE MANAGEMENT ON LONG-RANGE AND ULTRA-LONG-RANGE ROUTES**

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**Introduction:** Fatigue risk is inherent to long haul flight operations, which involve long duty periods and transmeridian flights. Pilots operating such long-haul flights often experience periods of extended wakefulness and sleep loss. Although the use of in-flight rest is the primary recommended fatigue countermeasure, information about other fatigue countermeasures used by pilots is mainly anecdotal. The present analyses aimed to identify how pilots manage their fatigue during these flights.

**Methods:** Duty diary data collected as part of five prior studies of pilot sleep on different routes was combined and responses to a question relating to how they managed fatigue on each flight segment were extracted. Accepted methods of thematic analysis were applied to these responses.

**Results:** A total of 629 responses were included in these analyses. Fatigue management strategies did not appear to be linked to the type of flight (long range vs. ultra-long range). The main method of managing fatigue was the use of the allocated in-flight rest opportunities, although the organisation of these breaks varied by route and fleet. Pilots described different flight preparation techniques which were aimed at either maximising sleep pre-flight (e.g. taking a nap) or at maximising sleepiness prior to the flight (e.g. shortening sleep pre-flight). These practices were frequently linked to planning for a specific in-flight rest break. Pilots also reported techniques used to increase their alertness in-flight (e.g. coffee, exercise) and strategies to improve their in-flight sleep (e.g. avoiding caffeine, relaxing).

**Conclusion:** The fatigue management techniques reported imply that pilots make use of in-flight rest opportunities which align with current recommendations when additional pilots are on board (augmented crews). However, responses indicated that flight preparation was another important fatigue management strategy, which highlights the importance of pilots knowing the pattern of in-flight rest breaks well ahead of the flight.

**Support (If Any):** This research was funded by the Commonwealth Scholarship and Fellowship Plan. The included prior studies were funded by four different airlines.

**0193 REPORTED SLEEP PROBLEMS AND PRACTICES IN ACTIVE DUTY MILITARY MEMBERS DURING DEPLOYMENT**

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**Introduction:** Members of the military are plagued by sleep challenges often resulting in chronic sleep deprivation and elevated fatigue. This study assessed a) the prevalence of sleep-related problems in a sample of active-duty military members, and b) the effect of interventions designed to improve sleep hygiene (e.g., sleep education, use of melatonin, improving shift schedules).

**Methods:** Completed between 2012 and 2015, the annual survey (4,653 respondents; 69% between 19 and 25 years old; ∼80% response rate) covered shiftwork practices, sleep quantity/quality, sleeping conditions, prevalence of sleep problems and sleep paralysis, and personal sleep-related habits and behaviors, such as caffeine intake, activities before bedtime, etc.
Results: Over the four-year period, approximately 58% of the respondents reported receiving ≤ 6 hours of daily sleep, with six hours being the most frequent response (35%). To improve their sleep, respondents reported using blackouts (48%), taking melatonin (21%), or using alcohol (15%). Overall, 49% of respondents relied on pharmacological interventions to improve their sleep (e.g., melatonin, prescription drugs or over-the-counter medications). Respondents reported that effective sleep aids included using alcohol, black-out shades, pharmacological interventions, and white noise machines. Nearly half of respondents reported having trouble staying asleep (48%), followed by oversleeping (26%), sleep paralysis (26%) and experiencing bad dreams (24%). Participants reporting seven, or more, hours of sleep increased from 34% in 2012 to 45% in 2015 (p < 0.001), whereas melatonin use increased from 10.3% in 2012 to 29.6% in 2015 (p < 0.001).

Conclusion: Preliminary results showed that sleep education and the promotion of healthy sleep-related practices improved reported sleep and was associated with increased melatonin use. However, further education should emphasize the potentially negative impact of questionable practices (e.g., physical workouts before sleep, use of alcohol).

TIED COPS: THE IMPACT OF FATIGUE ON TACTICAL SOCIAL INTERACTION IN POLICING
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Introduction: Chronic fatigue due to shift work, long work hours, and sleep disruption is pervasive among police. On the streets, officers who are tired are less in control of their emotions, and are less likely to interact with people in ways that build trust in police. This abstract presents results from a groundbreaking three-year experimental study of the effects of shift-work related fatigue on officers’ performance, including their “tactical social interaction” (TSI) skills.

Methods: N = 80 experienced police patrol officers (selected from day and night shifts) were tested in a controlled laboratory setting using high-fidelity computerized training simulators with custom-made, research-based TSI scenarios. Novel TSI metrics were developed to measure participant performance in real time, which enabled branching of TSI scenarios based on how effectively participants were interacting with people in the simulator. TSI performance immediately after the last of five consecutive 10:40 hour work shifts (fatigued condition) was compared to TSI performance at the same time of day after 72 hours off (rested condition). Participants were monitored using wrist actigraphy for seven days immediately preceding each experimental day.

Results: Multi-level modeling (MLM) revealed that participants in the “day sleeper” condition (night-shift workers) were significantly less likely to have a successful outcome on the TSI scenarios (wald = 5.11; df = 1; p = 0.024). Although being in the fatigued condition did not significantly predict scenario outcome, fatigued officers were less likely to introduce themselves to civilians than they were when rested (wald = 4.27; df = 1; p = 0.039).

Conclusion: These results lay the foundation for addressing the impact of shift work-related fatigue on how officers interact with members of the public in day-to-day encounters that can either increase or erode trust in police. The negative impact of fatigue on TSI has significant implications in the current climate of police-citizen unrest, where perceptions of police legitimacy are low.

Support (If Any): Department of Defense (DOD) Office of Naval Research (ONR)

0195

IST BREAK VS 2ND BREAK AS A PREDICTOR OF FATIGUE, SLEEPINESS, AND PERFORMANCE AT TOP OF DESCENT DURING LONG RANGE AND ULTRA-LONG RANGE FLIGHTS
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Introduction: Top of descent (TOD) is a critical phase of flight because it is when the pilot initiates the descent to landing. We studied the effect of taking a 4-5 hour rest/sleep opportunity in the 1st half compared to the 2nd half of the flight on fatigue, sleepiness, and performance at TOD in long-range (8-16 hours) and ultra-long range (16+ hours) flights.

Methods: The flights studied originated either in 1) San Francisco (SFO), California and flew non-stop to Sydney (SYD) or Taipei (TPE), Taiwan or 2) Los Angeles (LAX), California and flew non-stop to Melbourne (MEL) or Shanghai (PVG), China. The pilots had a layover between 24-48 hours and then returned to SFO or LAX. Each pilot’s total inflight sleep (TIFS) was measured by actigraphy. At TOD for both Outbound and Inbound flights, fatigue was measured by the Samn-Pennelli Fatigue Scale (SP) and sleepiness was measured by the Karolinska Sleepiness Scale (KSS). Pilot performance at TOD was measured by the 5-minute psychomotor vigilance task (PVT).

Results: We studied 79 pilots (11 women), mean age 52 years +/- 7.01 SEM. We examined whether taking the 1st break or 2nd break predicted fatigue, sleepiness, and performance at TOD. Flight times were between 10-18 hours. We found significantly more fatigue and sleepiness at TOD in pilots taking the first break compared to those taking the second break. We found no significant difference in total inflight sleep or speed on the PVT between pilots taking the first break and those taking the second break. These results were the same for pilots flying Outbound and Inbound.

Conclusion: The results indicate that taking the second break for rest and sleep reduced fatigue and sleepiness at TOD for pilots flying long range and ultra-long range flights.

Support (If Any): The study was supported by United Airlines.

AN EXPLORATORY ANALYSIS OF PILOT SLEEP OPPORTUNITY PREFERENCES ON ULTRA-LONG RANGE FLIGHTS
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Introduction: Ultra-Long Range (ULR) flights are flown with 4 pilots. During cruise, 2 pilots at a time can be in the bunk facility sleeping. The ULR flights studied originated in California (San Francisco or Los Angeles) and flew non-stop to Australia (Melbourne (MEL) or Sydney (SYD)) and, after a layover, returned to California. Flight times were between 13-15 hours. The pilots in command (PICs) - the two pilots flying the aircraft during take-off and landing - have their choice of when to take their inflight sleep opportunity. We examined whether the PICs preferred to sleep during the 1st break, 2nd break, or take a split break, and how their choice related to their estimated circadian rhythm.

Methods: Pilots flew Outbound and Inbound for MEL or SYD. Inflight sleep, measured by actigraphy and self-report, was plotted to determine which break the PICs chose and if there was, relative to home base time, a preference to sleep during the window of circadian low (02:00 - 06:00), the afternoon dip in alertness (15:00 - 17:00), or the window of circadian high (20:00 - 22:00).

Results: We studied 38 pilots (6 women), mean age 56 years +/- 5.97 SEM. For Outbound flights, the PICs chose first break on 14 of 38 flights, second break on 19 of 38 flights, and split break on 5 of 38
flights. For Inbound flights, the PICs chose first break on 3 of 38 flights, second break on 34 of 38 flights, and split break on 1 of 38 flights. For Outbound and Inbound flights combined, the PICs most often chose to sleep during the window of circadian low.

Conclusion: The PICs preferred second break to first break or split break. The PICs preferred their inflight sleep opportunity to coincide with their window of circadian low, a circadian phase favorable for sleep.

Support (If Any): The study was supported by United Airlines.

0197 PATTERN OF RECOVERY SLEEP AMONG PILOTS FOLLOWING MULTIPLE TRANS-PACIFIC FLIGHTS

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Introduction: Little is known about recovery sleep patterns of pilots after flying sequences of transmeridian flights with successive 1-d layovers in different time zones.

Methods: Thirty-nine B747-400 pilots (19 captains, 20 first officers, mean age = 55.5 y) were monitored on 9-13 d trips with multiple return flights between the East Coast USA and Japan (4-pilot crews) and Japan and Hawaii (3-pilot crews), with 1-d layovers between each flight. Sleep was monitored (actigraphy and diaries) from 3 days prior to the first flight through 5 days following the last flight. Mixed effects modelling was used to compare total sleep/24h between pre-trip days 1-5 and pre-trip baseline (days 1-2 excluding the 24h prior to duty start). Sleep timing was compared using chi-square periodogram analyses of sleep propensity curves for pre-trip and post-trip days (excluding pilots who lived > 1 time zone west of EDT).

Results: Pilots obtained more sleep during the first 24h post-trip relative to baseline. Total sleep/24h was not significantly different from baseline from post-trip day 2 onwards. Recovery sleep patterns across post-trip days for 38 pilots could be classified into three groups. Group A (n = 12) immediately resumed their pre-trip pattern of a single nocturnal sleep episode. Group B (n = 9) had a daytime nap on most days, that moved progressively earlier until it merged with nocturnal sleep. Group C (n = 17) had both nocturnal sleep and intermittent naps. Chi-square periodogram analyses of the sleep propensity curves for each group across baseline and post-trip days (dominant period = 24h) suggests full adaptation to EDT from post-trip day 1.

Conclusion: Grouped total sleep duration and chi-square periodogram analyses suggest rapid post-trip re-adaptation. However, this may be an over-simplification considering the variable patterns of post-trip sleep for Groups B and C, including persistent patterns of split sleep post-trip compared to pre-trip. Further investigation of circadian readaptation under these conditions is warranted.

Support (If Any): Delta Air Lines

0198 PREDICTORS OF GPA IN FIRST-YEAR COLLEGE STUDENTS: RELATIONSHIPS WITH SLEEP REGULARITY, MOOD, EMOTION REGULATION, AND MORNINGNESS-EVENINGNESS TENDENCIES

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Introduction: College students are known for having poor sleep and irregular sleep schedules, especially during the first year of college. These sleep habits may contribute to poor academic outcomes. Using self-report questionnaires, we examine the relationship between GPA, sleep, and mood.

Methods: Data were obtained from 311 college freshmen (237 female). The Morningness-Eveningness Questionnaire (MEQ) was used to assess morning and evening tendencies. The Sleep Schedule Regularity Questionnaire (SSRQ), created for this study, was used to assess students’ perceptions of their sleep regularity. Higher scores on the SSRQ subscales indicate a more regular sleep schedule. The Pittsburgh Sleep Quality Inventory (PSQI) was used to assess sleep disturbance. The Beck Depression Inventory (BDI) was used to assess symptoms of depression. The Emotion Regulation Questionnaire (ERQ) was used to assess emotion regulation strategies. Students rated mood in a daily online diary. A hierarchical multiple regression was performed to examine the relationship between GPA and other variables. The first block contained sleep variables (schedule variability, sleep disturbance, and morningness-eveningness) and the second included mood variables (depression, daily mood, and use of reappraisal). Correlations were performed to examine the relationship between GPA and the individual factors.

Results: GPA was significantly predicted by the entire model (R2 = .11, p < .001). Higher GPA was associated with fewer sleep complaints, (r = -.21, p < .001), a more regular sleep schedule (r = .25, p < .001), greater use of reappraisal (r = .13, p < .05), fewer depression symptoms (r = -.15, p < .01), and more morning tendencies (r = .22, p < .001).

Conclusion: Both mood and sleep factors contribute to the academic performance of first year college students. Having a more regular schedule, though not necessarily sleeping more, is especially predictive of a higher GPA. Although the study did not examine causal relationships between variables, these findings suggest that regularizing students’ sleep should be explored as a strategy for improving academic performance.

0199 EFFECTS OF A SLEEP HYGIENE TEXT-MESSAGE INTERVENTION ON SLEEP IN COLLEGE STUDENTS

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Introduction: Young adulthood is a time of transition with multiple stressors that may affect healthy lifestyle habits such as sleep. Habits formed during this time may impact health in later life. Text-messaging interventions have been effective with other health behaviors in the young adult population; no studies using text-messaging to improve sleep related behaviors were identified. The purpose of this study was to test the effectiveness of a text-message intervention on sleep among young adult college students. Using Bandura’s Social Cognitive Theory, it was hypothesized that a sleep hygiene text-message intervention would increase sleep hygiene knowledge, increase self-efficacy for sleep hygiene, and improve sleep quality and sleep hygiene among young adult college students.

Methods: A randomized control trial (RCT) with a 2-group pretest-posttest design was used to test the hypotheses. A convenience sample of undergraduate students (n = 96), 18-26 years old, were recruited using email messages, flyers, social media and in-class announcements across campus. Participants were randomized to receive biweekly text messages about sleep (experimental group) or healthy behaviors (attention control group) for six weeks. The Pittsburgh Sleep Quality Index (PSQI), Sleep Hygiene Awareness and Practice Scale (SHAPS), Self-efficacy for Sleep Hygiene Inventory (SESHI), and Sleep Hygiene Index (SHI) were completed pre- and posttest. Within-between ANOVA was used to compare results.
Results: There were no significant differences between groups. Sleep quality was significantly related to students major (r = .27), level of stress (r = .35), and social activities with friends at night (r = -.29); sleep hygiene self-efficacy was significantly related to sleep quality (r = -.45) and SHI, (r = .38).

Conclusion: This study suggests that self-efficacy for sleep hygiene is an influential factor in sleep quality. Sleep quality improved in both groups. Text-messaging may be an appropriate intervention to promote healthy behaviors to the young adult population.

Support (If Any): Research supported by the Institute for Integrated Healthcare

0200 TEMPORAL ASSOCIATIONS BETWEEN SLEEP AND PHYSICAL ACTIVITY AMONG COLLEGE STUDENTS

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Introduction: Rising levels of insufficient sleep and sedentary behavior are of growing public health concern. These poor health habits tend to co-occur and likely exert a bidirectional influence on one another, though it is not clear whether one direction yields a stronger influence than the other. College students may be particularly vulnerable to the consequences of insufficient sleep because their natural circadian rhythms and social norms are often misaligned with early daytime obligations.

Methods: The current study examined temporal relationships between objectively-assessed sleep and exercise in a sample of 54 college students. Participants wore a Fitbit Flex for one week that provided both daily sleep (e.g. total sleep time, wake after sleep onset) and physical activity (e.g. number of steps, sedentary behavior) data.

Results: Multilevel modeling revealed that daytime physical activity was not a significant predictor of sleep the following night. However, nocturnal sleep was a strong predictor of physical activity the following day (all p’s < .05). Our examination of daily data suggests that, in contrast to findings with more aggregate data, sleep is a robust predictor of subsequent physical activity, but that physical activity is not a predictor of subsequent sleep.

Conclusion: These findings may result from the unique nature of a college student lifestyle, and future research should consider this question in a variety of populations. These results may provide some insight into the utility of developing health promotion programs designed to target multiple health risk behaviors among college students.

0201 SLEEP QUALITY PARTIALLY MEDIATES THE RELATIONSHIP BETWEEN ACES AND PERCEIVED HEALTH IN COLLEGE FRESHMAN

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Introduction: The relationship between adverse childhood experiences (ACES) and chronic physical health problems in later adulthood is well established. Less is known about whether these relationships arise in earlier adulthood. Although sleep quality is strongly tied to physical health, little research has explored sleep quality as a mediator between ACES and health. The goal of the present study is to address both of these questions, investigating sleep quality as a mediator between ACES and health in college freshmen.

Methods: College freshmen (N = 379) completed study measures through an online survey that included the Pittsburgh Sleep Quality Index (PSQI), the General Health Questionnaire (GHQ), and demographic assessments. Multiple imputation was used to account for missing data. Mediation analyses were used to test sleep quality as a mediator between ACES and health (Baron & Kenney, 1986).

Results: Linear hierarchical regression was employed to examine whether sleep quality mediated the relationship between ACES and general perceived health. The standardized regression coefficient between ACES and sleep quality was significant (β = 0.25, p < .001), as was the standardized regression coefficient between sleep quality and health when controlling for ACES (β = -0.32 p < .001). The standardized indirect effect using Sobel’s test was -2.25 (p < .05). A partial mediation was suggested, given that ACES continued to predict health with sleep quality in the model (β = -0.28, p < .001).

Conclusion: Previous research has investigated the relationship between ACES and general health in older adults. These findings suggest that the relationship between ACE and health may begin in early adulthood. Sleep quality may be an important target of intervention for health and especially for college freshmen, a demographic notorious for reporting low sleep quality. Future research should investigate the temporal relationships between ACES, sleep, and physical health using objective measures of sleep and physical health.

0202 SLEEP AND RISK ON COLLEGE STUDENTS’ ENTREPRENEURIAL BEHAVIOR

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Introduction: Research findings suggest that risk-taking behaviors are impacted by quality and duration of sleep. A lack of sleep impairs assessment of risk, resulting in a decrease of risk taking behaviors. In the business world, hesitation to take innovative and creative risks could potentially lead to a loss of revenue. To our knowledge, there is no research that assesses the link between sleep, risk-taking behaviors, and entrepreneurial success. The goal of our study was to analyze student group performance on an entrepreneurial task as a function of their sleeping habits and associated risk-taking behaviors.

Methods: Participants were James Madison University students (N = 39) enrolled in a business class, MGT 372. The participants were divided into groups and completed an entrepreneurial project in which the group sales of a product dictated the group’s grade. Actigraph watches were supplied to the participants for one week in order to record sleep variables such as sleep duration and napping frequency.

Results: Preliminary data analysis shows a moderate correlation between average group sleep duration (excluding naps) and group profit on the entrepreneurial task (R = 0.402).

Conclusion: Preliminary findings suggest that greater group sleep duration positively impacted student performance on the entrepreneurial task. This finding, in conjunction with previous literature, suggests that entrepreneurs with healthy sleep habits are more likely to accurately assess potential risks, resulting in a more lucrative performance during entrepreneurial tasks.

0203 CONSIDERING THE ROLE OF SOCIAL INFLUENCE ON COLLEGE STUDENTS’ SLEEP BEHAVIOR: IMPLICATIONS FOR BEHAVIOR CHANGE INTERVENTION PROGRAMS

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Introduction: Social influence is a strong predictor of health behavior in college. This research extends these findings to college students’
sleep, exploring how social influence is exerted on their sleep intentions. Exploring social factors that predict uptake of healthful sleep practices in college will illuminate directions for future sleep education programs on college campuses.

Methods: Data were collected from a random sample of students at Cornell University (N = 157; mean age = 20 ± 1.4 years; 78%, female; and 56%, white). Online surveys assessed self-reported sleep behavior, intention, social norm beliefs (e.g., “People important to me would be supportive of me sleeping 7 to 8 hours at night”), and sleep-related conversation (e.g., about healthful sleep practices, “Getting adequate sleep,” and unhealthful practices, “Staying up late”). Regression analysis was used to assess relationships between social variables and intentions.

Results: Insufficient sleep (<7 hrs) is common on weeknights (48.4% agreed with statement “I sleep 7 to 8 hours on most weeknights”), yet sufficient sleep (7-8hrs) is common on weekends (73.0% agreed with statement “I sleep 7 to 8 hours on most weekend nights”). Students reported intention to sleep (M = 1.1, range -3 to +3), and positive norms (M = 1.8, same range). Conversations about healthful sleep (M = 6.3, range 1 to 14) were less common than unhealthful sleep (M = 7.2, same range). Regression analysis also showed significant relationships between conversation and social norm beliefs (healthful sleep conversation (b = .43, p < .01, r² = .1), unhealthful sleep conversation (b = -.44, p < .01; r² = .11). Analysis also showed a strong positive relationship between social norm and intention (b = .3, p < .001; r² = .12).

Conclusion: Our findings are consistent with previous research on relationships between social norm and sleep behavior. They extend this literature, documenting negative relationships between unhealthy sleep-related conversation and social norm beliefs. These suggest these undesirable conversations may be important to target in interventions.

### 0204ENDORSEMENT OF SLEEP MYTHS CORRELATES WITH RISK-TAKING BEHAVIOR IN ADOLESCENTS

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Introduction: Poor sleep has been repeatedly linked with increased risk-taking behavior in adolescents. Despite the objectively poor nature of their sleep, those with poorest sleep tend to report subjective satisfaction with their sleep. To date, no study has directly addressed this contradiction. Adolescents’ knowledge and understanding of sleep may link these vital developmental behaviors.

Methods: 148 college students completed a new 18-item, 7-point Likert-type scale (The Sleep Myths Scale [SMS]) to capture misunderstanding of sleep via endorsement of common sleep myths. Participants also completed questions about their risk-taking behavior (e.g., alcohol and drug consumption), personality, depression, sleep amount and overall sleep satisfaction. Initial reliability of the SMS was computed using Cronbach’s alpha and SMS scores were correlated with the remaining measures.

Results: The SMS showed good initial reliability, Cronbach’s alpha = .75, and significant Pearson’s correlations with risk-taking and personality factors (all p < .05). Specifically, as endorsement of the SMS increased, High School GPA decreased, average nightly sleep decreased, and average alcohol, marijuana, nicotine and caffeine consumption on weeknights increased. High SMS endorsement was also related to higher ratings of personal carelessness, disorganization, laziness, starting fights, and task inefficiency. Despite this, individuals with high SMS endorsement also tended to be relatively satisfied with their sleep.

Conclusion: College students with a poor understanding of sleep engage in riskier behaviors than those who understand sleep, suffer the consequences of poor sleep (e.g., GPA), and yet report higher satisfaction with their sleep overall. High SMS endorsement may be rooted in several potential causes, including low need for cognition. Further study is needed to determine these causes. Current results suggest that targeted educational interventions designed to inform students about the importance and impact of sleep may improve risk-taking behavior outcomes for those who need it most.

### 0205 EFFECTS OF PHYSICAL ACTIVITY LEVELS AND SLEEP-WAKE SCHEDULE ON BEHAVIOR AND MOOD: PRELIMINARY RESULTS FROM A PILOT STUDY OF COLLEGE STUDENTS

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Introduction: Two major concerns on the lifestyle of college students are lack of physical activity and disturbances in sleep-wake cycles that may lead to sleep and behavioral disorders. The goal of this study is to test how physical activity levels and sleep-wake schedule impact daily behavior and mood of college students.

Methods: Twenty healthy college students (18-30 years old) were studied for 3 weeks during their normal daily routines. Motor activity levels were continuously monitored using a wristband (LKK Health Products Group, Infinitus Company Ltd.), and data were stored over 1-min bins and used to calculate interdaily stability (IS) and intradaily variability (IV) for assessment of daily behavioral rhythms. Sleep-wake regularity (SWR) was determined based on daily sleep-wake diaries. Physical activity levels were assessed weekly based on International Physical Activity Questionnaires. Chronotype (Owl & Lark score: OLS) and depression level (Beck Depression index: BDI) were estimated based on questionnaires.

Results: Mean sleep duration was 5.7-10.1h per day (mean = 7.5h). Physical activity level was low in 1 subject, moderate in 11 subjects, and high in 8 subjects. Four students were evening type (OLS ≤ 41), 3 were morning type (OLS ≥ 59), and 12 were neither morning nor evening type (OLS = 42-58). Subjects with smaller OLS (evening type) had smaller SWR (p = 0.0005) and higher BDI (p = 0.001). SWR had no significant correlation with mean sleep duration (p > 0.05). Physical activity levels were positively correlated with mean sleep duration (p = 0.0015; r = 0.42). Higher physical activity levels were associated with larger IS (p = 0.014) and with lower IV (p = 0.0043).

Conclusion: Subjects with long sleep durations had higher daytime physical activity levels, which were accompanied by more stable daily activity rhythms. Subjects with more regular sleep-wake schedules tend to have higher Owl & Lark scores (more toward morning type) and lower depression indices.
THE EFFECT OF AN INFORMATIONAL SLEEP HYGIENE HANDOUT ON COLLEGE STUDENTS OVER A 2-3 WEEK INTERVAL

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Introduction: Sleep hygiene is a set of behaviors and environmental variables which impact sleep quality. Although it has been suggested that sleep hygiene knowledge is the first step towards adaptive sleep behavior change, research regarding sleep hygiene education has produced mixed results. We examined the impact of a sleep hygiene informational handout on self-reported sleep hygiene behaviors, associated features of inadequate sleep hygiene, sleep quality, and daytime sleepiness in college students.

Methods: University students (N = 161; M = 20.16 years old, SD = 4.28; 102 females) recruited from introductory psychology courses were given extra credit for participation. Each completed the Sleep Hygiene Index (SHI), the Epworth Sleepiness Scale (ESS), the Pittsburgh Sleep Quality Index (PSQI), additional questions regarding associated features of inadequate sleep hygiene, and demographic information. All students were retested after a 14-21 day interval where they received a sleep hygiene informational handout at first testing with a three minute discussion led by a researcher (N = 90) or received no handout or discussion (N = 71).

Results: A 2 (baseline and retesting) x 2 (informational handout or control) mixed design ANOVA revealed a significant interaction between time and informational handout on SHI (F(1,159) = 5.00, p < .05). Simple effects showed no significant differences in SHI between the groups at baseline (F(1,159) = 2.19, p > .05). However, at retesting, the control group showed a significant increase in maladaptive sleep hygiene (F(1,159) = 4.08, p < .05), while the informational handout group showed no significant change (F(1,159) = 1.20, p > .05). Similar analyses examining associated features of inadequate sleep hygiene, Global PSQI scores, and ESS showed no significant handout effects.

Conclusion: A sleep hygiene informational handout (with brief discussion) resulted in a mitigation of the deterioration of sleep hygiene behavior at the end of the semester for college students. Differences were not found for daytime sleepiness, associated features of a diagnosis of inadequate sleep hygiene, or sleep quality.

PROSPECTIVE MEASUREMENT OF DAILY SLEEP, STRESS, AND AFFECT IN COLLEGE STUDENTS

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Introduction: College students often experience poor quality and disrupted sleep, and can also experience high levels of stress and affective disturbance. Sleep, stress, and affect are known to be highly interrelated factors, however little prospective evidence currently exists that examines daily reciprocal associations between sleep, stress, and affect using both subjective and objective measures in this population. A better understanding of how normative, everyday changes in sleep may be associated with same-day or next-day experiences of stress and affect may offer insight into the evolution of premorbid or subclinical sleep, stress, or affective disturbances, into more serious disruption.

Methods: Thirty healthy young adults (18-25 years old) have been enrolled to date in this ongoing prospective naturalistic study (Mean age = 21.4 years, females = 15). Participants completed the Consensus Sleep Diary, and reduced versions of the Perceived Stress Scale and the Positive and Negative Affective Schedule daily for 7 days. Sleep, stress and affect were measured continuously using actigraphs and wearable electrocardiograms across the week.

Results: At the group level, participants reported their sleep quality as fair across the week. Preliminary correlational analyses suggest no significant associations between day-to-day sleep quality, stress or affect. Significant associations were found between stress and negative affect across the week. Results from multilevel models will be presented to assess intra-individual reciprocal relationships between sleep, affect and stress across the week.

Conclusion: Poor sleep and increased stress are strong predictors of affective disorders, however the trajectory of this relationship is little understood. Our results suggest that daily variations in stress appear to have an association with negative affect, but the role of sleep in this relationship remains uncertain. College students may be resistant to normative short-term changes in sleep, stress and affect, however longer-term and more complex interactions need to be examined.

Support (If Any): NRMA-ACT Road Safety Trust

REPORTED SLEEP PATTERNS PRECEDING EPISODES OF HEAVY EPISODIC DRINKING IN FIRST YEAR COLLEGE STUDENTS

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Introduction: Heavy Episodic Drinking (HED) is common among college students and places students at risk for the development of an alcohol use disorder (AUD). Sleep plays an important role in maintaining AUD, but less is known about how sleep timing contributes to HED in young adults at risk for developing an AUD.

Methods: Between 2009 and 2014, 1328 first year college students at Brown University completed daily diaries during their first semester of college. They reported the bedtime (BT), wake-time (WT), and total sleep time (TST) for the previous major sleep episode, as well as the number of drinks during the previous 24 hours. HED was defined as 5+ drinks for males and 4+ drinks for females. Among the 1074 who completed at least 50% of the diaries, 523 reported at least one HED episode with a total of 3340 episodes being reported. Within each participant, we selected the day of each HED episode plus the 6 preceding days and matched them with a 7-day window that started on the same day of the week and was not followed by an HED episode. HED and non-HED windows were excluded if they overlapped with the 6 days following an HED episode. 789 HED episodes from 458 participants (average 1.72 episodes per participant) were successfully matched with non-HED windows.

Results: Linear mixed models were used to evaluate differences between HED and non-HED windows in BT, WT, and TST. To account for the uncertainty in the matching process, the matching and analyses were bootstrapped. Results showed significant differences between HED and non-HED in BT (1:43 am vs 1:30 am), WT (10:18 am vs. 10:04 am), and TST (7h 11m vs 7h 30m) on the day of the HED episode. There were no significant differences in BT, WT, or TST during the 6 days preceding the episode.

Conclusion: Analyses capitalized on the strength of within-person comparisons and showed minimal associations between reported sleep behavior preceding HED episodes, with the exception of the day of
HED episodes. Differences on the day of the HED episode likely reflect the impact of drinking behavior (e.g., drinking late at night) and not sleep behavior predicting increased drinking. Future analyses will examine whether stronger sleep/HED associations emerge in students who have more frequent HED episodes.

Support (If Any): NIMH MH079179 (to MAC), K23MH102131 (NIMH) (to DHB)

0209 THE EFFECT OF NICOTINE CONSUMPTION AND WITHDRAWAL ON SLEEP IN MICE
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Introduction: Despite the fact that sleep disturbance is a common symptom during smoking abstinence and a predictor of relapse, there have been no reported attempts to study the impact of nicotine withdrawal on sleep in an animal model. The current study investigates the effect of nicotine administration and withdrawal on sleep quantity and quality in mice.

Methods: In experiment one, twelve mice were implanted with EEG and EMG recording devices and after recovery, EEG/EMG data were recorded continually for 4 weeks. Initially, mice had at libitum access to food and a drinking solution containing 0.2% saccharin. Baseline sleep and wake data was scored for three consecutive days, and averaged. Immediately following baseline recording, 8 of the 12 subjects were switched to a drinking solution of 200μg/ml of nicotine in 0.2% saccharin for a period of 2 weeks (nicotine group). No changes were made in the control group (n = 4). EEG data for this period were scored on days 1, 4, 8, 11, and 12/13. Withdrawal was initiated by excluding the nicotine from the drinking solution and the first two days of withdrawal were scored. In experiment two, the delta power (0-4hz) was analyzed in nicotine receiving mice (n = 4) using the previously mentioned protocol.

Results: Nicotine consumption significantly decreased total sleep. The effect was primarily observed during the lights off phase and is explained by a decrease in both NREM and REM. The trend during nicotine withdrawal was a decrease in total sleep during the lights off and on phases, primarily explained by a decreased in NREM. Compared to baseline, delta power decreased during the lights off phase and increased during the lights on phase for mice consuming nicotine. For the nicotine withdrawal condition, delta power increased during both phases.

Conclusion: The current data suggests that nicotine consumption and withdrawal affect the sleep/wake cycle and homeostatic measures of sleep.

Support (If Any): DA015663

0210 INSUFFICIENT SLEEP AND EMOTIONAL/PSYCHOLOGICAL AND PHYSICAL HEALTH AMONG BLACKS WITH COMORBID OSA AND INSOMNIA SYMPTOMS
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Introduction: General health consequences of co-occurring obstructive sleep apnea (OSA) and insomnia have been well documented. However, little is known about the emotional/psychological consequences of comorbid OSA and insomnia symptoms. The current study investigated emotional/psychological and physical health of blacks with co-morbid OSA and insomnia symptoms and explored whether insufficient sleep duration influences this relationship.

Methods: Data collected from individuals belonging to faith-based organizations participating in the Peer Enhanced Education to Reduce Sleep Ethnic Disparities Study, a NIMHD-funded clinical trial looking at effectiveness of peer-delivered sleep health education in minority communities. A sample of 201 individuals (mean age = 47.83 years; female = 70.15%) were screened for high OSA risk (score ≥ 6) using the ARES Questionnaire. A Sleep Disorders Questionnaire was used to assess insufficient sleep duration (<7 hours) and prevalence of insomnia based on the three common symptoms: trouble falling asleep, difficulty staying asleep and waking up early in the morning. Physical composite score (SF-12PCS) and mental composite score (SF-12MCS) were determined using the Short Form 12 Health Survey.

Results: 70.56% of the participants reported insufficient sleep; of those, 36.69% were at high OSA risk and endorsed insomnia symptoms. Bivariate logistic regression indicated significant association between mental health and likelihood of reporting OSA and insomnia (OR = 0.92, 95% Cl = 0.87-0.97, p < 0.01). Bivariate logistic regression analysis revealed no significant association of comorbid OSA risk and insomnia symptoms with physical health. Backward stepwise regression models adjusted for effects of BMI, age, sex, and sleep duration. People who reported both OSA and Insomnia were less likely to report sufficient sleep (≥7 hours) (OR = 0.35, 95% CI = 0.14-0.85, p = 0.02) and higher mental health scores (OR = 0.93, 95% CI = 0.88-0.99, p = 0.02).

Conclusion: Results demonstrate that individuals with comorbid OSA and insomnia are more likely to endorse lower mental health. Presence of insomnia symptoms and OSA risk were not related to physical health as herein defined.

Support (If Any): This research was supported by funding from the NIH-NIMHD (RO1MD007716) and NIH (U54NS081765).
0211
THAT TIME OF THE MONTH: THE EFFECT OF MENSTRUAL CYCLE ON SLEEP-DEPENDENT MEMORY CONSOLIDATION
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Introduction: Sleep benefits the transformation of new information into long-term memories. Recent studies have indicated that sex hormones may influence this process (Genzel et al., 2012). We used a declarative face-name association task (FNA) to compare sleep-dependent memory consolidation in women during two phases of their menstrual cycle: 1) high hormones (days 8 to 21) and 2) low hormones (days 1 to 7 and 22 to 28), and men.

Methods: 16 healthy females recorded their menstrual cycle daily for four weeks. In a within-subjects design, women completed a verbal recognition memory test before and after a 90-minute polysomnographically (PSG)-recorded nap on two separate occasions: high hormone and low hormone. We used repeated-measures ANOVA and paired t-tests to compare women in each phase on sleep variables and memory performance (d-prime), as well as independent-samples t-tests comparing women in each phase to men (n = 18). Bivariate correlations were used for sleep variables and performance.

Results: We found a significant main effect of cycle (p = .02) and an interaction of cycle and performance (p = .05) in women. There was no difference in pre-nap performance (p = .93), but women-high performed better than women-low after the nap (p = .04). Post-nap d-prime was similar in women-low and men (p = .46), whereas it was enhanced in women-high compared to men (p = .01). Post-nap d-prime performance and spindle density during non-REM sleep were significantly correlated at electrode sites C3 (r = .55, p = .03) and P4 (r = .73, p = .02) in women-low, and at F4 (r = .6, p = .01), C4 (r = .58, p = .014) and P4 (r = .66, p = .02) in men. There were no significant correlations in women-high.

Conclusion: We found that menstrual cycle influences the magnitude of sleep-dependent consolidation, whereby women-high show less forgetting after a nap compared with women-low. Men performed significantly worse on this paired associates memory task, however, similar to women-high, men showed less forgetting after a nap than women-low.

Support (If Any): R01AG046646 and NSF 1439210

0212
TEST EXPECTATION ENHANCES MEMORY CONSOLIDATION ACROSS BOTH SLEEP AND WAKE
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Introduction: Recent studies have suggested that sleep preferentially consolidates information that is important to the individual. Here, we examined the effect of test expectation on memory consolidation across sleep and wakefulness. Following prior reports (e.g. Wilhelm et al. 2010), we hypothesized that test expectation would enhance memory consolidation across a period of sleep, but not across wakefulness. We also hypothesized that test expectation would increase incorporation of the learning task into dreaming.

Methods: Immediately following encoding of a Virtual Maze Task (VMT) and Motor Sequence Task (MST), participants in “Expected” groups (n = 39) were instructed that they would later be tested again on the same material. Participants in “Unexpected” groups (n = 58) were instructed that the tasks were complete. “Sleep” participants trained in the evening and were tested the following morning, 11hr later. “Wake” participants trained in the morning and were tested after 11hr of wakefulness.

Results: Those assigned to the “Expected” groups were much more likely to report that they had expected or suspected the delayed retrieval test (p = .001). In line with our hypotheses, test expectation significantly enhanced memory at delayed test for the MST (p = .04) and VMT (p = .01). But contrary to our hypotheses, this effect of test expectation was strongly equivalent across sleep and waking retention intervals. There was also no evidence that test expectation increased incorporation of the learning tasks into dream content.

Conclusion: We found that expectation of a future test enhanced memory for both spatial and motor learning, even though the test instruction was not introduced until after encoding was complete. However, this effect was equivalently present across both sleep and wakefulness. This observation contradicts those of at least two prior reports, and fails to support the hypothesis that the “future relevance” of learned material selectively influences consolidation during sleep.

Support (If Any): This work was supported by a Bursaries award from the BIAL Foundation, Portugal, as well as R01-MH48832 from the NIH.

0213
SELECTIVE CONSOLIDATION OF EMOTIONALLY SALIENT INFORMATION DURING A NAP IS PRESERVED ACROSS AGE
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Introduction: Recent studies suggest that sleep preferentially preserves aspects of memory that are most salient and valuable to remember at the expense of memory for less relevant details. However, the majority of these studies were conducted primarily in young adults. Both memory and sleep, particularly slow wave sleep (SWS), decline with age. Recent evidence points to a role for SWS during a daytime nap in the selective preservation of emotionally salient information in young adults. Little is known about whether the contribution of sleep to selective memory consolidation varies with age.

Methods: Subjects (18-64yrs.) viewed scenes containing emotional or neutral foreground objects placed on neutral backgrounds. A baseline test assessed memory for half the encoded objects and backgrounds, presented separately. Subjects either took an immediate or delayed 90-min nap, or remained awake. Retest on the remaining images occurred 7 hours after encoding, holding constant the time of training and testing between groups.

Results: We found evidence for the emotional memory tradeoff effect across all subjects, with negative objects better remembered than neutral objects, but with memory for their corresponding backgrounds worse than neutral related backgrounds (F = 38.43, p < .001). Interestingly, when using age as a covariate, we found that the increase from baseline to retest in the magnitude of this emotional memory tradeoff differed between groups (F = 3.65, p = .03). The immediate nap group led to the greatest increase in the negative memory tradeoff compared to both the wake and delayed nap groups (p = .02, p = .04, respectively). Importantly, mirroring prior results, there was a positive correlation between SWS percentage and negative object memory at retest across all nap subjects (r = .35, p = .03).

Conclusion: Taken together, this provides strong evidence that even as we age, sleep, particularly SWS, in a nap taken soon after learning preserves salient information over less important details, despite general declines in memory and sleep with age.

Support (If Any): Research was supported by the National Institute On Aging of the National Institutes of Health under Award Number F32AG047807
Introduction: Recent studies have suggested that subjects show better recall of recently learned material when they are expecting to be tested, but only if that testing comes after a period of sleep, and not if it comes after an equivalent period of wake. In contrast to these findings, we report here an instance of the opposite outcome, with a period of wake, but not a period of sleep, leading to a benefit from test expectancy.

Methods: Subjects (n = 93) were trained either at 9AM or 9PM on the location of 15 animals and 15 vehicles on a 5x5 spatial grid, and tested on their memory 5 minutes later. Subjects were then either told that they would be retested 12hr later on the animals or that they would be rested on the vehicles. Some also received an unexpected post hoc cash bonus based on their recent test performance on either animals or vehicles. All subjects were then retested on both animals and vehicles 12hr later.

Results: Sleep conferred a significant benefit on subjects’ overall performance at retest, seen as a reduced percent forgetting from test to retest (Wake: 16.9%, Sleep: 5.4%; p = 0.0001), as did expectation of retest (Expected: 17.3%, Unexpected: 23.3%; p = 0.0005). There was also a significant Group x Expectation interaction (p = 0.0005). Selective retention based on expectation was only observed across wake (%forgetting-expected: 21.3%, unexpected: 34.2%; p = .007), and not across sleep (expected: 13.2%, unexpected: 12.5%; p = .58). Post hoc rewards had no effects on outcome.

Conclusion: Contrary to previously reported findings, adding relevance and future salience to recently formed memories by telling subjects to expect retest on a subset of the memories had no effect on the benefit that sleep added to memory performance, but did reduce the amount of forgetting seen across an equivalent period of wake.

Support (If Any): This work was supported by NIH grant MH048832.

we examined the effect of sleep and wake on concept learning using Posner and Keele’s classic “dot distortion” task. We hypothesized that the abstraction of prototypes from learned concept exemplars would be facilitated by a period of sleep but not wakefulness.

Methods: Four groups of subjects (n = 20 per group) learned how to categorize 270 abstract dot patterns into three different categories. Following 12hrs containing sleep or wakefulness, we tested subjects’ ability to categorize these same dot patterns (old exemplars), as well as new dot patterns (new exemplars), and the category “prototypes” from which the exemplars were derived. Two additional groups performed this categorization test immediately after training, either in the morning or evening.

Results: Performance on both exemplars and prototypes improved across 12hrs of sleep but declined across 12hrs of wakefulness, in comparison to the performance of immediate test groups. Performance on old exemplars improved by 5% across sleep and declined 13.2% across wakefulness (F(1,76) = 5.96, p = .02). New exemplars improved by 7.8% across sleep and declined 10.0% across wakefulness (F(1,76) = 4.70, p = .03). For prototypes, the effect was only significant in the third testing block, where performance improved 6.7% across sleep and declined by 21.7% across wakefulness (F(1,76) = 4.84, p = .03). Immediate test groups tended to perform better in the morning than in the evening, indicating a possible circadian effect, although this reached significance only for old exemplars (t(38) = 2.82, p = .008).

Conclusion: We observed that memory for prototypes and exemplars is facilitated by sleep, in comparison to an equivalent period of wakefulness. Contrary to our expectations, there is no evidence that sleep selectively led to the development of prototypes. Instead, we found that sleep benefits memory for both specific exemplars and generalized prototypes.

0218
ACOUSTIC STIMULATION INCREASES SLOW-WAVE ACTIVITY AND IMPROVES DECLARATIVE MEMORY IN OLDER ADULTS
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Introduction: Age-related reduction in the amount of slow-wave sleep has been postulated to play a role in impaired cognitive function. Acoustic stimulation during sleep has been shown to increase slow-wave activity (SWA) and improve memory retention in young adults, but has not been examined in older adults. The aim of this study is to examine the ability of acoustic stimulation to increase SWA and improve declarative memory in older adults.

Methods: Thirty healthy and cognitively intact adults (age 75.2 ± 6.84, 3 men) completed one night of acoustic stimulation and one night of sham stimulation in counterbalanced order. During sleep, an adaptive phase-locked loop (PLL) algorithm was used to lock on to endogenous slow-waves recorded from the midline frontopolar electroencephalogram in real time. Bursts of 1/4 Hz noise were delivered when the PLL system predicted the positive upstate of the slow-wave. Tones occurred in blocks of 5 pulses (“ON blocks”) followed by a refractory period of equal length (“OFF blocks”). Participants completed an 88-word pair recall with feedback, before and after sleep, to assess declarative memory. Power spectral analysis was used to identify power in delta frequency band (0.5 Hz-4 Hz). Performance was measured as percent change in word recall from evening to morning. Non-parametric t-tests were used to evaluate differences between stimulation and sham conditions.

Results: There was a significant increase in delta power in the ON blocks relative to OFF blocks during the stimulation night compared to the sham night (16% v. -2.3%, p = 0.002). Delta power during ON blocks of the stimulation night was 8% higher compared to ON blocks of the sham night (p = 0.002). Overall delta power across the entire night was not significantly different. Participants recalled significantly more words following a night of acoustic stimulation compared to a night of sham stimulation (27.2% v. 4.5%, p = 0.008).

Conclusion: There was a significant increase in delta power in the ON blocks relative to OFF blocks during the stimulation night compared to the sham night (16% v. -2.3%, p = 0.002). Delta power during ON blocks of the stimulation night was 8% higher compared to ON blocks of the sham night (p = 0.002). Overall delta power across the entire night was not significantly different. Participants recalled significantly more words following a night of acoustic stimulation compared to a night of sham stimulation (27.2% v. 4.5%, p = 0.008).

Support (If Any): Dixon Translational Research Grant, NIH T32 NS047987, NSF GRFP DGE-1324585, NIA P01 AG11412, NIA AG 13854

0219
STRATEGIC GLUCOSE USAGE SUSTAINS PERFORMANCE DURING SLEEP DEPRIVATION
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Introduction: Insufficient sleep is a constant threat to the health and effectiveness of the US military. Pharmacologic and scheduling countermeasures can be risky and difficult to implement. Nutritional interventions have largely been ignored. Sleep loss disrupts how the body utilizes glucose, and glucose bioavailability influences attention and cognitive self-control. Strategic glucose supplementation during sleep loss may act as a simple adjunct to more traditional fatigue countermeasures.

Methods: Twenty college students stayed awake for 40 hours. Cognitive performance was quantified while rested, then every three hours across the sleep deprivation period. Participants received 15 grams of glucose solution or an equivalent sucralose placebo at hours 18 and 36. Participant survival time and cognitive function were analyzed by group across time.

Results: Participants in the glucose condition completed significantly more testing sessions (14.1 versus 12.0, t[14.98] = 2.44, p = .038) exhibited significantly fewer psychomotor vigilance (PVT) lapses (73 versus 2.78 two trials post-dose, F[3,70, 66.63] = 3.11, p = .02) and slightly better self-control in a go / no go (GNG) task (d’Prime of 2.02 versus 1.33 three trial post-dose, F[10,190] = 1.80, p = .21) across time compared to controls.

Conclusion: Strategic glucose supplementation can temporarily sustain performance during total sleep deprivation within certain parameters. While there was a significant survival difference between groups and a strong group by time interaction for PVT lapses, there was no statistically significant effect on response sensitivity in the GNG task. This difference between cognitive measures could stem from 1) a lack of statistical power for the GNG or 2) glucose failing to provide an effect strong enough to impact more complex cognitive tasks downstream. Data collection is ongoing to answer the former, and a cognitive stream analysis is planned to explore the latter. Current results are promising and warrant further investigation.

Support (If Any): Navy Medical Research Unit-Dayton

0220
IMPACT OF SUSTAINED SLEEP LOSS AND WEEKEND RECOVERY SLEEP ON VIGILANCE PERFORMANCE AND SUBJECTIVE SLEEPINESS
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Introduction: Short sleep schedules during the workweek and catch-up sleep on the weekend is common in modern societies. Yet, whether
ad libitum weekend recovery sleep restores performance to pre-sleep restricted levels, thus preventing impairments from cumulating during subsequent workweeks, is unknown. We hypothesized that ad libitum weekend recovery sleep will restore reaction time performance and subjective sleepiness to near baseline levels.

**Methods:** Thirty-six healthy participants (18 females [25.5 ± 4.7yr; mean ± SD]) were studied in a ~14-16d in-laboratory protocol. Following an ambulatory week with 9h per night sleep opportunities and three baseline laboratory days of 9h per night, participants were randomized into three sleep opportunity conditions: sleep restriction (10 days of 5h per night), weekend recovery sleep (five days simulated workweek of 5h per night followed by two days of ad libitum weekend recovery sleep — ≥ 10h per day, followed by three days of 5h per night), or control (10 days of 9h per night). Karolinska Sleepiness Scale (KSS) and Psychomotor Vigilance Task (PVT) reaction times were assessed during scheduled wakefulness every 2h during simulated workweeks. All conditions had the “weekend” free from performance testing.

**Results:** Sleepiness increased and median reaction time slowed across days of sleep restriction, even after a “weekend” free from performance testing (p < 0.05). In contrast, sleepiness and median reaction time showed little change after weekend recovery sleep and did not approach baseline or control levels.

**Conclusion:** Weekend recovery sleep appears to attenuate the impact of short sleep schedules on cumulative impairments in PVT performance and sleepiness ratings. However, ad libitum weekend recovery sleep does not appear to restore PVT performance or sleepiness ratings to baseline levels indicating the common behavior of weekend recovery sleep is insufficient as a countermeasure strategy for restoring reaction time performance and sleepiness to baseline at the beginning of a subsequent work week.

**Support (If Any):** NIH R01HL109706 and UL1TR000154

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**0221 OBSTRUCTIVE SLEEP APNEA AND ITS ASSOCIATION WITH COGNITIVE PERFORMANCE, EXCESSIVE DAILY SLEEPINESS, AND QUALITY OF LIFE IN THE GENERAL POPULATION**

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**Introduction:** While patients with obstructive sleep apnea (OSA) frequently present to the sleep clinic with attention and memory dysfunction, population-based epidemiological investigations have shown inconsistent effects of OSA on cognition. The current study was conducted to examine the association between OSA and performance on a wide range of cognitive measures in the general population. Furthermore, OSA's association with excessive daytime sleepiness and quality of life were investigated.

**Methods:** A total of 1,492 participants from the Korean Genome and Epidemiology Study (KoGES) (mean age 60.39 ± 7.24, 712 males) underwent overnight polysomnography and were categorized into OSA (apnea-hypopnea index (AHI) ≥ 5) and Control (AHI < 5). Cognitive performance was measured using a comprehensive neuropsychological test battery that consisted of memory, language, attention, and executive function domains. Additionally, participants' excessive daytime sleepiness (EDS) and quality of life were examined using Epworth Sleepiness Scale (ESS) ≥ 11 and the short form health survey (SF-12), respectively.

**Results:** Results from the multiple analysis of covariance (MANCOVA) analysis with adjustment of covariates (age, sex, BMI, education, hypertension, current smoking, and heavy drinking) demonstrated that individuals with OSA had poorer performance on the Digit Symbol Coding (score 52.73 ± 17.08), a multi-domain test reflecting attention, visual scanning, and visuoperceptual skills, compared to Control (58.72 ± 18.03)(P = 0.02). Multiple logistic regressions also revealed that OSA was associated with presence of EDS (odds ratio = 1.5, 95% CI 0.97-2.43). SF-12 was not significantly different between OSA groups.

**Conclusion:** Poorer cognitive performance is associated with the presence of OSA. Therefore, early recognition and treatment of OSA could reduce the risk of cognitive impairment in middle-aged and older population.

**Support (If Any):** Grant 2011-E71004-00, 2012-E71005-00 from the Korea Centers for Disease Control and Prevention

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**0222 MILD TRAUMATIC BRAIN INJURY IMPACTS SLEEP-DEPENDENT EMOTIONAL PROCESSES**

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**Introduction:** Sleep architecture and quality change following mild traumatic brain injury (TBI, i.e., a concussion). Emotional disturbances (e.g., increased risk for depression, anxiety) also follow TBI. Given that high-quality sleep is critical for both emotional memory consolidation and emotional reactivity, we tested whether sleep-dependent emotional processes are altered in this population.

**Methods:** Young adults (18-30 yrs) with or without mild, chronic (> 1 yr since injury) TBI viewed negative and neutral pictorial stimuli either in the morning (wake group) or the evening (sleep group; non-TBI sleep: n = 14; non-TBI wake: n = 15; TBI sleep: n = 9; TBI wake: n = 11). Twelve hours later, participants were asked to recall which stimuli they had seen in the first session. Pictures were rated for emotional valence and arousability at both sessions. Two-way ANOVA tests sought differences (for negative stimuli) in (1) memory accuracy, (2) inter-session change in valence, and (3) inter-session change in arousability between injury groups (TBI/non-TBI) and conditions (sleep/wake).

**Results:** For memory accuracy, there was a significant main effect of injury group (F(1,46) = 4.96, p = .03), such that the non-TBI group outperformed the TBI group. There was also a marginally significant interaction between factors (F(1,46) = 3.24, p = .07), as the non-TBI sleep group significantly outperformed the non-TBI wake group (t(27) = 2.74, p = .01), yet the TBI sleep group performed slightly worse than the TBI wake group. There was also a significant main effect of injury group for change in arousability (F(1,46) = 5.22, p = .03), wherein the TBI group rated negative stimuli as more arousing during the second presentation. There were no group differences or interactions for inter-session change in valence.

**Conclusion:** These findings provide early evidence that sleep-dependent emotional processing is altered following mild TBI. We posit this alteration may increase the risk for developing emotional disturbances. Given the pervasiveness of concussions, these results have broad implications for a wide range of individuals - from the football field to the battlefield.

**Support (If Any):** NIH R01 AG040133
**A223**

**CHRONIC SLEEP DEPRIVATION DIFFERENTIALLY IMPAIRS SHORT AND LONG-TERM ASSOCIATIVE MEMORY FORMATION IN APYLSIA CALIFORNICA**

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**Introduction:** Technological advances and the functioning of a modern society have increased acute and chronic sleep deprivation in children and adults. Given the impact of sleep loss on cognition, the need exists for a model system with a relatively simple neural circuitry to identify molecular and neuronal changes induced by sleep deprivation. Aplysia californica, with its well-characterized learning paradigms and consolidated sleep pattern, presents an ideal system for studying the interactions of sleep and memory.

**Methods:** Aplysia were sleep deprived for 6 hours on two consecutive nights or for 4 hours on three consecutive nights using context changes and manual stimulation. The effects of sleep deprivation on memory were evaluated using an operant learning paradigm, learning that food is inedible, in which the animal associates a specific netted seaweed with failed swallowing attempts.

**Results:** Two nights of 6h sleep deprivation inhibited the induction of short (STM) and long-term memory (LTM). However, when animals were allowed to recover for 24h following sleep deprivation, training induced robust LTM. Three nights of 4h sleep deprivation blocked the induction of STM but not LTM, regardless of whether sleep deprivation occurred at the beginning or end of the night.

**Conclusion:** The induction of STM, relative to LTM, appears more susceptible to disruption by three days of restricted sleep despite the same training protocol used to induce both forms of memory. Similarly, the effects of two days of sleep deprivation appear to persistently inhibit STM more than LTM suggesting that the additional signaling pathways and macromolecular synthesis required for LTM may promote compensatory mechanisms against memory disruption. These behavioral studies establish Aplysia californica as a simple model system in which the effects of acute and chronic sleep deprivation on multiple forms of memory can be studied providing a foundation for future mechanistic studies.

**Support (If Any):** NIH Grant MH-5893 (SD)

**A224**

**LONG PHOTOPERIODS INDUCE A DEPRESSIVE PHENOTYPE AND IMPAIR NOVEL OBJECT RECOGNITION IN THE LONG-EVANS RAT**

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**Introduction:** Changes in the length of daily light exposure affect animal behavior, including sleep. In particular, effects on emotional behaviors are consistently reported and are often attributed to altered sleep periods. For example, nocturnal rodents exposed to extended periods of light (longer photoperiods), which lengthens their inactive period, have been shown to exhibit depressive and anxiogenic behaviors. However, little has been done to investigate effects on memory and cognitive function. To address this question, we examined how the emotional effects of longer photoperiods relate to performance in a novel object recognition (NOR) task.

**Methods:** 16 Long-Evans adult male rats underwent a NOR task, a forced swim test (FST), a tail suspension test (TST), and an elevated plus maze (EPM) before a two week exposure to long photoperiod cycles (Days 1 - 5: 24h light-only cycle; Days 6 - 14: 22h light/2h dark cycle). After the exposure period, the NOR, FST, TST, and EPM measures were repeated. Videos of each task were scored and analyzed for relevant behaviors. Performances before and after long photoperiod exposure were compared.

**Results:** Results indicate that two weeks of long photoperiod cycles significantly increased immobility in the FST and TST. After exposure, animals spent significantly more time in the closed arms, compared to the open arms of the EPM. Also after exposure, animals spent significantly less time with objects in the familiarization phase of the NOR task, and showed impaired novel object discrimination.

**Conclusion:** Exposure to long photoperiod cycles produced a depressive phenotype in the Long-Evans rat. Long photoperiod cycles were also shown, for the first time, to correlate with impaired performance in the NOR task. These results suggest that the phenotype produced from long photoperiod exposure may have cognitive deficits, as well as emotional consequences, likely related to changes in sleep-wake activity that result from lengthened periods of inactivity/sleep.

**Support (If Any):** NIH Grant MH-5893 (SD)
0226

PHYSICAL ACTIVITY AND COGNITIVE FUNCTION: A MEDIATING ROLE OF SLEEP
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Introduction: Physical activity benefits executive function, but the mechanism through which this benefit occurs is unclear. Sleep is a candidate mechanism given that it improves with exercise and has restorative effects on the brain. The present study examined the mediating role of sleep in the relationship between physical activity and multiple domains of cognition.

Methods: Young (n = 59) and older (n = 53) community-dwelling adults wore an accelerometer for one week to assess sleep efficiency, total sleep time, and physical activity, operationalized as metabolic equivalent of task (METs) during time spent awake. Cognition was assessed in the laboratory across multiple measures of executive function, memory, and processing speed. Covariates included age, sex, and education.

Results: METs was significantly associated with sleep efficiency but not total sleep time. Relationships between METs and cognition were no longer significant after accounting for covariates. Higher sleep efficiency, but not total sleep time, was associated with greater METs and significantly mediated the relationship between METs and executive function assessed with working memory, switching, verbal fluency, and memory recall. Mediation was not significant for processing speed. The mediating role of sleep efficiency was not moderated by age group.

Conclusion: Sleep efficiency is one pathway by which physical activity is associated with executive function and controlled memory processes across the lifespan.

Support (If Any): This work was performed at the University of Pittsburgh Learning Research and Development Center. This project was supported by the National Institute of Mental Health (MH086492, PI: M.E.W.). K.A.W. was supported by training grants through the National Institute of General Medical Sciences and National Institute of Mental Health (T32 GM081760 and T32 MH019986) at the National Institutes of Health.

0227

THETA ACTIVITY DURING REM SLEEP MAY PREDICT FEAR RENEWAL OUTCOMES
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Introduction: Fear conditioning, extinction learning, extinction recall, and fear renewal are components of a well-established and validated paradigm used both experimentally and to model anxiety disorders in humans, including posttraumatic stress disorder (PTSD). Previous studies have suggested that the amount of theta activity during REM sleep may be an indicator of vulnerability or resilience to maladaptive stress responses. Here, we assessed the relationships of REM- and NREM-sleep theta activity with fear conditioning, fear extinction learning and memory and fear renewal using the above paradigm in a sample of healthy young adults.

Methods: Thirty-one healthy young adults (16 females; 15 males; mean age = 23.6; SD = 3.8) underwent two consecutive nights of polysomnographic (PSG) sleep recording. Whole night theta activity during REM and NREM sleep on both nights was derived from power spectral analysis. The morning following Night 1, participants underwent fear conditioning and fear extinction learning phases of the paradigm. Approximately eight hours later, participants completed the fear extinction-recall phase. Finally, the morning following Night 2, participants completed a contextual fear renewal task. Skin conductance response (SCR) was recorded during all phases of the protocol. Regressions were used to assess the relationship between theta activity and fear learning and memory outcomes.

Results: There was no significant relationship of REM- or NREM-sleep theta power on Night 1 with fear conditioning, extinction, or extinction recall. Higher REM-sleep theta power on Night 2 predicted greater retention of the extinction memory during contextual fear renewal at trend level (F(1, 16) = 3.371, R squared = 0.417; p = 0.08).

Conclusion: Theta power during REM sleep may be marker of resilience-related processes such as an enhanced consolidation of fear extinction memory allowing relative resistance to contextual fear renewal. These findings have important implications for understanding the relationship between sleep and PTSD.

Support (If Any): This work was supported by the US DoD DMRDP (W81XWH-12-0024 Log # 11293006, PI: Germain)

0228

DREAM REPORTING MAY SHIFT MEMORY PROCESSING TO A GIST-LIKE STATE
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Introduction: Gist-based false memory has been widely studied using the Deese-Roediger-McDermott (DRM) task, in which participants, after studying a list of semantically related words (nurse, sick, hospital, etc.), later falsely remember an unstudied ‘gist’ word (doctor). Sleeping soon after learning benefits studied words (i.e. nurse, sick) and memory for gist (i.e. doctor) when tested 24 or 48hr after encoding. It has been proposed that, through trace reactivation, memory-related content may be incorporated into dreams, and reports of stimulus-related dream content have been shown to increase subsequent performance. Here we explored whether dreaming about the DRM task would modulate sleep-based memory enhancement.

Methods: Participants encoded 16 DRM lists in the evening and were tested either 24 or 48 hours later. Testing consisted of a free recall task followed by a recognition test. For both tests, participants had to indicate how confident they were in their responses using a 1-4 Likert scale. They spent their first night in our laboratory while their sleep was monitored with PSG. The following morning, participants were awakened and asked to report their mentation and then were asked a yes/no question about whether they dreamt about the DRM task and/ or words.

Results: There was no difference in memory for studied words between participants who reported task-related mentation (YES, n = 18) and those who did not (NO, n = 37), all t’s < 1.15, all p’s > .26. However, when subjects were highly confident in their gist memory (3-4 ratings), recognition memory was elevated in the YES group, compared to the NO group t(53) = 1.98, p = .05. Similarly, high-confidence false recall was increased in the YES group, compared to the NO group t(53) = 3.17, p = .003.

Conclusion: These results suggest a role for dreaming in the “gistification” of memories, particularly for those memories that were consolidated more strongly and later retrieved with high confidence.
A Basic Sleep Science

0229
EFFECTS OF NAPPING ON RESPONSE INHIBITION IN YOUNG ADULTS
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Introduction: Accumulating evidence has shown that conflict monitoring and attention allocation are reduced following an interval of wakefulness relative to an equivalent interval of time spent asleep. Likewise, response inhibition is reduced after prolonged wakefulness. However, it is not well understood whether this reduction in the ability to withhold prepotent responses is a result of wakefulness or circadian influences. In order to parse these effects, we compared response inhibition following a mid-day nap and equivalent period of time spent awake, thus controlling for circadian effects.

Methods: Seventeen young adults (12 females, M = 20.71, SD = 2.02 years) completed a Flanker task that assessed response inhibition following a mid-day nap and equivalent period of wakefulness (within-subjects design, condition order counterbalanced across participants). Participants were instructed to indicate the orientation of a center target stimulus. The target and flanking stimuli were oriented in the same direction in congruent trials, but were in opposite orientations in incongruent trials. Paired sample t-tests were used to compare reaction time (RT) and accuracy following the nap and wake intervals.

Results: As anticipated, responses were slower and more inaccurate on incongruent compared to congruent trials following both the nap and wake intervals (all p's ≤ 0.006). Interestingly, the congruency effect (RT on correct congruent trials - RT correct incongruent trials) was reduced following the nap (M = -34.02, SD = 15.74 ms) relative to the wake interval (M = -39.42, SD = 22.10 ms) at trend-level (t(16) = 1.93, p = 0.07), indicating that response inhibition is enhanced following a mid-day nap.

Conclusion: These data suggest that response inhibition is enhanced following an interval of sleep relative to wake. Importantly, as this effect was observed following a mid-day nap, allowing time of testing to be comparable between sleep and wake intervals, our findings indicate that sleep-dependent enhancement of response inhibition is driven by an active process in sleep rather than circadian influences.

0230
EPISODIC MEMORY IS POORER IN OLDER ADULTS WITH RISK OF OBSTRUCTIVE SLEEP APNEA AND HYPERTENSION
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Introduction: Clinical obstructive sleep apnea (OSA) contributes to the development of hypertension (HTN), and both OSA and HTN are linked to impaired episodic memory. However, few studies have investigated the interaction of OSA risk and HTN on impaired episodic memory. The purpose of this study was to investigate this interaction effect.

Methods: In this descriptive study, data were collected from 40 older, healthy adults (age: 70.2 ± 6.8; male: 27.5%). Persons with neurological disorders, advanced medical conditions, and diagnosed sleep disorders were excluded. OSA risk was determined by a score ≥ 3 on the STOP-BANG questionnaire and HTN by self-report and medications used. Episodic memory was evaluated by the Hopkins Verbal Learning Test-Revised [i.e., delayed recall, false recognition errors, and retention rate]. Descriptive statistics and two-way ANCOVA were used (covariates: age, health conditions, body mass index, depressive symptoms, and education).

Results: After controlling for covariates and compared with older adults with lower OSA risk, older adults with high OSA risk had more false recognition errors [F(1, 31) = 5.6, p = .024]. After controlling for covariates and compared with older adults without HTN, those with HTN had poorer delayed recall [F(1, 31) = 9.9, p = .004] and lower retention rate [F(1, 31) = 10.6, p = .003]. No interaction of OSA risk and HTN was found on episodic memory.

Conclusion: Although different subsystems of episodic memory (i.e., recognition versus delayed recall) were affected by high OSA risk and HTN independently, there was no interaction between OSA risk and HTN. These results suggest that interventions directed at reducing OSA risk or lowering blood pressure to normal level may improve aspects of episodic memory in older adults. However, findings of this study need to be confirmed in a larger sample with diagnosed OSA and HTN.

0231
THE EFFECT OF SLEEP ON EMOTIONAL MEMORY CONSOLIDATION AND EMOTIONAL AFFECT IN OLDER ADULTS
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Introduction: In young adults, sleep is widely implicated in emotional processing, including consolidation of emotional memories. Evidence suggests that aging is associated with changes in emotion, including a positive memory bias and enhanced emotional well-being. However, the influence of sleep on these measures has not been investigated in healthy older individuals. The objective of this study was to determine the effect of sleep on emotional memory consolidation and emotional well-being in older adults.

Methods: Healthy older (50-80 yrs) and young (18-30 yrs) adults viewed a mixture of either negative and neutral pictures (Negative condition) or positive and neutral pictures (Positive condition) in either the morning (Wake groups) or evening (Sleep groups). Twelve hours later, participants underwent a recognition task in which they viewed the previously seen pictures (targets) intermixed with novel pictures and indicated whether they remembered each one. Positive and negative affect were measured in each session using the Positive and Negative Affect Schedule. Overnight polysomnography was recorded for participants in the Sleep groups.

Results: Compared to waking, sleep benefited negative (F(1,80) = 10.27, p = 0.002) but not positive (F(1,84) = 1.507, p = 0.223) memories in young adults and positive (F(1,46) = 6.50, p = 0.014) but not negative (F(1,44) = 0.059, p = 0.809) memories in older adults. Older adults had higher positive affect and lower negative affect than young adults (p's < 0.01). Time spent in slow wave sleep predicted lower positive affect in young adults (r = -0.65, p = 0.001) and higher positive affect in older adults (r = 0.56, p = 0.009). These relationships were moderated by memory for negative pictures (B = -89.269, p = 0.015) and positive pictures (trend level, B = 330.948, p = 0.099), respectively.

Conclusion: These results suggest an emotional bias in sleep-dependent memory consolidation that shifts from negative to positive with aging. Furthermore, memory processing during sleep influences emotional affect, perhaps contributing to greater well-being in healthy older adults.

Support (If Any): This work was funded by NIH R01 AG040133 (PI: Spencer).
**0232**

**CHRONOTYPE AND EMOTIONAL INTELLIGENCE**

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**Introduction:** Emotional Intelligence (EI), the ability to reason about and use emotions to solve problems, may be related to chronotype, but the association may be complex and dependent upon the method by which EI is assessed. EI can be conceptualized from either a “Trait” (i.e., self-report) or an “Ability” (i.e., objective problem solving) perspective. We examined the relationship between chronotype and both models of EI using well-established metrics. We hypothesized that greater morningness would be associated with higher Trait EI and lower Ability EI.

**Methods:** Sixty-two healthy 18-45 year olds (31 males, M age = 30.2) completed the BarOn EQ-i and Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) measures of EI. The EQ-i provides a global score of “Trait” emotional intelligence, while the MSCEIT is a measure of “Ability” EI. Participants also completed the Morningness-Eveningness questionnaire (MEQ) as a measure of chronotype. Scores ranging between 0-41 indicate “evening type,” scores ranging from 59 or greater indicate “morning type,” and scores ranging from 42-58 indicate “intermediary type.”

**Results:** A repeated measures ANOVA yielded a significant interaction between chronotype and EI metrics, F(2,59) = 4.82, p = .012. One-way ANOVAs showed that the effect was driven by the effect of chronotype on EQ-i (Trait EI) scores, F(2,59) = 5.36, p = .007, suggesting a monotonic trend toward higher Trait EI among earlier chronotypes. In contrast, chronotype had no relationship to MSCEIT (Ability EI) scores, F(2,59) = 0.37, p = .69.

**Conclusion:** Consistent with our hypothesis, morning chronotype was associated with higher self-reported Trait EI. However, contrary to expectation, Ability EI did not differ by chronotype. The results suggest that morning chronotype may be associated with better mood regulation and self-perceived emotional functioning, but that this may not necessarily translate into actual objectively measured emotional capacities. Future research should explore the neurobiological basis of these relationships and the extent to which they are modifiable through training or experience.

**0233**

**TYPICAL SLEEP DURATION IS ASSOCIATED WITH CONSTRUCTIVE THINKING PATTERNS**

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**Introduction:** Sleep is believed to play an important role in emotional functioning, coping, and well-being. Prior research suggests that total sleep deprivation leads to declines in Constructive Thinking (CT), which involves habitual thought processes that influence how people construe events and cope with stressful circumstances. We hypothesized that individuals who habitually obtain more nightly sleep would show greater CT.

**Methods:** Forty-five healthy adults (23 male; Ages 20-43) completed a questionnaire about their typical weekday and weekend sleep habits. From these data, typical sleep duration was calculated for each individual based on a 5/7:2/7 weighted average of weekday and weekend sleep hours. Later the same week, participants completed the Constructive Thinking Inventory (CTI), which includes a Global Constructive Thinking (GCT) scale, six facet scales, and 15 subscales.

**Results:** Typical sleep duration was positively correlated with higher GCT (r = .39, p = .009) and subscales, including Emotional Coping (r = .35, p = .002), Absence of Dwelling (r = .41, p = .006), Belief in the Unusual (r = .33, p = .029), Naïve Optimism (r = .33, p = .027), and Pollyannaish Thinking (r = .31, p = .04). Stepwise multiple linear regression, including only the 15 subscales as independent variables showed that a combination of greater Pollyannaish Thinking (β = .43, p = .002) and Absence of Dwelling (β = .39, p = .004) was significantly associated with longer sleep duration (R2 = .31, p = .001). All things being equal, a one standard deviation increase on either scale was associated with approximately 35 minutes of additional sleep.

**Conclusion:** Shorter sleep duration was associated with lower CT traits, consistent with prior work showing a decline in these traits during prolonged sleep loss. The most strongly associated of these involved the combined tendency to avoid obsessing over negative experiences and the tendency to think in simplistically and unrealistically optimistic ways, particularly about others. Thus, while causal direction cannot be inferred from these data, those who sleep longer tend to also worry less and have a more positive opinion of people.

**Support (If Any):** DARPA-12-12-11-YFA11-FP-029

**0234**

**THE EFFECTS OF CHOLINERGIC ENHANCEMENT DURING SLEEP-DEPENDENT CONSOLIDATION OF VISUAL PERCEPTUAL LEARNING: AN ERP STUDY**

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**Introduction:** Previous studies have shown that pharmacologically enhancing cholinergic transmission increases performance on a perceptual task (i.e., perceptual learning (PL)) (Rokem & Silver 2010; Beer et al., 2013). These studies did not specifically control for sleep. However, studies demonstrate a critical role of rapid eye movement (REM) sleep in PL (Mednick et al., 2003), and REM sleep is associated with high acetylcholine (ACh) release. In this study, we investigated whether increases in ACh during sleep modulates the magnitude and/or specificity of PL. On the first night after training on the texture discrimination task (TDT), we administered the cholinesterase inhibitor rivastigmine, which increased the synaptic levels of ACh during the subsequent sleep consolidation, and then examined event-related potentials (ERPs) both during training and 48-hrs later at retrieval.

**Methods:** High-density electroencephalography (hd-EEG) was recorded during training and retrieval, and ERP components C1 (early sensory processing) & N1 (attentional discrimination) in response to the TDT target array were compared in rivastigmine and placebo conditions.

**Results:** There were no differences in amplitude of either ERP component at training between drug groups (p > .05). Similar to prior studies, PL decreased the C1 in the placebo condition (i.e., decreased amplitude from training to retrieval). In contrast, with rivastigmine, PL increased C1 amplitude. In both groups, C1 amplitude change was correlated with learning. For the N1 component, no changes were found in the placebo condition, however a PL-induced increase was found with rivastigmine. Importantly, time in REM sleep did not differ between drug groups.

**Conclusion:** Enhancing ACh signaling with rivastigmine affected PL-induced changes in both C1 amplitude (local changes in primary visual cortex) and N1 amplitude (top-down attentional influences). The lack of effects of rivastigmine on REM sleep may indicate that the important factor for consolidation may not be time in REM sleep, but rather the amount of cholinergic transmission that occurs during REM sleep.

**Support (If Any):** NSF 1439210
**A. Basic Sleep Science**

**0235**

**SLEEP YOUR WAY TO AN A?**

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**Introduction:** Much research has demonstrated that college students obtain insufficient sleep and exhibit poor sleep habits. Moreover, some aspects of sleep architecture, such as wake times, have been linked to poorer grade point averages. The current study aims to better understand the links between measures of sleep and measures of academic success.

**Methods:** Data were collected from 32 college students aged 18-22 (M = 19.7, SD = 1.1), predominantly white (88%) and female (57%). Demographics, including current grade point average (GPA; 0-2.49/2.5-2.99/3.0-3.49/3.5-4.0), ACT scores, and whether students kept a consistent bed time were collected during the first month of spring semester. The Pittsburgh Sleep Quality Index (PSQI) was administered during the first month of the semester (Time1) and again 3 months later (Time2). For the regression, Timel Global PSQI was dichotomized for good sleepers (0-5) and poor sleepers (6+).

**Results:** A regression analysis was used to examine if a regular bed time and being a good/poor sleeper was related to ACT scores. Results indicated that these predictors explained 25.3% of the variance (R² = .253, F(2,29) = 4.91, p = .015), but that neither having a regular bedtime (β = .26, p = .16) nor sleep category (β = -.34, p = .06) independently predicted ACT scores. An overall repeated measures analysis of variance examining the relation of GPA to Global PSQI scores at Timel and Time2 was not significant [F(3,30) = 1.01, p = .405], however between-subjects tests were significant [F(3,30) = 3.87, p = .019] with post-hoc tests demonstrating that those with low GPAs (0-2.49) had significantly poorer sleep quality overall (M = 12.17, SD = 2.53) than those with higher GPAs 3.0-3.49 (M = 6.68, SD = 3.04) 3.5-4.0 (M = 6.24, SD = 3.01).

**Conclusion:** In line with previous research, having a consistent bedtime and good sleep quality accounted for a significant proportion of variance in ACT scores. Additionally, college students reporting GPAs above 3.0 had significantly better Global PSQI scores than those reporting GPAs below 2.49. This study suggests sleep and academics are intrinsically linked, providing evidence that improving sleep may be a useful point of intervention to boost academic performance.

**0236**

**WORKING MEMORY PRECISION IMPROVEMENTS FOLLOWING A NAP ARE SPECIFIC TO WOMEN AND RELATED TO SPINDLE DENSITY**

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**Introduction:** Sleep plays an important role in many cognitive processes and memory in particular. Research demonstrates working memory is impaired following sleep deprivation. The current study investigated the role of sleep physiology in working memory performance following a daytime nap.

**Methods:** Twenty-seven participants (M age = 20, 14 women) completed a continuous report measure of working memory performance following a nap and no-nap condition. Participants reported the colour of a square after a short delay on a colour wheel; the precision to target was the dependent variable. PSG was recorded (from 12 scalp sites) during the 90-min nap beginning at 14:00hrs. Performance was assessed one hour after the nap/no-nap period.

**Results:** There was a significant Sex by Condition interaction (F(1,25) = 6.84, p = .015), such that women showed increased precision in working memory after a nap compared to the no-nap condition, whereas men showed a slight decrease. To understand the nature of the interaction, sex differences in sleep parameters were examined. Compared to men, women had less Stage 2 (55 versus 44 minutes; t(25) = -2.11, p = .045), higher Stage 2 spindle density (t(25) = 2.53, p = .018), and higher NREM spindle density (t(25) = 2.05, p = .051). Although associations were not robust when investigated by sex, greater NREM spindle density was found to predict increased working memory precision following a nap in the full sample (F(1,25) = 4.23, p = .05; R squared = .145).

**Conclusion:** A 90-minute nap led to better precision in the working memory task compared to the no-nap condition, but only for women. This may be attributed to the fact that women had a higher spindle density. Altogether, spindle density predicted working memory precision in the entire sample. In conclusion, individual differences in the benefits of napping for working memory precision may be related to spindle generation and may be predominately in women.

**Support (If Any):** NSERC of Canada

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**IX. Learning, Memory and Cognition**

**0237**

**THE ROLE OF AUTONOMIC ACTIVITY DURING SLEEP FOR DECLARATIVE AND NONDECLARATIVE MEMORY**

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**Introduction:** The autonomic nervous system (ANS) modulates memory consolidation during wake (Clark et al., 1999; McCaugh et al., 2013) and shows strong variation across sleep stages. Recently, we demonstrated that ANS activity during sleep, measured by heart rate variability (HRV), predicts performance on a creativity task (Whitehurst et al., APSS 2015). Here, we explore the contribution of autonomic activity during sleep in the procedural and declarative memory domains.

**Methods:** 33 (16F) young, healthy adults completed mirror tracing (MT) and word-paired associates (WPA) tasks in counterbalanced order. For MT, subjects traced 4 novel images in Session1. For WPA, subjects encoded 40, unrelated word pairs followed by an immediate recognition test including 20 intact and 20 rearranged word pairs. At 1:30PM, waking, supine electrocardiogram (ECG) was recorded followed by a 2-hour nap with polysomnography and ECG. The following day, subjects were tested on the 4 MT images and the remaining 20 intact/20 rearranged word pairs (Session2). For each sleep stage, we indexed the high frequency (HF) component of HRV, which has been related to parasympathetic/vagal activity. Linear regression models assessed the contribution of each individual predictor (minutes of individual sleep stages, HF HRV, and spindle density, SpD) to performance change (Session1-Session2).

**Results:** MT improvement was predicted by a model that tested REMMIN+HF HRVREM+ SpDStage2 (adjusted R² = 0.44,p = .01), with HF HRVREM being the only significant predictor of performance (β = .66,p = .003). For declarative memory, Stage REMMIN+HF HRVREM+SpDStage2 predicted performance (adjusted R² = 0.31, p = 0.05). In this model, SpDStage2 was the only significant predictor (β = .58,p = .001).

**Conclusion:** The current results extend previous findings on the role of autonomic activity during sleep for memory consolidation to the procedural memory domain. Additionally, vagally-mediated autonomic activity may have predictive specificity to the non-declarative memory domain, as our declarative task was not strongly influenced by sleep-related autonomic activity.

**Support (If Any):** R01AG046646
0238
GREATER NON-REM SLOW-WAVE ACTIVITY DURING A NAP IS ASSOCIATED WITH INCREASED ACCESSIBILITY BUT NOT FIDELITY OF MEMORIES
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Introduction: Research has shown better declarative memory when a period of sleep follows learning compared to an equal period of wakefulness. However, memory and sleep are not unitary constructs. Sleep is composed of distinct physiological stages, and memories can independently vary in accessibility and fidelity. The current research investigated how neurophysiological aspects of a nap impact these two components of memory.

Methods: In a repeated-measures design, twenty-three participants (13 women; M age = 20) viewed 180 colored household objects and reported colors of the objects after a 2-hr retention period containing either a 90-minute nap opportunity or continuous wakefulness. Participants reported colors of objects using a 360 degree color wheel; estimates of Guess Rate and Precision of recollected items were computed. Sleep was scored and Fast-Fourier transformation quantified EEG power at 12 scalp sites in standard frequency bands within sleep stages.

Results: Neither Guess Rate nor the Precision of recollected items differed between the Nap and No-Nap conditions. Sleep variables were examined to determine whether aspects of the nap related to memory performance. Time spent in SWS correlated negatively with the change (Nap minus No-Nap) in Guess Rate between conditions (r = -.47, p = .02). Stage 2 delta (0.5-4Hz) power at occipital regions (PO7, Oz, PO8) correlated negatively with Guess Rate after the Nap (r = -.46, p = .03), and the change in Guess Rate between conditions (r = -.53, p = .01). Thus, naps richer in slow-wave activity were associated with an increased ability to report the approximate colours of items after the nap. There was no evidence that features of the nap influenced the Precision of recollected items.

Conclusion: These results suggest that NREM slow-wave activity improves memory performance by increasing the accessibility of memories (lower Guess Rate) without necessarily increasing their fidelity (Precision).

Support (If Any): NSERC of Canada

0239
THE ROLE OF GENDER AND NAP STATUS IN EXECUTIVE FUNCTIONING OF KOREAN CHILDREN
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Introduction: The current study investigated the executive function and its relationship to nap habits and gender in four-year olds.

Methods: The study was done with seventy-six children aged four years old living in Gyeonggi-do province in South Korea. Children’s nap habits were distinguished by a sleep diary kept by parents and their executive function was assessed using the Flanker task.

Results: Gender differences were found in nighttime sleep duration depending on their nap status. Girls did not differ on their night time sleep duration as a function of nap status, however, habitual napper boys exhibited significantly less nighttime sleep than non-habitual napper boys. The nap status for boys did not perform differently despite their nap status on their reaction time on the Flanker Task. Contrarily, habitual napper girls were significantly slower on incongruent trials during the standard Flanker phase and marginally in the reverse Flanker phase; however, they eventually reached the similar reaction time on the mixed phase as non-habitual napper girls.

Conclusion: Most children discontinue daytime napping at the age of four. Korean boys might take naps to fulfill their insufficient nighttime sleep whereas Korean girls do not. Children having enough nighttime sleep yet continuing to take naps when they need to transit out from naps may inhibit their cognitive development.

0240
DREAMS FROM ADOLESCENCE TO OLD AGE: GENDER DIMENSIONS AND ONTOGENESIS
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Introduction: While gender differences in various dimensions of dreams are well documented for young adults, little documentation exists on their ontogenesis patterns. The present study is a first attempt to bridge this gap with a large sample of dreams of Canadians from 12 to 85 years old.

Methods: Participants included 50 men and 50 women in each of five age groups (12-17, 18-24, 25-39, 40-64, 65-85), with the exception of only 31 men 65 to 85 years. Participants completed a very thorough and detailed dream diary package and recorded the day’s events and dreams for ten days or until two dreams were reported. One dream from each participant was scored by two independent judges, with high inter-rater reliability using the Hall and Van de Castle (1966) categories of characters, activities, interactions, and emotions.

Results: Two-way analyses of variance with gender and age as factors were performed for each main category. We report on statistically significant findings (at least p < .05). For the presence of female characters, there was a significant main effect for gender, females incorporating more female characters across all age groups. For total aggressions, there was a significant main effect for both gender and age groups. Overall, males had more aggressions but adolescents, both male and female, had more aggressions than all other age groups. For total emotions, there was a main effect for both gender and age group. Females had more total emotions but adolescents, both male and female, had more emotions than both young adults (18-24) and older adults (40-64).

Conclusion: It is interesting to note that previously observed gender differences in young adults for female characters, total aggressions, and total emotions do appear, overall, across the lifespan. However, both aggression and total emotions do decrease with age but with particularly high levels in adolescence.

Support (If Any): Social Sciences and Humanities Research Council of Canada

0241
THREATS IN WAKING AND DREAMING: REFLECTION OF EMOTIONAL CONTROL ACROSS THE LIFE SPAN?
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Introduction: It is well documented that the processing of emotion-related stimuli changes from adolescence to senescence. More precisely, adolescents tend to respond more emotionally than adults to situations of everyday life and the elderly shows further improved emotional control, are more attentive to positive information, and tend to react less intensely than adolescents to negative stimuli. These changes influence the way threatening events are perceived and treated across the lifespan. The Dream Threat Simulation Theory (TST) states that the experience of real threats triggers the activation of the threat simulation system; in this regard it would be expected that while the prevalence of daytime threats may be stable across age, their management would be such that fewer threats would appear in dreams with age.
Methods: The study included 52 participants in each of five age groups (12-17, 18-24, 25-39, 40-64, 65-80 years old), for a total of 260. They had written their home dreams and daily activities over a two week period. One dream per participant and the corresponding preceding day activities were rated, with control for word count, for the presence, type and intensity of threats by two independent judges, using a subset of the Dream Threat Scale.

Results: While there was no significant difference in the presence of daytime threats across ages, there were significant ontogenetic decreases in the prevalence of oneiric threats (F(1,259) = 49.18, p < .0001) including “life-threatening events” (F(1,259) = 14.73, p < .0001), “socially, psychologically or financially severe threats” (F(1,259) = 18.94, p < .0001), “physically dangerous events” (F(1,259) = 11.79, p < .0001) and “minor threats” (F(1,259) = 6.27, p = .013).

Conclusion: These results support the notion that indeed the waking management of threats reduces their incorporation into dreams. They provide support for both the Continuity Hypothesis between waking experience and dreaming, and the TST.

Support (If Any): Social Sciences and Humanities Research Council of Canada

0242
RAPID EYE MOVEMENT SLEEP MEDIATES THE RELATIONSHIP BETWEEN SLEEP DURATION AND VERBAL LEARNING
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Introduction: Studies have examined sleep-dependent memory and cognitive processes, though few have examined the role of sleep on next day neurobehavioral function without intervening sleep. The present study examined the role of prior night sleep on subsequent verbal learning and memory.

Methods: Forty-four African American participants (59% female, mean age 21.5, SD = 3.9) underwent two consecutive nights of polysomnography (PSG). On the morning following the second PSG, participants completed the Rey auditory verbal learning test (AVLT), a measure of verbal learning and memory, and retroactive and proactive interference.

Results: Mean AVLT scores were 55/75 for learning, 11/15 for immediate recall, and 11/15 for delayed recall. Adjusting for age, sex, and education, polysomnographic total sleep time (TST) was positively associated with verbal learning, immediate recall, and delayed recall, such that every hour of increase in sleep was associated with a 2.4-point increase in verbal learning, 1.0-point increase in immediate recall, and 1.2-point increase in delayed recall. Rapid eye movement (REM) sleep total minutes was also associated with verbal learning (β = 0.11, p < .001), immediate recall (β = 0.03, p = .031), and delayed recall (β = 0.04, p = .007). Stage 2 sleep total minutes was positively associated with immediate recall (β = 0.02, p = .016) and delayed recall (β = 0.02, p = .006). Analyses testing potential mediators (Stage 1, Stage 2, slow wave sleep, and REM sleep total minutes) of the relationship between TST and outcome measures (verbal learning, immediate and delayed recall) found that REM sleep minutes mediated the relationship between TST and verbal learning, accounting for 60% of the relationship after adjusting for effects of age, sex, and education.

Conclusion: These data emphasize the importance of REM sleep for verbal learning and memory processing, and suggest that REM sleep duration is a significant predictor and potential marker for subsequent neurobehavioral function.

Support (If Any): This study was supported by NIH grants 3R01HL087995-01A2S1 and UL1TR000101.

0243
HUMAN HIPPOCAMPAL REPLAY PRIORITIZES WEAKLY-LEARNED INFORMATION AND PREDICTS MEMORY PERFORMANCE
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Introduction: Hippocampal replay during rest periods has been well documented in rodents but has proven difficult to observe in humans. Furthermore, across species, it is unknown how memories are prioritized for replay.

Methods: Participants learned about three categories of “satellite” objects, where satellites in the same category had similar parts. After learning the satellite features, they were tested on their memory for each satellite, and then immediately participated in an fMRI scan. The first part of the FMRI scan consisted of many presentations of the satellites in a random order, and the second part was a 6.5-min rest run. We used the first part to estimate the responses to each of the individual satellites, and then compared those templates to the activity during every time point in the rest period. When a satellite template closely matched the activity pattern in a time point in the rest period, we counted this as a potential replay event. The participants came back 12 hours later for a second identical fMRI session, followed by a second memory test.

Results: In the first session, in which the memory test preceded the rest period, objects that were remembered less well were replayed more in the hippocampus during the subsequent rest period, suggesting a prioritization of weak memories. In the second session, in which the rest period preceded the memory test, more hippocampal replay of a satellite during the rest period predicted better memory for that satellite. We also found evidence that objects replayed more often in the first session were subsequently better remembered.

Conclusion: Our results suggest that replay happens during rest in humans, that it predicts memory performance, and that there may be a prioritization process in which the objects most in need of further learning are replayed the most.

Support (If Any): NIH R01-MH069456
HOMEOSTATIC RESPONSE TO REPEATED SLEEP RESTRICTION IN ADOLESCENTS
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Introduction: Slow wave activity (SWA delta, 0.5 to 4 Hz range) during sleep behaves homeostatically in response to sleep deprivation. Moreover, SWA declines drastically across adolescence, mapping on to normative developmental changes in cortical thickness and synaptic density. The relationship between changes in sleep and homeostatic drive has been underexplored in the context of development. We hypothesized that delta power in particular would increase with repeated sleep restriction.

Methods: Quantitative sleep EEG was examined in 51 healthy adolescents (11.5-15 years old) during two consecutive nights of both sleep extension (SE, 10h time in bed, 2200 bedtime) and sleep restriction (SR, 4h time in bed, 0100 bedtime), separated by one week. Absolute EEG power variables in a central electrode (C3) were examined with a 2-sleep (SE, SR) by 2-night mixed effects analysis, and with respect to age.

Results: Main effects of sleep (F = 10.3, p = 0.002) and night (F = 106.0, p < 0.001), and a sleep by night interaction (F = 5.2, p = 0.025) on absolute delta power were observed in the first non-REM period: delta power increased from night 1 to 2 in SR (p < 0.001) but not SE (p = 0.386); SR and SE differed on night 2 (p = 0.016), but not night 1 (p = 0.851). The age by delta power relationship was best described by a quadratic fit (night 1 SR R2 = 0.156; night 2 SR R2 = 0.228), peaking around age 13. However, when treating sleep extension as a baseline, SR-related increases in delta power were unrelated to age.

Conclusion: We observed a homeostatic increase in delta power during the second consecutive night of sleep restriction, though this increase was unrelated to age. While adolescent development strongly attenuates slow wave sleep, homeostatic response to sleep loss was constant in this age group of middle school students.

Support (If Any): R01 DA033064, UL1 RR024153 and UL1TR000005

TESTOSTERONE LEVELS AFTER ONE NIGHT OF SLEEP RESTRICTION PREDICT ACCURACY CATEGORIZING SAD FACES
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Introduction: Testosterone has been shown to be reduced after 24-hours sleep deprivation and chronic sleep restriction. There are several reports of emotional face processing being affected by sleep loss; Our lab reported increased N170 ERP amplitude to threat-relevant faces, and reduced N170 to sad faces. Studies addressing the role of testosterone in emotional processing have found correlations with testosterone over the night (M = 19.81, SD = 17.46) relative to controls (M = 37.01, SD = 19.24), t(20) = 2.20, p = .040. Regression analyses showed testosterone at 07:30 was a significant predictor of accuracy in identifying sad faces at 40% (F(1,10) = 6.49, p = .029; r = .627), 50% (F(1,10) = 13.89, p = .004; r = .763) and 60% (F(1,10) = 5.36, p = .044; r = .590) levels of intensity, for the SR group only. There was no association for C group, or for other face categories.

Conclusion: Sleep loss may selectively impair identification of sad facial expressions. Men with lower testosterone levels after SR were more vulnerable to effects of sleep loss for identifying sad faces.

Support (If Any): NSERC of Canada

HEART RATE RESPONSE DURING TASK PREDICTS ACCURACY CATEGORIZING ANGRY AND FEARFUL FACES
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Introduction: Sleep loss is associated with differential processing of emotional material, as shown in previous research in our lab demonstrating increased N170 ERP amplitude to threat-relevant faces during sleep deprivation. Previous research has shown cardiac measures such as heart rate (HR) are related to individual differences in emotional responding and performance on cognitive tasks. HR deceleration is associated with attentional engagement on moderately demanding tasks, such as the behavioural task used here. We sought to investigate the role of HR variability in categorization of emotional faces following one night of sleep restriction.

Methods: 35 participants were randomly assigned to a Control group sleeping 23:00-07:00 (C: men = 12, M age = 20.9); 33 participants were assigned to a sleep restriction group sleeping 03:00-07:00 (SR: men = 11, M age = 20.2). Baseline HR was recorded during seated rest prior to the face categorization task. HR was recorded during the task wherein four face types (happy, sad, angry, fearful) were presented at random (duration = 400ms, ITI = 1-2s) ranging from 20-60% emotional intensity. Participants were instructed to select the emotional face type or neutral.

Results: Regression analysis showed that increased accuracy categorizing fearful and angry faces at 40-60% intensity was predicted by group (C, SR) and HR reactivity (HRR = task minus baseline HR) during task performance (R Squared = .196; F(3,62) = 5.02, p = .004). First order correlations revealed HRR in the C group was related to accuracy for angry and fearful faces (r = -.506, p = .002). There was no significant relationship between HRR and accuracy in the SR group.

Conclusion: In rested controls, HR deceleration was associated with better accuracy on threat-relevant face stimuli; The SR group failed to show the expected response suggesting impairments in regulatory control. The lack of regulatory control in peripheral systems may explain hyper-attention to threat stimuli reported in prior studies of sleep deprivation.

Support (If Any): NSERC of Canada
**0247**

**NEURAL CIRCUITRY INVOLVED IN SLEEP HOMEOSTASIS AND COGNITION IN DROSPHILA**

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**Introduction:** While abundant experimental evidence suggests that sleep need increases with time spent awake, the contributions of different brain arousal systems have not been assessed independently of each other to determine if certain neural circuits, rather than waking per se, selectively contribute to sleep homeostasis.

**Methods:** Transgenic heat-activatable TrpA1 channels were expressed in different brain regions of Drosophila to drive waking and subsequent homeostatic recovery sleep. Sleep was measured using DAMS from Trikinetics. Learning and memory was measured using a taste-based assay in which appetitive fructose was paired with noxious quinine.

**Results:** Thermogenetic activation of three independent neurotransmitter systems promoted nighttime wakefulness. However, only sleep deprivation resulting from activation of cholinergic neurons was sufficient to elicit subsequent homeostatic recovery sleep. Neurons that promote sleep homeostasis were found to innervate the central brain and motor control regions of the thoracic ganglion. Blocking activity of these neurons suppressed recovery sleep but did not alter baseline sleep. Selective activation of wake-promoting neurons without engaging the sleep homeostat impaired subsequent short-term memory.

**Conclusion:** Prior wakefulness can be dissociated from homeostatic control of sleep need. Our data also suggest a neural circuit model involving distinct populations of wake-promoting neurons, some of which are involved in homeostatic control of sleep and cognition.

**Support (If Any):** NIH grant # R01 NS072431 and Whitehall Foundation grant # WF20110560 to WJJ, NIH grant # R01 NS085152 to ACK, and NSF grant # IOS142625 to ACK and PM.

**0248**

**SLEEP LOSS PROMOTES ASTROCYTIC PHAGOCYTOSIS OF SYNAPTIC ELEMENTS IN MOUSE CEREBRAL CORTEX**

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**Introduction:** Recent studies showed that astrocytes, as well as microglia, display phagocytic activity, being capable of engulfing synapses through the activation of Merkt and Megf10 pathways. Transcriptomic profiling of astrocytes in sleep, wake, and sleep deprived mice found that some genes involved in these phagocytic pathways (Merkt and its co-factor Gas6) were upregulated after few hours of sleep deprivation, suggesting that astrocytes may engage in phagocytic activity during prolonged periods of wake.

**Methods:** Serial block-face scanning electron microscopy was used in sleeping (6-8h of sleep, S), sleep deprived (8h of sleep deprivation, SD), and chronically sleep restricted (5 days of sleep restriction with a reduction of > 70% of sleep, CSR) 30-day old mice to quantify astrocytic phagocytosis at cortical synapses. Assessment of microglial activation was carried out using Iba1 staining on coronal sections of S, SD, and CSR mice and subsequently analyzed with confocal microscopy.

**Results:** Tri-dimensional ultrastructural analysis of frontal cortex synapses (layer II/III) of S (n = 289), SD (n = 355), and CSR (n = 280, 3 mice/group) revealed that astrocytic phagocytosis, identified as a portion of spine head, axon terminal, or dendrite being invaginated by the surrounding astrocytic process, occurs more frequently in SD and CSR than S (p < 0.01). Western blots of cortical synaptoneurosomes confirmed the upregulation of Merkt receptor in SD and CSR relative to S (p = 0.02, 4-5 mice per group). Finally, confocal analysis (3 sections per mouse, 6 mice per group) showed a trend toward an increase of the number of microglial cells (p = 0.065) and a significant reduction of their process branching (p < 0.01) in CSR relative to S. No differences in microglia were observed between S and SD.

**Conclusion:** SD and CSR induce the astrocytic phagocytosis of portions of synapses in mouse cerebral cortex, likely through the activation of the Merkt pathway. In CSR, this effect is accompanied by microglia activation.

**Support (If Any):** Supported by R01MH099231 and P01NS083514 to CC and GT.

**0249**

**ACUTE (50H) SLEEP DEPRIVATION IMPACTS SALIVARY DNA METHYLATION AND TELOMERE LENGTH IN PERIPHERAL BLOOD MONONUCLEAR CELLS**


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**Introduction:** Telomeres are protective structures which cap the ends of chromosomes. Loss of structural integrity, and accelerated telomere shortening, are both associated with biological ageing and increased disease risk. Epigenetic factors, including DNA methylation, are critical for telomere maintenance. Acute sleep deprivation and shift work have both been associated with rapid changes in DNA methylation status, resulting in altered expression of clock and other key regulatory genes, such as brain-derived neurotrophic factor (BDNF). To our knowledge the impact of acute sleep deprivation on telomere length and methylation status has not previously been reported.

**Methods:** In this double-blinded, laboratory based study, participants were assigned to either a caffeine (n = 12, 4F, 22.5 ± 3.3y, BMI 21.7 ± 1.5kg/m2) or placebo condition (n = 12, 5F, 22.5 ± 2.5 y, BMI 22.3 ± 2.1kg/m2). The protocol included one baseline sleep (BL; 22:00h-08:00h), 50h sleep deprivation (SD) and a daytime recovery sleep (10:00h-19:00h). Caffeine (200mg) or placebo gum was chewed for 5min at 01:00h, 03:00h, 05:00h and 07:00h during each night of sleep deprivation. We examined the impact of 50h SD, with and without caffeine, on telomere length and salivary DNA methylation status. Blood was drawn after BL sleep (11:00h on day one), and after 48h SD (08:00h on day 3), and after recovery sleep (20:00h on day 3). Telomere length was determined in peripheral blood mononuclear cells (PBMC) by flow cytometry using a telomere-specific FITC-conjugated PNA probe. Global methylation status was measured using an ELISA assay.

**Results:** TL was increased after SD in the caffeine group when compared to both BL (p = 0.04) and the placebo group (p = 0.03). Telomere length returned to BL levels after recovery sleep (p = 0.10). Salivary DNA methylation also increased after SD in all subjects, and continued to increase even after recovery sleep. This effect reached statistical significance in the caffeine group (p = 0.05).

**Conclusion:** Previously chronic SD has been associated with shorter telomere length. The current data suggests that short term, acute SD increases telomere length, specifically when caffeine is administered. This may be due to an acute stress response, stimulating a transient up regulation of telomere maintenance processes. Rapid changes in DNA methylation with SD have been reported, however the current observation in salivary DNA is novel. Further investigations are warranted to determine the mechanisms underlying the interactive impact of acute SD, and caffeine, on DNA methylation, telomere length and genome integrity.

**Support (If Any):** Defence Science and Technology Organisation.
0250
SEX DIFFERENCES AND EFFECTS OF INSUFFICIENT SLEEP ON THE HUMAN PLASMA METABOLOME

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Introduction: Investigating the plasma metabolome during insufficient sleep may identify biomarkers and mechanisms contributing to metabolic dysregulation associated with sleep loss. Previously, we reported sex differences in energy balance, food intake, and weight gain during insufficient sleep. To further explore sex differences and identify potential sleep loss biomarkers, we investigated the plasma metabolome during insufficient sleep in men versus women.

Methods: We conducted a randomized cross-over 14-15 day laboratory study where 16 (8M/8F) healthy participants aged 22.4 ± 4.8y (mean ± SD) completed 3 baseline days (9h scheduled sleep opportunity/night) followed by 5 days of insufficient (5h/night), and adequate (9h/night) sleep conditions. Food intake was designed to meet energy requirements at baseline and was ad libitum during insufficient and adequate sleep. Plasma was analyzed by untargeted LC/MS every 4h on the final day of baseline, insufficient, and adequate sleep.

Results: Principle component analysis (2,737 metabolites detected) showed separation between men and women. At baseline, 70 metabolites had a main effect for sex (p < 0.05) and a model using 20 metabolites predicted sex (0.987 area under the ROC curve). During insufficient sleep, 11 metabolites differed similarly for men and women versus baseline and adequate sleep (p < 0.05) including increases in two short-chain triglyceride (TAG) species. Analyzed by sex, 13 metabolites were uniquely different in men, and 28 different in women, during insufficient sleep versus baseline and adequate sleep (p < 0.05).

Conclusion: Under these controlled conditions we found sex differences in the plasma metabolome. During insufficient sleep, short-chain TAGs increased in men and women. Similar short-chain TAGs are associated with Type 2 Diabetes, suggesting a mechanism by which insufficient sleep may contribute to metabolic dysregulation. Conversely, 41 metabolites responded differently in men versus women during insufficient sleep, and such sex specific changes likely have implications for identifying individual susceptibilities and biomarkers of sleep loss.

Support (If Any): NIH R01HL109706 and UL1 TR000154

0251
THE METABOLIC MARKER ACETYL carnitine PREDICTS NEUROBEHAVIORAL PERFORMANCE DURING CHRONIC SLEEP RESTRICTION

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Introduction: Sleep loss degrades neurobehavioral functions including behavioral attention, cognitive throughput and memory, and increases sleepiness. However, there are stable and trait-like individual differences in such responses to sleep loss: some individuals show few neurobehavioral decrements (resilient), others show intermediate decrements, and others show marked decrements (vulnerable). This study examined whether metabolomic markers could differentiate such vulnerable and resilient individuals.

Methods: Ten healthy subjects (27.5 ± 5.6 y; 5 females) participated in one of two 14-18 day laboratory protocols. Metabolomic blood samples were taken following 10-12h of fasting after: 1. one night of baseline sleep [10h time in bed (TIB), 2200h-0800h]; 2. chronic sleep restriction (5 nights of 4h TIB, 0400h-0800h); and 3. one night of recovery sleep (12h TIB, 2200h-1000h). The Psychomotor Vigilance Test (PVT), the Digit Symbol Substitution Task (DSST), the Digit Span Task (DS), the Karolinska Sleepiness Scale (KSS) and the Profile of Mood States (POMS) were administered every 2h while awake. Orthogonal Partial Least Square (OPLS) regression was used for statistical analysis.

Results: Preliminary data analyses indicate the metabolite acetyl carnitine associated with 6 neurobehavioral variables during sleep loss, but not at baseline or recovery: PVT lapses and errors, PVT response speed (1/RT), DSST total correct, DS total correct, KSS scores, and POMS vigor scores. Higher levels of acetyl carnitine predicted poorer performance on the PVT, DSST, and DS, and higher KSS scores.

Conclusion: This study provides the first experimental evidence that acetyl carnitine may be a predictor of differential neurobehavioral vulnerability to sleep loss in healthy adults. Reliable prediction using valid biomarkers of who is more or less likely to experience neurobehavioral decrements from sleep loss will allow the development of countermeasures to mitigate the disruptive effects of these changes in a variety of applied settings.

Support (If Any): Work supported by the Department of the Navy, Office of Naval Research Award No. N00014-11-1-0361 (NG); NASA NNX14AN49G (NG); NIH grant R01 NR004281 (DFD); the National Space Biomedical Research Institute (NSBRI) through NASA NCC 9-58 (DFD); Clinical and Translational Research Center (CTRC) grant U1TR000003; Defense Advanced Research Projects Agency (DARPA) and the U.S. Army Research Office (TA, W911NF1010093). A. Sehgal is an Investigator of the Howard Hughes Medical Institute.

0252
INDIVIDUAL DIFFERENCES IN NEUROBEHAVIORAL RESPONSE TO CHRONIC SLEEP RESTRICTION ARE NOT RELATED TO MARKERS OF PHYSIOLOGICAL SLEEP HOMEOSTASIS

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Introduction: We investigated whether phenotypic differences in neurobehavioral response to chronic partial sleep restriction were related to differences in PSG and NREM EEG delta activity.

Methods: N = 309 healthy adults were randomized to either 5 consecutive days of sleep restriction (n = 281, 4h TIB from SR1 to SR5) or to a control condition (n = 28, 10h TIB) after 2 baseline nights of sleep in the laboratory (Bi-2; 10h TIB). SR subjects in the top and bottom quartile of daily PVT lapse performance change from B2 to SR5 were classified as Resilient (n = 70) and Vulnerable (n = 71), respectively. Neurobehavioral measures (10:00h to 20:00h daily) included the Psychomotor Vigilance Test (PVT), Digit Symbol Substitution Task (DSST), Karolinska Sleepiness Scale (KSS), and fatigue subscale of the Profile of Mood States (POMS-F). PSG was recorded on B2, SR1, and SR5 nights, and NREM EEG power spectral analyses (PSA) were performed to measure NREM slow wave activity (SWA) and slow wave energy (SWE). PSA responses were compared among Control (CON), Vulnerable (VUL), and Resilient (RES) subjects, with B2 measures, age, and gender as covariates.

Results: Baseline sleep measures did not differ among groups (all p > 0.05). As expected, VUL subjects performed worse than CON subjects on all outcome measures from SR1-SR5 (p < 0.01). Remarkably, RES subjects did not differ significantly from the CON subjects on any performance measure. However, RES subjects had higher levels of KSS sleepiness (p < 0.01) and POMS-Fatigue (p < 0.05) during SR, although their ratings were below those of VUL subjects during SR (p < 0.01). The only PSG difference between the VUL and RES groups
was less Stage 4 sleep percentage in the former at SR5 (p < 0.01). There were no significant differences between the VUL and RES groups in SWA and SWE at SR1 and SR5, although across days both had increased SWA (p < 0.01) and reduced SWE (p < 0.001) relative to controls, indicating sleep homeostatic responses to SR. The rate of accumulation of SWA from SR1 to SR5 did not differ between the VUL and RES groups (p = 0.58).

Conclusion: The results challenge the assumption that differences in sleep homeostatic responses underlie phenotypic differences in waking neurobehavioral vulnerability to sleep restriction. They suggest instead that the differential vulnerability to sleep restriction may involve waking neurobiology underlying the stability of vigilance and cognitive speed.

Support (If Any): NIH R01 NR004281, NIH CTRC UL1TR000003; NSBRI NASA NCC 9-58.

0253 DETERIORATION OF NEUROBEHAVIORAL PERFORMANCE DURING CHRONIC SLEEP RESTRICTION IN THE ABSENCE OF EXTENDED WAKE EPISODES
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Introduction: Significant deficits in alertness and cognitive function occur with sleep loss. Sleep loss can be the result of acute severe deprivation (wake duration > 24h) and chronic sleep restriction (CSR; insufficient sleep duration over consecutive days). Millions of Americans average < 6h of sleep per night, which usually results in extended wake duration (> 16h). However, the effect of CSR on cognitive function following durations of wakefulness < 16h is unknown. We therefore investigated whether imposing CSR causes significant, cumulative deterioration after wake durations < 16h on psychomotor vigilance task (PVT) performance.

Methods: Fifteen (8 female) healthy participants participated in a 32-day inpatient protocol free of time cues and dim-lighting (< 4lux). Participants were scheduled to 24 cycles of a 20h forced desynchrony (FD) protocol and randomized to one of two sleep/wake FD conditions; Habitual (1:2, 6.67h sleep, 13.33h wake; 8 participants) or CSR (1:3.3, 4.67h sleep, 15.33h wake; 7 participants). Participants completed a 10-min PVT session every 2h during scheduled wakefulness. PVT data were assigned circadian phase using core body temperature data. Inverse of median reaction time (RT) and number of lapses (RTs > 500msec) were analyzed using mixed-effect model techniques.

Results: There was a significant interaction between circadian phase, time awake, and condition for both inverse median RT and number of lapses (p < 0.01). RT was slower and lapses increased under CSR conditions (vs. Habitual) with increasing time awake and during circadian night phases. When separated to circadian day or night, inverse median RT was slower in the CSR condition during the circadian night (p < 0.05), but not during the circadian day (p = 0.37).

Conclusion: PVT performance is affected by an interaction of circadian phase, length of time awake during the current wake episode, and sleep history even without prolonged wake duration. These data suggest that the chronic sleep loss, independent of extended wakefulness, affects vigilance, particularly during the circadian night.

Support (If Any): NIH R01HL114088, R01GM105018, P01AG009975, K24HL105664 (EBK), T32HL007901 (AWM) and UL1TR001102, and the Harvard Catalyst; NSBRI HFP02802 and HFP04201

0254 CAFFEINE EFFICACY ACROSS A SIMULATED 5-DAY WORK WEEK WITH SLEEP RESTRICTION
So CJ, Quartana PJ, Ratcliffe RH, Bergman EM, Trach SK, Maguire KM, Ephred D, Simonelli G, Yarnell AM, Capaldi V, Moon JE, Balkin TJ, Doty TJ
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Introduction: Caffeine is an efficacious, widely-used sleepiness countermeasure. However, the extent to which its efficacy is maintained across a 5-day period of sleep restriction (5 hours time-in-bed per night) characterized by high cognitive workload each day (simulating a work week) is unclear. The purpose of this study was to investigate the ability to sustain alertness and performance under these conditions via repeated administrations of a standard 200mg dose of caffeine.

Methods: Forty-eight healthy individuals participated in this double-blind, placebo-controlled study. Following 5 nights of 10-hour TIB sleep satiation, participants remained in-laboratory for 9 days. The first day consisted of baseline testing. During the next 5 days, sleep was restricted to 5 hours TIB and participants were administered either 200mg of caffeine or placebo twice daily (0800 and 1200hrs). During the final 3 days of the study, participants were allowed recovery sleep (8hrs TIB per night). A cognitive task battery was administered hourly during wake periods and included a 10-minute Psychomotor Vigilance Task (PVT), Profile of Mood States (POMS), and the Stanford Sleepiness Scale (SSS). A modified Maintenance of Wakefulness Test (mMWT) was administered approximately every 4 hours during waking periods.

Results: Relative to placebo, caffeine significantly improved PVT performance during the first 2 days, but not during the last 3 days, of sleep restriction (SR). Likewise, caffeine effectively increased sleep latencies and improved ratings of happiness only for the first few days of SR. In fact, over the final days of SR, those in the caffeine group rated themselves more annoyed than those in the placebo group.

Conclusion: The efficacy of caffeine for maintaining alertness and performance waned across 3+ days of sleep restriction. The extent of this decline as a function of the (possibly interactive) effects of mounting sleep debt and high cognitive load remains to be determined.

Support (If Any): Department of Defense Military Operational Medicine Research Program (MOMRP)

0255 SLEEP DEPRIVATION AFFECTS BRAIN GLOBAL CORTICAL RESPONSIVENESS
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Introduction: How the brain reacts to sleep deprivation is crucial for our modern lifestyle. It is currently unknown if cortical reactivity and connectivity change across sleep deprivation, and if a link exists between these cortical features and cognitive function. We therefore investigated global cortical responsiveness to a transcranial magnetic stimulation (TMS) during a sleep deprivation protocol.

Methods: 22 healthy young men (18-30 years) underwent 8 TMS-EEG sessions during 29h of sleep deprivation under constant routine condi-
ACUTE TOTAL SLEEP DEPRIVATION ALTERS MIDBRAIN WATER DIFFUSIVITY IN COGNITIVELY VULNERABLE INDIVIDUALS

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Introduction: Sleep loss impairs neurocognitive performance and disrupts brain function. However, it is unknown whether sleep loss disrupts white matter microstructure in humans, which can be measured by diffusion tensor imaging (DTI). In this study, we used DTI to non-invasively evaluate the effects of one night of acute total sleep deprivation (TSD) on fractional anisotropy (FA), a widely used index reflecting the degree of anisotropic water diffusion in the brain.

Methods: Forty healthy adults (17 females, 21-50y) participated in a 5-day in-laboratory controlled protocol and were randomized to either the TSD condition (n = 29) or a control condition (n = 11) without sleep loss. Subjects were scanned on a Siemens 3T Trio scanner between 0700h-1000h after a 9h baseline sleep night and after either 24h TSD or a 8h sleep night. DTI data were acquired using a 30 direction, single shot spin echo EPI sequence. During each scan, participants completed a 10-minute Psychomotor Vigilance Test (PVT), which was used to determine their cognitive vulnerability to sleep loss. Imaging data were analyzed using PANDA and SPMB.

Results: TSD significantly impaired performance on the PVT (all p < 0.001). Based on PVT performance (number of lapses), a median split was performed to categorize subjects in the TSD condition as cognitively vulnerable (n = 14) or resistant (n = 15). Vulnerable subjects showed a significant FA decrease in the midbrain, red nucleus, and cerebral peduncle after TSD (corrected p < 0.05). However, no FA changes were found for controls or resistant subjects.

Conclusion: Individuals who were cognitively vulnerable to sleep loss also exhibited acutely reduced anisotropy of water diffusion in midbrain and cerebral peduncle areas primarily thought to be involved in motor control and coordination. The mechanistic basis for the observed FA decrease is unknown, but might reflect changes in water compartmentalization or conceivably glymphatic function. Future studies are needed to further characterize the timecourse of these changes and their biophysical basis.

Support (If Any): Supported in part by NIH grants R01 HL102119, R01 NR004281, CTRC UL1RR024134, P30 NS045839, National Space Biomedical Research Institute through NASA NCC 9-58, the PENN ITMAT-TBIC Pilot Project, the PENN IOA Pilot Project, and Chinese NSF grants 31070984 and 31400872.
0258
SLEEP RESTRICTION AMPLIFIES NEURAL RESPONSE TO REWARD CUES COMPARED TO NORMAL SLEEP AND SLEEP DEPRIVATION
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Introduction: Sleep disturbance is a risk factor of mood and addictive disorders, which are associated with altered neural responses to reward stimuli. This study aimed to investigate the impact of sleep deprivation and sleep restriction on neural response to monetary reward. We hypothesized a dose-dependent relationship between sleep loss and increased activation in regions of the reward circuitry including the ventral striatum (VS), amygdala, orbitofrontal cortex (OFC), and dorsal ACC (dACC).

Methods: After an in-lab baseline night, 114 good sleepers (age range: 18-30 years old; mean 23.7 ± 3.2, 55% women) were randomized to total sleep deprivation (SD, N = 30), sleep restriction (SR: 50% of habitual sleep duration, N = 41), or normal sleep (NS, N = 43) on Night 2. On the following evening, participants completed a monetary reward task while in the 3T scanner. BOLD signals in the VS, amygdala, OFC, dACC were compared across the three groups for reward anticipation and outcome. ROI analyses were conducted using SPM8 and SPSS.

Results: During reward anticipation, NS (p = .041) and SR (p = .005) showed significantly greater activation in the right caudate compared to SD. Reward anticipation was also associated with greater activation of the dACC in SR compared to SD (p = .001). During reward outcome, bilateral activation of the caudate regions was greater in SR than both NS (p = 0.007) and SD (p = 0.003). SR also showed greater activation than SD in the dACC (p = 0.003) and OFC (p = 0.005).

Conclusion: Contrary to our hypothesis, no dose-dependent effect of sleep loss on neural responses to reward was found. Rather, sleep deprivation appears to blunt neural responses to reward compared to NS, whereas SR enhances neural activation during reward anticipation and reward outcomes. The findings suggest that sleep restriction, which is pervasive in the general population, may heighten the risk for developing mood and addictive disorders.

Support (If Any): This work was supported by the US DoD DMRDP (W81XWH-12-0024 Log # 11293006: PI: Germain).

0259
THE EFFECTS OF PARTIAL SLEEP RESTRICTION AND ALTERED SLEEP TIMING ON ENERGY INTAKE AND ACTIVITY ENERGY EXPENDITURE
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Introduction: Experimental studies suggest that reduced sleep duration increases energy intake (EI) and may affect total and/or activity energy expenditure (EE). However, it is unknown whether alterations in sleep timing, independently of sleep duration, impact measures of energy balance (EI and EE). Hence, we examined the effects of partial sleep restriction (PSR) with an advanced wake-time or delayed bedtime on measures of energy intake (EI) and total energy expenditure (EE) over 36 hours.

Methods: Twelve men and 6 women (age: 23 ± 4 years, body fat: 18.8 ± 10.1%) participated in 3 randomized crossover sessions: control (habitual bed- and wake-time), 50% PSR with an advanced wake-time, and 50% PSR with a delayed bedtime. Outcome variables included sleep architecture (polysomnography), EI (validated food menu), total and activity EE and activity times (accelerometry).

Results: Energy and carbohydrate intakes were greater on day 2 and over 36 hours in the delayed bedtime vs. control session (P = 0.03). Activity EE and moderate-intensity PA time were greater in the delayed bedtime session vs. control and advanced wake-time sessions on day 1 and over 36 hours, whereas vigorous-intensity PA time was greater following advanced wake-time vs. delayed bedtime on day 1 (P = 0.01-0.04). Greater sleep quality (high sleep efficiency and lower sleep latency) and slow-wave sleep (SWS) duration between sleep restriction sessions were associated with reduced EI and increased vigorous-intensity PA time, respectively (P = 0.01-0.04).

Conclusion: These findings suggest that PSR with a delayed bedtime increases activity EE and EI. However, the temporal order of effects suggests that increased EE is associated with greater EI during this session. These findings also suggest that individuals with higher levels of sleep efficiency and SWS in response to sleep restriction are able to maintain high-activity levels and exert greater control over food intake following the day.

0260
ALTERED FOOD INTAKE PATTERNS DURING INSUFFICIENT SLEEP AND IMPACT FROM WEEKEND RECOVERY SLEEP
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Introduction: Epidemiological findings show short nightly sleep duration is a risk factor for metabolic disease. Findings from human and animal studies suggest the timing of food intake may also contribute to metabolic disease risk. We previously reported a work-week of insufficient sleep (5h/night) results in altered food intake patterns (smaller breakfast and increased post-dinner snacks) and reduced insulin sensitivity. To investigate the impact of weekend recovery sleep on food intake patterns, we assessed food intake during insufficient sleep followed by weekend recovery sleep.

Methods: We conducted an in-laboratory study where 36 healthy adults (18M/18F) aged 25.5 ± 4.7yr and BMI 22.7 ± 1.5kg/m²(mean ± SD), completed three baseline days and then were randomized to one of three conditions: control (10 days 9h sleep/night), insufficient sleep (10 days 5h sleep/night) or weekend recovery (five days of 5h, then two days ad libitum sleep followed by three days of 5h). Baseline food intake was designed to meet caloric needs. After baseline, food intake was ad-libitum with scheduled meals (breakfast, lunch, dinner, and 2 snacks) and freely available snacks during scheduled wakefulness.

Results: Insufficient sleep reduced breakfast food intake and elevated nighttime post-dinner food intake versus (p < 0.05) control. Weekend recovery sleep increased breakfast food intake and decreased nighttime post-dinner food intake similar to levels in control, and decreased total food intake (p < 0.05; within subject). During insufficient sleep following weekend recovery, night-time post-dinner food intake and total food intake were immediately increased (p < 0.05) similar to levels during insufficient sleep prior to the weekend.

Conclusion: Altered food intake patterns occur during insufficient sleep and are reversed during weekend recovery sleep. However, increased food intake during insufficient sleep immediately following the weekend suggests the common behavior of weekend recovery sleep is unlikely to prevent altered food intake patterns associated with weight gain during sleep loss.

Support (If Any): NIH R01HL109706 and UL1 TR000154
**A. Basic Sleep Science**

**X. Sleep Deprivation**

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**0261**

**RECOVERY OF BEHAVIORAL ATTENTION OUTCOMES, BUT NOT OTHER NEUROBEHAVIORAL MEASURES, DIFFERS AFTER SLEEP RESTRICTION AND ACUTE TOTAL SLEEP DEPRIVATION**

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**Introduction:** We sought to determine whether four days of recovery sleep following sleep loss would reveal different neurobehavioral recovery dynamics after sleep restriction (SR) versus after acute total sleep deprivation (TSD).

**Methods:** 89 healthy adults (34.3 ± 9.0y; 39f) were randomized to receive two baseline nights (BL1-2; 10h-12h time in bed (TIB), 2200h-0800h) followed by five SR nights (n = 44; 4h TIB, 0400h-0800h) or 36 hrs TSD (n = 45). After sleep loss, all subjects received four consecutive recovery nights (12h TIB, 2200h-1000h). Neurobehavioral testing included the Psychomotor Vigilance Test (PVT), Digit Symbol Substitution Test (DSST), Karolinska Sleepiness Scale (KSS), and Profile of Mood States (POMS-F) every 2h during wakefulness. Paired t-tests with corrections for multiple comparisons compared responses between baseline, sleep loss and recovery for each group. Mann-Whitney U tests compared changes in neurobehavioral measures from baseline to each recovery night (R1-BL2, R2-BL2, etc) between the SR and TSD groups.

**Results:** As expected, TSD and SR produced deficits in performance (PVT, DSST; p's < 0.001) and increases in subjective sleepiness and fatigue (KSS, POMS-F; p's < 0.001). Recovery from TSD occurred after one night of recovery sleep and was maintained for all neurobehavioral measures (p's < 0.001). Recovery from five nights of SR occurred after one night of recovery sleep and was maintained for all neurobehavioral measures except PVT lapses and response speed, which failed to show complete recovery after four nights of recovery sleep. Accordingly, after R1 and through R4, the SR group showed significantly greater PVT deficits (more lapses, slower response speed) than the TSD group; no other measures differed between groups.

**Conclusion:** Neurobehavioral recovery from TSD deficits occurred rapidly and completely across measures. PVT deficits from SR, however, failed to reverse completely even after four recovery nights. Whether physiological sleep and other factors contribute to these lingering behavioral attention deficits after SR requires examination.

**Support (If Any):** Work funded by the Department of the Navy, Office of Naval Research (Award No. N00014-11-1-0361 to NG) and CTRC ULTR000003.

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**0262**

**SLEEP DURATION AND MORTALITY AMONG ADULTS 18-60 YEARS: UNITED STATES, 1990-2011**

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**Introduction:** U-shaped relationships of sleep duration with mortality have often been reported; however, evidence suggests that associations with long durations may reflect chronic conditions. We examine association of the recently recommended sufficient sleep duration (> 7 hours for ages 18-60 years) to mortality.

**Methods:** Among 30,706 adults, aged 18-60 years in 1990 and followed through the 2011 National Health Interview Survey Linked Mortality files, the association of self-reported sleep duration was assessed for mortality (3,413 deaths) through December 31, 2011 using multivariable logistic regression models that included age, sex, and race/ethnicity, and baseline smoking, body mass index, exercise, alcohol drinking, hypertension, diabetes, heart conditions, and stroke.

**Results:** The baseline distribution of sleep duration was 6.2% for 10 hours; overall 25.4% (95% CI: 24.7-26.0%) reported sleeping < 7 hours. The crude cumulative incidence of mortality during follow-up was 14.7% for 10 hours of baseline sleep. Compared to those reporting 7 hours sleep, a significant U-shaped relationship with 20-year mortality remained after adjustment for sociodemographic factors, health behaviors, and chronic conditions, particularly among those reporting < 6 hours (adjusted risk ratio [RR] = 1.30, 95% CI: 1.12-1.51), 9 hours (RR = 1.42, 95% CI: 1.17-1.71) and ≥ 10 hours (RR = 1.83, 95% CI: 1.50-2.25). Although greater death was observed among those sleeping 7 hours (12.3% vs. 10.3%, p < 0.0001), the significant association disappeared after adjustment (RR = 1.05, 95% CI: 0.97-1.14).

**Conclusion:** Our results confirmed a U-shaped relationship of sleep duration with 20-year mortality among adults aged 18-60 years and provide evidence that long sleep duration may have impacts on mortality independent of baseline chronic diseases.

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**0263**

**MEDIAL PREFRONTAL GABA PREDICTS HUNGER RATINGS DURING SLEEP DEPRIVATION FOR MEN BUT NOT WOMEN**

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**Introduction:** Sleep deprivation (SD) has been shown to increase food intake relative to energy expenditure. One proposed pathway involves alterations of leptin-sensitive systems that regulate metabolism and appetite. Some evidence suggests that this association may differ for men and women. The role of γ-Aminobutyric acid (GABA) in relation to sleep and appetite is not well understood. GABA levels change significantly following prolonged waking, and leads to increased GABAergic inhibition of cholinergic activity. We examined subjective hunger ratings of total sleep-deprived men and women several days after rested GABA levels were measured at baseline using proton magnetic resonance spectroscopy (MRS).

**Methods:** Forty-five healthy, right-handed individuals (23 males, mean age = 25.4) were recruited to undergo 3T magnetic resonance spectroscopy and asked to return 1-4 days later. Participants underwent a 29-hour total sleep deprivation (SD) session, rating their hunger on a 7-point scale at five time points throughout the SD session (23:30; 02:30; 05:30; 08:30; 11:30). This metric was examined relative to brain GABA levels (normalized to creatine).

**Results:** Men showed greater hunger ratings than women at 23:30 (p = .003), even after controlling for total calories consumed during the SD session, but not at any other time point. After controlling for age and total calories consumed during the SD session, there was a positive correlation between baseline GABA levels in the medial prefrontal cortex (MPFC) and hunger levels of men at 02:30 (r = 0.61, p = .008) and 11:30 (r = 0.51, p = .03), but not women (2:30, r = 0.15, ns; 11:30, r = 0.14, ns).

**Conclusion:** Higher baseline GABA in the medial prefrontal regions predicted greater hunger during overnight SD in men only. These findings build on prior work suggesting that men may be more susceptible to weight gain following insufficient sleep, but further suggest that this may be partly attributable to differences in baseline GABA and its effects on hunger during periods of sleep loss.

**Support (If Any):** DARPA-12-12-11-YFA11-FP-029
0264
DISTINCT NETWORK RESPONSE TO THE PSYCHOMOTOR VIGILANCE TASK DURING LAPSES IN ADOLESCENTS, INCLUDING THE EFFECT OF SLEEP DEPRIVATION
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Introduction: Adolescents often experience chronic sleep restriction (SR) on school nights, but little is known about how SR impacts brain function during attention breakdown. Here we report on a network-based neuroimaging analysis of a vigilance task in which we compare responses based on performance (lapse vs. normal) and sleep condition (SR vs. healthy sleep; HS).

Methods: Thirty-three typically-developing teens ages 14-16 underwent a 3-week within-subject protocol: a baseline week followed by 2 experimental weeks with 5 nights of 6.5 hours (SR) or 10 hours (HS) in bed, with random cross-over and 2-day wash-out. Teens underwent fMRI on the mornings at the end of HS and SR, performing a psychomotor vigilance task that measured reaction time (RT) in response to stimuli presented at random intervals. Imaging data were analyzed using event-related independent component analysis (eICA). Group eICA, with 20 components, was applied to deconvolved responses separated into those in the normal range of RT (RT = 100-499ms) versus lapses (RT > 500ms). Back-projected timecourses were compared according to RT grouping and sleep condition.

Results: Ten components described networks relevant to attention or sensory response. We report on response timecourses for an attention-related right-lateralized fronto-parietal network. Post-stimulus, mean response peaked after 6-8 seconds with a significant main effect of RT grouping: mean peak was more marked and occurred later after lapses. There was no main effect of sleep condition on peak height or timing. RT grouping interacted with sleep condition: the peak response was slower during SD than HS for lapses, but not for normal RT.

Conclusion: This presentation illustrates the ability of eICA to identify distinct brain networks involved in vigilance, allowing subsequent analysis of network-specific response characteristics. Lapses are marked by unusual brain responses in an attention-relevant network, especially during SR. Further analysis will examine additional networks with distinct timecourses.

Support (If Any): NIH (R01-HL092149, UL1-TR000077).

0265
SMALLER GRAY MATTER VOLUME OF THE VISUAL CORTEX PREDICTS VULNERABILITY TO SLEEP DEPRIVATION
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Introduction: Sleep deprivation impairs performance on the Psychomotor Vigilance Test (PVT). One common metric of PVT performance is the number of attentional lapses, which typically increase as the period of continuous wakefulness is extended. Interestingly, some individuals are more vulnerable to increased lapses during SD than others, suggesting a trait-like phenotype. Prior research has demonstrated decreased functional activation within primary visual sensory cortex in these individuals during SD, suggesting a possible phenotypic pattern of reduced ability to process visual stimuli among vulnerable individuals. Here, we correlated the number of lapses during a night of total SD with gray matter volume of the visual cortex.

Methods: 33 healthy participants (aged 20–43; 17 males) underwent structural magnetic resonance imaging (MRI) at 3 T. Using an automated algorithm of the VB8 toolbox in SPM8, T1-weighted structural images were first DARTEL-normalized to MNI space, segmented into grey matter, white matter and cerebrospinal fluid, and spatially smoothed with an 8mm FWHM Gaussian kernel. Modulated images were used to provide an estimate of voxelwise gray matter volume. Participants then completed a 24-hour overnight sleep deprivation session involving hourly completion of a 10-minute PVT. In SPM12, gray matter volume within the visual cortex was then regressed against the number of PVT lapses (≥ 500 ms) during the entire session, controlling for gender and age.

Results: Individuals showing more lapses during the overnight sleep deprivation period showed significantly reduced gray matter volume within primary visual cortex, including cuneus and calcareous cortex (MNI: x = -2, y = -76, z = 24; small volume cluster corrected, p < .05, FWE).

Conclusion: Reduced gray matter volume within the primary visual sensory cortex is associated with significantly more attentional lapses during sleep deprivation, suggesting a potential stable structural biomarker of the trait-like vulnerability to sleep loss. These findings converge with prior functional neuroimaging research to implicate the visual processing system as particularly vulnerable to SD.

Support (If Any): DARPA-12-12-11-YFA11-FP-029

0266
SLEEP DEPRIVATION IMPAIRS FEAR EXTINCTION LEARNING AND RECALL IN HEALTHY SUBJECTS: AN FMRI STUDY
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Introduction: Sleep promotes generalization of fear extinction, suggesting that promoting restorative sleep may augment exposure-based treatments for fear-based disorders, such as posttraumatic stress disorder (PTSD). However, chronic sleep disturbances characterize these disorders, and this may interfere with exposure-based treatment outcomes by impairing fear extinction learning and memory. This study aimed to evaluate the impact of sleep deprivation on fear extinction recall in healthy adults.

Methods: After completing a baseline night in the laboratory, 72 participants (23.9 ± 3.4 years, 52% women) were randomized to total sleep deprivation (SD, n = 31) or normal sleep (NS, n = 41) on Night 2. The following morning, participants completed well-established fear conditioning and extinction learning tasks. In the evening, fear extinction recall was tested. All tasks were conducted in a 3T MR scanner. BOLD signals in the amygdala, dorsal anterior cingulate cortex (dACC), ventromedial prefrontal cortex (vmPFC), and hippocampus were extracted as regions of interest (ROI) and compared between the two groups. ROI analyses were conducted using SPSS and SPM8.

Results: Compared to NS, SD showed lower activation of the vmPFC (p < 0.05) and greater activation of the left amygdala (p < 0.05) during late fear conditioning. During late fear extinction, SD showed lower activation of the dACC, vmPFC, amygdala, and hippocampus (all p < 0.05) compared to NS. During early fear extinction recall, NS showed greater activation of the dACC (p < 0.01) to the unextinguished conditioned stimuli. However during later recall, SD showed greater dACC (p < 0.03) and vmPFC (p < 0.06) activation to both extinguished and unextinguished conditioned stimuli, suggesting a failure of previous extinction learning and/or memory.

Conclusion: Sleep deprivation impairs fear extinction learning and recall. Targeting sleep consolidation may be a critical strategy to augment the short-term and long-term efficacy of exposure-based treatments for PTSD and other fear-based disorders.
Support (If Any): This work was supported by the US DoD DMRDP (W81XWH-12-0024, Log #11293006 PI: Germain).

0267 EFFECTS OF ACUTE TOTAL SLEEP DEPRIVATION ON RESTING AND ATTENDING BRAIN FUNCTION
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Introduction: Sleep is essential for optimal brain function and sleep loss impairs a range of neurocognitive capabilities. The detrimental effects of sleep deprivation on brain activation during various cognitive tasks have been well demonstrated. However, it remains unknown whether sleep loss impacts resting and working brain function in a similar manner. We used arterial spin labeling (ASL) perfusion functional magnetic resonance imaging (fMRI) to non-invasively quantify regional cerebral blood flow (CBF) at rest and while performing the Psychomotor Vigilance Test (PVT), in order to dissociate the effects of one night of acute total sleep deprivation (TSD) on resting and attending brain function.

Methods: Thirty-five healthy adults (33.3 ± 8.4y, 18 females) participated in a 5-day in-laboratory controlled protocol including one night of TSD and 3 fMRI scan sessions. Subjects were scanned between 0700h-1000h at rest and while performing a 10-minute PVT after a night of 9h baseline sleep, after 24h TSD, and followed two nights of 20h recovery sleep. A pseudo-continuous ASL sequence was used to quantify CBF in the brain. Imaging data were analyzed using SPM8 and fMRI-Grocer toolbox.

Results: TSD significantly reduced resting CBF in the thalamus, frontoparietal, and default mode network, and increased resting CBF in the visual and sensorimotor cortices (whole brain corrected p < 0.05). Blunted regional CBF changes were found during the PVT. Resting CBF changes in the thalamus, occipital, and prefrontal regions significantly correlated with PVT performance deficits after TSD (all ps < 0.05).

Conclusion: Robust resting CBF decreases after TSD reflect a de-rousing effect of sleep loss on brain function. Blunted CBF changes during the PVT suggest a compensated arousing effect of task performance on impaired brain function after sleep loss. The correlations between resting CBF changes and PVT performance deficits suggest that resting brain responses to TSD may underlie differential cognitive vulnerability to sleep loss.

Support (If Any): This work was supported by the US DoD DMRDP (W81XWH-12-0024 Log #11293006 PI: Germain)

0269 EFFECTS OF SLEEP DEPRIVATION ON THE AUTONOMIC RESPONSE TO A PSYCHOSOCIAL STRESS TASK
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Introduction: Sleep has been shown to play an important role in the regulation of emotional response such as stress. Heart rate variability (HRV) has become a popular method of measuring autonomic activity. In the present study, the role of sleep deprivation on the autonomic response to a social stress was investigated.

Methods: Healthy participants (M = 26.3, SD = 6.4, 49% Female) were randomly assigned to one of three groups: 1) sleep deprived one night (n = 21), 2) allowed to sleep (n = 18), 3) daytime control tested over the same time period while normally awake (n = 14). Participants were brought into the lab for baseline recordings and then again approximately eight hours later. All participants were given the Trier social stress test where they were asked to perform an oral speech followed by a mental math task.

Results: As measured by the Stanford Sleepiness Scale, sleep deprived participants were significantly more sleepy compared to their baseline (p < .001) during the stress task than sleep controls (p = .616) or daytime controls (p = 1.00). As expected, for all groups, the stress task resulted in a significant increase in heart (p < .001), systolic (p < .001) and diastolic blood pressure (p < .001). There were no significant differences among the three groups in heart rate (p = .361), systolic (p = .434), or diastolic blood pressure (p = .705). HRV analysis indicated there was a significant interaction in the low frequency/high frequency (LF/HF) ratio among the three experimental groups over the three time periods measured (F(4,100) = 2.118, p = .010). Specifically, participants that were allowed to sleep overnight had a significant increase in LF/HF ratio due to the stress task as compared to the sleep deprivation group (p = .031) and day group (p = .043). No other measures of heart rate variability were significantly different among the three groups.
Conclusion: Increases in LF/HF ratio is generally thought to indicate either an increase in sympathetic activation or a decrease in parasympathetic activation. The results may indicate that participants following a night of sleep demonstrated an appropriate increase in sympathetic activation following the social stress task while autonomic changes were blunted in the sleep deprived group. However, these changes may be related to time awake and not relative sleepiness.

Support (If Any): Faculty Research Support Fund (FRSF) from UHCL

0270

SLEEP DEPRIVATION INDUCES PERCEPTIONS OF GREATER TASK DIFFICULTY AND USE OF HEURISTICS

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Introduction: This study examined whether sleep deprivation leads to perception of greater task difficulty and increased heuristics use. Research suggests a link between sleep quality and perception of difficulty. Engle-Friedman et al. (2010) found that less sleep and earlier wakeup time were associated with perception of greater difficulty of skating maneuvers in adolescent athletes. Individuals may employ heuristics (mental shortcuts) when facing with challenging situations (Shah & Oppenheimer, 2008). This study assessed whether sleep deprivation results in a greater perception of task difficulty and use of heuristics.

Methods: Participants were screened for eligibility and randomly assigned to the Fully Rested (FR, n = 18) or Sleep Deprived (SD, n = 16) group. The FR group slept at home while SD participants remained awake overnight. The following morning, participants took assessments evaluating perception of task difficulty and heuristic use.

Results: SD participants rated an article as significantly more difficult (p = .03) and requiring significantly more time to read (p = .01) than FR participants. Regarding heuristics, SD participants rated an image of an unattractive refrigerator with a positive consumer review as significantly lower quality (p = .002) and were significantly less likely to purchase this refrigerator (p = .02) than the FR group. SD males were more likely to bypass instructions preceding a reading passage compared to FR males (p = .04).

Conclusion: Results suggest that sleep loss leads to changes in perceptions and an increase in the use of heuristics. Sleep-deprived individuals seem to be aware of the limitations in capacity caused by the loss of sleep and use mental shortcuts to reduce cognitive demands. Using heuristics rather than fully engaging cognitive processes when sleep deprived may impact outcomes in circumstances under which life and safety are at risk.

0271

MULTIPLE CONSECUTIVE SHIFTS AND COGNITIVE IMPAIRMENT FROM SLEEP RESTRICTION IN WILDLAND FIREFIGHTERS

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Introduction: Wildland firefighters in British Columbia commonly work 12 hours daily, for 14 consecutive days. Working multiple consecutive shifts in a physically and psychologically demanding occupation could compromise vigilance, daily sleep opportunity, and ultimately worker safety. We hypothesized that cognitive impairment, assessed with the Psychomotor Vigilance Test (PVT), would increase as the number of consecutive firefighting shifts increased. As well, total sleep time (TST) and sleep quality would be associated with increased cognitive impairments over the 14 consecutive days worked.

Methods: We recruited 39 wildland firefighters between July 2015 and August 2015 on-site, at two separate wild fires. Each participant completed a full 14-day work cycle followed by a 3-day rest period. Participants completed the 5-min PVT each day immediately after their shift. Throughout the work and rest cycle we measured TST objectively using wrist worn actigraphy (wGT3X-BT) and subjective sleep quality using a 5-point Likert scale. Paired sample t-tests were conducted to examine changes in TST and PVT across the work cycle. A Pearson product-moment correlation coefficient was conducted to evaluate the association between PVT and sleep quality scores.

Results: We found a significant increase in mean PVT reaction time (reflecting a deterioration in psychomotor vigilance) from Day 1 (M = 278.92, SD = 38.41) to Day 14 (M = 299.86, SD = 60.19); t (38) = -2.388, p = .022. There were no significant changes in TST from Day 1 (M = 391.90 min, SD = 39.85) to Day 14 (M = 394.21 min, SD = 76.130). A significant negative association was observed between daily mean PVT scores (M = 289.50, SD = 59.94) and subjective sleep quality (M = 3.04, SD = .94); r = -.261, p = .05.

Conclusion: Working 14 consecutive firefighting shifts is associated with reaction time impairment. Although firefighters had no significant decreases in TST across the work cycle, they still showed a decline in vigilance consistent with chronic sleep restriction. Subjective sleep quality was associated with reduced psychomotor vigilance on the PVT in wildland firefighters during a work cycle.

Support (If Any): This work was supported by WorkSafeBC and the Wildfire Management Branch of British Columbia.
sleep episodes per day (p < 0.001) but decreased when crewmembers worked fixed watchstanding schedules (p = 0.004).

**Conclusion:** Results indicate that in the naval operational environment, PSQI scores are associated with watchstanding schedule, daily duration of watchstanding, and the number of sleep episodes per day. Reported sleep quality deteriorated when crewmembers stand watch for long hours, when sleep is split into multiple episodes, and when standing watch on rotating schedules. In contrast, sleep quality is improved when crewmembers stand watch using fixed schedules and sleep is consolidated into fewer daily sleep episodes.

**0273**

**SLEEP DEPRIVATION AND DRIVING IN ADOLESCENTS AND YOUNG ADULTS**

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**Introduction:** Sleep-deprived driving is the operation of a motor vehicle while being cognitively impaired by a lack of sleep. Sleep deprivation is a major cause of motor vehicle accidents, and it can impair the human brain as much as alcohol. It has been estimated that between 16% and 60% of all accidents have sleep deprivation as a cause. Adolescents and young adults frequently complain of symptoms of sleep disorders and suffer from chronic sleep deprivation. There is an absence of evidence in the literature regarding sleep deprivation in young novice drivers versus young adults. This study employing functional MRI during driving simulation aims to quantify the effect of sleep deprivation on driving function.

**Methods:** Our study is a prospective cohort study of two subject groups (adolescents versus young adults) with each subject serving as their own control. The enrolled subjects are 16 - 26 years old, right-handed, with driving experience either less than 6 months or ≥ 4 years of driving experience. Participants with a chronic or acute ongoing health condition which might affect the study results were excluded. Study procedures were following: actigraphy, polysomnography, multiple sleep latency test, driving simulator testing, functional MRI brain scan and driving simulation test with and without sleep deprivation.

**Results:** The preliminary results showed the total collisions was 0.2 during the control driving simulation test and 1.2 after 22 hours sleep deprivation. The total number of centerline crossings was 3.32 and 6.76 respectively and the total number of crossing out of the road outline was 3.32 and 5.6 respectively.

**Conclusion:** The sleep deprivation significantly impairs the driving function in adolescents and young adults. The more detailed study data analysis is in progress. The preliminary results suggest that the sleep impact is greater in adolescent versus young adults.

**0274**

**WEEEKEND RECOVERY SLEEP AFTER A WORK WEEK OF SHORT SLEEP**

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**Introduction:** Chronic sleep loss affects millions of Americans each year with many individuals maintaining short sleep schedules during the work week and extending their sleep on the weekend. Sleep loss has been shown to shorten sleep latency, decrease wakefulness after sleep onset (WASO), and to point preserve slow wave sleep (SWS) time predominantly at the cost of Stage 2 and REM sleep. In most prior studies that examined recovery sleep, the duration of the sleep opportunity was limited. Therefore, the aim of the current investigation was to examine changes in total sleep time and in NREM and REM sleep architecture during ad libitum weekend recovery sleep.

**Methods:** 36 (18 females) healthy adults (aged 25.5 ± 4.7y mean ± SD) completed three baseline days (9h sleep/night) and then were randomized to one of three conditions: control (9h sleep/night), sustained sleep loss (5h sleep/night) or weekend recovery sleep (five days of 5h sleep/night [simulated work-week], then two days ad libitum weekend recovery sleep).

**Results:** There was a significant interaction between study day and condition for sleep onset latency and time spent in Stages 1, 2, and REM sleep, WASO and total sleep time (TST) (p < 0.05). No significant change was observe for SWS time. Sleep restriction reduced sleep onset latency, time in Stages 1, 2, and REM sleep, and WASO (p < 0.05 versus control); whereas weekend recovery sleep increased time in Stage 2, REM and TST (average sleep duration of ~10h) on the first weekend recovery night, and increased time in REM and WASO on the second weekend recovery night (p < 0.05 versus control).

**Conclusion:** Increased TST, Stage 2, and REM sleep time during ad libitum weekend recovery sleep suggests a NREM and REM sleep rebound on the weekend after a work-week (5 days) of sleep loss.

**Support (If Any):** R01 HL109706 and TR001082

**0275**

**THE EFFECTS OF CAFFEINE ON PSYCHOMOTOR VIGILANCE TASK PERFORMANCE DURING SLEEP RESTRICTION AND RECOVERY**

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**Introduction:** The efficacy of repeated caffeine administration for maintaining attention during chronic sleep restriction and recovery is unclear. We examined effects of caffeine on psychomotor vigilance task (PVT) performance in a sleep restriction paradigm and explored whether effects were moderated by ADORA2A, an adenosine A2 receptor gene associated with caffeine sensitivity.

**Methods:** In this double-blind study, 48 adults (18-33 years old) randomized to caffeine (400mg daily during sleep restriction) or placebo drug groups provided blood samples for genotyping and completed PVTs hourly during wakefulness on one baseline day (10 hours time in bed or TIB), five sleep restriction days (5 hours TIB), and three recovery days (8 hours TIB). Using multivariate analyses of covariance (adjustments for baseline, demographics, morningness-eveningness, and affective restlessness response; ADORA2A for exploratory analyses), the effects of caffeine were examined on daily PVT metrics: mean reaction time (RT), fastest 10% and slowest 10% of responses, lapses, and response time divergence (RTD).

**Results:** Multivariate effects of drug group were significant (ps < .05) or marginal (p < .07) for PVT metrics. Mean RT (p < .001) and slowest 10% of responses (p < .01) were faster and lapses were fewer (p < .05) in the caffeine group during sleep restriction and in the placebo group during recovery. Regarding RTD and fastest 10% of responses, the effects of caffeine diminished after two days of sleep restriction. ADORA2A homozygous dominant genotype was significantly associated with RTD during sleep restriction and recovery (ps < .05), with slight attenuation of caffeine effects on RTD during the second sleep restriction day.

**Conclusion:** Repeated caffeine administration during sleep restriction resulted in initially better attention, but worse attention during recovery. While this could be due to repeated caffeine exposure increasing the adenosinergic response to sleep loss, the influence of ADORA2A on performance during recovery was limited to RTD, which showed no significant effects of caffeine during recovery.

**Support (If Any):** Department of Defense Military Operational Medicine Research Program (MOMRP).
0276
THE ROLE OF CAFFEINE IN PREVENTING RECOVERY FOLLOWING SLEEP RESTRICTION

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Introduction: Previous studies have shown that the rate of recovery from sleep loss depends on the type (chronic sleep restriction vs. acute total sleep deprivation) and severity of loss. While sleep restriction is an ecologically valid paradigm that closely reflects sleep patterns in our daily lives, previous research has omitted an important covariate: caffeine. In the present study, the effects of caffeine on recovery from sleep restriction were investigated.

Methods: Forty-eight healthy subjects first underwent 5 nights of sleep satiation (TIB: 10 hr) and then underwent 5 nights of sleep restriction (TIB: 5 hr) followed by 3 nights of recovery sleep (TIB: 8 hr) in a sleep laboratory. Caffeine gum (200 mg) or placebo was administered at 0800 and 1200 hrs each day during the sleep restriction phase. While awake, during the sleep restriction, and recovery phases, subjects completed a 10-min PVT and mood word ratings every hour, and a modified Maintenance of Wakefulness Test was administered about every 4 hours.

Results: Overall, performance metrics did not return to baseline following two nights of recovery sleep. In fact, no significant improvements in sleep latency, subjective sleepiness, happiness, or irritability were found, even after the 2nd night of recovery sleep. However, partial recovery was evident for PVT performance. There was also a significant group effect observed, wherein participants receiving caffeine showed no recovery compared to placebo for sleep latencies and self-reported sleepiness and irritability.

Conclusion: Two nights of recovery sleep (8 hrs TIB per night) were not sufficient to fully restore alertness and performance following a 5-night sleep restriction paradigm. This result was largely driven by those participants who received caffeine during the sleep restriction period. These results indicate that the use of caffeine while restricting sleep can negatively impact recovery.

Support (If Any): Department of Defense Military Operational Medicine Research Program (MOMRP)

0277
THE EFFECT OF 35 HOURS OF TOTAL SLEEP DEPRIVATION ON THE SHOOT/DON’T SHOOT DECISIONS IN POLICE OFFICERS IN TRAINING: PRELIMINARY ANALYSES

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Introduction: It has been suggested that not only sleep loss may play a role in police officers’ decisions to shoot, but that it may also compromise some cognitive processes underlying ethnic biases. Our study examines the impact of 35h of total sleep deprivation (TSD) on shoot/ don’t shoot decisions in a multiethnic context.

Methods: Forty male police officers trainee were asked to perform a first person shooter task (FPST) before and after a night of sleep (control group = 21) or TSD (TSD group = 19). The task involved African American (AA) or White (W) targets embedded within complex backgrounds, holding guns or harmless objects. Participants were asked to “shoot” armed targets and to “not shoot” unarmed targets, and their decision needed to be made within 800ms. This task has been shown to reveal an ethnic bias: participants correctly decide to shoot armed targets more quickly when they are AA, whereas they correctly decide to “not shoot” unarmed targets more quickly when they are W. Two mixed ANOVAs Group (Control vs TSD) X Time-of-task (Before vs After) X Ethnicity (AA vs W) were calculated on the reaction time (RT) of correct decisions for each weapon condition (i.e. armed and unarmed) separately.

Results: Results confirmed the ethnic bias previously observed, i.e. faster RTs with armed AA than armed W (F (1,38) = 59.05, p < 0.001), and faster RTs with unarmed W than unarmed AA (F(1,38) = 21.20, p < 0.001). Most importantly, neither of these effects were moderated by the sleep condition (F(1,38) = 0.664, p = .801; F(1,38) = 0.888, p = .489, for armed and unarmed targets respectively). There was, however, a main effect of Time-of-Task (F(1,38) = 19.63, p < 0.001), indicating an improvement in RTs across sessions for unarmed targets.

Conclusion: These results suggest that even though the classic ethnic bias associated with the FPST is present in police officers in training, this bias is not amplified or modulated by one night of total sleep deprivation.

Support (If Any): Social Sciences and Humanities Research Council of Canada

0278
INDIVIDUALS DISPLAY ROBUST STABILITY OF TRAIT-LIKE VULNERABILITY OR RESILIENCE TO DIFFERENT TYPES OF SLEEP LOSS AND DIFFERENT NEUROBEHAVIORAL MEASURES

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Introduction: We determined whether trait-like responses are observed after chronic sleep restriction (SR) and total sleep deprivation (TSD) separated by recovery sleep in the same protocol, and determined the consistency of such responses among different neurobehavioral measures.

Methods: 83 healthy adults (34.7 ± 8.9y; 36f) completed 2 baseline nights (10-12h time in bed, TIB) followed by 5 SR nights (4h TIB) or 36h TSD. Subjects then received 4 recovery (12h TIB) nights followed by 5 SR nights or 36h TSD in counterbalanced order to the first sleep loss condition sequence. Neurobehavioral outcomes included the Psychomotor Vigilance Test (PVT), Digit Symbol Substitution Test (DSST), Digit Span (DS), Karolinska Sleepiness Scale (KSS), and Profile of Mood States (POMS) every 2h during wakefulness. Intraclass correlation coefficients (ICCs) were computed as the ratio of between-subjects variance to the sum of the between- and within-subjects variances using data from 0800h/1000h to 2000h after the fifth SR night and data from 2200h/0000h to 2000h of TSD. Spearman’s rho assessed the relative rank of individuals’ averaged SR-TSD responses across neurobehavioral measures.

Results: Regardless of sleep loss order, subjects who displayed vulnerability to TSD also displayed vulnerability to SR, evidenced by substantial ICCs: PVT lapses, ICC = 0.806; PVT response speed, ICC = 0.896; DSST correct, ICC = 0.885; DS correct, ICC = 0.922; KSS, ICC = 0.837; POMS fatigue, ICC = 0.787. Individuals also exhibited significant consistency of responses within performance (PVT, DS, DSST; p’s < 0.001) and subjective (KSS, POMS; p’s < 0.001) measurement domains, but not between the domains (p’s > 0.05).

Conclusion: Vulnerability to SR and TSD showed trait-like stability in neurobehavioral measures evidenced by substantial inter-individual variance (79%-92% across measures). Moreover, individuals displayed consistent, but different, vulnerability within performance and subjective domains. Interestingly, performance vulnerability did not predict subjective vulnerability or vice versa. These data confirm the remarkable stability of phenotypic neurobehavioral responses across different...
forms of sleep loss and across different performance and subjective measures.

Support (If Any): Work funded by the Department of the Navy, Office of Naval Research (Award No. N00014-11-1-0361 to NG), CTRC UL1TR000003 and by the National Institute of Health T32 HL7953.

0279
PREVIOUS ACUTE SLEEP DEPRIVATION INCREASES PAIN LEVELS AND DURATION IN A RAT MODEL OF SURGICAL PAIN

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Introduction: Persistent postoperative pain affects up to 50% of patients. Insufficient sleep worsens pain and predicts the development of future chronic pain. To date, the mechanisms that mediate the relationship between sleep disturbances and postoperative pain remain poorly understood. Valid animal models are needed to probe the brain mechanisms underlying this interaction. This study tested the hypothesis that sleep loss prior to surgery contributes to persistent postoperative pain.

Methods: Male and female Sprague-Dawley rats (n = 34) underwent 6 h of undisturbed sleep (US) or sleep deprivation (SD). Under brief anesthesia a surgical incision was performed on the plantar surface of a hind paw, the skin was sutured and covered with an antibiotic ointment. Mechanical hypersensitivity (allodynia) in the skin near the wound was quantified using the von Frey test expressed as the threshold in grams. Nociceptive measures were obtained daily for six days.

Results: Compared to baseline, all rats developed allodynia that persisted for several days after surgery. The threshold in the US group was significantly reduced on days 1 and 2 after surgery. In the SD group, allodynia persisted until recovery on days 5 and 6 in females and males, respectively. Mean levels of allodynia obtained by averaging the data from each group across time after surgery were significantly lower (i.e., lower mechanical threshold) in the SD group in both males (mean ± SD: 11.7 ± 2.11 vs 8.4 ± 2.23; P = 0.043) and females (11.5 ± 0.86 vs 7.5 ± 2.04; P = 0.011). There were no sex differences in the mean mechanical threshold in the US and SD group.

Conclusion: These results suggest that previous sleep loss worsens postoperative pain and may contribute to the development of persistent pain. Ongoing studies are focusing on brain mechanisms by which previous sleep loss can lead to persistent postoperative pain.

Support (If Any): Supported by the Department of Anesthesiology.

0280
QUALITATIVE DIFFERENCES IN SLEEP BETWEEN AN INBRED AND OUTBRED MOUSE STRAIN

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Introduction: Sleep is a complex behavioral state that is under strong genetic influence. We compared sleep/waking activity, electroencephalograph (EEG) power, wheel running, and sleep rebound following chronic, partial sleep deprivation (SD) in inbred C56BL/6 and outbred CD1 mice.

Methods: We employed two experimental paradigms both of which featured adult male C57BL/6 and CD1 mice implanted with EEG and EMG recording electrodes, with 2 weeks recovery, 1 week acclimation to tethers, and 1 week off tether prior to start of baseline recording. Set 1 (n = 6 BL6, n = 5 CD1) were placed in floorless cages set over a treadmill and allowed to acclimate for one day followed by baseline recording for 2 days and chronic, partial SD across 2 days (4 hours SD, 2 hours recovery). Set 2 (n = 5 BL6, n = 6 CD1) were placed in recording cages and given access to open-topped running wheels for one week prior to the surgery and with access to running wheels throughout the data collection period which was similar to set 1, with the exception that baseline activity was recorded for one week and SD was not performed.

Results: Under baseline conditions for both recording conditions, time in state was similar between BL6 and CD1 strains, while SWA power (0.5-4.5 Hz) was significantly lower in CD1 mice and the decay of SWS SWA within a group-averaged SWS bout was faster. Sleep and waking were relatively fragmented in CD1 compared to BL6. CD1 mice also completed more wheel turns on average compared to BL6 mice throughout the experimental period, reaching significant differences for the post-surgery and baseline recording periods. Following chronic, partial SD, CD1 mice showed a higher SWA rebound response.

Conclusion: These results suggest that although the quantities of time in sleep/waking states are similar between BL6 and CD1 mice, there are significant qualitative and quantitative differences with respect to SWA parameters.

Support (If Any): Supported by R01NS075545 to R.W.G.

0281
SLEEP RESTRICTION REDUCES THE SURVIVAL TIME AND AGGRAVATES THE NEUROLOGICAL DYSFUNCTION AND MEMORY IMPAIRMENTS IN AN ANIMAL MODEL OF CEREBRAL HYPOPERFUSION

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Introduction: Cerebral blood flow is associated with the cerebrovascular prognosis. Sleep restriction (SR) may be a limiting factor of the prognosis after a cerebrovascular event, impairing the neurological recovery. We aimed to investigate the effects of SR on mortality rate and on behavioral and histological parameters of animals submitted to permanent cerebral hypoperfusion.

Methods: Sixty male Wistar rats were distributed in 4 groups, according to the protocol of common carotid artery occlusion (CCAO) and SR: nSR+nCCAO, SR+nCCAO, nSR+CCAO, and SR+CCAO. The groups SR+nCCAO and SR+CCAO were submitted to SR during 10 days. The cerebral hypoperfusion was induced by the permanent CCAO. Neurological function and memory were assessed over 14 days of cerebral hypoperfusion. Analysis of neuropathological alterations were performed in the CA1 region of hippocampus.

Results: The mortality rate was 40% in the nSR+CCAO and SR+CCAO groups. SR significantly reduced the survival time of animals submitted to CCAO. After 7 and 14 days of cerebral hypoperfusion, 11% and 33% of the nSR+CCAO and SR+CCAO animals showed severe neurological dysfunction, respectively. A significant association between a high frequency of memory impairments with the group SR+CCAO was observed. The neuropathological alterations in CA1 region of hippocampus were similar among the groups.

Conclusion: SR potentiates the negative effects of cerebral hypoperfusion conditions, suggesting that SR could be a factor associated with a worse prognosis after a cerebrovascular event.

Support (If Any): Associação Fundo de Incentivo à Pesquisa (AFIP), São Paulo Research Foundation (FAPESP) #2013/14420-1 to L.J.K. and #2014/10255-9 to P.A.) and CNPq.
0282

DIAGNOSTIC VALUE OF SLEEP STAGE DISSOCIATION IN NARCOLEPTIC PATIENTS

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Introduction: Narcolepsy is characterized by excessive daytime sleepiness, sleep fragmentation, and cataplexy. These factors suggest a degree of sleep stage dissociation in narcoleptic patients. We hypothesized that sleep stage dissociation can be used as a diagnostic feature for narcolepsy.

Methods: Sleep stages were projected onto a 2D surface by defining a state space with 38 features using LDA projection. Next, a control model was created and features calculated by taking the square of the residual sleep stage probability in the 2D space. Finally, an LDA classifier was used to determine the best separation plane. ROC curves were used to select the best classifier, optimizing it for a minimum specificity of 95%. A dataset of 23 narcoleptics and 537 sex and age-matched controls with different sleep pathologies were used for training. A dataset of 16 narcoleptics and 159 healthy controls was used for validation. The classifier was also used on a database consisting of 47 narcoleptics and 68 other hypersomnias and a database with narcoleptics receiving treatment.

Results: Using eight prominent features in both training and validation dataset resulted in specificity of 95% across datasets. Most of the features reflected difficulties in differentiating N1, REM sleep and wake, sensitivity was 35% for the training set and 31% for the validation set. The hypersomnia dataset yielded a specificity of 84% and sensitivity of 23%. When analyzing treated narcoleptics, we obtained a specificity of 84% and sensitivity of 23%. The hypersomnia dataset yielded a specificity of 84% and sensitivity of 23%. The hypersomnia dataset yielded a specificity of 84% and sensitivity of 23%. The hypersomnia dataset yielded a specificity of 84% and sensitivity of 23%.

Conclusion: Sleep stage dissociation can be used for the diagnosis of narcolepsy. However the use of some medications impact on the result.

0283

NON-CONTACT FORCE SENSORS CAN IDENTIFY BREATHING OF TWO INDIVIDUALS IN A SHARED BED

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Introduction: Non-contact force sensors fitted under beds are an emerging approach to long term monitoring of sleep. Past studies have focused on situations where there is only one individual on a bed at a time. We present a mathematical model and algorithm to extract and disambiguate individual respiration signatures when two persons are present on the bed and quantified its efficacy.

Methods: Experiments were conducted in a lab setting with a bed fitted with 11 force sensors placed between the box spring and the bed frame. We assessed breathing in 38 pairs of subjects (n = 76). Testing for each pair of subjects consisted of non-contact load cell monitoring of 2 subjects lying in the bed simultaneously for 30 minutes awake and breathing normally through a sequence of left, right, prone, supine body positions. The load-cell estimated breathing was compared with each subject’s true breathing signal as measured using chest and abdomen respiratory inductance plethysmography, nasal pressure transducer, and a position sensor.

Results: Over 38 subject-pairs, the mean absolute body-mass index difference between paired individuals was 3.5 and the mean breathing rate difference was 5.44 breaths per minute. Over an aggregate of 560 l-minute epochs, chosen to exclude movement artifacts, we observed that force-sensor inferred breathing signals were unambiguously separable in 57% of the epochs. Across all epochs and separable epochs, the mean absolute error of algorithmic respiration rate estimation was 1.83 and 0.93 breaths per minute (bpm) respectively.

Conclusion: We demonstrated the feasibility of identifying respiration from two individuals simultaneously with non-contact force sensors applied to a shared bed. Future work includes in-home studies, improving the algorithm, and associating breathing signals to individuals.

Support (If Any): NHLBI 5R01HL098621

0284

2B-ALERT WEB: A TOOL TO DESIGN SLEEP STUDIES AND WORK/REST SCHEDULES

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Introduction: To date, there are no validated publically available computer-based tools to help design sleep studies or optimize work/rest schedules. Recently, our group developed and extensively validated a predictive mathematical model of performance [the unified model of performance (UMP)], which can accurately predict the effects of sleep/wake schedules and caffeine on cognitive performance. However, to be useful to researchers and schedule planners, the UMP needs to be made available as a software tool freely accessible through the Internet to allow users to compare and contrast the effects of different sleep and caffeine conditions on performance.

Methods: We instantiated the UMP as a Web-based software tool that can be accessed through the Internet from desktop or mobile computing devices. This includes graphical user interfaces that allow users to 1) input sleep/wake schedules and the timing and concentration of caffeine consumed, 2) display the UMP predictions in the form of psychomotor vigilance task statistics, and 3) export the predictions to a spreadsheet. Together, these capabilities constitute the 2B-Alert Web tool.

Results: We thoroughly tested that each of the functionalities of the 2B-Alert Web tool performed as designed when accessed by a browser (e.g., Internet Explorer and Chrome) on both desktop and mobile devices (e.g., Moto X and iPhone 6 smartphones). In particular, we demonstrated that the tool correctly duplicated performance predictions previously obtained with desktop computers. The 2B-Alert Web is undergoing independent validation tests and should be publicly available by the time of this meeting.

Conclusion: With the instantiation of the validated UMP into a Web-based environment, 2B-Alert Web can serve as a practical tool to help optimize experimental study designs and work/rest schedules. In particular, for military application, it could be used to determine the optimal sleep/wake schedules and caffeine-dosing strategies that yield peak performance at desired times of the day.

Support (If Any): Disclaimer: The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Army or of the U.S. Department of Defense. This abstract has been approved for public release with unlimited distribution.
A SPARSE BAYESIAN REPRESENTATION ALGORITHM SUCCESSFULLY REMOVES BLINK ARTIFACTS FROM EEG

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Introduction: The EEG often contains artifacts. This limits its use as a potential physiological marker of sleepiness for monitoring alertness in safety-sensitive environments. Current artifact elimination methods require manual intervention, require at least 10 electrodes for accuracy, and/or can remove substantial amounts of valid data. Using structural properties of the artifacts, we developed a sparse coding algorithm for automated artifact elimination in 6-channel EEG data with minimal data loss.

Methods: A dictionary comprising of skew Gaussian shaped elements was constructed and validated against manually extracted blink artifacts from testing portions (Karolinska Drowsiness Test and Psychomotor Vigilance Test) of two EEG recordings in healthy individuals. We developed a Bayesian sparse learning algorithm that uses temporal and spatial correlations in a multi-channel signal and applied it in conjunction with this dictionary to detect and extract blink artifacts in five other EEG recordings. The extracted artifacts were then subtracted from the original signals to obtain artifact-free EEG. The output was also compared to that from (i) Independent Component Analysis (ICA) for artifact removal and (ii) Standard Bayesian Leaning (SBL). The spectrum of each dataset was compared to those of RPSGT-identified artifact-free EEG epochs for each method.

Results: When used as an artifact detection technique, our method had a specificity of 96% and sensitivity of 97%. Our algorithm successfully eliminated blink artifacts without any data loss. The spectrum was qualitatively similar to that of artifact-free EEG and had smaller differences than the spectra from ICA and SBL output did.

Conclusion: We demonstrated the successful use of a powerful non-linear signal processing technique (sparse coding) for removing blink EEG artifacts. Our methodology can be also used to eliminate other structured artifacts such as EKG and other eye movements, and opens the possibility of automated, real-time artifact elimination in EEG monitoring applications with minimal data loss.

Support (If Any): NSDR1HF020802 (supported by the National Space Biomedical Research Institute through NASA NCC 9-50), NIH K24-HL105664 (EBK), P01-AG009975, R01-HL-114088, R01- HL114088, T32 HL07901, UL1 TR001102

AGREEMENT BETWEEN POLYSOMNOGRAPHY-DERIVED SLEEP STAGING AND AUTO-STAGING OF SIGNALS ACQUIRED FROM THREE FRONTOPOLAR SITES

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Introduction: The capacity for case-control epidemiological investigations into the relationship between sleep duration, structure and continuity, and memory consolidation, metabolic syndrome, neurodegenerative disorders and hospital stays might be expanded by using non-traditional sleep measurement, if the results were accurate.

Methods: With IRB approval, subjects underwent laboratory polysomnography (PSG) while wearing a forehead-affixed device that acquired signals from three frontopolar sites (Sleep Profiler, Advanced Brain Monitoring, Carlsbad, CA). Forty-three records with > 3.75 hrs of diagnostic recording time were staged by a technician from three acquired signals from three frontopolar sites (Sleep Profiler, Advanced Brain Monitoring, Carlsbad, CA). Forty-three records with > 3.75 hrs of diagnostic recording time were staged by a technician from three

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0286

DOSERESPONSE RELATIONSHIP FOR THE EFFECTS OF LIGHT ON DEPRESSIVE SYMPTOMS USING PHOTORECEPTOR-WEIGHTED IRRADIANCES

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Introduction: Light is a powerful factor for human health and well-being. Changes in brightness and spectral composition act as strong cues to set the phase of the biological clock, suppress melatonin, stimulate alertness and improve mood. These effects are initiated through retinal photoreception, altering the state of the five retinal photopigments in the eye, ultimately evoking down-stream physiological responses. However, the human visual pigments do not respond uniformly to all light intensities and wavelengths in the visible spectrum, hence spectral composition, intensity, timing and dynamics of light are key characteristics that will determine the stimulation efficiency. This differential response has not yet been implemented for assessing the sensitivity of all five human photoreceptors. Recent attempts resulted in a new tool that calculates photoreceptor-weighted irradiances for all five photoreceptors, which permits comparison between different studies. The aim of the present study was to calculate and compare dose-response curves across light treatment studies for depression in order to determine the most effective dose metrics.

Methods: From 92 published and reviewed light studies, 11 studies fulfilled inclusion criteria, which included light therapy being the sole intervention for depression, and provision of methodological and technical details sufficient for photometric conversion. An expanded, macro-based excel worksheet was used to convert published photometric data and to calculate photo-receptor weighted irradiances.

Results: Across all studies, a monotonic decrease in depression scores with increasing light dose regardless of clinical condition was found for all photoreceptor sensitivities (Rsquare = 0.61). Light-emitting diodes (LED) light sources needed significantly lower doses (median = 66 kilo-lux-hours) to achieve the same reduction in depression compared to fluorescent-type light sources (median = 174 kilo-lux-hours) (Mann-Whitney test, p < 0.016).

Conclusion: Photoreceptor-weighted irradiance dose-response curves are expected to uncover the dynamics between different illuminance ranges in humans and at which magnitude a certain physiological response can be predicted.

Support (If Any): The study is supported by ‘Accelerate SSL Innovation for Europe’, a 7th framework programme (project number 619249) and by the National Institute for Health Research (NIHR) Oxford Biomedical Research Centre based at Oxford University Hospitals NHS Trust, Oxford University (KW, RGF, A90305 and A92181). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.
Results: The percentage of PSG epochs that all three raters agreed for stages wake, N1, N2, N3 and REM were 91%, 10%, 67%, 43% and 80%, respectively. Seventy-nine percent of the epochs were staged by consensus between raters 2+3, the kappa between the consensus epochs and rater 1 was 0.52, with PPAs for stages wake, N1, N2, N3 and REM of 0.95, 0.99, 0.82, 0.39 and 0.82, and PPVs of 0.99, 0.10, 0.75, 0.99 and 0.98, respectively. Raters 1+3 agreed in 75% of the epochs, resulting in a kappa of 0.58 when compared to rater 2, with PPAs for stages wake, N1, N2, N3 and REM of 0.90, 0.21, 0.90, 0.76 and 0.83, and PPVs of 0.96, 0.47, 0.74, 0.94 and 0.94, respectively. Consensus scoring for raters 1+2 occurred in 72% of the epochs, the kappa when the epochs were compared to rater 3 was 0.58, PPAs were 0.98, 0.43, 0.83, 0.77 and 0.90, and the PPVs were 0.95, 0.60, 0.89, 0.84 and 0.94, respectively. In 96% of epochs, two of three raters agreed, and when these epochs were compared to auto-scored staging, the kappa was 0.61. The PPAs for stages wake, N1, N2, N3 and REM were 0.76, 0.24, 0.74, 0.73 and 0.75 respectively with PPVs of 0.78, 0.19, 0.77, 0.75 and 0.84, respectively. Agreement improved for stages N2 and N3 in the 27 subjects with an apnea/hypopnea index less than 10.

Conclusion: The accuracy of the auto-scored frontal EEG appears consistent with the inter-rater reliability among three independent raters staging conventional PSG recordings.

0288
CHARACTERISTICS OF THE 3-DIMENSIONAL SLEEP SCALE: A NEW SLEEP SCALE THAT MEASURES SLEEP PHASE, QUALITY, AND QUANTITY
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Introduction: We developed a new sleep scale, the 3-Dimensional Sleep Scale (3DSS), which consists of three categories (sleep phase, quality, and quantity). This scale can classify individuals into eight sleep types: All Good Sleep, Owl (poor phase), Inefficient (poor quality), Short (poor quantity), Owl + Inefficient (poor phase and quality), Owl + Short (poor phase and quantity), Inefficient + Short (poor quality and quantity), and All Poor Sleep. We sought to investigate the distribution of participants by age and gender among these sleep types.

Methods: Participants in the study were 805 Japanese day workers (595 men and 210 women). Their average age was 41.9 ± 10.3 years. We used a two-way ANOVA (age and sex) to compare their scores on each of the three categories and then a χ²-test to compare the age and gender composition among the eight sleep types.

Results: The phase score of young individuals was higher than that of older individuals. The quality score decreased with age in both men and women, although there was a significant interaction effect. Quantity scores were higher in the age groups of 30-39 and 50-59 among men. All Good Sleep was the most prevalent of the eight types, while the Owl + Inefficient was the least prevalent. All sleep types that included the Owl subtype were more common among young individuals, while sleep types that included Inefficient (except Owl + Inefficient) were more common among older individuals. Short and Owl + Short were more common among women.

Conclusion: We demonstrated that the eight sleep types determined by 3DSS have differing characteristics by gender and age. The 3DSS can characterize an individual’s sleep type in an easy to understand manner and we hope to develop a version for use among English speakers.

0289
MODA - MASSIVE ONLINE DATA ANNOTATION
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Introduction: It has become increasingly apparent that features of the Polysomnography (PSG) signal such as sleep spindles, rapid eye movements (REMs) and k-complexes play an important biological and psychological role in sleep. Automated feature detection algorithms can benefit sleep science by increasing the quality, detection speed and standardization of these sleep features. However, due to the generally small and low validity datasets currently used in algorithm development, many published detectors have not undergone rigorous validation techniques and often perform poorly in practice. New and powerful signal analysis techniques are commonplace in the signal processing world, many of which can be leveraged to aid the analysis and detection of sleep features. However, too few of these methodologies are utilized in sleep science due to the lack of access to large, high quality scored PSG data for algorithm development and validation.

Methods: To increase algorithm performance, and more importantly, generalizability, a high quality ‘gold standard’ dataset for algorithm development and validation is required. We have developed a freely available, open source, user friendly, online crowdsourcing platform to collect massive, open, multi-expert scoring for PSG datasets.

Results: We tested the software’s scoring performance by comparing REMs from 110minutes of REM sleep scored by 2 experts on traditional scoring software with our online software. Both raters found over 90% of the REMs as marked by the traditional program, using the online interface. This is comparable to the agreement between both raters when using the traditional program (89%).

Conclusion: These results show the online interface is a viable and effective method to collect massive amounts of sleep data. Future plans will bring the benefits of crowdsourcing to the sleep research community through integration with Amazon’s M-Turk platform. This program, and eventual datasets, will enable rapid advances in automated software and aid standardization of sleep research.

0290
IS 2 MINUTES LONG ENOUGH TO MEASURE ALERTNESS VARIATIONS DURING EXTENDED WAKEFULNESS USING A NEW SMARTPHONE « PVT TYPE » APPLICATION?
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Introduction: A 3min smartphone PVT type application, sleep-2-Peak (s2P), was recently validated by our team. In particular research settings, an even shorter version of a PVT could have several advantages. The aim of this study was to investigate the validity of a 2min version of s2P to assess alertness changes during sleep deprivation.

Methods: Ten subjects completed 3min versions of s2P and the classic PVT at every even hour in a counterbalanced design during 35 hours of a total sleep deprivation protocol. We analysed the first 2min of s2P and the full 3min of the PVT. Outcomes variables were lapses, false starts (FS), mean reaction time (RT), reciprocal response time (RRT), 10% fastest RT and 10% slowest RRT. Outcomes were compared using (1) Pearson product moment correlations (mean performance score from 8AM to 6PM the next day), (2) repeated measures ANOVAs Device (s2P vs PVT) X Test Time (test bouts from 8 AM to 6PM the next day), and (3) T-tests between the «alert» state (test bouts from 8AM to
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17:59, 18:00-21:59, 22:00-01:59), rest break number (1st, 2nd or 3rd) at 10PM) and the «sleepy» state (test bouts from 12AM to 6PM the next day) for each device.

Results: Results show that s2P and PVT were significantly correlated on all outcomes except FS. The strongest relationship was with the mean RT ($r = .65$) and the weakest was with lapses ($r = .31$). Except for lapses, the ANOVAs results showed that both tests vary similarly as the subjects cumulate sleep loss. T-tests showed that on both tests, except for false starts, all outcomes significantly distinguished between the alert and sleepy states (t ranges t(9) = -2.847 to 6.928, $p < .05$), with high effect sizes in both tests.

Conclusion: These results suggest that outcomes on a very short (2min) version of a RT test are able to differentiate alert from sleepy states and can be used to track fatigue-related changes during extended wakfulness.

0291
SUBJECTIVE MEASURES OF IN-FLIGHT SLEEP: CIRCADIAN VARIATION AND RELATION TO FATIGUE AT TOP OF DESCENT
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Introduction: The aim of the present study was to determine whether subjective measures of in-flight sleep could be used as a reliable alternative to actigraphically recorded sleep for monitoring pilot fatigue in a large-scale survey study.

Methods: Pilots (3-pilot crews) completed a 1-page survey (n = 584) on outbound and inbound long-haul flights crossing 1-7 time zones between 53 city pairs with 1-day layovers in the destination city. Across each flight, pilots documented flight start and end times, break times, and in-flight sleep duration and quality if they attempted sleep in available Class 2 rest facilities. They also rated their fatigue (Samm-Perelli Crew Status Check) and sleepiness (Karolinska Sleepiness Scale) at top of descent (TOD). Linear mixed model ANCOVAs were used to identify independent factors associated with sleep duration, quality, and TOD measures. Domicile time was used as a surrogate measure of circadian phase. Factors included: ID, domicile break start- or arrival time in 4-hourly bins (02:00-05:59, 06:00-09:59, 10:00-13:59, 14:00-17:59, 18:00-21:59, 22:00-01:59), rest break number (1st, 2nd or 3rd) and flight (or sleep) duration.

Results: Self-reported sleep duration increased by 10.2 min for every 1-hr increase in flight duration. Pilots obtained more sleep during breaks starting between 02:00-05:59 (domicile time) than in breaks starting between 06:00-09:59 (p = .001), 10:00-13:59 (p = .0042) and 18:00-21:59 (p < .0001). Pilots also obtained more sleep during breaks starting between 22:00-01:59 than in breaks starting between 18:00-21:59 (p = .03). With every 1-hour increase in sleep duration, subjective sleepiness ratings at TOD decreased by 0.6 points and fatigue ratings decreased by 0.4 points.

Conclusion: The present findings are consistent with a previous multi-airline study with actigraphic sleep monitoring of 237 crewmembers in 4-pilot crews on 730 flight segments and suggest that self-reported sleep duration can be used as a reliable alternative to actigraphically recorded sleep in field studies of airline pilot fatigue, but only using validated measures with sufficiently large sample sizes and where fatigue risk is expected to be low.

Support (If Any): This study was funded by Delta Air Lines

0292
EFFECT OF A DISPOSABLE, STRAPLESS, EYE SLEEP MASK ON SUBJECTIVE: SLEEP, ALERTNESS AND MOOD
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Introduction: Light has negative effects on sleep. A light-blocking, disposable, strapless eye mask that stays in place is needed for a general use sleep aid. The primary measures of a study, using the Instant Eclipse Sleep Strips ® (mask), were reported previously: Overall product interest (would use if available) was excellent: 95% and subjective overall sleep rating was significantly improved (paired two-tailed t-test: $p < 0.01$, n:20, t:2.92). All participants attested to this mask efficiently blocked ambient light and stayed in place all night. Post hoc Wilcoxon non-parametric results of patients' logs revealed this mask significantly improved (p < 0.05) subjective: Alertness AM interval (Stanford Sleepiness Scale), mood PM interval (range:-10/+10); And p < 0.01: Alertness PM interval; With positive trends (p < 0.10) for subjective: Alertness after awakening and mood AM interval. Additional post hoc comparisons are reported below.

Methods: Participants were healthy adults, experienced using eye masks, recruited from advertising and enrolled after signing an informed consent. Of 22 enrolled (ages 19-52), 20 completed study requirements. Participants kept daily logs of their subjective sleep, daytime alertness and mood: 1 week without and 1 week with mask. At the end of each week, they handed in their logs and completed assessment questionnaires. The log data was evaluated with Wilcoxon non-parametric, z-value, two-tailed test, comparing means: 1 week no use compared to 1 week using this mask on several measures additional measures.

Results: The additional noteworthy positive trends derived from the subjective log data are: P < / = 0.20: Number of wakeups, minutes awake after sleep onset, and number cups of coffee; P = 0.22: Total sleep time.

Conclusion: Overall, these results support proof of concept for this eye mask as a general use sleep aid in healthy adults, and demonstrated potential for improving subjective: Sleep quality, daytime alertness, and mood.

Support (If Any): Radicles, Inc. provided financial support and masks for this study.

0293
A QUANTITATIVE METHOD FOR RESPIRATORY-EFFORT DETECTION BY POWER-SPECTRAL DENSITY ANALYSIS OF ON-MATTRESS PIEZOELECTRIC-SENSOR SIGNAL
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Introduction: Central sleep apnea (CSA) overestimation is an issue that often occurs during polysomnography (PSG) analysis, which is performed by sleep experts manually, in the cases of apnea events with inarticulate signal waveforms. For the purpose to separate CSA and obstructive events quantitatively, we assessed the relevance between respiratory efforts and power spectral density (PSD) over respiratory-frequency band of apnea event signal detected by an on-mattress piezoelectric (OMP) sensor.

Methods: Conventional PSG analyses following overnight PSG recordings with additional OMP sensor (sampling rate: 200Hz) were performed in 19 patients (age: 58.9 ± 18.7). Then, we calculated the
PSD values over 3 frequency bands (0–0.6, 0.1–0.5, 0.2–0.5 Hz) after first-Fourier transform (FFT) with a window size of 10.24 s (2048 points) of the OMP-sensor signal at the same durations where no respiratory efforts were observed in chest/abdomen belt-sensor signals in 159 CSA events, which were selected by sleep technologists from all apnea events scored in the PSG analyses. Normalized PSD (nPSD) values were also computed by dividing with average heart-sound amplitude over the each FFT windows. These PSD values were assessed by comparing with re-classified apnea data, which were obtained by careful observer analyses performed by sleep-expert physicians using signal-analysis softwares (Excel and Clampex9.2, Axon Instruments) other than PSG.

**Results:** The careful observer analysis has found respiratory efforts during the 10.24 s durations in 29 events out of the 159 events. The lowest nPSD value among the 29 events was set as the threshold for respiratory-effort detection to make sensitivity 100 % and consequently, specificities computed for the above 3 frequency bands were 76.9, 84.6, 86.2 % (20.8, 27.7, 33.8 % when not normalized), respectively. The nPSD of the frequency band of 0.2–0.5 Hz yielded the best accuracy for respiratory-effort detection and the number of false positive (high nPSD but no respiratory effort) was 18; 15 arrhythmias, 2 bradycardias and 1 abnormal heart sound signal.

**Conclusion:** Respiratory-effort assessment in apnea events by PSD value may be of high accuracy when normalized by heart-sound amplitude and exclude events with arrhythmia and/or bradycardia. This quantitative method for respiratory-effort assessment may reinforce the conventional PSG analysis and thus, may contribute to reduce the CSA overestimation.

**Support (If Any):** This study was supported in part by International Institute for Integrative Sleep Medicine (IIIS), Tsukuba, Japan.

### 0294

**DEVELOPMENT OF THE SELF-EFFICACY FOR SLEEP HYGIENE INVENTORY**  
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**Introduction:** Self-efficacy focuses on an individual’s belief in their ability to perform a particular behavior. Self-efficacy has been positively associated with numerous health behaviors. However, few studies have examined how self-efficacy is related to sleep behaviors. Didgon’s scale measures beliefs about sleep and included a section related to self-efficacy beliefs (Cronbach α = .73); a scale measuring self-efficacy for sleep hygiene was not located. The purpose of this study was to develop and test an instrument specifically designed to measure self-efficacy for sleep hygiene.

**Methods:** Following Bandura’s guidelines for construction of self-efficacy scales, the Self-Efficacy for Sleep Hygiene Inventory (SESHI) was developed based on best sleep hygiene practices as determined by the National Sleep Foundation. After review by two content experts, the scale included 30 items scored on a 0-100 point scale with higher scores representing increased confidence in performing specific sleep hygiene behaviors. The 30 item scale was pilot tested with a sample of 311 young adults using online surveys. Following scale refinement and deletion of items with low factor loading, a second study with a sample of 96 young adults confirmed reliability.

**Results:** Exploratory factor analysis revealed a 3-factor solution. Items with a factor loading < 0.4 were deleted. Two items were reworded and the final scale consisted of 24 items with 3 subscales. Reliability coefficient (Cronbach’s alpha) were: .83 (total SESHII), .87 (time management subscale), .69 (disruptive influences subscale), and .73 (sleep influences subscale). Analysis of the second study confirms the initial findings of the exploratory factor analysis.

**Conclusion:** Initial psychometric testing of the SESHII supports that, for a new instrument, it is a reliable measure of self-efficacy for sleep hygiene in young adults age 18-26. Further testing is necessary to determine if the SESHII is appropriate for use in other populations.

### 0295

**DEVELOPING A SCALE TO ASSESS SLEEP APNEA HEALTH LITERACY**  
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**Introduction:** Sleep apnea is an important medical condition, which is associated with adverse health outcomes and socioeconomic costs. As novel approaches to promoting awareness about sleep apnea symptoms and treatment emerge, there is a compelling need to develop a valid tool to assess sleep apnea health literacy in at-risk populations. The goal of this study was to develop a scale to assess sleep apnea literacy at the population level.

**Methods:** Using a multi-phase design, we developed a scale for measuring sleep apnea health literacy. This included 1) devising a list of relevant sleep apnea-related questions in consultation with several established sleep investigators, 2) collecting preliminary data, 3) exploring natural component structure, 4) selecting items comprising the final scale using standardized procedures, 5) collecting additional data, and 6) generating construct validity of the scale. The final scale was approved by an independent expert in sleep medicine and an expert in scale design.

**Results:** Data were collected using Amazon Mechanical Turk (MTurk) to gather data from 91 participants (mean age = 38yrs; 48% were White and 27%, African American). Analyses were conducted using exploratory and confirmatory factor analyses (SPSS version 20). The scale includes 26 items across three sub-domains, including sleep apnea health literacy (component alpha = 0.74), sleep apnea self-efficacy (component alpha = 0.76), and sleep apnea clinical management (component alpha = 0.65). Analysis showed that the concurrent scale validity was = 0.85.

**Conclusion:** This is the first scale to feature characteristics that assess sleep apnea health literacy at the population level. This scale can be useful in designing and evaluating sleep apnea health education programs. It will also enable adequate tailoring of future interventions to ascertain specific areas of knowledge about sleep apnea.

**Support (If Any):** This work was supported by funding from the National Institutes of Health R01MD007716.

### 0296

**ANALYZING BLOOD PRESSURE BEHAVIOR IN OSA PATIENTS BEFORE AND DURING CPAP THERAPY USING A CONTINUOUS, NON-INVASIVE AND CUFF-LESS METHOD**  
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**Introduction:** Obstructive sleep apnea (OSA) is a recognized cause of hypertension and continuous positive airway pressure (CPAP) is the most common therapy for reducing blood pressure in OSA patients. However, recent studies showed only a minor reduction in nocturnal blood pressure of 5-3 mmHg (systolic) and 4-2 mmHg (diastolic) after CPAP therapy in OSA patients. Since the investigated studies are performed using traditional cuff method we assume that the cuff inflation
influences the blood pressure measurement by inducing arousals and nocturnal blood pressure fluctuation (NBPF).

**Methods:** Polysomnography (PSG, SOMNOscreen, SOMNOmedics GmbH) according to American Academy of Sleep Medicine (AASM) standards was performed in 27 OSA patients (AHI 38 ± 19, age 63 ± 12, BMI 31 ± 4 kg/m²) before and during CPAP therapy. Systolic and diastolic blood pressure (SBP and DBP) was recorded continuously (beat-to-beat) using a cuff-less method of blood pressure determination based on pulse-transit-time.

**Results:** During CPAP therapy the apnea-hypopnea index (AHI), snoring time in % TST and respiratory NBPFs increased from 5/h to 15/h. Mean nocturnal SBP decreased by 12 ± 15 mmHg (138 mmHg to 126 mmHg) and mean DBP decreased by 4 ± 10 mmHg (83 mmHg to 79 mmHg).

**Conclusion:** This study suggests that nocturnal SBP and DBP values, measured continuously and cuff less based on PTT, are considerably decreased during CPAP therapy. In contrast to traditional cuff method, we found a stronger reduction in mean SBP and DBP by applying a cuff-less method. This indicates that cuff inflations cause blood pressure deviations which influence the recorded nocturnal blood pressure behaviour.

**0297**

2B-Alert: A Smartphone App for Individualized Cogntive Performance Assessment and Prediction

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**Introduction:** Biomathematical predictive models of cognitive performance are being used to design work/test schedules. However, such models cannot be tailored to an individual’s sleep-loss phenotype, cannot account for the performance-restoring effects of caffeine, and are not available on portable computing devices for real-time tracking and prediction of individual performance. Here, we describe the 2B-Alert, a smartphone app that uses a validated model of performance to accurately predict the effects of sleep loss and caffeine on human performance at an individual level.

**Methods:** First, we validated our predictive model of performance on psychomotor vigilance task (PVT) data from studies covering a wide range of sleep/wake schedules and caffeine consumption, at both group-average and individual levels. Once validated, we embedded the model into an app on an Android smartphone. To assess an individual’s current levels of performance, we allow users to perform PVT tests on the device, while accounting for hardware and software time delays (50-150 ms for Android phones). Finally, we developed user interfaces that allow users to 1) enter past and future sleep-wake schedules and caffeine usage and 2) display PVT test results and model predictions. Together, these capabilities constitute the 2B-Alert app.

**Results:** We verified the integrity of the models incorporated into the smartphone by demonstrating that the 2B-Alert app duplicated the original validated group-average and individualized predictions obtained in desktop computers. We also showed that the app successfully used results of the PVT tests to automatically adjust the model parameters and “learn” the sleep-loss phenotype of individuals. The 2B-Alert app is undergoing final validation tests and should be available by the time of this meeting.

**Conclusion:** With the integration of real-time, individualized prediction models of performance that account for the effects of caffeine into a smartphone, the 2B-Alert app offers a practical tool for personal fatigue management.

**Support (If Any):** Disclaimer: The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Army or of the U.S. Department of Defense. This abstract has been approved for public release with unlimited distribution.

**0298**

Validation of Sleep-2-Peak: A Smartphone Application That Can Track Fatigue-Related Changes in Reaction Times During Sleep Deprivation

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**Introduction:** Despite its high sensitivity and validity, the Psychomotor Vigilance Task (PVT) has often been considered too long (10min «gold standard» for clinical use and its price too high for widespread community accessibility. Thus, the aim of this study was to validate a new smartphone «PVT type» application, sleep-2-Peak (s2P), and verify its ability to assess fatigue-related changes in alertness in a context of extended wakefulness.

**Methods:** Twelve men and ten women (18-27 years old) completed a 3min version of s2P (iPod touch 4th generation) and a 3min version of the classic PVT (PVT-192) at every even hour in a counterbalanced design during 35 hours of a total sleep deprivation protocol. Outcomes included lapses, false starts, mean reaction time (RT), reciprocal response time (RRT), 10% fastest RT and 10% slowest RRT. Outcomes were compared using (1) T-tests between the «alert» state (test bouts from 8AM to 10PM) and the «sleepy» state (test bouts from 12AM to 6PM the next day) for each device, and (2) repeated measures ANOVAs Device (s2P vs PVT) X Test Time (test bouts from 8AM to 6PM the next day).

**Results:** Results showed that on both tests, except for false starts, all outcomes significantly distinguished between the alert and sleepy states (p < 0.001), with effect sizes from moderate to high in both tests. The ANOVAs results showed no significant difference between tests and revealed that both tests showed similar sensitivity as the subjects cumulate sleep loss.

**Conclusion:** These results suggest that a 3min version of s2P is a valid tool for differentiating alert from sleepy states and is as sensitive as the classic PVT to track fatigue-related changes during extended wakefulness and sleep loss conditions. Considering its low cost, ease of use (IOS and Android) and portability, s2P may represent an interesting alternative in particular clinical or research settings.
A NEW APPROACH TO MEASURING SLEEP IN ADVERSE ENVIRONMENTAL CONDITIONS: A COMPARISON BETWEEN SEA LEVEL AND 4,300 METERS ON DENALI

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Introduction: Disruptions in sleep can cause cognitive impairments, decreased blood oxygen saturation and increased oxidative stress and blood pressure. Exposure to high altitude also causes the above adverse physiological events. To successfully study sleep in high-altitude field locations requires specialized methods. Techniques previously used to measure sleep in cold and hypoxic conditions have their shortcomings. Actigraphy cannot measure individual sleep stages while polysomnography requires a laborious setup (e.g. International 10/20) that can be difficult in freezing temperatures without access to water. Therefore, the objective of the current study was to compare sleep metrics at high altitude (HA) to sea level (SL) using a novel method of quantifying sleep.

Methods: We quantified sleep parameters using a validated, battery powered, portable wireless sleep recorder on twenty participants [34.0 ± 9.7 years (mean ± SD); 1 female] at 4,300m on Denali (AK, USA) and on eight participants (30.8 ± 5.6 years; 4 females) at sea level (Anchorage, AK, USA). Health was verified by self-report through questionnaires.

Results: Independent t-tests revealed significant increases in arousals and sleep onset latency, and significant decreases in sleep efficiency and percent of deep sleep in the HA group compared to the SL group. The recorder had a failure rate of 13% and 6.7% for the HA and SL groups, respectively.

Conclusion: This was the first study using this portable sleep monitor at high altitude. The sleep recorders collected data that was more descriptive than actigraphy (e.g. sleep stages) and comparable to polysomnography, but required less of a tedious setup as PSG. The sleep recorders worked well in cold, hypoxic, extreme conditions with a failure rate similar to other at-home polysomnography studies. We recommend this methodology for future studies in adverse/HA conditions.

Support (If Any): This study was funded by Foundation and Faculty Development Grants from the University of Alaska Anchorage. We would like to acknowledge the contributions and support of Zeo, Inc., which provided modified equipment at no cost and Mountain Hardwear Inc. for equipment support.
0300
REDUCED GRAY MATTER VOLUME IN PEDIATRIC OBSTRUCTIVE SLEEP APNEA
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Introduction: Pediatric obstructive sleep apnea (OSA) is associated with cognitive difficulties and other symptoms related to central nervous system function. Since adults with OSA manifest MRI evidence of brain injury linked with their symptoms, and since animal models of intermittent hypoxia lead to regional neuronal cell losses, pediatric OSA patients may also experience brain alterations. The present study aimed to assess the presence of potential injury to neuronal areas measured as reduced gray matter volume in a group of pediatric OSA patients relative to a large set of control subjects.

Methods: We studied 16 pediatric OSA participants (8 male, mean age ± std = 8.1 ± 2.2 years, AHI = 11.1 ± 5.9 events/hr), and 199 control subjects (84 male, 82 ± 2.0 ± 2.0 years), 192 of whom were from the NIH Pediatric MRI database. High resolution T1-weighted anatomical whole brain scans were assessed for gray matter volume reductions using voxel-based morphometry, a technique sensitive to regional changes in gray matter structures. ANOVA comparisons with sex as a covariate were performed over the whole brain.

Results: Significant volume reductions appeared in the OSA group throughout extensive areas of the superior frontal and prefrontal cortices, and the superior parietal cortices (P < 0.01, family-wise error corrected). A bilateral area in the lateral parietal cortices also showed volume reductions. Other affected areas included the brainstem, ventral medial prefrontal cortex, and superior temporal lobe mostly on the left side.

Conclusion: Pediatric OSA is associated with extensive regionally-demarcated gray matter volume reductions. Since the duration of the disease in our OSA patients is unknown, they may have experienced OSA for several years, and the findings may either reflect delayed neuronal development or neuronal damaging processes. Similarly, the nature of the gray matter volume changes is unclear; atrophy arising from damage to neurons is one possibility, but reduction in volume of cells (neurons and glia) could also have occurred, in which case these alterations could be at least partially reversible with treatment. Regardless of the origin of these volume reductions, the altered gray matter is likely impacting brain function, and hence cognitive performance in children with OSA.

Support (If Any): This work was supported by the Herbert T. Abelson Chair in Pediatrics.

0301
PRELIMINARY ASSOCIATIONS BETWEEN SEVERITY AND DURATION OF SLEEP-DISORDERED BREATHING AND MEASURES OF BRAIN TISSUE VOLUME
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Introduction: Cross-sectional studies indicate sleep-disordered breathing (SDB) is associated with structural brain alterations, which may partly explain observed associations between SDB and cognitive deficits, depressed mood and other outcomes. However, it is unclear whether SDB precedes structural changes in the brain. The objective of this study is to investigate differences in brain tissue volume according to prior SDB exposure in a population-based cohort.

Methods: A subset of Wisconsin Sleep Cohort Study subjects (n = 116; 56% female; mean ± range, age = 68 [50-85] years) participated in a neuroimaging protocol. Additionally, up to 25 years of polysomnography data (repeated every ~4 years) were used to characterize history of SDB as never (AHI < 5 on all studies), recent-onset (AHI ≥ 5 for 10 years). White matter volume, gray matter volume, total volume of white matter hyperintensities (WMHI), and the ratio of WMHI volume/total intracranial volume (ICV) were compared between SDB groups using linear regression. We also examined associations between most recent AHI (up to 2 years prior to neuroimaging) and tissue volume variables. Results were adjusted for age, gender, and BMI.

Results: Individuals with chronic SDB had significantly lower white matter volume than individuals who never had SDB (beta = -19 mL, p < 0.05). Gray matter volume was lower among individuals with chronic SDB (beta = -21 mL, p < 0.2) and new-onset SDB (beta = -18 mL, p < 0.2) than those who never had SDB. Higher log(AHI+1) was associated lower gray matter volume (beta = -40mL per 10-fold increase in AHI, p < 0.01) and with greater total lesion volume (beta = 8.7 mL per 10-fold increase in AHI, p < 0.2) and a higher WMHI/ICV ratio (beta = 0.007 per 10-fold increase in AHI, p < 0.05).

Conclusion: More prolonged and severe SDB is associated with altered total brain structural outcomes. Differences in gray and white matter volume between chronic and never SDB groups were equivalent to those we found associated with 5 and 20 years of aging, respectively.

Support (If Any): This work was supported by the National Institute of Aging (IR01AG036838, 5P50AG033514-07), National Heart, Lung, and Blood Institute (R01HL05225), and the National Center for Research Resources (UL1RR025011) at the National Institutes of Health; support was also received from WWP 2368 PILOT, University of Wisconsin Institute for Clinical & Translational Research.

0302
THE EFFECT OF THE SEVERITY OF OBSTRUCTIVE SLEEP APNEA SYNDROME ON TELOMERE LENGTH
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Introduction: Sleep is one of the most important physiological processes for the maintenance of health along time. However, with aging, there is an increase in the prevalence of Obstructive Sleep Apnea Syndrome (OSAS). In parallel, it occurs the shortening of telomeres, as a result of cellular senescence mechanisms. It is known that intermittent hypoxia, important factor related to OSAS pathophysiology, is a stimulus for increased production of reactive oxygen species and proinflammatory cytokines. Taking into consideration that oxidative stress associated with increased inflammatory response can promote a progressive shortening of telomeres, the present study aimed to verify the correlation between respiratory sleep parameters and the mean leukocyte telomere length (LTL) in an epidemiological framework.

Methods: For this, we used DNA extracted from peripheral blood of 930 individuals from the São Paulo Epidemiologic Sleep Study (EPISONO) to measure the LTL by quantitative real-time polymerase chain reaction method. All individuals were subjected to one full-night polysomnography and OSAS was determined according AHI, following the International Classification of Sleep Disorders (2005).
Results: The results showed negative correlations between LTL and the following variables: apnea-hypopnea index, respiratory arousal index and number of obstructive events. LTL was positively correlated with basal, minimum and maximum oxygen saturation. Furthermore, LTL was significantly lower in OSAS compared to controls. Lastly, it was observed that OSAS severity was a predictor of LTL even after adjustment for sex, age, body mass index, diabetes, stroke and heart attack.

Conclusion: In conclusion, we propose a relationship between the pathophysiology of OSAS and the molecular pathways of cell aging that are related to the maintenance of telomere length.

Support (If Any): This work was supported by grants from AFIP and CNPq.

0303
IDENTIFYING OBSTRUCTIVE SLEEP APNEA PATIENTS VULNERABLE TO OPIOID-INDUCED RESPIRATORY DEPRESSION: RESULTS FROM A RANDOMIZED DOUBLE-BLIND PLACEBO-CONTROLLED CROSSOVER TRIAL
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Introduction: Worsening of Obstructive sleep apnea (OSA) from opioid use is recognized in anesthesiology guidelines despite there being no relevant controlled clinical trial (RCT). Moreover, there is a wide inter-individual variability in sensitivity to opioids (> 30 fold) which makes certain patients particularly vulnerable perioperatively. We conducted a RCT to identify the clinical phenotype/genotype of OSA patients potentially vulnerable to respiratory depression from a clinical morphine dose.

Methods: Using a crossover RCT, 60 male OSA patients attended 2 overnight visits with single dose 40mg slow-release oral morphine or placebo administered at 5:30 PM (at least 1-week washout). Ventilatory chemoreflex tests (two sessions of a 10-min test during wake) were performed at 9 pm prior to overnight polysomnography. Blood was sampled before sleep and the next morning for toxicology and genotype analyses (A118G OPRM1, ABCB1 and HTR3B SNP).

Results: Despite large inter-individual variability, 40mg morphine did not overall modify apnea hypopnea index (AHI) and sleep time with SpO2 < 90% (T90) and only decreased oxygen saturation (SpO2) nadir by 1.3% (p = 0.03). Sleep time with SpO2 < 95% (T95) was increased by 44.7 mins (p = 0.002). Morphine also increased CO2 ventilatory response threshold (VRT) (p = 0.02) and decreased ventilatory chemosensitivity (p < 0.001). The change in ventilatory chemosensitivity positively correlated with the change in AHI during sleep (r = 0.26, p 20), lower baseline VRT correlated with the worsening of T90 (r = -0.56, p = 0.03), AHI (r = -0.71, p = 0.003) and oxygen desaturation index (r = -0.54, p = 0.04) with morphine use. OSA patients with the A118G OPRM1 polymorphism of A/A and A/G had a significantly different respiratory response to morphine in awake ventilatory chemosensitivity (p = 0.005) and T90% during sleep (p = 0.047).

Conclusion: CO2 response threshold, measured during a 10-min awake chemoreflex test, potentially predicts respiratory depression with morphine in severe OSA. Individual morphine response may also relate to the A118G OPRM1 polymorphism.

Support (If Any): NHMRC Project Grant 1043633

0304
THE ACCUMULATED HYPOXEMIA DURING SLEEP INDEPENDENTLY PREDICTED VASCULAR ENDOTHELIAL DYSFUNCTION IN PATIENTS WITH CHRONIC HEART FAILURE
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Introduction: Patients with chronic heart failure (CHF) are frequently complicated with sleep disordered breathing (SDB), which might worsen the vascular endothelial function (VEF) and the prognosis of such patients. However, the most serious problem with managing endothelial dysfunction with SDB is that we have not established parameters that correctly predict the prognostic or functional changes in the patients. Thus, we tried to find a parameter that closely relates VEF in CHF patients with SDB.

Methods: Forty-four CHF patients underwent flow mediated vaso-dilation (FMD) measurement and polysomnography for assessment of VEF and SDB, respectively. We evaluated the relationships between various SDB parameters and FMD. In addition to the traditional parameters of SDB, we added another simple parameter to reflect accumulation of hypoxemia by SDB, namely time desaturation summation index (TDS; TDS = [100%-mean SpO2]% x total sleep time).

Results: The mean age was 58 ± 14 years, and 18 were male. The left ventricular ejection fraction (LVEF) was 27.4 ± 10.0%, and their VEF was slightly impaired (FMD: 5.3 ± 2.7%). They had various severity of SDB (apnea hypopnea index [AHI]: 8.8 ± 13.8 /hour), and their mean hypoxemia index (HI), minimum SpO2 total sleep time and TDS were 9.8 ± 7.8 /hour, 85.1 ± 6.6%, 5.8 ± 1.2 hour and 49.5 ± 19.2%/hour, respectively. Though the newly developed parameter, TDS, did not significantly relate to VEF, single regression analysis showed that only TDS significantly related FMD (β = -0.42, p < 0.05) but traditional parameters (i.e., AHI, HI and minimum SpO2) did not. Moreover, the significant relationship between TDS and FMD did not change after adjustment for confounding factors such as age, diastolic and systolic blood pressure, LVEF, hypertension and smoking (β = -0.39, p < 0.05).

Conclusion: This study showed that accumulated hypoxemia by SDB, not traditional indicators, independently predicted VEF in CHF patients. The treatment specifically against accumulation of hypoxemia by SDB might improve VEF, and eventually enhance their prognosis.

0305
COMPREHENSIVE ANALYSIS OF PLASMA AMINO ACIDS IN PATIENTS WITH SLEEP DISORDERS
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Introduction: Chronic sleep loss is known to impair dietary metabolism. Since many neurotransmitters that control sleep/wake status are amino acids per se or synthesized from amino acids, it is possible
that an altered balance and quantity of amino acids can cause sleep disorders, and vice versa. To evaluate whether changes in amino acid homeostasis occur in some sleep disorders, we measured amino acid levels in patients with sleep-disordered breathing (SDB) or restless legs syndrome (RLS).

**Methods:** Blood samples were collected from Stanford sleep clinic patients. Sleep changes of subjects have been well characterized, and all demographic and clinical characteristics are maintained in the Stanford clinic database. In total, 982 plasma samples (578 males, 404 females, respiratory disturbance index RDI ≥ 15 [mean ± SD: 37.6 ± 0.8]; n = 488, RDI ≤ 15 [11.5 ± 1.0]; n = 284, insomnia/RLS [RDI: 5.2 ± 1.1]; n = 210) were used. A 100-microl. aliquot of plasma samples was deproteinated and filtered. Blood amino acids were measured using an automatic amino acid analyzer L-8800A.

**Results:** Demographic data showed that older males with high BMI are vulnerable to moderate/severe SDB. In addition, the RDI ≥ 15 group showed shorter total sleep time than the RDI ≤ 15 group, and had higher total cholesterol than insomnia/RLS group. The amino acid concentrations were adjusted for the multiple confounding factors of age, sex, and BMI. Some essential amino acid (EAA) concentrations such as leucine, methionine, histidine, and phenylalanine were altered between RDI ≥ 15 and insomnia/RLS, while no non-essential amino acid concentrations were altered among groups. These essential amino acids are known to increase in the obese, insulin-resistant, or type 2 diabetic patients. Lysine (EAA) and ornithine (non-proteinogenic amino acid) concentrations were significantly different among the 3 groups and correlated with RDI (lowest Lysine and highest ornithine in RDI ≥ 15 group).

**Conclusion:** Our findings suggest altered amino acid metabolism in sever SDB patients. It is warranted to further evaluate functional and clinical significances of the changes in blood amino acids in these subjects.

**Support (If Any):** This study was supported by Ajinomoto Co., Inc.

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### 0306 HYPOTHYROIDISM AND CARDIOVASCULAR RISK FACTORS IN OBSTRUCTIVE SLEEP APNEA PATIENTS

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**Introduction:** Hypothyroidism is relatively common in patients with OSA. However, discordant results exist on the relationship between OSA and hypothyroidism. We aim in this study to examine the relationship between OSA and thyroid disease and evaluate the cardiovascular risk factors in OSA patients.

**Methods:** During the study period 112 patients were enrolled. All patients underwent overnight polysomnography and analysis of TSH, FT4, FT3, random glucose, total cholesterol, HDL, LDL, triglycerides, CRP and ESR. Patients with previous diagnoses of thyroid dysfunction were excluded.

**Results:** Based on the polysomnographic findings, 101 patients were diagnosed with OSA (15 mild, 8 moderate, 78 severe) and 11 patients were non-OSA patients. OSA patients’ (28 female, 73 male) mean age 55.9 ± 12.2y, AHI 43.5 ± 23.1/hr, ODI 48.4 ± 27.3/hr, BMI 32.9 ± 6.1kg/m2. Non-OSA patients’ (6 female, 5 male) mean age 48.1 ± 14.5y, AHI 2.7 ± 1.6/hr, ODI 5.9 ± 12.9/hr, BMI 15.8 ± 4.1kg/m2. Laboratory findings in OSA versus non-OSA patients: random blood glucose 118.9 ± 55.9mg/dl versus 93.7 ± 34.2mg/dl, triglycerides 221.2 ± 177mg/dl versus 168.1mg/dl, total cholesterol 216.2 ± 50.2mg/dl versus 208.5 ± 54.1mg/dl, HDL 54.5 ± 11.6mg/dl versus 135.1 ± 227.8mg/dl, LDL 127.4 ± 42.5mg/dl versus 185.3 ± 123.9mg/dl, CRP 6.1 ± 6.5mg/l versus 3.5 ± 6.7mg/l, ESR 13.5 ± 12.9mm/h versus 11.9 ± 12.2mm/h, TSH 2.56 ± 5.71uIU/ml versus 1.68 ± 0.53uIU/ml, TSH maximum 56.85uIU/ml versus 2.64uIU/ml, TSH minimum 1.04uIU/ml versus 1.04uIU/ml. There were no significant differences between the these groups, p > 0.05. In the OSA patients, the prevalence of hypothyroidism was 8.9% (6.7% mild, 0.0% moderate, 10.3% severe). Within these patients (n = 9) 3 suffered from clinical hypothyroidism (all severe OSA) and 6 suffered from subclinical hypothyroidism. In the non-OSA group every patient was euthyroid. The difference of the prevalence was not significant, p = 0.49.

**Conclusion:** Prevalence of subclinical and clinical hypothyroidism in OSA patients is greater than in non-OSA patients and in the average population. OSA patients presented higher hypothyroidism prevalence parallel to severity of OSA. We did not reveal any significant difference in the cardiovascular risk factors between OSA and non-OSA patients.

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### 0307 WHITE MATTER TRACT ALTERATIONS ASSOCIATED WITH SLEEP APNEA SEVERITY IN OBSTRUCTIVE SLEEP APNEA

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**Introduction:** Obstructive sleep apnea (OSA) patients show structure-specific white matter tract increases in volume, localized reductions in axonal integrity, and widespread reductions in overall diffusivity. Our objective was to assess whether white matter tract alterations vary according to OSA disease severity based on the apnea-hypopnea index (AHI).

**Methods:** We analyzed white matter in 43 newly-diagnosed OSA patients (mean age ± SD: 46.4 ± 8.8 years; mean AHI ± SD: 34.1 ± 21.5 events/hr) divided into moderate (AHI 15-29: N = 20) and severe (AHI ≥ 30; N = 23), and 58 controls (47.4 ± 9.0 years) using diffusion tensor and T1-weighted images. We isolated white matter structures with the FreeSurfer software package TRACULA, and extracted track volume, fractional anisotropy (FA), and mean diffusivity (MD) in the overall structure and along points in the tract (“trajectory analysis”). Measures were compared using t-tests (threshold p < 0.05) in the bilateral cingulum bundle, corticospinal tract, longitudinal fasciculus, forceps major and minor, thalamic tract, and uncinate.

**Results:** The severe OSA group showed increased (p < 0.05) tract-to-total-intracranial-volume ratios versus controls in the left anterior thalamic (control: 7.67x10^-4 ± 0.30x10^-4; OSA: 1.03x10^-3 ± 0.07x10^-3) and right cingulum gyrus (control: 1.81x10^-4 ± 0.09x10^-4; OSA: 2.23x10^-4 ± 0.19x10^-4) tracts. The severe group showed decreased overall tract FA in the bilateral infracollosal cingulum bundle: left (control: 0.323 ± 0.047; OSA: 0.341 ± 0.008) and right (control: 0.323 ± 0.047; OSA: 0.346 ± 0.009). MD (mm²/s) was lower in severe OSA in the right uncinate (control: 8.37x10^-4 ± 0.05x10^-4; OSA: 8.08x10^-4 ± 0.09x10^-4), forceps major (control: 8.83x10^-4 ± 0.07x10^-4; OSA: 8.46x10^-4 ± 0.09x10^-4), forceps minor (control: 9.45x10^-4 ± 0.09x10^-4; OSA: 9.14x10^-4 ± 0.11x10^-4), left infracollosal cingulum (control: 8.21x10^-3 ± 0.08x10^-3; OSA: 7.80x10^-3 ± 0.12x10^-3), right infracollosal cingulum (control: 8.06x10^-4 ± 0.05x10^-4; OSA: 7.74x10^-4 ± 0.11x10^-4), right supracollosal cingulum (control: 8.18x10^-4 ± 0.07x10^-4; OSA: 7.90x10^-4 ± 0.11x10^-4), left corticospinal (control: 7.81x10^-4 ± 0.07x10^-4; OSA: 7.22x10^-4 ± 0.07x10^-4), right corticospinal (control: 8.07x10^-4 ± 0.10x10^-4; OSA: 7.48x10^-4 ± 0.08x10^-4), right inferior longitudinal fasciculus (control: 8.01x10^-4 ± 0.07x10^-4; OSA: 7.75x10^-4 ± 0.10x10^-4), and right anterior thalamic (control:
I. Sleep Disordered Breathing

Conclusion: The hippocampus in OSA shows increased bilateral regional volumes in anterior and posterior lateral areas, and left medial mid-to-posterior sites, and volume decreases on the right mid-to-posterior. Volume increases suggest inflammation and glial activation, while decreases could arise from localized neuronal injury. Sites of volume increase appeared in depression-related areas, whereas right-side volume decrease sites mediate non-spatial cognitive processing functions.

Support (If Any): Supported by the National Institute of Nursing Research NR-013693.

0309 LEUKOCYTE MAXIK CHANNEL EXPRESSION IN PATIENTS WITH SUSPECTED OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) increases risk and progression of hypertension. MaxiK channels on vascular smooth muscle cells exert a vasodilatory effect on arteriolar tone. Previous studies show downregulation of MaxiK channel expression in selected patients with severe OSA and reversal of these changes following continuous positive airway pressure (CPAP) treatment. We examined the association of MaxiK channel expression with severity of OSA and changes with CPAP treatment in a sleep clinic population.

Methods: Single-center, prospective study of patients with suspected OSA (n = 30). All participants completed polysomnography with CPAP titration. Morning blood samples were collected in PAXgene RNA tubes at baseline and following 1 month of CPAP treatment. MaxiK expression was measured in leukocytes by qPCR with 28S as loading control.

Results: Participants were middle-aged (mean ± SD; years = 47.8 ± 11.7), sleepy (ESS = 12.3 ± 5.9), and obese (body mass index; BMI = 38.0 ± 9.0) with a high prevalence of hypertension (77%). None of the participants reported changes in medications during the treatment period. 3 groups were analyzed: 6 controls (apnea hypopnea index; AHI 15). ANOVA showed no group differences in MaxiK channel expression at baseline (F statistic = 0.31, p = 0.8). Moreover, no change in MaxiK channel expression was noted following one month of CPAP treatment (n = 24) after adjusting for OSA severity, CPAP adherence, age and BMI (F statistic = 0.04, p = 0.9).

Conclusion: In patients with suspected OSA, MaxiK channel activity is not associated with AHI and its expression is unchanged with CPAP treatment in the short-term. Longer duration of CPAP treatment in OSA patients with hypertension may clarify the potential pathogenic role of MaxiK channel.

Support (If Any): VA CSR&D; 1IK2CX001026-01

0310 DOES TONGUE SIZE PREDICT GESTATIONAL OBSTRUCTIVE SLEEP APNEA?

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Introduction: The emerging evidence suggests that gestational Obstructive sleep apnea (OSA), has been associated with maternal-fetal complications, yet most obstetricians do not routinely screen for OSA. Upper airway narrowing is a main determinant of OSA. Its evaluation with other measures may be useful for screening OSA risk. We aimed

B. Clinical Sleep Science

8.36x10^-4 ± 0.04x10^-4; OSA: 8.13x10^-4 ± 0.08x10^-4) tracts. Moderate OSA showed decreased MD in the left corticospinal (control: 7.81x10^-4 ± 0.07x10^-4; OSA: 7.52x10^-4 ± 0.07x10^-4), right corticospinal (control: 8.07x10^-4 ± 0.10x10^-4; OSA: 7.66x10^-4 ± 0.08x10^-4), and forceps minor (control: 9.45x10^-4 ± 0.09x10^-4; OSA: 9.13x10^-4 ± 0.24x10^-4).

Conclusion: Severe OSA is associated with white-matter specific changes, including increased volume and widespread decreased mean diffusivity, while subjects with moderate OSA show limited reductions in axonal integrity. Damage in severe OSA is preferentially localized to the right hemisphere, which especially affects sympathetic autonomic regulation, as well as other functions modified in the condition. The white matter tract damage in moderate OSA is substantially less than in the severe group. The findings suggest that OSA severity does not linearly contribute to white matter injury, but that more-severe apnea has the potential to elicit much greater brain impairments.

Support (If Any): Supported by the National Institute of Nursing Research NR-013693.

0308 HIPPOCAMPAL SUB-REGIONAL VOLUME DIFFERENCES IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) patients suffer from hippocampal-related autonomic and neurological symptoms, including cognition, depression, and memory. Distinct hippocampal subfields serve different functional roles, and vary in hypoxic vulnerability. The objective was to assess hippocampal sub-regional injury using surface-based volume analyses.

Methods: We performed high-resolution T1-weighted imaging in 66 newly-diagnosed, untreated OSA (mean age ± SD; 46.3 ± 8.8years; mean AHI ± SD: 34.1 ± 21.5 events/hour; 30 male) and 59 healthy control (46.8 ± 9.0 years; 38 male) participants. To address potential inconsistencies from limited subject numbers available for MRI studies, we combined a healthy control sample with two large datasets to compare OSA changes, the IXI and OASIS MRI datasets, which include T1-weighted scans (1mm^2 resolution), for a total of 979 controls (426 male, 45.6 ± 9.9 years). We analyzed scans with “FSL FIRST” software, which segments the hippocampus and assesses regional surface-based structure. Hippocampal volumes were scaled for total brain size based on registration to a common space (6 parameter affine normalization), and included total intracranial volume and gender as covariates (ANOVA; P < 0.05, permutation testing correction for multiple comparisons).

Results: Left and right hippocampi showed regional volume differences in OSA over controls, accounting for head size and gender (all results P < 0.05, corrected). The left hippocampus showed increased volume in anterior and posterior lateral areas, and medial mid and mid-to-posterior sites, encompassing CA1, CA2, and subiculum. The right hippocampus also showed volume increases in anterior and posterior lateral regions; however, a mid-to-posterior region showed a volume decrease.
to develop a screening tool combining subjective and objective measures to predict gestational OSA diagnosis.

**Methods:** Data were collected from a completed prospective study of OSA including 130 women in first-trimester and 102 in third-trimester. All women underwent full polysomnography, visual assessment of the anatomy of oral cavity and completed questionnaires (Epworth Sleepiness Scale-(ESS), Sleep Apnea Symptom score-(SASS) from Multi-variable Apnea Prediction index). An examiner blinded to participants’ disease status assessed the oral cavity. Bivariate regression analyses were performed to identify characteristics associated with OSA (AHI ≥ 5/hour). Each variable with p < 0.2 associated with OSA was examined in multivariate analyses to determine the best performing models for identifying OSA. Analyses was performed using 3 covariate/outcome combinations: first trimester covariates predicting first trimester OSA, third trimester covariates predicting third trimester OSA and first trimester covariates predicting third trimester OSA.

**Results:** Mean age was 26.8 ± 7.0 at baseline. Seventeen (13%) women in first and 27 (26%) women in third-trimester had AHI ≥ 5. Habitual snoring, ESS and SASS did not accurately predict sleep apnea in this group, with ROC area under the curves (AUC) of 0.53 (95%CI, 0.42-0.64), 0.58 (95%CI, 0.45-0.72) and 0.66 (95%CI, 0.53-0.79), respectively. However a model combining age, BMI and tongue size (normal vs. large) performed better in both trimesters. The AUC of this model was 0.86 (95%CI, 0.77-0.94) in first-trimester, and 0.84 (95%CI, 0.75-0.93) in third-trimester. Further analysis demonstrated that the same model including the same variables in first-trimester predicted OSA risk in third-trimester (AUC 0.82; 95%CI, 0.72-0.92).

**Conclusion:** Existing tools assessing OSA symptoms are poor predictors of OSA risk in pregnant women. BMI, age and tongue size can reliably predict OSA risk over the course of pregnancy.

**0311**

**SYSTEMIC INFLAMMATION IS A BETTER PREDICTOR OF CARDIOMETABOLIC RISK THAN APNEA/HYPOPNEA INDEX IN MILD-TO-MODERATE OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** The guidelines for when and how to treat mild-to-moderate obstructive sleep apnea (OSA) continue to be a clinically gray area, particularly if patients are asymptomatic. We examined the relative contribution of apnea/hypopnea index (AHI) and C-reactive protein (CRP) in predicting cardiometabolic risk in individuals with mild-to-moderate OSA.

**Methods:** 62 middle-aged, relatively non-obese men and post-menopausal women (55.6% male, age 55.0 ± 0.7y, mean BMI 29.2 ± 0.5) underwent an 8-h polysomnography study. Mild-to-moderate OSA was defined as 5 ≤ AHI ≤ 30. Blood pressure (BP) was assessed in the evening before bed. A single blood draw was taken upon awakening for measures of CRP as well as fasting glucose and cholesterol. Linear and logistic regression models assessed the relative contribution of AHI and CRP in predicting cardiometabolic outcomes, while ANCOVA assessed differences in groups defined by combinations of low/high CRP and AHI based on clinically-relevant cut-offs (CRP ≥ 1.5 mg/L, AHI ≥ 10), adjusting for age, gender, and BMI.

**Results:** CRP was a stronger predictor of glucose levels (β = 0.31, p = 0.05) and elevated glucose (defined as ≥ 100 mg/dL; OR = 18.32, p = 0.02) than AHI (β = 0.07, p = 0.65; OR = 1.07, p = 0.24). CRP was also a stronger predictor of diastolic BP than AHI in men (β = 0.45, p = 0.02 vs. β = 0.03, p = 0.17). While there were no differences in cardiometabolic risk between those with AHI0.44), those with CRP ≥ 1.5 mg/L had a trend elevation in glucose (103.83 mg/dL, p = 0.18) and elevated cholesterol (225.16 mg/dL, p = 0.009) compared to the CRP < 1.5 mg/L group. There was a significant interaction between AHI ≥ 10 and CRP ≥ 1.5 mg/L on cholesterol (p = 0.006); specifically, the group with high-CRP/AHI had the highest cholesterol (231.86 mg/dL, p = 0.002 vs. high AHI/low CRP; p = 0.069 vs. low AHI/low CRP).

**Conclusion:** Incorporating a measure of systemic inflammation in assessing the medical severity of mild-to-moderate OSA strongly enhances the diagnostic utility of AHI. These findings have implications in how OSA is diagnosed and treated.

**Support (If Any):** NIH R01 HL64415

**0312**

**EVALUATION OF GENIOGLOSSUS ACTIVITY DURING EARLY SLEEP ONSET IN CHINESE PATIENTS WITH OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** It’s broadly considered that loss of neuromuscular compensatory after sleep is associated with pharyngeal collapse. However, some research found that the G genioglossus electromyography (GGEMG) could increase at sleep onset in a minority of OSA patients. Whether these inconsistent changes of GG activities at sleep onset are associated with individual pathophysiology phenotypes remains unclear. The goal of this study was to evaluate GGEMG in Chinese population at early sleep onset, and clarify the interaction of GG activities and the apnea severity in patients with Obstructive Sleep Apnea (OSA).

**Methods:** Thirty-five OSA patients and 10 normal controls underwent overnight polysomnography with synchronous GGEMG using intra-oral electrodes. The UA anatomy was evaluated by three-dimensional computer tomography (3D-CT) in all subjects.

**Results:** The mean GGEMG and mean tonic GGEMG values were higher in the apnea patients than in the controls during wakefulness and sleep onset (P < 0.01). Eight OSA patients had increased GGEMG activity at sleep onset, and the remaining 27 patients had decreased GGEMG values. Between the two groups, there were significant differences in the apnea/hypopnea index (AHI), lowest oxygen saturation (LSAT) % time SaO2 < 90% (T9590),oxygen desaturation index ≥ 3% (OD3), minimal cross-sectional airway area (mCAS) and minimal lateral airway dimension (mLAT) at the velopharynx (P < 0.05). The change in GGEMG, change in tonic GGEMG and change in phasic GGEMG from awake to sleep showed positive correlations with supine-AHI, negative correlations with the velopharynx (mLAT) (p < 0.01).

**Conclusion:** Variability of GGEMG at sleep onset is associated with apnea severity in OSA patients. We speculate that rapid reflex-driven neuromuscular compensation in response to heavy mechanical loads still exist at early sleep onset. The mechanical loads might be the main contributor to the apnea severity in patients with increased GGEMG at early sleep onset.

**Support (If Any):** The project was supported by the National Science Foundation of Chinese (No. 81170902), the National Science Foundation of Chinese (No. 81200735) and the National Science and Technology Support Plan (No. 2013BAI03B05).
0313
MATERNAL SERUM GALECTIN-3 IN OBSTRUCTIVE SLEEP APNEA (OSA)
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Introduction: Galectin-3 is a novel biomarker that is indicative of inflammation, cardiac remodeling and heart failure. OSA is associated with cardiovascular disease. We sought to evaluate levels of serum Galectin-3 in pregnant women with and without OSA.

Methods: We performed a nested cohort study of pregnant women enrolled in a prospective protocol to screen pregnant women for obstructive sleep apnea. Obese women underwent morphometric measurements and measurement of body composition using air displacement plethysmography. Women were evaluated with in-home portable polysomnography for the detection of OSA. All studies were manually scored by an independent reading center. Fasting serum was collected, stored at -80°C, and analyzed in duplicate for levels of galectin-3 using the DGAL30 ELISA kit from R&D Systems. Data were analyzed using chi square, student T test and Spearman correlation. A p-value < 0.05 was considered significant.

Results: We included 25 women with OSA and 135 without OSA. Women with OSA were older in age (30 ± vs. 27 years, p = 0.04) and had a greater body mass index (40.2 vs. 35.5 kg/m², p = 0.02). Both groups were similar in gestational age at screening (21 vs. 20, p = 0.8) and percent body fat (43.5 vs. 43.9, p = 0.4). Serum levels of galectin-3 were similar between the two groups. (8.6 vs. 8.4). Galectin-3 levels were significantly correlated with maternal age (r = -0.18, p = 0.02) and gestational age (r = 0.28, p < 0.001) but not with BMI (r = 0.06, p = 0.1), body fat percentage (r = 0.03, p = 0.7) or apnea hypopnea index (r = 0.03, p = 0.6).

Conclusion: Galectin-3 levels are not elevated among obese women with OSA. Galectin-3 was associated with maternal age and gestational age. Any future studies that use Galectin-3 as a biomarker should take into account these associations.

Support (If Any): Supported by the National Institute of Nursing Research 1R01NR013693-01.

0315
THE EFFECT OF UPPER AIRWAY SURGERY ON LOOP GAIN IN ASIAN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA
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Introduction: Unstable ventilatory control (high loop gain) is an important non-anatomical risk factor for obstructive sleep apnea (OSA). Studies have shown high loop gain (LG) might also be acquired from long-term hypoxemia/hypercapnia due to OSA, and could be decreased by CPAP therapy in some of the individuals. Whether other treatments, i.e. upper airway surgery, could achieve a similar improvement in LG is not known. We hypothesize that 1) high LG could be reversible with improved hypoxemia and reduced AHI by surgical treatment; 2) high loop gain at baseline may be associated with poor treatment outcomes.

Methods: PSGs were performed pre- and postoperatively to assess the OSA severity in participants who underwent uvulopalatopharyngoplasty and concomitant transpalatal advancement pharyngoplasty. LG (at a disturbance of frequency one cycle/minute) were calculated using a published method by fitting a feedback control model to airflow using MATLAB. The LG values at baseline and follow-up were compared. The association between LG change and improvement of OSA were analyzed.

Results: To date, four male OSA patients (age 41 [34,45] yrs; BMI 27.6 [26.7,31.3] kg/m²) have been studied. Patients were followed up at 6 [2,10] months after surgery. AHI changed from 54.4 [50.6,80.9] to 37.4 [7.9,65.8] events/hr. Nadir oxygen desaturation (SaO2) improved...
from 76 [67,85] to 81 [75,86]%]. Percentage of time with SaO2 < 90% decreased from 16.7 [4.0,27.3] to 2.00 [8.7,3]%. Pre and post-operative LG were 0.81 [0.64,1.03] and 0.54 [0.31,0.76] respectively. In the two responders (AHI ≤ 20/h and decreased ≥ 50% of baseline), LG changed from 0.91 to 0.27, 0.72 to 0.44 respectively; in non-responders LG changed from 1.07 to 0.79, 0.61 to 0.65 respectively.

**Conclusion:** High LG might be reversible by successful surgical treatment of OSA. Reduction of LG seemed to be related to improvement of severity of OSA. More data are needed to investigate whether an elevated LG is related to residual OSA after surgery.

**Support (If Any):** The National Natural Science Foundation of China (81200735)

### 0316

**NASAL CYCLE DURING SLEEP**

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**Introduction:** The physiologic mechanisms of nasal cycle have not been entirely clarified, even more so during sleep. In this study, we measured the periodic patterns of the normal nasal cycle during sleep.

**Methods:** We evaluate nasal cycle during sleep using nPSG and the portable rhinoflowmeter, Rhinocycle, Rhinometrics, Lynge, Denmark, measuring airflow independently through each nostril during sleep on 9 healthy subjects.

**Results:** Eight of 9 subjects showed a detectable nasal cycle during sleep. Nasal cycle during sleep tended to be associated with REM sleep (87.5%) and postural changes (12.5%). Most Nasal Cycle occurred during REM sleep of the sleep latter half. And also, occurred during REM sleep occurred during REM sleep. Futhermore It never occurred in slow-wave sleep.

**Conclusion:** Changes in laterality of nasal cycle frequently coincide with switches in posture, tend to occur in REM sleep, never occur in slow-wave sleep.

### 0317

**CORRELATIONS BETWEEN WAIST AND NECK CIRCUMFERENCES AND OBSTRUCTIVE SLEEP APNEA CHARACTERISTICS**

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**Introduction:** Obstructive sleep apnea (OSA) subjects often show obesity, which can be examined by body mass index (BMI), a measure that estimates body fat and indicates risk for various diseases, including OSA. While BMI has been linked to OSA severity, it can overestimate/underestimate body fat, and thus, associated risks in OSA may be deceptive. Other measures of obesity include waist and neck circumferences, and may be useful to examine associated disease severity in OSA. Our aim is to examine whether waist and neck measures correlate better than BMI with disease severity, sleep, and neuropsychologic measures in newly-diagnosed, treatment-naive OSA subjects.

**Methods:** We measured the waist and neck circumferences (waist, 108.5 ± 15.3 cm; neck, 42.5 ± 5.0 cm), collected other variables (age, 49.4 ± 9.8 years; BMI 32.4 ± 7.4 kg/m²; AHI, 40.4 ± 25.2 events/hr; SaO2 nadir, 78.1 ± 8.8%; 30 male), assessed daytime sleepiness [Epworth sleepiness scale (ESS), 8.3 ± 4.4], and depression [Beck depression inventory II (BDI-II), 6.2 ± 5.4] and anxiety [Beck anxiety inventory (BAI), 5.5 ± 7.0] symptoms from 38 OSA subjects. We used the Pearson correlation procedures to examine associations between BMI and waist and neck circumferences vs. AHI, sleep, and neuropsychologic variables.

**Results:** BMI showed significant relationships with SaO2 nadir (r = -0.386, p = 0.017), but other variables (AHI, r = 0.29, p = 0.077; PSQI, r = 0.126, p = 0.452; ESS, r = 0.153, p = 0.36; BDI-II, r = -0.217, p = 0.19; BAI, r = -0.006, p = 0.973) did not show such associations. However, waist and neck circumferences revealed more significant correlations with those variables than BMI. Waist circumference values showed correlations with AHI (r = 0.441, p = 0.006), ESS (r = 0.387, p = 0.016), SaO2 nadir (r = -0.399, p = 0.013), but not with PSQI (r = 0.244, p = 0.139), BDI-II (r = -0.236, p = 0.154), and BAI (r = 0.095, p = 0.569), and the neck circumference values showed significant associations with AHI (r = 0.366, p = 0.024) and ESS (r = 0.534, p = 0.001) scores. Although other variables did not show significant correlations with neck circumference, correlation values indicated better associations than BMI (PSQI, r = 0.28, p = 0.089; BDI-II, r = 0.096, p = 0.567; BAI, r = 0.24, p = 0.147), except SaO2 nadir (r = -0.052, p = 0.754).

**Conclusion:** The waist and neck circumference values showed more significant correlations with disease severity, sleep, and neuropsychologic scores than BMI in OSA subjects. The findings indicate that neck and waist circumferences are overall sensitive measures for obesity that can indicate disease severity in the condition.

**Support (If Any):** This work was supported by National Institutes of Health R01 HL-113251 and R01 NR-015038.

### 0318

**ATTENTION BIAS IN PEOPLE WITH DIFFERENT SLEEP VULNERABLE AND CHRONIC INSOMNIA**

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**Introduction:** Stress-related sleep vulnerability is considered to be a predisposing factor for insomnia disorder. A shift of attention from life stressor to the sleep-related stimulus was proposed to be the critical transitions that perpetuate acute insomnia into a chronic one. The current study aims to evaluate this model by comparing the attention bias in non-insomniac individuals with high and low sleep vulnerable and patients with chronic insomnia. Also, the study further explored the nature of the attentional bias as vigilance and/or disengagement.

**Methods:** Thirty-three participants were recruited, including 11 patients with chronic insomnia (CI) and 22 non-insomniac participants categorized into 10 good sleepers (GS) and 12 high sleep-vulnerable sleepers (HV) based on their scores on the Ford Insomnia Response to Stress Scale. All participants completed a visual dot-probe task with stimuli comprising sleep-related, threatening and neutral pictures. RTs on congruent and incongruent threatening and sleep-related trials were compared to RTs on the neutral trials to determine whether the attentional bias scores reflect vigilance or a difficulty to disengage attention.

**Results:** Results showed no significant difference among the three groups on vigilance index in both sleep-neutral and threat-neutral trials. There was a marginal trend toward significant difference between HV and CI groups on disengagement index of sleep-neutral trials (HV = .70, CI = .119, pH-I = .115) at 500 ms picture presentation. In addition, HV groups also showed a trend of impaired disengagement from threatening picture to GS groups (HV = 18.11, CI = 4.99, pG-H = .115) at 500 ms picture presentation.

**Conclusion:** The findings, although not are not significant statistically, showed a trend that is consistent with the prediction that high vulnerable sleepers tend to attend to sleep-related stimulus. The study further demonstrated that the incapacity to disengage from threatening stimuli might be more critical than over-vigilant to the stimulus.
Introduction: Sleepiness and cardiovascular disease share common molecular pathways; thus, genetic risk factors for sleepiness may also predict cardiovascular disease risk. The associations between subjective sleepiness and 6 candidate genes and single nucleotide polymorphisms (SNPs) within oxidative stress and inflammatory pathways, which may contribute to sleepiness and cardiovascular disease risk, were explored.

Methods: 918 adults from the general population who are a part of The Epidemiologic Sleep Study (EPISONO) in Sao Paulo, Brazil were genotyped using IlluminaOmniExpress. The average age was 42 ± 14.5 years; subjects had a mean body mass index (BMI) of 26.9 ± 5.4 kg/m² and 44% were male. Based on the Epworth Sleepiness Score subjects were categorized as sleepy (ESS > 10) or non-sleepy. Logistic regression models were used to examine the associations with 375 individual SNPs within candidate genes, adjusting for age and body mass index (BMI), as well as 20 principal components (PCs) derived from genome wide SNPs to control for population structure. Regression models were conducted in the full population. We pruned the SNPs to a subset of 78 independent SNPs based on an r2 threshold of 0.15 and a sliding 50 SNP window.

Results: In the full population, the T allele of the rs1445918 SNP on Phosphodiesterase 4D, an inflammatory gene located on chromosome 5, was significantly associated with increased risk of subjective sleepiness in both the PC adjusted [OR (95% CI): 1.49 (1.19, 1.87); p = 0.0005; Bonferroni-corrected p = 0.041] and age, BMI, and PC adjusted [OR (95% CI): 1.48 (1.18, 1.86); p = 0.0006, Bonferroni-corrected p = 0.051].

Conclusion: We present data for an association at rs1445918 on the PDE4D gene which is significantly associated with sleepiness. Our findings identify a potentially novel gene target for the treatment of sleepiness and the prevention of cardiovascular disease.

Support (If Any): This work was supported by grants from Associação Fundo de Incentivo à Pesquisa (AFIP) and the 1K99NR014675-01/R00NR014675-03 National Institutes of Health Pathway to Independence Award.

0320
POPULATION-BASED STUDY OF SLEEP APNEA IN PREGNANCY AND MATERNAL AND INFANT OUTCOMES
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Introduction: Sleep apnea appears to be common in pregnant women although its impact on pregnancy is unclear. The aim of this study was to examine the association between sleep apnea and infant and maternal outcomes in a population-based cohort.

Methods: Birth and hospital records in New South Wales, Australia, were linked to conduct a population-based cohort study. Participants were all women who gave birth in hospital from 2002 to 2012 (N = 636,227). Sleep apnea in the year before pregnancy or during pregnancy was identified from hospital records. Outcomes of interest were gestational diabetes, pregnancy hypertension, planned delivery, caesarean section, preterm birth, perinatal death, 5-minute Apgar score, admission to neonatal intensive care or special care nursery, and infant size for gestational age. Maternal outcomes were identified using a combination of hospital and birth records. Infant outcomes came from the birth record. Modified Poisson regression models were used to examine associations between sleep apnea and each outcome taking into account maternal age, country of birth, socioeconomic disadvantage, smoking, obesity, parity, pre-existing diabetes and hypertension.

Results: Sleep apnea was significantly associated with pregnancy hypertension (adjusted RR 1.68; 95% CI 1.40 - 2.07), planned delivery (1.15; 1.07 - 1.23), preterm birth (1.50; 1.21 - 1.84), 5-minute Apgar < 7 (1.60; 1.07 - 2.38), admission to neonatal intensive care/special care nursery (1.26; 1.11 - 1.44), large-for-gestational-age infants (1.27; 1.04 - 1.55) but not with gestational diabetes (1.09; 0.82 - 1.46), caesarean section (1.06; 0.96 - 1.17), perinatal death (1.73; 0.92 - 3.25), or small-for-gestational-age infants (0.81; 0.61 - 1.08).

Conclusion: Sleep apnea is associated with higher rates of obstetric intervention and preterm delivery. Future research should examine if these risks are independent of obstetric history.

Support (If Any): This work was supported by an Australian National Health and Medical Research Council (NHMRC) Centre for Research Excellence grant (1001066). JBF is supported by an Australian Research Council Future Fellowship (FT120100069). The funding sources had no involvement in the study design; collection, analysis, and interpretation of the data; or the decision to submit this paper for publication.

0321
SLEEP DISORDERED BREATHING ASSOCIATED WITH INCIDENT FATAL CORONARY HEART DISEASE IN OLDER MEN
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Introduction: Sleep disordered breathing (SDB) has been associated with increased risk of incident coronary heart disease (CHD) in middle-aged adults, but the nature of this relationship is less clear among older adults. Using data from the MrOS Sleep Study, we examined the association of SDB with risk of incident CHD, and incident fatal CHD, among older men.

Methods: We recorded in-home polysomnography (PSG) in a cohort of 2872 men (mean age 76.4 years). Incident coronary heart disease (CHD) events were centrally adjudicated during 8.7 ± 2.6 years of follow-up. The apnea-hypopnea index (AHI) was defined as the number of apneas and hypopneas with ≥ 3% oxygen desaturation per hour of sleep. The obstructive apnea-hypopnea index (OHAI) was also examined. Both AHI and OHAI were categorized as < 5, 5 to < 15, 15 to < 30, and 30 or more events per hour.
I. Sleep Disordered Breathing

B. Clinical Sleep Science

**APNEA IN HYPERTENSIVE POPULATIONS**


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**Introduction:** To investigate epidemiological characteristics and gender-related differences of obstructive sleep apnea (OSA) in randomly selected hypertensive populations.

**Methods:** Participants diagnosed as arterial hypertension and had not been diagnosed as OSA previously were recruited and polysomnography was performed to evaluate the apnea-hypopnea index (AHI). Clinical data were recorded and fasting venous blood was sampled for measurements of lipid profiles, fasting plasma glucose, glycated hemoglobin and uric acid. Echocardiography was used to evaluate thickness of inter-ventricular septum and left ventricular posterior wall. Comparisons were performed between subjects with different degrees of OSA and subjects without OSA. Thereafter, gender-related differences were assessed, and univariate and multivariate regression analyses were conducted to analyze the associations between OSA and other clinical variables.

**Results:** Totally, 971 hypertensive subjects were enrolled and 685 (70.5%) were diagnosed as OSA. Compared to those without OSA, subjects with OSA were at higher cardiovascular risk profile. Furthermore, dose-effect relationship was observed as reflected by higher cardiovascular risk profile in moderate and severe OSA groups than mild OSA group. Among the 685 OSA subjects, the males were predominant with 79.4% (537 cases). Gender-related differences in epidemiological characteristics were observed in OSA patients and multivariate regression analyses revealed that after extensively adjusted to potential confounding covariates, only BMI remained positively with OSA in male (odds ratio (OR): 1.064, 95% confidence interval (CI): 1.008-1.123, P = 0.024). While in the female subjects, after extensively adjusted to potential confounding covariates, only age was still positively with OSA (OR: 1.071, 95% CI: 1.029-1.116, P = 0.001).

**Conclusion:** In Chinese population, incidence of OSA in hypertensive population is strikingly high and male is predominant. Hypertensive subjects with OSA are at higher cardiovascular risk profile. There are significant differences in epidemiological characteristics of OSA between male and female.

**0323**

MEAN SEGMENT DURATION OF HYPOXEMIA IN OBSTRUCTIVE SLEEP APNEA: A REVIEW OF 94,045 BASELINE POLYSOMNOGRAMS

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**Introduction:** Sleep apnea continues to be the most common diagnosis evaluated. Sleep apnea severity is measured by the apnea hypopnea index. Oxygen desaturation measures include nadir oxygen and duration of desaturation. Assessment of mean segment duration of hypoxemia per event is a method of assessing sleep disordered breathing. The present study looks at mean segment duration of hypoxemia in seconds by gender, age, and BMI in a population of individuals undergoing a baseline PSG who present to a sleep lab for evaluation of a sleep complaint.

**Methods:** Database assessment of consecutive PSGs SleepMed with baseline PSG between 2011-2014 are reviewed. Those ages 18 years or older with AHI $>$ 15 events per hour; nadir oxygen 0-88%; and total sleep time of $>$ 300 minutes were selected for analysis. Mean segment duration of hypoxemia in seconds per event is reported for the group. Comparison by gender, age, and BMI > 30 in mean segment duration (seconds) are analyzed with t-tests.

**Results:** Of all baseline PSGs 26692 met criteria. Sample characteristics for the group were: 8954 (34%) women and men 17738 (66%); mean age females = 57(13) males = 54(14); BMI females = 36(8) males 39(10); AHI females = 33(19) males 37(19); SaO2 min < 90 females = 72 min (82); males = 65 min (72). For the group average mean segment duration (MSD) per event in seconds = 24 (31). By gender 8954 women MSD = 27sec (36) compared with 17789 men MSD = 21sec (27) is significant p < 0.001. MSD means by gender and BMI equal to or greater than 30: 13892 men MSD = 22sec (28) vs 7518 women MSD = 29sec (38) is significant p < 0.001. By gender and age equal to or greater than 50 years: the women 6638 MSD = 30 sec (38) and men 6637 MSD = 23 sec (30) is significant p = 0.001.

**Conclusion:** The majority of patients had a MSD of less than 25 seconds. Our research shows that females, females ages 50 or older, and females with BMI > 30 have a disproportionally higher MSD when compared to males which could be related to arousability or differences in regulation of breathing. The measure of MSD could give us insights into what should be the distribution in sleep apnea patients and may be an important indicator of arousability, medical risk, intrinsic cardiac or pulmonary disease and/or obesity hyperventilation; especially since MSD in sleep hyperventilation is about six times longer than in obstructive sleep apnea.

**0324**

MEAN SEGMENT DURATION (MSD) IN SECONDS IN SLEEP INDUCED HYPOXEMIA: A REVIEW OF 4041 BASELINE POLYSOMNOGRAMS

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**Introduction:** Oxygen desaturation measures during sleep include duration of desaturation events. Assessment of mean segment duration of hypoxemia per event is a method of assessing patients as to pathophysiology of abnormal breathing. The present study looks at mean segment duration of hypoxemia in seconds by gender, age, and BMI in a population of individuals undergoing a baseline PSG with hypoxemia but low AHI’s.

**Methods:** Database assessment of 4041 consecutive PSGs at three SleepMed sites in SC with baseline PSG between 2012-2014 were selected with this criteria: AHI less than 10 events per hour; nadir oxygen
0.88%; desaturation index less than 10 events per hour at 4% level or greater; total sleep time greater than 300 minutes and age 18 years or greater. MSD of hypoxemia in seconds per event is reported for the group. Comparison by gender, age > 50 years, and BMI > 30 in MSD (sec) are analyzed with t-tests.

Results: Of 4041 baseline studies 222 met the criteria for sleep induced hypoxemia. Sample characteristics for the group were: 144(65%) women and men 78(35%); mean age females = 60(12) males = 56(16); BMI females = 33(7) males 32(7); AHI females = 6(3) males 7(2); SaO2 min < 90 females = 46(61) males 27(31); desaturation index females = 6(3) males = 6(2). For the group average mean segment duration (MSD) per event in seconds = 142(286). By gender 143 women MSD = 123 sec (190) compared with 78 men MSD = 67sec (98) was significant p = 0.001. MSD by gender with BMI 30 or higher was significant: 92/143 women MSD 121 sec (187)and 40/78 men MSD 61sec (103) p = 0.02. By gender and age equal to or greater than 50 years: women 107/143 MSD = 134 sec (188) and men 51/78 MSD = 79 sec (109) is significant p = 0.01.

Conclusion: MSD is suggesting that prolonged segments are more prevalent in individuals with sleep induced hypoxemia compatible with alveolar hypoventilation. Women are disproportionally represented in this group and that suggests a high prevalence of sleep induced hypoxemia in females.

0325
PREVALENCE OF OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITH IDIOPATHIC INTRACRANIAL HYPERTENSION
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Introduction: To describe the prevalence of obstructive sleep apnea (OSA) in patients with Idiopathic Intracranial Hypertension (IIH).

Methods: We retrospectively reviewed patients with a known diagnosis of IIH between 2010 to 2015. Patients ≥ 18 years of age were included from both inpatient and outpatient services of the University of Missouri Hospitals and Clinics. We reviewed the polysomnographic reports including the apnea hypopnea index (AHI) and respiratory disturbance index (RDI).

Results: Ninety patients met our inclusion criteria. Presenting complaints mainly included headache and visual disturbances. Mean age was 35.8 years (range 18-75) and 79/90 (87.8%) were females. The average body mass index (BMI) of our study population was 39.5 kg/ m2. Snoring during sleep was present in 32 patients (35%). Of these 32, 28 (87.5%) had a sleep study and 21 (75%) were diagnosed with OSA. The mean AHI and RDI in our study population were: 5.3±3.2 and 10.2±2.4 respectively. All patients underwent lumbar puncture with a mean opening pressure of 35.83 cm of H2O. The mean opening pressure in patients with OSA was 37.8 cm of H2O. Mean opening pressure in those without OSA was 35.3 cm of H2O. The mean difference in the opening pressure, between the two groups was 2.5 cm of H2O.

Conclusion: Close to a quarter of patients with IIH had OSA in our cohort. As previously reported, this entity was seen in obese individuals and affected females more than males. However, prospective studies with long-term follow up are necessary to inform the outcome in patients with OSA in Idiopathic Intracranial Hypertension.

0326
ASSOCIATION OF SLEEP DISORDERED BREATHING AND C-REACTIVE PROTEIN (CRP) LEVELS: EFFECT OF AGE
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Introduction: Study Objective: We hypothesize that the association of sleep disordered breathing (SDB) with C-reactive protein (CRP), a pro-inflammatory marker of cardiovascular disease risk, is different in younger vs older subjects.

Methods: Design: Cross-sectional. Setting: Population-based research. Participants: Nationally representative sample of 2005-2006 and 2007-2008 National Health and Nutrition Examination Survey participants (n = 11,329 adults). Intervention: None. Measurements: Association between CRP and SDB was examined. Obstructive sleep apnea (OSA) was documented as a positive response to a physician-diagnosed condition. Presence of SDB was based on self-reported nocturnal ‘snoring’ and ‘snorting/stopping breathing’. CRP levels (mg/dL) were measured in subjects. Subjects were divided in 2 groups: Age < 55 years and ≥ 55 years of age.

Results: Mean age (SD) of subjects < 55 years and ≥ 55 years was 34.5 (11.2) and 68.6 (8.6) years respectively. There were 463 subjects with diagnosis of OSA. There were 6,823 subjects who were noted to have snoring, and 2,033 subjects with witnessed apneas. CRP levels were significantly higher in subjects ≥ 55 years compared to subjects < 55 years (0.51 vs. 0.41, p-value < 0.0001). CRP levels were significantly higher in subjects with OSA (0.68 vs 0.44, p-value < 0.0001), snoring (0.46 vs 0.41, p-value 0.0021) and witnessed apneas (0.52 vs 0.43, p-value < 0.0001) when compared with subjects without these conditions. For subjects ≥ 55 years, CRP levels were not significantly different in subjects with and without OSA, snoring or witnessed apneas. CRP levels were significantly higher in subjects ≥ 55 years compared to subjects < 55 years (0.51 vs. 0.41, p-value < 0.0001). CRP levels were significantly higher in subjects with OSA (0.68 vs 0.44, p-value < 0.0001), snoring (0.46 vs 0.41, p-value 0.0021) and witnessed apneas (0.52 vs 0.43, p-value < 0.0001) when compared with subjects without these conditions.

Conclusion: CRP levels are significantly elevated in subjects with OSA, snoring and witnessed apneas. This association is significantly stronger in subjects < 55 years of age. The lack of association in subjects ≥ 55 years of age or older is likely due to elevated CRP levels in subjects without sleep disordered breathing.

Support (If Any): Centers for Disease Control and Prevention for NHANES data.

0327
GENDER-SPECIFIC AND AGE-DEPENDENT ASSOCIATION OF OBESITY AND DAYTIME SLEEPINESS WITH INCIDENT DEPRESSION: IMPLICATIONS FOR OBSTRUCTIVE SLEEP APNEA
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Introduction: Obstructive sleep apnea (OSA) is postulated to be a risk factor for depression. However, obesity, an etiopathogenic mechanism of OSA and excessive daytime sleepiness (EDS), is also a key risk factor for depression. The goal of this study was to examine the predictive role of OSA, obesity, and EDS for incident depression in young, middle-aged and older adult men and women.

Methods: 1,137 adults without depression from the Penn State Adult Cohort were followed-up after 7.5 years. All subjects underwent a full
medical examination and polysomnography at baseline. OSA was defined as an apnea/hypopnea index (AHI) ≥ 5, overweight as a body mass index (BMI) of 25-29.9 kg/m², obesity as a BMI ≥ 30 kg/m², and EDS as moderate-to-severe drowsiness/sleepiness and/or irresistible sleep attacks. Incident depression was defined as a current history of and/or treatment for depression at follow-up.

Results: Overweight was associated with incident depression in women, while obesity and EDS were associated with incident depression in both genders. The association of overweight and obesity with incident depression was independent of premorbid emotional distress, while that of EDS was not. Younger age modified the association between BMI and EDS with incident depression in women, but not in men. The vast majority of participants with OSA were overweight or obese (91.9%) and female gender and the severity of EDS predicted incident depression, while AHI or SpO2 did not.

Conclusion: Overweight, obesity, and EDS are the main predictors of incident depression, including in individuals with OSA from the general population. Obesity may be linked to depression through psychobiological mechanisms, while EDS may be an early sign of depression. Obesity and EDS should be the targets of our preventative strategies for depression, particularly in young adult women. A goal within our sleep medicine clinics should be to integrate obesity specialists in order to better serve our patient population with OSA.

Support (If Any): AHA's 14SDG19830018 and NIH's R01 HL51931, R01 HL40916, and R01 HL64415

0328
RISK OF OBSTRUCTIVE SLEEP APNEA (OSA) IN A POPULATION OF PATIENTS WITH CORONARY ARTERY DISEASE (CAD) UNDERGOING CORONARY ARTERY BYPASS GRAFTING (CABG) IN THE VETERANS AFFAIRS CARIBBEAN HEALTHCARE SYSTEM (VACHS)

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Introduction: OSA patients, who undergo surgeries such as CABG, have increased morbidity. We aim to document the prevalence of OSA or high risk for OSA and to establish the incidence of OSA in those who underwent overnight Polysomnography.

Methods: A record review was done of patients who had CABG at the VACHS from to July 1, 2009 until April 15, 2015 and had a preoperative evaluation in which the STOP-BANG questionnaire was done to determine the risk of OSA. Sleep study results were recorded to determine OSA incidence in patients with positive OSA screening.

Results: So far, 25 records have met the inclusion criteria. 100% were found to have either a previous diagnosis or a high risk of OSA. Of those found at high risk for OSA, 4 had a sleep study done, of which 2 were normal. All patients were men with a mean age of 70.68% were overweight or obese; 56% were ex-smokers and 8% were current smokers. 8% used alcohol often, while none used illicit drugs. 44% underwent CABG due to 3 vessels CAD. 84% had heart dysfunction. 76% had diabetes mellitus (DM), 92% had hypertension (HTN), 88% had dyslipidemia, 36% had chronic kidney disease, 8% had atrial fibrillation, and 28% had history of stroke. 8% of patients had a Mallampati score of either III or IV. 46% of those with recorded neck measurement were above 40cm.

Conclusion: Preliminary data suggests that all of the patients with CAD who underwent CABG either had a diagnosis or were at high risk of OSA. They were all men with age above 50 and either overweight or obese. The most common identified comorbidities were DM, HTN, and dyslipidemia. Even though most of our population was classified as high risk for OSA, only 20% underwent sleep testing.

0329
THE ASSOCIATION BETWEEN OBSTRUCTIVE SLEEP APNEA AND HEART DISEASE BY RACE/ETHNICITY IN A NATIONALLY REPRESENTATIVE SAMPLE

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Introduction: The association between OSA and heart disease by race/ethnicity has not yet been well characterized in a national sample.

Methods: The investigator evaluated self-reports of sleep apnea diagnosis, snoring, snorting, gasping or apnea during sleep to assess whether OSA was probable (pOSA). The investigator studied self-reports of coronary heart disease, congestive heart failure, and heart attack to determine whether heart disease was probable (pHeartD). Chi-Square test and multi-variable logistic regression ascertained whether pOSA predicted heart disease in the cohort.

Results: Overall pOSA predicted heart disease amongst all the subjects in the study [OR (95% CI) = 11.487 (5.786, 22.805)], pOSA predicted heart disease in several groups: 1) Within BMI strata, there was a significant association among individuals with normal BMI [OR (95% CI) = 13.263 (4.051-43.423)] overweight individuals [OR (95% CI) = 17.565 (4.174-73.916)]; obese individuals [OR (95% CI) = 7.451 (2.235-24.840)]; 2) In race/ethnicity subgroups, the association was significant among whites [OR (95% CI) = 11.368 (4.888, 26.441)], African-Americans [OR (95% CI) = 14.656 (3.458, 62.107)], and Hispanic/Latinos [OR (95% CI) = 8.971 (1.158, 69.505)] 3) In models stratified by both race/ethnicity and weight, pOSA predicted pHeartD among overweight Black/African Americans [OR (95% CI) = 12.000 (1.472, 97.800)], overweight whites [OR (95% CI) = 20.167 (2.664, 152.659)]. Of note, overweight Hispanic/Latino participants OR was incalculable since all patients with pHeartD had OSA, and obese Hispanic/Latino participants’ OR was not statistically significant [OR (95% CI) = 2.361 (0.254, 21.947)].

Conclusion: A concise self-report tool for OSA was strongly associated with heart disease, and may serve as a potential future opportunity for OSA and heart disease screening.

0330
MULTILEVEL OBSTRUCTION IN OBSTRUCTIVE SLEEP APNEA: PREVALENCE, SEVERITY AND PREDICTIVE FACTORS

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Introduction: Obstruction of upper airway in Obstructive Sleep Apnea (OSA) patients can be single or multilevel. Recent surgical management trend towards multilevel surgery and preliminary data shows promising results. However, little is known regarding how single/multilevel obstruction correlate with severity of OSA. Correlation of severity of OSA with levels of obstruction is important in providing a guide to the selection and prioritisation of treatment strategies in the surgical modification of the upper airway. We aim to characterise multilevel obstruction in terms of prevalence, relation to OSA severity and predictive factors in our OSA population.

Methods: Retrospective chart review was performed. All patients with polysomnography proven OSA from 2012 - 2015 were included.

Results: A total 250 patients were included in our study. The mean BMI and AHI are 29.4 and 42.2 respectively. 171 (68.4%) had multilevel obstruction, 49 (19.6%) had single-level obstruction, and 30 (12%) patients showed no obstruction on clinical examination. Within each category of OSA severity, multilevel obstruction is more prevalent. Patients with multilevel obstruction are associated with severe OSA (AHI > 30) (p = 0.001). With increasing number of obstruction
sites, the severity of OSA increases (correlation coefficient = 0.303 p < 0.001). Multivariate analysis showed that patients with high BMI (p < 0.001), male gender (p = 0.045) and younger patients (p = 0.042) are more likely to have multilevel obstruction. Of the different anatomic levels of obstruction, patients with palatal (p = 0.004), tongue (p = 0.026) and lateral pharyngeal wall obstructions (p = 0.006) are associated with severe OSA. 

Conclusion: In summary, multilevel upper airway obstruction is more prevalent in the OSA population and is associated with more severe OSA. Surgical management of these patients should be focused on localising the levels of obstruction and tailoring surgical intervention accordingly. In our study, some anatomic levels of obstruction contribute more significantly towards the severity of OSA, hence should be prioritised in the management of OSA patients to achieve optimal results.

0331 THE DEMOGRAPHIC CHARACTERIZATION OF REM SLEEP-PREDOMINANT OBSTRUCTIVE SLEEP APNEA

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Introduction: Over 18 million Americans have OSA. Untreated OSA increases risk of CVD and diminishes quality of life. Predominance of sleep-disordered breathing during REM compared to NREM sleep is often observed. Per current diagnostic standards, some individuals escape diagnosis in consideration of overall AHI alone. Given the norm of 15-25% of TST in REM, these individuals likely bear similar comorbidity as those with a diagnostic overall AHI. This study explores these relationships.

Methods: A small retrospective cohort randomly extracted from the 2013 VCU Sleep Database was queried to: 1.) define population characteristics, 2.) determine OSA incidence, 3.) determine the proportion of REM sleep-predominant OSA (R-OSA) defined by REM AHI ≥ 33% higher than NREM AHI and 4.) identify unique attributes of R-OSA patients. 35 subjects randomly selected from 716 diagnostic PSGs were analyzed.

Results: 21 (60%) had OSA per AASM criteria, reflecting the general characteristics of our patient population and those associated with higher incidence of OSA (54.3% white, 40.0% black, 2.9% Asian and 2.9% of unidentified race). Subjects with OSA were older (mean: 50.0 vs 39.8 [r: 15.6 vs. 15.2]) and had a higher BMI (mean: 36.7 vs. 29.8 [r: 10.2 vs. 7.7]). Black subjects (71.4% with OSA vs 28.6% without OSA) were more commonly affected than white (52.6% with OSA vs 47.4% without OSA). If those with OSA, 16 had R-OSA (76.2%). 4 subjects (19.0%) had R-OSA with an overall non-diagnostic AHI (i.e. < 5). The R-OSA, non-diagnostic cohort was younger, more likely to be female and white as well as had a lower ODI.

Conclusion: Though the sample size is small, the analysis supports that the source population is generalizable. Thus, trends inspire future studies to better understand this often recognized but seldom investigated subgroup. A phenotypic profile as compared and contrasted with the overall OSA population may also be determined.

0332 PREVALENCE OF OBSTRUCTIVE SLEEP APNEA AMONG THE LONG-DISTANCE COMMERCIAL TRUCK DRIVERS OF INDIA

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Introduction: Obstructive sleep apnea (OSA) appears to be associated with increased risk of road traffic accidents. A study was undertaken to determine the prevalence of obstructive sleep apnea (OSA) among long-distance commercial truck drivers of India, and to study the contributory risk factors.

Methods: 1,624 subjects were enrolled for the study, on the national highway and at the main fruit stores of Kashmir valley. All were males with the mean age+SD of 38.6+10.4 years. They were categorized into high and low risk groups for OSA on the basis of clinical picture, Berlin questionnaire, and Epworth Sleepiness Score. Demographic variables including body mass index (BMI), neck circumference, blood pressure and random plasma glucose levels were studied in all. Besides history of smoking, alcohol consumption and sedative medications was elicited. Hospital-attended level 1 polysomnography, the gold standard for diagnosis of OSA was conducted among 132 (8.1%) subjects only because of mobile schedule of the drivers and accompanying financial issues. To compare the variables, odds ratios were determined using logistic regression, and percentage were compared by using chi-square test and student ‘t’ test. A p value of < 0.05 was considered statistically significant.

Results: The overall prevalence of OSA among the study population was 22.2% and OSA was confirmed on polysomnography in 116 (7.1%) subjects belonging to high risk group having apnea hypopnea index (AHI). AHI of more than 5 events per hour of sleep (p < 0.001). Obesity was noticed in over half of the study population with BMI of 30.4±2.9 kg/m² in the high risk group. Hypertension was noted in 20.38% and 2.3% among the high and low risk group (OR 1.04, 95% CI 1.01 to 1.27, p < 0.001), respectively. Other variables associated with high risk of OSA included alcohol consumption in 13.7% (OR 1.02, 95% CI 1.07 to 6.38, p < 0.05) and use of sedative medication in 8.5% (OR 1.15, 95% CI 1.11 to 36.37, p < 0.01). Diabetes was observed in 146 (8.9%) of 132 study subjects (OR 1.04, 95% CI 1.01 to 23.16) who underwent sleep studies.

Conclusion: The prevalence of OSA among commercial long-distance truck drivers of India is far more than published prevalence of general population. Approximately one among five drivers is suffering from the disorder. To further substantiate this observation, large sample studies are required in future, and, this public health issue needs intervention by the concerned governmental authorities.

0333 OBSTRUCTIVE SLEEP APNEA AND CARDIOVASCULAR RISK IN CHINESE POPULATION: A META-ANALYSIS

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Introduction: Background: The association between obstructive sleep apnea (OSA) and cardiovascular disease (CVD) has been discussed in many studies, but the results still remains inconclusive. We aimed to systematically evaluate the effect of OSA on the incidence of cardiovascular events based on Chinese population by a meta-analysis of prospective cohort studies.

Methods: We searched multiple English and Chinese electronic databases in January 2015 for studies that evaluated the prospective associations between OSA and the risk of CVD, stroke, and death due to cardiovascular or cerebrovascular disease (cardiovascular or cerebrovascular death, CCVD). Outcome data were pooled using random effects meta-analysis. Subgroup, heterogeneity, and publication bias were performed.

Results: Of 8 cohort studies included, 5 reported results on CVD (n = 153,186), 7 reported on stroke (n = 153, 417), and 3 reported on CCVD (n = 3,288). OSA was significantly associated with the risk of CVD, stroke and CCVD. The pooled relative risks were 3.45(95% confidence interval [CI], 2.66-4.77) for CVD, 2.85 (95%CI, 1.70-4.78) for
stroke and 2.44 (95% CI, 1.10-5.40) for CCVD. There was no evidence of significant between-study heterogeneity for subgroup analysis. The results did not materially change in the sensitivity analyses for the outcomes of CVD, stroke and CCVD.

**Conclusion:** This meta-analysis of prospective cohort studies suggests that OSA significantly increases the risk of CVD, stroke and CCVD in Chinese population.

### 0334

**THE PREVALENCE OF OSA AMONG AN ADULT POPULATION WITH DOWN SYNDROME**

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**Introduction:** Obstructive sleep apnea (OSA) is a common sleep disorder affecting 2-4% of adults, and if untreated it can cause significant cardiopulmonary complications. Among adults with OSA, studies involving individuals with Down syndrome (DS) are rare, although the limited research available show that individuals with DS have a high prevalence of OSA. Given the lack of evidence of the association of OSA and DS in adults in the current literature, there are no universal guidelines for screening. However, the American Academy of Pediatrics (AAP) recommends obtaining polysomnography (PSG) for all children with DS by the age of 4. Unfortunately, many children are not screened and are left undiagnosed and untreated. Therefore, it is important to further evaluate the disease burden in adults with DS.

**Methods:** A retrospective chart review of adults with DS was performed at the Baylor College of Medicine (BCM) Transition Clinic to yield the following information: history of PSG; results of PSG; and if no sleep study completed, reason why not. The prevalence of OSA in adult patients with DS was then determined.

**Results:** Of the 125 patients with DS seen at Transition Medicine Clinic, 82 (65.6%) of them have undergone PSG testing. Records of PSG testing were available for 69 of those patients, 60 of whom were adults (≥ 18yo) at the time of PSG. Of those 60, 56 (93.3%) of participants were diagnosed with OSA. For those patients who did not have PSG testing done, the most common reasons cited were (1) referral made for PSG but not completed (34.9%) and (2) patient was screened for symptoms of OSA and was asymptomatic (25.6%).

**Conclusion:** The purpose of this study was to evaluate the prevalence of OSA in the adult DS population. The AAP recommends that all children with DS be screened for OSA; however, no such recommendations exist for adults with DS. Given that adults with DS have even more predisposing factors for OSA and that the prevalence of OSA tends to increase with age across all populations, it is particularly important to understand the prevalence of OSA in this population in order to make appropriate screening recommendations. Our study shows that adult DS patients who undergo PSG testing have high rates of OSA. Because of the high prevalence of OSA among our study population, we recommend that all adults with DS be screened for OSA with PSG.

### 0336

**DETERMINANT FACTORS IN HEALTH-RELATED QUALITY OF LIFE IN PATIENTS WITH UPPER AIRWAY RESISTANCE SYNDROME**

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**Introduction:** While in obstructive sleep apnea/hypopnea syndrome (OSAHS) patients, health-related quality of life (HRQoL) seems to be affected by obesity, subjective daytime sleepiness and the sleep stage, there is scarce information regarding upper airway resistance syndrome (UARS). The aim of this study was first to compare HRQoL in UARS with the general population and OSAHS patients and then determine factors that adversely affect HRQoL in UARS.

**Methods:** Retrospective study assessing all consecutive medical registries included in-lab, full-night PSG in a sleep disorder center from 2007 to 2012 was performed. UARS was defined as apnea hypopnea index (AHI) < 5, minimum oxygen saturation ≥ 92%, RERA index ≥ 10 and at least one of the functional somatic complaints. HRQoL was assessed with the peruvian-validated SF-36v1 questionnaire including 8 domains. Data from the general population were provided from a population-based survey published elsewhere. HRQoL was adjusted for gender, age and socioeconomic status for comparison. Robust-weighted multiple regression with robust standard error was performed.

**Results:** From all PSG records, 52 had UARS and 372 OSAHS. HRQoL scores in UARS patients regarding physical functioning (86.4 ± 22), role-physical (62.5 ± 40), bodily pain (73.2 ± 25) and vitality (56.1 ± 23) was statistically lower than in general population (95.3 ± 9, 93.1 ± 15, 84.8 ± 17 and 77.3 ± 12, respectively) after adjusting for gender, age and socioeconomic status; no difference with OSAHS patients was found. Self-reported depressive symptoms (B = -45.9 ± 9) and psychotropic medication (B = -26.3 ± 12) explain 51.3% of the variability ways. Our previous work demonstrates an increased risk of hospitalizations involving OSA among children with DS at elevations > 1500m.

**Objective:** To characterize the rates of OSA in children with DS living at elevations > 1500m versus ≤ 1500m using inpatient and outpatient data.

**Methods:** We merged Medicaid billing data (2006-2008) in Colorado and North Carolina with topographic sources to assign elevation categories by patient zip code. We matched each DS case (n = 1365) ages 2-20years with 4 nonDS controls (n = 5460) by age, duration of Medicaid enrollment, and chronic conditions outside of DS, OSA, and congenital heart disease (CHD) and compared differences in prevalence of OSA, pneumonia, and CHD at elevations > 1500M vs ≤ 1500M. Risk differences (RD) were calculated from the proportion of children with the specified condition living at ≥ 1500m vs. ≤ 1500m.

**Results:** Children with DS had higher rates of OSA than nonDS children (DS 14.0%, nonDS 3.9%, p < 0.001). The RD for OSA at higher elevations was significantly greater within the DS cohort (DS 5.3%, nonDS 0.4%, p = 0.023). This was not observed in CHD or pneumonia at higher elevations. Subgroup analysis within the DS cohort indicates additional risk for OSA with concurrent CHD at higher elevations (RD 20.9%, 95%CI 9.5-32.3%), but does not negate the effect of elevation on OSA in children with DS without CHD (RD 6.4%, 95%CI 1.8-10.9%).

**Conclusion:** Residence at elevations > 1500m confers additional risk of OSA for children with DS that is not observed with pneumonia or CHD. This increased risk of OSA is present in children with DS with and without CHD, although moreso with CHD. Further work is needed to investigate the implications for OSA screening among children with DS living at higher elevations.
of role-physical. Same predictors were found for vitality, explaining 53.7% of the variability adding Epworth sleepiness scale. For physical functioning, diabetes mellitus (B = -8.6 ± 3) and depressive symptoms (B = -8.3 ± 3) account for 32.9% of the variability. No PSG findings adversely affect HRQoL. Similar findings were found regarding OSAHS patients, adding female gender and Epworth sleeping scale for most domain variation.

Conclusion: Four of eight domains in HRQoL are impaired in UARS compared to general population and markedly affected by self-reported depressive symptoms and psychotropic medication.

0337
PREVALENCE AND ASSOCIATED FACTORS TO SNORING
BY GENDER IN A BRAZILIAN CITY
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Introduction: Obstructive sleep apnea syndrome is very common disease. Snoring is one of the most frequent associated complaints. This population-based survey intends to estimate the prevalence of snoring in this sample of Campinas City

Methods: It is a population-based, cross-sectional study, carried out with data from the Campinas Health Survey developed in 2014/2015. A total of 3021 participants: adolescents (n = 1023), adults (n = 1011) and elderly (n = 987) participated in the study. Prevalence and confidence intervals for the dependent variable were estimated according to independent variables. Differences were tested by Chi-square test. Prevalence ratio was estimated by multiple Poisson regression, adjusting for age. The analyses were stratified by gender and performed with svy commands of STATA 11.0

Results: The prevalence of snoring in the survey was: 40.4%. Among adults: 45.6% (men 54 % women 37.8%). For women (mean age 46,4 years old), there was significantly association with Hypertension (PR = 1,3); Heart attack (PR = 2,0), Cholesterol High Levels (PR = 1,31); Dizziness (PR = 1,6); Bad self-assessed health (PR = 1,3); Witnessed apnea (PR = 2,24) and Difficulty to maintain awake during the day (PR = 1,14). For men (mean age 43,3 years old), there was significantly association with Hypertension (PR = 1,3); Cholesterol High Levels (PR = 1,18); Witnessed apnea (PR = 1,82) and Difficulty to maintain awake during the day (PR = 1,12)

Conclusion: Snoring is a very common sleep complaint associated to the Obstructive Sleep Apnea Syndrome (OSAS). Hypertension and Cholesterol high levels are common comorbidities in adults (both gender). Heart attack, dizziness and bad self-assessed health were associated for women in this sample. Witnessed apnea and difficulty to maintain awake during the day were associated in this sample for adults (both gender)

Support (If Any): FAPESP #2013/19338-1

0338
ARE WE OVER PAPTIZING OUR PATIENTS? THE AASM 2012 CRITERIA FOR HYPOPNEAS SCORING, ITS IMPACT ON OBJECTIVE SLEEP APNEA PREVALENCE AND HEALTHCARE COSTS
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Introduction: Moderate to severe obstructive severe apnea (OSA) is associated with cardiorespiratory risk factors and patients being offered continuous positive airway pressure (CPAP) therapy. Due to the change in American Academy of Sleep Medicine (AASM) recommended scoring criteria in 2012, it was observed that many patients were diagnosed to have moderate to severe OSA but may not need CPAP therapy. We compared Apnea-hypopnea index (AHI) using AASM recommended scoring definitions in 2007 (AHI2007) and 2012 (AHI2012). We also assessed the impact of the prevalence of OSA diagnosis due to this change and suggest new OSA classification.

Methods: Retrospective review of 290 consecutive in-lab polysomnograms at a tertiary care hospital over 3 months period. For AHI2007, hypopneas were required to have ≥ 30% airflow reduction with ≥ 4% desaturation; and for AHI2012, hypopneas were required to have ≥30% airflow reduction with ≥ 3% desaturation or arousals.

Results: Frequency of mild, moderate and severe OSA were 27.6%, 17.9%, 23% vs 23.1%, 22.8%, 39.7% using AHI2007 and AHI2012 respectively. This resulted in increased prevalence from 68.6% to 85.5%, diagnosing moderate to severe OSA in 62.5% vs 41% and labeling 21.5% with absent or mild OSA as having moderate to severe disease. Equivalent cut-points of 10, 20, 40 were chosen for AHI2012 to classify mild, moderate and severe OSA instead of 5,15, 30 by giving equal weightage to maximize both sensitivity and specificity. Using the new cut-points, prevalence was 71%, moderate-severe OSA 45%, and severe OSA 26%, each comparable to 2007 scoring system.

Conclusion: Most studies found significant health risks associated with moderate to severe OSA. However, the old AASM scoring criteria for hypopneas were used. This study demonstrates, by using AHI2012 with same OSA category cut-points, overall prevalence increased and a significant proportion of patients with absent or mild OSA were labeled into a category with higher risks. This translates to unnecessary CPAP treatment and higher healthcare costs without any significant health benefits. Consideration should be given to a new cut-point for classification of OSA while using AHI2012

0339
OBJECTIVE, BUT NOT SUBJECTIVE, SLEEPINESS IS ASSOCIATED WITH INFLAMMATION IN SLEEP APNEA
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Introduction: Objective and subjective measures of excessive daytime sleepiness (EDS) are weakly associated. However, no study has examined whether the underlying mechanisms of these two types of EDS differ. Pro-inflammatory cytokines, i.e., interleukin-6 (IL-6), appear to promote sleepiness/fatigue, while cortisol promotes vigilance. We hypothesized that objective daytime sleepiness is associated with increased levels of IL-6 and decreased levels of cortisol.

Methods: We studied 58 sleep apnea (OSA) patients (53.7 ± 7.0y, 63.8% male) who underwent 8-hour in-lab polysomnography for 4 consecutive nights. Twenty-four-hour profiles of IL-6 and cortisol levels, objective and subjective daytime sleepiness were assessed on the 4th day. Objective EDS was defined as mean multiple sleep latency test (MSLT) values ≤ 8 min, while subjective EDS was defined as Epworth scale score (ESS) > 10. Depressive symptomatology was assessed using the Beck depression inventory-II (BDI-II).

Results: After adjusting for gender, age, BMI, AHI, and BDI-II values, OSA with objective EDS was associated with significantly elevated 24-hour (p = 0.03), daytime (8:00-22:00, p = 0.05) and nighttime (23:00-7:00, p = 0.02) IL-6 levels and significantly decreased 24-hour (p = 0.01) and daytime (p = 0.01) cortisol levels as compared to OSA without objective EDS. No differences were observed in terms of IL-6 and cortisol levels in OSA with subjective EDS (all p values > 0.1).

Conclusion: Our findings suggest that OSA with objective EDS is the more severe phenotype of the disorder associated with low-grade inflammation, a link to cardiometabolic morbidity and mortality. Objec-
I. Sleep Disordered Breathing

0340
INPATIENT TYPE III MONITORING: FEASIBILITY, DIAGNOSTIC AND TREATMENT OUTCOMES
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Introduction: Sleep disordered breathing (SDB) is associated with increased morbidity and mortality, is underdiagnosed and undertreated, and has a high prevalence in hospitalized patients. We evaluated sleep characteristics, screening reliability and prevalence of SDB among inpatients undergoing type-III sleep screens compared to subsequent outpatient polysomnography (PSG).

Methods: Inpatients ≥ 18 years-old screened by type-III monitoring for SDB followed by outpatient PSG were included. Sleep screen vs. PSG apnea-hypopnea index (AHI), sleep screen vs. PSG sleep time, sleep screen reliability (device failure, poor signal, reported short sleep time) and positive pressure therapy (PPT) mode were evaluated. Patient characteristics, hospital length-of-stay and 30 and 90-day readmission analysis was done for a subgroup with AHI ≥ 5 placed on PPT vs. not.

Results: 78 of 750 inpatients met inclusion criteria. Most were African-American (55%), obese (BMI 38.31 ± 10.76 kg/m2), female (55.1%), with snoring and daytime sleepiness. Median age was 52 years (52.03 ± 14.62). Hypertension, hyperlipidemia, diabetes, heart failure, asthma and GERD were highly prevalent. Median PSG AHI was 42.91 vs. 26.45 events/hour in sleep screen (p = 0.0001). Sleep screen vs. PSG reported having had a home sleep apnea test (HSAT) while the remainder had an in-lab sleep study. No differences by sleep study type were observed by sex, race, or education level. However, in-lab studies were more common in patients with multiple health conditions. Of patients who had a HSAT, 62% reported satisfaction with their sleep study, compared to 72% of those who had in-lab studies (p = 0.002). Never use of CPAP was reported by 38% of those who had a HSAT compared to 20% of patients evaluated with an in-lab study (P < 0.0001). CPAP was used by 1,110, APAP by 183 and MADs by 188. Of those using a PAP device, 66% reported satisfaction with treatment compared to 35% of the patients using a MAD (P < 0.0001).

Conclusion: Sleep apnea patients participating in a patient-centered network report greater satisfaction with PAP compared to MAD, and greater satisfaction with in-lab studies compared to HSATs. The high rate of “never using CPAP” in those receiving HSATs may indicate problems with the sensitivity or implementation of HSAT pathways which require further study. Systematic input by patients on sleep apnea care pathways may lead to improved outcomes and care quality.

Support (If Any): PCORI PPRN-1306-04344

0341
PATIENT PERSPECTIVES ON EXPERIENCES WITH DIAGNOSIS AND TREATMENT OF SLEEP APNEA: THE SLEEP APNEA PATIENT-CENTERED OUTCOMES NETWORK
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Introduction: Sleep apnea diagnostic and treatment strategies are changing as payers seek better outcomes at reduced cost. However, the “patient’s voice” has been missing in assessments of the impact of alternative approaches. To improve the understanding of quality of sleep medicine care we solicited input from patients in the Sleep Apnea Patient-Centered Outcomes Network (SAPCON), specifically comparing satisfaction with home vs in-lab testing and use of CPAP vs mandibular advancement devices (MAD).

Methods: Data from patient-completed on-line surveys on diagnostic studies, treatments, and satisfaction administered through the MyApnea.Org portal were analyzed using contingency table analysis.

Results: Of the first 1,767 patients with a sleep apnea diagnosis, 14% reported having had a home sleep apnea test (HSAT) while the remainder had an in-lab sleep study. No differences by sleep study type were observed by sex, race, or education level. However, in-lab studies were more common in patients with multiple health conditions. Of patients who had a HSAT, 62% reported satisfaction with their sleep study, compared to 72% of those who had in-lab studies (p = 0.002). Never use of CPAP was reported by 38% of those who had a HSAT compared to 20% of patients evaluated with an in-lab study (P < 0.0001). CPAP was used by 1,110, APAP by 183 and MADs by 188. Of those using a PAP device, 66% reported satisfaction with treatment compared to 35% of the patients using a MAD (P < 0.0001).

Conclusion: Sleep apnea patients participating in a patient-centered network report greater satisfaction with PAP compared to MAD, and greater satisfaction with in-lab studies compared to HSATs. The high rate of “never using CPAP” in those receiving HSATs may indicate problems with the sensitivity or implementation of HSAT pathways which require further study. Systematic input by patients on sleep apnea care pathways may lead to improved outcomes and care quality.

Support (If Any): PCORI PPRN-1306-04344
I. Sleep Disordered Breathing

(20%), heart disease (14%) and attention deficit disorder (ADD; 9%). The majority (83%) identified > 5 symptoms that triggered an evaluation, most commonly tiredness (87%), snoring (84%), sleepiness (83%), apneas (66%), irritability (53%), and forgetfulness (47%). Only 39% reported that evaluation was triggered by a health care provider’s recommendation. Breathing-related symptoms (snoring, apneas) were more common triggers in men, while mood and cognitive problems were reported as triggers more commonly in women and in individuals with co-morbid ADD, insomnia or RLS (p’s less than 0.05).

Conclusion: Prolonged diagnostic delays relative to duration of symptoms are common for sleep apnea. The non-specificity of symptoms, multiplicity of symptoms and co-morbidities, and variation in presentation by sex and co-morbidity likely contribute to under-recognition. Improved recognition may require more systematic screening approaches tailored for different “at-risk” groups.

Support (If Any): PCORI PPRN-1306-04344

0343 SCREENING FOR SLEEP APNEA IN EMPLOYEE WELLNESS VISITS
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Introduction: Obstructive sleep apnea (OSA) is common, has significant medical consequences, and is associated with twice the healthcare costs in untreated individuals compared to those without apnea. Employee wellness programs aim to improve employee health, optimize work attendance and productivity, and reduce healthcare costs, but little has been written about identification of OSA in that setting. This study investigates the value of screening for OSA and deploying diagnostic home sleep apnea testing at the time of the wellness visit.

Methods: Employees of OSF healthcare who underwent wellness visits from 4/1/2013 through 7/29/2015 completed the STOP-BANG OSA screening questionnaire. Those at high risk of OSA were advised to seek a sleep evaluation. Prior to 02/1/2015, no further evaluation or testing was arranged by employee health. After that date those at risk for OSA were offered a diagnostic home sleep apnea test to be deployed at the time of the wellness visit. Subjects at risk for OSA were divided into two groups. Group 1 (n = 147) consisted of employees who were seen prior to 2/1/2015, and group 2 (n = 22) consisted of those seen after.

Results: Subjects in group 1 were significantly less likely to have sleep testing of any kind subsequent to a wellness visit compared to those in group 2 (50/147 (34%) vs. 19/22 (86%), p = 0.000003). Subjects in group 1 were significantly less likely to be diagnosed with OSA (38/147 (25.9%) vs. 17/22 (77.3%), p = 0.000002).

Conclusion: Employees undergoing a wellness visit who were identified as being at risk for OSA were much more likely to undergo sleep testing, or be diagnosed with OSA if home testing was offered at the time of the wellness visit.

0344 IN A POPULATION WITH PREDOMINANTLY MILD-TO-MODERATE DISEASE, EXISTING PRE-TEST PROBABILITY SCORES DO NOT PREDICT THE PRESENCE OF SLEEP APNEA
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Introduction: Tools like the STOPBANG score or Berlin questionnaire are often used by providers to assess the probability of finding sleep apnea (OSA) in different patient populations. These tools have generally been derived from and validated in patient populations with severe disease (apnea hypopnea index (AHI) ≥ 30). We applied the STOPBANG and Berlin, as well as two other validated OSA pre-test probability (PTP) questionnaires to a cohort of patients with predominantly mild-to-moderate disease.

Methods: Using data collected at the initial clinic encounter we calculated PTP for all four PTP tools. All patients had in lab polysomnography scored using 2012 AASM criteria. We calculated sensitivity, specificity, area under receiver-operator characteristic curves (AUROC).

Results: There were 338 patients who had data available for analysis. The mean age and BMI were 40.3 ± 9.9 and 28.7 ± 4.2 respectively, and the mean Epworth Sleepiness Score (ESS) was 10.1 ± 5.4. The mean AHI was 12.9 ± 16.4, and a majority of patients (216 (63.9%)) had an AHI ≥ 5 and were considered positive for OSA. Of those with OSA, 90.3% had mild-to-moderate disease. For the Berlin, STOPBANG (positive at ≥ 3) and one of the additional PTP tools, sensitivities ranged from 69.5-83.8% and specificities from 18.0-33.6% for detecting AHI ≥ 5. The second validated tool had a sensitivity and specificity of 29.5% and 70.6%, respectively. AUROC was generally poor for predicting an AHI ≥ 5 (0.50-0.54) and improved only slightly for AHI ≥ 15 (0.56-0.58). Negative and positive likelihood ratios (LRs) were 0.90-0.99 and 1.02-1.05 respectively for AHI ≥ 5.

Conclusion: In a population with predominantly mild-to-moderate OSA, existing PTP tools perform poorly. New scoring systems may be required to assess for mild OSA.

0345 VALIDATION OF THE ALLIANCE SLEEP QUESTIONNAIRE (ASQ) OBSTRUCTIVE SLEEP APNEA (OSA) MODULE IN SLEEP DISORDERED PATIENTS
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Introduction: The Alliance Sleep Questionnaire (ASQ) is a comprehensive on-line questionnaire designed to evaluate sleep disorders and symptoms. It uses branching logic to deliver novel questions and validated measures, including the Multivariate Apnea Prediction (MAP). The MAP is a relative risk measure, developed at University of Pennsylvania, based on symptom-frequency questions, BMI, age and gender. The ASQ has been standard of care since 2012 at the Stanford Sleep Disorders Clinic (SSDC) for new and returning patients. In this study, we evaluated the ASQ’s ability to predict individuals with Obstructive Sleep Apnea (OSA) in SSDC patients.

Methods: The population included SSDC patients who agreed to re-search, completed the ASQ, and had a diagnostic or split night sleep study within 6 months of completing the ASQ. Individuals were excluded for using CPAP or previous sleep apnea surgery. Several ASQ definitions were identified apriori and explored to optimize sensitivity. The final ASQ OSA definition for positive endorsement was previous OSA diagnosis, snoring or gasping as primary complaints, or MAP score > 0.44. Gold standard was Oxygen Desaturation Index (ODI) ≥ 10. Apnea Hypopnea Index (AHI) ≥ 10 was also evaluated based on previous MAP publications.

Results: 954 patients met inclusion exclusion criteria with 529 males, 425 females; mean age 46.3 ± 15.9, range 18-90, mean BMI 27.0 ± 7.0, 309 had ODI ≥ 10 and 608 had AHI ≥ 10. The ASQ correctly identified 295 of 309 ODI+ individuals (Sensitivity = 95.5%) and 142 of the 642 true negatives (Specificity = 22.0%). Positive Predictive Value (PPV) was 37.0% and Negative Predictive Value (NPV) was 91.0%. The ASQ captured 545 of 608 AHI+ individuals (Sensitivity = 89.6%) and 93 of
the 346 true negatives (Specificity = 26.9%). Positive Predictive Value (PPV) was 68.3% and Negative Predictive Value (NPV) was 59.6%.

**Conclusion:** These initial definitions have a high false positive rate, which fits with our use of the ASQ as a screening device to identify individuals who would benefit from further testing. Next we will evaluate whether refining the ASQ definition improves PPV and specificity.

**Support (If Any):** ASQ was initially funded by a Respironics Foundation grant.

### 0346

**PREDICTIVE VALUE OF SLEEP APNEA SCREENING INSTRUMENTS IN A CARDIOVASCULAR SURGERY POPULATION**

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**Introduction:** Obstructive sleep apnea (OSA) is a highly prevalent disorder associated with a host of medical and psychosocial consequences including increased odds of cardiovascular events. We explored the predictive value of OSA screening instruments in cardiovascular disease patients awaiting cardiac surgery (not selected for OSA symptoms).

**Methods:** In this prospective cohort study, 107 participants awaiting cardiac surgery from Cleveland Clinic and Johns Hopkins underwent polysomnography after completing the Epworth Sleepiness Scale (ESS), Sleep Apnea/Sleep Disorder Questionnaire (SA/SDQ), STOP and Berlin questionnaires. Score comparisons between groups based on apnea-hypopnea index (AHI) cutpoints of 15 were performed by statistical methods based on type of variables and data distribution. Logistic regression with receiver operating characteristic (ROC) analysis was used to investigate the optimal SA/SDQ cutoff for predicting moderate-to-severe OSA.

**Results:** Prevalence of OSA (AHI ≥ 5) was 71.9% (77/107) and 51 (47.7%) had moderate-to-severe disease (AHI ≥ 15). 57% of participants were male and 76.6% were white. Mean age was 67.3 ± 13.3 years and BMI was 26.5 ± 6.6. Of the four screening tools, only the SA/SDQ and STOP questionnaire had enough power to differentiate patients with AHI ≥ 15 vs. AHI < 15. SA/SDQ ROC analysis yielded a cutoff of 32 for all subjects regardless of gender (AUC:0.62 [OR = 1.06, p = 0.04]) with sensitivity and specificity of 60% and 62% respectively, while STOP score ≥ 2 provided operating sensitivity and specificity of 67% and 52% respectively (AUC: 0.61 [OR = 1.49, p = 0.046]) for AHI ≥ 15. Among STOP items, “Observed apnea” had the strongest correlation with AHI ≥ 15 (p = 0.002).

**Conclusion:** Sensitivities and specificities of the SA/SDQ and STOP questionnaire as well as the SA/SDQ cutoff for moderate-to-severe OSA were lower than published results in general populations supporting prior work suggesting that chronic disease populations perform differently on OSA screening instruments. A single STOP item (observed apnea) was strongly predictive for moderate-to-severe OSA in hospitalized cardiac patients awaiting cardiac surgery.

### 0347

**STOP-OSA: VALIDATION OF STOP-BANG AND ALTERNATIVE SCORING MODELS AT A SAFETY-NET HOSPITAL**

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**Introduction:** STOP-BANG was developed as a screen for obstructive sleep apnea (OSA) in elective surgical patients though its utility in the sleep clinic is still unclear. While more sensitive than other sleep questionnaires, it is limited by low specificity. Alternative scoring models, with higher specificity, have been examined but only in the pre-surgical population. We assessed the predictive value of STOP-BANG among patients referred to the sleep laboratory at a safety-net hospital as well as two alternative scoring models: STOP-BANG30 (BMI of 30) and STOP-OSA (Snoring, Tiredness, Observed Apneas, Blood Pressure, Obesity (BMI > 30), Sex, Age).

**Methods:** We retrospectively analyzed pre-test likelihood of OSA in consecutive adult patients, between November 2013 and January 2014, who underwent in-laboratory polysomnography for any reason. We evaluated sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for STOP-BANG, STOP-BANG30 and STOP-OSA to identify OSA.

**Results:** Of 298 evaluated adults, 290 had complete data. Mean age was 49 years with 55% males; the population was equally divided between Caucasian, African-Americans and Hispanic ethnicities. Most were obese (65.9% BMI > 30). The prevalence of OSA (AHI > 5) was 68.6% with a mean AHI of 31.7. A positive STOP-BANG had a sensitivity of 100%, specificity 11.7%, PPV 44.07% and NPV 100% for moderate to severe OSA. A positive STOP-BANG30 or STOP-OSA (score ≥ 3) had similar sensitivity, specificity and NPV.

**Conclusion:** All three variations represent good screening tools with high sensitivities and NPVs though unfortunately still with low specificity. The alternative models benefit from a more practical obesity diagnosis. STOP-OSA eliminates the non-standardized neck circumference. Limitations of this study include retrospective data in a high prevalence population; these models should be further evaluated for applicability in community populations.

### 0348

**THE STOP-BANG QUESTIONNAIRE AS A SCREENING TOOL FOR OBSTRUCTIVE SLEEP APNEA-INDUCED HYPERTENSION FOR THAI POPULATION**

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**Introduction:** Obstructive sleep apnea (OSA) is a common public health issue. If left untreated, OSA may cause a large health economic burden from cardiovascular complications particularly stroke. The diagnosis of OSA can be made by polysomnography but its availability is limited in the developing countries in Asia. STOP-BANG questionnaire is a good screening tool but may need some adjustment for Asian population.

**Methods:** We compared clinical features in STOP-BANG questionnaire between 42 OSA induced hypertension patients and 82 healthy control subjects in the Faculty of Medicine, Khon Kaen University, Thailand.
Results: The best cutoff point for the BMI and the neck circumference were 24.5 kg/m² and 36 cm, respectively. The sensitivity and specificity of the BMI cutoff point were 97.2% and 91.40, while those of the neck circumference were 94.7% and 82.9%.

Conclusion: The appropriate cutoff points of BMI and neck circumference for Thai STOP-BANG questionnaire were 25 kg/m² and 36 cm.

0349
PREDICTORS OF ABNORMAL AHI IN HIGH-RISK VETERANS USING HOME SLEEP APNEA TESTING
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Introduction: OSA is a serious medical condition associated with impairment in nearly all performance, cognitive, emotional, and health-related domains. The prevalence of OSA is up to four times higher in veterans compared to the general population, and many Veterans Affairs Medical Centers (VAMCs) have implemented HST in lieu of in-lab PSG to establish a timely diagnosis of OSA. However, concern remains for the sensitivity and specificity of HSTs in this population because the high rate of comorbidities that are currently recommended as exclusion criteria for HST eligibility. This study aims to examine similarities/differences in predictors of abnormal AHI as per HST in a sample of veterans compared to general sleep clinic patients.

Methods: All patients were tested for OSA with the Apnea Risk Evaluation System (ARES) which records data on airflow, oxygen, pulse rate, snoring, EEG, and accelerometry. A random sample of 3000 studies (1500 from each sample) was selected from a large repository of anonymized HST test outcomes. Self-reported medical comorbidities were obtained from an integrated OSA risk questionnaire. All studies were autoscored, human edited, and physician interpreted.

Results: The VA sample was similar to the general sample in terms of age and BMI, but was mostly male (90%) and had a much higher rate of self-reported medical comorbidities (especially depression [44.1% vs. 25.7%] and use of sleep [33.1% vs. 16.6%] and pain [30.2% vs. 15.1%]) medication). Controlling for medical comorbidities, age (VA OR: 1.06; General OR: 1.05), neck circumference (VA OR: 1.31; General OR: 1.3), and BMI (VA only; OR: 1.09) were the most robust independent predictors of OSA (AHI [4%] > 5). Hypertension, diabetes, and heart disease were robust predictors in both groups in unadjusted models, but attenuated after controlling for age, sex, and BMI. In neither group was sleepiness, depression, insomnia, nor use of pain medication associated with OSA. Use of sleep medication was associated with less risk for OA in veterans.

Conclusion: Predictors of OSA as per HST in this sample of veterans converge with well-known risk factors including age and measures of adiposity. Veterans may be at risk for more complicated sleep management as their report sleep medication (and low corresponding AHIs) may indicate undiagnosed insomnia.

Support (If Any): SleepMed, Inc.

0350
ANALYSIS OF POLYSOMNOGRAM DATA DEMONSTRATES THAT HOME SLEEP TESTING HAS POOR DIAGNOSTIC SENSITIVITY IN CERTAIN PATIENT POPULATIONS
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Introduction: Current guidelines for many insurances recommend home sleep testing (HST) as a diagnostic alternative to in-laboratory polysomnography (PSG) for Obstructive Sleep Apnea (OSA). In 2012 the AASM scoring rules were revised (hypopnea rule 1A) to recognize obstructive hypopneas that were associated with arousals even in the absence of oxygen desaturation. Initial guidelines for utilizing HST in lieu of PSG were derived from data collected prior to that revision. HST relies extensively on oxygen desaturation to identify obstructive breathing events, hindering proper identification of non-desaturation arousal related obstructive hypopneas. We present data demonstrating that HST is not an effective screening tool in certain populations, such as women < age 50 and women with BMI < 30.

Methods: At the time of submission, we analyzed 102 consecutive PSGs conducted on patients with complaints suspicious for OSA. The studies were performed from January-February 2015 at the three laboratories of Comprehensive Sleep Medicine Associates in Greater Houston, Texas. Inclusion criteria consisted of abnormal PSGs (based on AHI > 5 based on hypopnea rule 1A) with a 3% oxygen desaturation index (ODI) < 5. ODI was used because HST analysis is dependent on this oxygen desaturation threshold for hypopnea identification. Results were compared based on gender, age (18-50 years vs. 50+ years), and BMI (< 30 vs. 30+).

Results: 24 patients met inclusion criteria. Of these, 6 were men and 18 were women. Using the criteria of ODI < 5 as indicative of a false negative recording, preliminary data show that sensitivity of HST in certain patient populations is low, suggesting that HST should be bypassed in these populations in favor of PSG testing. HST sensitivity is 53.6% in women aged 18-50 (n = 28), 40% in women with BMI < 30 (n = 25), and 16.7% in women ages 18-50 with BMI > 30 (n = 12).

Conclusion: Sleep centers are confronted by clinically flawed selection criteria for PSG testing imposed by third-party payer guidelines. Our data show that women ages 18-50 years or with BMI < 30 have a low probability of demonstrating pathology on HST. Current guidelines used to determine necessity of PSG testing require modification based on these results, as HST has low yield in the highlighted populations. We will provide more extensive results at the time of presentation with a higher sample population.

0351
INFLUENCES OF PATIENT CHARACTERISTICS AND POLYSOMNOGRAPHIC PARAMETERS ON A SHEET TYPE HOME SCREENING TEST
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Introduction: Home screening tests (HST) have been widely used to monitor sleep apnea syndrome (SAS), however, they have some problems such as disconnecting oro-nasal and respiratory effort sensors. A sheet type HST using a multi-point pressure sensitive sensor is a nonrestrictive and user-friendly device and was validated reliability and diagnostic accuracy. We investigated the factors that affect the difference of data between polysomnography (PSG) and HST for better understanding the usefulness and limitation of HST.

Methods: We studied 67 patients who visited our hospital to perform PSG (52 male and 15 female, 58.8 ± 15.8 yrs). PSG and the sheet type HST with a pulse oximetry were performed simultaneously and compared data. We calculated sleep efficiency, % sleep stages, arousal index, apnea/hypopnea index (AHI) on PSG and respiratory disturbance index (RDI) on HST. The relationship of the difference of AHI on PSG from RDI on HST with age, body mass index (BMI) and sleep parameters was analysed using Spearman’s correlation analysis and multiple regression analysis.
I. Sleep Disordered Breathing

Results: The sensitivity and specificity for diagnosis of SAS were 98.4% and 66.6%, respectively. The accuracy of discriminating AHI severity was 85.2%. HST tended to score extra sleep apnea/hypopnea in patients with AHI < 5/h and underscore in patients with AHI ≥ 30/h. The correlation analysis revealed that the difference of AHI on PSG from RDI on HST significantly correlated to BMI, sleep efficiency, % stage N1 and N2 and arousal index. Using multiple regression analysis, arousal index, BMI, sleep efficiency and %stageN1 were independently affected the difference between two methods.

Conclusion: The sheet type HST showed good sensitivity and accuracy to evaluate SAS, and RDI was affected by BMI and arousals after sleep onset. This device, noninvasive and simple to use, might have high utility to examine SAS under natural sleep.

0352 DETERMINANTS FOR INADEQUATE HOME SLEEP APNEA TESTING
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Introduction: Home Sleep Apnea Test (HSAT) is frequently used in the diagnosis of obstructive sleep apnea (OSA); however, many HSAT studies are unsuccessful. This study evaluates predictors of unsuccessful HSAT at an accredited VA Sleep Center.

Methods: A retrospective chart review was performed for all patients who underwent HSAT with a Type III monitoring system from 3/2013 to 6/2015. Demographics, smoking history (active or former smoker), Epworth sleepiness scale (ESS), use of sleep-modifying agents (SMA), and HSAT variables were abstracted. HSAT was considered “inadequate” if it was technically limited, demonstrated oxygen saturation (SpO2) 5 events/hour, or deemed inadequate by the sleep physician. HSAT was considered “unsuccessful” if HSAT needed to be repeated or if an in-lab Polysomnogram (PSG) or PAP titration study had to be done. A multivariate logistic regression analysis was performed to determine predictors of inadequate and unsuccessful HSAT using age, gender, body mass index (BMI), smoking history, baseline SpO2, ESS, STOP-BANG Score, hypotension, and SMA use.

Results: 416 subjects were included, 88.5% were male, age 47.6 ± 12.2 years, BMI 31.8 ± 5.7 kg/m2, ESS = 11.4 ± 6.0 and STOP-BANG score = 4.9 ± 1.6. HSAT was inadequate in 35.1% of cases (N = 146) and unsuccessful in 46.6% of the cases (N = 194). HSAT was repeated in 4.1% (N = 17); in lab PSG/split studies and PAP titration were performed in 17.5% (N = 73) and 26.0% (N = 108), respectively. The following variables predicted inadequate HSAT: older age, higher BMI and smoking history (ORs 1.03, 1.05, and 1.6, respectively; P < 0.05). Smoking history and higher ESS were independent predictors of unsuccessful HSAT (ORs 1.83 and 1.04, respectively; P < 0.05).

Conclusion: HSAT has a high failure rate, requiring a repeat HSAT, PSG or PAP titration even in patients with high pretest probability for OSA. Smoking history is an independent predictor of inadequate and unsuccessful HSAT.

0353 ANTHROPOMETRIC FACTORS ASSOCIATED WITH THE SEVERITY OF APNEA-HYPOPNEA INDEX. A RETROSPECTIVE STUDY IN MEXICO
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Introduction: Clinically in the obstructive sleep apnea syndrome, the neck circumference is known to be a strong predictor of the severity of the Apnea-Hypopnea Index. However, some authors have shown that the body mass index correlates more with the severity of Apnea-Hypopnea Index rather than the circumference of the neck.

Methods: We conducted a retrospective study from patients’ medical charts, aged between 17-80 years old and with complete medical records, treated at the Sleep Disorders Clinic of the National Autonomous University of Mexico between January 1st through December 31st 2014. Age, gender, weight, height, body mass index, neck circumference, waist circumference, oxygen saturation and apnea-hypopnea index were registered. Analysis of variance and Tukey’s test were used to analyze the data.

Results: We found a total of 252 patients that met our inclusion criteria. There was a significant association between Apnea-Hypopnea index and body mass index (F = 5.34, p < 0.001), neck circumference (F = 3.62, p < 0.016) and oxygen saturation (F = 9.94, p < 0.001). However, non-significant correlation was found between apnea-hypopnea index and waist circumference (F = 0.80, p < 0.49).

Conclusion: Our study showed a significant correlation between body mass index, neck circumference and oxygen saturation with more elevated Apnea-Hypopnea index. Correlation between waist circumference, and apnea-hypopnea index in this study was weaker and not significant.

0354 THE NATIONAL HEALTHY SLEEP AWARENESS PROJECT SLEEP HEALTH SURVEILLANCE QUESTIONNAIRE AS AN OBSTRUCTIVE SLEEP APNEA SCREENING TOOL
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Introduction: The National Healthy Sleep Awareness Project (NHSAP) Surveillance and Epidemiology Workgroup created five survey questions designed for surveillance of sleep health in America by inquiring about sleep quality and satisfaction, alertness, and OSA risk. Our objective was to evaluate to what extent survey answers positively correlate with the severity of OSA and predict the presence of moderate to severe OSA.

Methods: The NHSAP questions were constructed to mimic elements of the STOP-BANG sleep apnea questionnaire, and included number of days with sleep disruption and unintentional dozing and a history of snoring, apneas, and hypertension. In addition, age, gender, and BMI were collected from 178 adults undergoing polysomnography at Mayo Clinic, Rochester, MN. Univariate and logistic regression analyses were performed, and p < 0.05 was considered statistically significant.

Results: Ninety-five men and 83 women with mean age 56 (± 15) and BMI 32.4 (± 7.6) participated in the study. One hundred eighteen subjects had no or mild OSA and 60 (33.7%) subjects had moderate to severe OSA. The median AHI was 9 (interquartile range 3 - 24). AHI positively correlated with age, male gender, BMI, days with un-
I. Sleep Disordered Breathing

B. Clinical Sleep Science

I. Sleep Disordered Breathing

intentional dozing, and a history of snoring, witnessed apneas, and hypertension. The ROC curve for the questionnaire and demographic characteristics had an area under the curve of 0.77. Increased age, male gender, and higher BMI were the most highly weighted factors in predicting the presence of moderate to severe OSA. Among the questions, a history of hypertension strongly predicted the presence of moderate to severe OSA.

Conclusion: Although many NHSAp questionnaire results are positively associated with AHI, increased age, male gender, higher BMI, and hypertension, which must be gleaned from other sources, are the most highly predictive of the presence of moderate to severe OSA.

0355
SCREENING, ASSESSMENT, AND DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA IN PATIENTS REFERRED TO A SLEEP CLINIC
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Introduction: Obstructive Sleep Apnea (OSA) contributes to all-cause and cardiac mortality. There is no guideline for screening for OSA in outpatient settings. An American Academy of Sleep Medicine task force released quality measures for the care of adult patients with OSA in 2015, in part to improve detection and categorization of OSA symptoms/severity and to promote assessment and diagnosis of the disorder. Primary and specialty care providers are in essential roles to screen and assess patients for OSA. However, psychometric properties of screening measurements need to be improved before developing study procedures to used in patients referred to a sleep specialist for OSA consultation. Procedures included: (a) recruitment; (b) informed consent/enrollment; (c) completion of Berlin Questionnaire, Epworth Sleepiness Scale, STOP Bang; (d) collection of biomarkers (blood pressure, heart rate, body mass index (BMI), neck circumference, blood for Troponin I levels); (e) home sleep testing (HST); (f) polysomnography (PSG); and (g) retention.

Methods: This descriptive feasibility study enrolled 10 subjects. Questionnaires and biomarker collection were completed. Two participants were randomized for Troponin I laboratory draws. Participants who met criteria were sent home with HST. PSG testing was completed. Missing data and data collection time were evaluated. Descriptive statistics were performed.

Results: All participants completed OSA screening questionnaires and had biomarkers collected. Troponin I lab draws were negative. All eligible participants (n = 8) completed HST and PSG (n = 10). Small amounts HST data were missing.

Conclusion: Feasibility of procedures was confirmed. Small amounts of missing data may occur when using HST. Minor changes to procedures were made before starting a larger study examining psychometric properties of OSA screening measures. The results of the larger study will contribute to the reliability and validity data of measurements used to screen for OSA.

0356
INCORPORATING SLEEP APNEA TESTING SERVICES AT WORKSITE CLINICS
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Introduction: Healthcare policies are shifting the delivery of care to more convenient and cost effective settings like worksite clinics housed within employers’ facilities. The study objective was to assess feasibility and acceptance of HST at worksite clinics.

Methods: Clinic staff members at 8 schools and municipalities received education on HST from sleep specialists. The healthcare provider screened patients using ESS, STOP BANG, and clinical symptomology. Eligible patients were trained on sensor hookup and received a monitor (SleepView) for self-administration at home. After the night recording was completed, the monitor was mailed to CleveMed where studies were manually scored by RPSGT and interpreted by a sleep physician. With a formal diagnosis and treatment recommendations in hand, the healthcare provider reviewed the results with the patient and referred them to appropriate resources in the community such as a sleep lab or local DME for follow up.

Results: HST data from 284 studies were analyzed retrospectively. 272 studies (96%) were completed successfully, 12 studies were incomplete (4%). Completed studies consisted of 125 men and 147 women with average age of 49 years. 249 patients (92%) were found to be OSA positive: 160 (59%) had mild to moderate OSA, and 89 (33%) were severe OSA. The average AHI was 27.2 and BMI average was 37.4. Customer satisfaction survey from healthcare providers administering the program showed very high to excellent rating in all aspects of the HST.

Conclusion: The Crowne/CareHere sleep apnea program efficiently and conveniently captured at-risk employees at 8 work site clinics. We believe a main reason behind this success was the healthcare providers’ commitment to OSA care and the strong collaboration with sleep specialty. We believe HST is a natural extension to current programs at worksite clinics that can reduce overall healthcare expenses, enhance patient experience, and improve health.

0357
APNEA RELATED NOCTURNAL BLOOD PRESSURE FLUCTUATIONS (NBPFs) AND SUPERPOSITION OF THE SYSTOLIC BLOOD PRESSURE - HIGHER RISK FOR HYPERTENSION AND CARDIOVASCULAR EVENTS
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Introduction: Obstructive sleep apnea syndrome (OSAS) is highly correlated with hypertension and cardiovascular diseases. Transient increases of the systolic blood pressure (SBP) of about 27 mmHg are commonly observed at the end of obstructive apneas and hypopneas. In the present study, continuous and non-invasive blood pressure measurement was used to investigate apnea/hypopnea-related NBPFs leading to an increase of the SBP baseline and extreme high SBV values (superposition of SBP).

Methods: Polysomnography (PSG, SOMNOscreen, SOMNOmedics GmbH) according to Rechtschaffen and Kales (R&K) was performed in 97 patients with the diagnosis of OSAS (AHI > 30). SBP was determined beat-to-beat and non-invasively based on pulse-transit-time (PTT) and apnea/hypopnea-related NBPFs were analysed. Continuous increases of the SBP baseline of ≥ 10 mmHg were considered as “superposition” and analysed versus “non-superposition” periods.

Results: We found a total of 84 superposition periods in 48 patients (8 women, mean age 57 ± 10.7 years, BMI 37.3 ± 6.8 kg/m2). During these episodes we observed significantly higher SBP peak values of 204 ± 32 mmHg (up to 250 mmHg) caused by an increase of the SBP baseline in combination with major NBPFs. The average increase of the SBP baseline in superposition periods was 16.7 ± 6.7 mmHg with a range from 10 to 49 mmHg. Average duration of the superposition was 17 ± 7 minutes. Superposition periods were related to mean apnea duration and hypoxia. Most superpositions were observed during REM sleep (76%).
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**Conclusion:** This study demonstrates a new phenomenon, namely the superposition of the SBP, which was determined by non-invasive and continuous BP measurement based on PTT. Extremely high SBP values of 204 ± 32 mmHg during superposition periods directly indicate a high risk for cardiovascular diseases. The correlation of superposition periods to REM sleep corresponds to observations of early morning infarct and stroke events.

**0358 SCREENING THE ORTHOPEDIC PATIENT FOR OBSTRUCTIVE SLEEP APNEA: A PROSPECTIVE APPROACH**

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**Introduction:** Literature previously suggested an increased perioperative risk for orthopedic patients with untreated obstructive sleep apnea.

**Methods:** The Berlin and Epworth Sleepiness Scale were employed to identify patients at risk for obstructive sleep apnea. High risk patients identified by both a high risk score on the Berlin as well as acknowledgement of pauses in breathing were recommended to the attending orthopedist to undergo inpatient evaluation prior to surgery.

**Results:** Four hundred and twelve patients underwent preoperative screening from 12/25/14 to 12/8/15. One hundred and twelve patients (27%) were identified as high risk with the following outcomes: 51 (45%) underwent inpatient preop sleep assessment, 9 (8%) were recommended to undergo CPAP support perioperatively, 8 (7%) underwent diagnostic polysomnograms identifying sleep apnea postoperatively and 17 (15%) chose to cancel or not show for scheduled and recommended postoperative sleep evaluation.

**Conclusion:** Preoperative screening of orthopedic patients can identify those high risk for obstructive sleep apnea. Inpatient consultation ordered by the orthopedist can increase identification of those at high risk. No show appointments and cancellations of recommended sleep evaluations remain challenging.

**0359 IS THE EPWORTH SLEEPINESS SCALE USEFUL FOR PREDICTING OSA?**

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**Introduction:** It is unclear whether the Epworth Sleepiness Scale (ESS) correlates with polysomnographic (PSG) measures of Obstructive Sleep Apnea (OSA). The military healthcare system serves a population that is younger, predominantly male, and with a lower BMI, compared to civilian centers. We hypothesized that the ESS score would predict OSA based on PSG in our population.

**Methods:** We conducted an observational study of patients undergoing level-one attended in-lab PSG at our Sleep Center (2013-2015). Self-administered ESS scores were collected prior to PSG. We collected demographic and clinical data, including PSG parameters. The diagnosis of OSA was based on an apnea hypopnea index (AHI) ≥ 5 events per hour (mild 5.0-14.9/h, moderate 15.0-29.9/h, severe ≥ 30.0/h). Data are presented as mean ± standard deviation or median. Logistic regression analysis predicting OSA was performed using the ESS and PSG variables (AHI, sleep architecture, total arousal index (TAI), and oxygenation parameters).

**Results:** 3,179 consecutive patients (78.9% male; age 40.6 ± 13.0 years; BMI 28.8 ± 8.5 kg/m2) were included. The median ESS was 11.0 (51.9% had an ESS ≥ 11.0). OSA was diagnosed in 61.0% of the cohort with a median AHI of 7.4 events per hour (58.3% mild, 30.9% moderate, and 10.8% severe). The median oxygen saturation nadir was 87.0%. Logistic regression demonstrated that ESS does not predict the presence of OSA (OR 1.1, p = 0.41), or other PSG parameters to include AHI in events per hour, sleep architecture, arousal index or oxygenation.

**Conclusion:** The ESS does not appear to predict PSG parameters or the diagnosis of OSA in a large military healthcare system population with predominantly mild-to-moderate disease severity.

**0360 PREDICTING SLEEP APNEA IN CHRONIC KIDNEY DISEASE: FINAL RESULTS FROM THE SNORE STUDY**

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**Introduction:** Chronic kidney disease (CKD) patients suffer disproportionately from sleep apnea (SA). To date, it is unclear whether a screening tool developed for the general population, the Berlin Questionnaire (BQ), is valid to predict SA in CKD.

**Methods:** We conducted a cross-sectional analysis of 248 veterans aged 18-89 with eGFR of 15-44 ml/min/1.73m2 enrolled in the SNORE Study. At baseline, subjects completed BQ and underwent complete overnight sleep study. SA was defined using the apnea-hypopnea index(AHI). We calculated the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the receiver operating characteristics curve (AUC) of BQ at a standard cutoff ≥ 2 to predict SA (at cut-points of ≥ 5, 15, and 30).

**Results:** Baseline characteristics of enrolled subjects: mean age, 73 ± 10 years; 95% male; 78% Caucasian; body mass-index (BMI), 30.3 ± 4.8 kg/m2; 52% had BMI ≥ 30 kg/m2; 96% had hypertension. BQ score ≥ 2 was 68. Median (IQR) AHI was 10.3 (3.9-23.1). The proportion with AHI ≥ 5, 15, and 30 were 71%, 39%, and 19%, respectively. Using a BQ score ≥ 2 to predict AHI ≥ 5, the sensitivity, specificity, PPV, NPV, and AUC (95%CI) were 70%, 38%, 73%, and 35%, 0.543 (0.478-0.609), respectively. Using a BQ score ≥ 2 to predict AHI ≥ 15, the sensitivity, specificity, PPV, NPV, and AUC (95%CI) were 74%, 36%, 42%, and 68%, 0.545 (0.486-0.603), respectively. Finally, using a BQ score ≥ 2 to predict AHI ≥ 30, the sensitivity, specificity, PPV, NPV, and AUC (95%CI) were 75%, 34%, 21%, and 85%, 0.545 (0.475-0.615), respectively.

**Conclusion:** BQ ≥ 2 was a sensitive but not specific predictor of SA in CKD across various cut-points for SA severity. Further research is needed to develop better screening tools to identify which CKD patients would benefit from formal evaluation for SA.

**Support (If Any):** This material is the result of work supported by a VA CSR&D Career Development Award (CX000533-01A1) for Dr. Canales and by Gatorade support from the Division of Nephrology, Hypertension and Renal Transplantation, Department of Medicine, University of Florida.
0361
EXPERIENCE WITH A HEALTHY SUBJECT POPULATION AT A SLEEP RESEARCH CENTER UNDERGOING COGNITIVE NEUROSCIENCE RESEARCH

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Introduction: The role of sleep in learning and memory has gained significant attention in cognitive neuroscience. We report our experience with a healthy subject population at a sleep research center.

Methods: We recruited subjects for a daytime nap and overnight sleep study by advertising at an urban university over one year. Subjects were eligible if aged 18 to 35, English-speaking, and scored above 26 on the Montreal Cognitive Assessment (MOCA). They were excluded for any diagnosis of a neurologic or psychiatric disorder, including a sleep disorder (as identified by the insomnia symptom questionnaire, STOP-BANG, and Morningness-Eveningness scale); used psychoactive medications, alcohol or recreational drugs; or recent travel across time zones. Subjects participated in cognitive tasks and slept with simultaneous EEG-PSG, which was scored by a board-certified sleep neurologist.

Results: We obtained 40 nap studies and 20 nighttime studies. Screeninquestionnaires identified eligible subjects with a low risk of insomnia (0.22 ± 0.52), low risk of sleep apnea (0.82 ± 0.75), and intermediate circadian preferences (47.15 ± 0.75). There was a wide variance in sleep efficiency (0.68 ± 0.29) and total sleep time (TST, 69.86 ± 33.78 min) during naps; with less variance seen during nocturnal studies (SD 0.84 ± 0.08; TST 454.13 ± 45.0 min). Three (15%) nap subjects demonstrated excessive daytime REM. Two nap subjects (5%) and three (15%) nighttime subjects were diagnosed with OSA. One nap subject (2.5%) and two nighttime subjects (10%) were diagnosed with periodic limb movements of sleep (PLMS).

Conclusion: Our experience with a healthy subject population suggests a wide variance in daytime sleep behavior and a notable prevalence of sleep disorders such as OSA, PLMS, and excessive daytime REM. These variables should be considered in planning and analysis of sleep and cognition studies.


0362
THE CLINICAL GLOBAL IMPRESSION SCALE IN PATIENTS WITH SUSPECTED OBSTRUCTIVE SLEEP APNEA - DATA FROM THE ESADA NETWORK

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Introduction: The severity of obstructive sleep apnea (OSA) is conventionally expressed by the apnea/hypopnea index (AHI). However, the AHI does not always correspond to subjective symptoms or presence of comorbidities. In mental disorders, the Clinical Global Impression (CGI) scale is used to provide a global impression of the disease. We aimed to assess the applicability of the CGI scale.

Methods: Data from the European Sleep Apnea Database (ESADA) are used. ESADA reflects a network of 30 sleep disorders centers in Europe and Israel, with the objective to recruit a large prospective cohort of patients with suspected OSA. The CGI is a 7-point scale ranging from 1 ‘not at all ill’ to 7 ‘among the most extremely ill’.

Results: CGI ratings from 7581 subjects (70% male, age 52 ± 13 years, AHI 24 ± 25/h) were analyzed. Most of the patients (44%) were scored as mild to moderately ill. CGI rating was associated with both AHI (p = 0.528 and p < 0.01) and oxygen desaturation index (ODI) (p = 0.534 and p < 0.01). Furthermore, the CGI rating score did show a positive relationship with the Epworth Sleepiness Scale (ESS) (p < 0.01), the reported numbers of cardiovascular (p < 0.01) and metabolic comorbidities (p < 0.01) (ρ = 0.186, 0.201 and 0.138, respectively). A sub-analysis by gender (5290 men and 2291 women) showed more severe CGI ratings for men. This is in line with the higher AHI among men (AHI = 26 ± 25/h in men versus 17 ± 22/h in women). In contrast, CGI rating for the same degree of AHI was higher in women than in men (p < 0.01). This may be in part explained by the higher ESS (p < 0.01) and higher prevalence of psychiatric comorbidity in women (16% vs 8%).

Conclusion: The CGI rating scale provides a strong reflection of the clinical burden of OSA. The CGI scale detected a gender difference in OSA severity ratings.

Support (If Any): Dr. Marijke Dieltjens was recipient of a European Respiratory Society Short-Term Fellowship (STRTF 2015) to perform data analysis at the ESADA center, Gothenburg University

0363
COMPARISON OF FRIEDMAN TONGUE POSITION AND MUELLER’S MANEUVER RESULTS

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Introduction: The Friedman Tongue Position (FTP) is a 4-item grading system used to assess the relationship of the palate to the tongue. It is frequently utilized in the pre-operative evaluation of patients with obstructive sleep apnea (OSA). Higher FTP grades (3 or 4) predict a lower likelihood of improvement following uvulopalatopharyngoplasty (UP3). The Mueller’s maneuver has been utilized to identify tongue base collapse in OSA, a potential site of obstruction not addressed by UP3 alone. Previous studies have shown that patients with a higher FTP and a positive Mueller’s maneuver (> 50% collapse) at the tongue base, independent of each other, are likely to achieve additional improvement with surgery directed at the tongue base.

Methods: A retrospective review of FTP grades and Mueller’s maneuver findings from 1,047 patients attending a surgical “Alternatives to CPAP” clinic from October 2003 to November 2015 was performed. A Chi-square analysis was conducted to determine the relationship between FTP and Mueller’s maneuver. Data were dichotomized into high and low FTP grades (score 3 or 4 vs. 1 or 2) and Mueller’s scores (> 50% vs. < 50% collapse). Odds ratios were calculated to determine the odds of a positive FTP if the Mueller’s maneuver was positive.

Results: A significant relationship between FTP grade and Mueller’s maneuver result was identified (p50% collapse on the Muller’s maneuver to be an indication of clinically significant tongue base obstruction, there was an odds ratio of 2.1 (95% CI 1.4-3.1, p < 0.001) for a positive Friedman if the Mueller’s maneuver was positive.

Conclusion: There is a strong correlation between the FTP and Mueller’s maneuver results. This correlation lends additional support to the concept that patients with a higher FTP grade are more likely to experi-
ence base of tongue collapse and may benefit from additional surgery at this site.

0364 OUTCOME DATA SUPPORT THE 2012 AASM SCORING CRITERIA OF HYPOPNEAS IN THE ABSENCE OF SAO2 DESATURATION (RULE 1A). IT IS UNJUSTIFIED TO WITHHOLD TREATMENT FROM PATIENTS WHO DO NOT DESATURATE

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Introduction: Despite AASM recommendations in 2012, controversy still exists regarding the scoring and treatment of arousal-related obstructive hypopneas that are not associated with oxygen desaturation (“Non-desat-arousal-related OHS”). Prior clinical observations and studies have demonstrated benefits in treatment of non-desat-arousal-related OHS, leading to changes in scoring recommendations (Rule 1A) in 2012. Nonetheless, many within the field oppose these new recommended guidelines. Therefore, many practitioners within the field still follow the alternate hypopnea scoring rule that does not score non-desat-arousal-related OHS (Rule 1B). A featured lecture at the 2015 APSS suggested there was a lack of data to support treatment of mild OSA and non-desat-arousal-related OHS. The studies referenced in the presentation consisted of small sample sizes and there was no clear description of how PAP titrations were carried out, an important concern since the patients did not desaturate on the diagnostic study. We present outcome data from 240 adult patients with obstructive respirations, during sleep, (non-desat-arousal-related OH index of ≥5/ hr) as defined by Rule 1A but not Rule 1B, having a range of symptoms consistent with sleep-disordered breathing, and in whom outcome data was obtained after 6+ months of treatment to assess if such treatment is a worthy endeavor.

Methods: More than 400 patient records were reviewed who met criteria: Symptomatic and NPSG showing non-desat-arousal-related OHS without 4% desaturations. Outcome measures included changes in Epworth Sleepiness Scale (ESS) and a 7-point Patient Global Impression Scale (PGI). Post-treatment assessments were performed after at least six-months of treatment.

Results: Successful outcome data has been obtained on 240 patients to-date and demonstrates ESS scores and PGI score reduction from 12.3 (±/− 5) and 5 (±/− 1.9) pre-treatment to 7.6 (±/− 1.6) and 2.6 (±/− 1.5) post-treatment, respectively. These changes are statistically significant (p < 0.05).

Conclusion: Our data fills a void in the literature, demonstrating significant clinical improvement when treating this largely neglected population in whom obstructive respirations do not result in desaturations. These results contradict the final conclusion presented at the 2015 APSS invited lecture session addressing this topic. If the field of sleep medicine is going to raise the standard of care, then sleep centers should be required to abide by hypopnea scoring Rule 1A as recommended by the AASM. The lack of consensus within the field of sleep medicine has facilitated certain insurance providers including Medicare to decline treatment coverage for this population, thus hindering proper care.

0365 APNEA-HYPOPNEA INDEX (AHI) IS ASSOCIATED WITH RIGHT VERSUS LEFT LATERAL SLEEP POSITIONING IN ADULT FEMALES WITH SLEEP DISORDERED BREATHING

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Introduction: Positional sleep therapy is as effective as continuous positive airway pressure (CPAP) in normalizing apnea-hypopnea index (AHI) in adults with positional, obstructive sleep disordered breathing (SDB). However, the impact of gender specific right versus left lateral sleep positioning on SDB has not been previously reported.

Methods: We retrospectively examined the association between right versus left lateral sleep and SDB severity in a community-based, adult cohort referred for diagnostic sleep testing at the Keck of USC Sleep Disorders Center between January 1-December 31, 2014. Patients were included if they had a mean polysomnogram total sleep time (TST) of ≥5 hours and spent ≥20% of TST in each lateral position. Comparisons were made using the Wilcoxon signed-rank test.

Results: Inclusion criteria were met by 106 patients (54 males, 52 females; p = 0.55). Baseline characteristics of the two groups were similar in terms of body mass index (BMI; 28, 27; p = 0.48), AHI (6.5, 6; p = 0.08), Respiratory Disorder Index (RDI; 15.3, 10.3; p = 0.24), and Mean O2 saturation (Mean O2; 94%, 95%; p = 0.09). Males in this cohort had no significant differences in right-sided versus left-sided AHI (2.6 right-sided, 2.2 left-sided; p = 0.73), RDI (8.5 right-side, 9.6 left-side; p = 0.89) or Min O2 saturation (89% right-side, 88% left-side; p = 0.12). However, females had significantly higher left-side AHI (1.2 right-side 2.3 left-side; p < 0.05) and RDI (5.4 right-side, 9.1 left-side; p = 0.05). The Min O2 saturation was lower in females (90% right-side, 86% left-side; p < 0.05).

Conclusion: When compared to males, females with SDB had improvement in AHI, RDI and Min O2 during right versus left lateral sleep. Given this association, female patients may benefit from preferential right-sided sleep when positional therapy is employed as a primary treatment for OSA. Further study is warranted.

0366 THE IMPACT OF FOLLICULAR VersUS LUTEAL MENSTRUAL PHASE ON POLYSOMNOGRAPHY: A RETROSPECTIVE COHORT ANALYSIS

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Introduction: The primary objective of this study was to determine if the phases of the menstrual cycle influence the results of polysomnography (PSG). Second, we investigate whether age greater than 40 is an OSA risk factor in premenopausal patients. To corroborate our findings, we provide a comprehensive literature review on the therapeutic efficacy of estrogen versus progesterone hormonal therapy in OSA.

Methods: Subjects were divided into the Follicular (days 0-13 of cycle) or Luteal Cohort (days 14-26 of cycle) and a one-way analysis using a t-test was performed to test the hypothesis that the follicular phase provides a protective effect against OSA. A likelihood-ratio chi-square test was applied to assess for a statistically significant association be-
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between menstrual stage and AHFI greater than 15/h. This statistical analysis was repeated in our secondary investigation of age greater than 40 as an OSA risk factor in premenopausal patients.

Results: The mean AHFI for the Follicular Cohort (6.1/h) was significantly lower than the Luteal Cohort (14.3/h, p = 0.003). In the Follicular Cohort, 12% of patients had moderate to severe OSA. In the Luteal Cohort, 46% of patients had moderate to severe OSA (p = 0.045). Age greater than 40 was associated with significantly increased overall AHFI (p = 0.03) relative to the Age < / = 40 group (p = 0.03). Patients in the Older Cohort showed a significantly higher rate of moderate to severe OSA than the Younger Cohort (53% vs. 19%, p = 0.03).

Conclusion: Subjects undergoing PSG during the follicular phase have significantly lower AHFIIs than those in the luteal phase and a much lower likelihood of returning a result of moderate to severe OSA. Thus, the timing of PSG acquisition for premenopausal women should be considered when interpreting results. Age greater than 40 in premenopausal patients is associated with higher AHFIIs, suggesting that serial PSGs could be indicated in high-risk patients who have a negative study before the age of 40.

0367
VALIDITY OF ASSESSMENT OF AIRWAY ELLIPTICITY USING CINE-MRI IMAGING TO DIFFERENTIATE SEVERE OBSTRUCTIVE SLEEP APNEA
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Introduction: Obstructive sleep apnea (OSA) is a common sleep disorder characterized by repetitive episodes of airway narrowing. For accurate diagnosis, overnight polysomnography (PSG) is mandatory; however, which requires specialized facility with well-trained specialists, and takes overnight. Current study was designed to evaluate the validity of cine magnetic resonance imaging (cine-MRI), as a screening test to differentiate patients with severe OSA, who would need PSG and proper treatment.

Methods: Thirty-one patients (59 ± 17yo, 28 (90%) male, BMI 28.4 ± 5.2kg/m2) with suspected OSA were prospectively evaluated with PSG and cine-MRI. Five other healthy volunteers served as control. Cine-MRI imaging for airway was obtained in the evening at 5pm before PSG during wakefulness, using 1.5 T-MRI (Achieva 1.5 T, Philips Healthcare, The Netherlands). Under ad-lubtum breathing, changes in airway area and airway ellipticity (AE) [1-(antero-posterior diameter / lateral dimension)] over 30 seconds at retrogrossal level were obtained. In addition, averaged, maximum, and minimum values of AE throughout cine imaging were calculated. These parameters were compared between any two groups among severe OSA (Apnea Hypopnea Index (AHI) ≥30), not-severe (AHI <30), and controls, divided according to PSG results, using Wilcoxon rank-sum test.

Results: Nineteen were diagnosed as severe OSA, and the remaining 12 as not-severe. Airway areas showed no significant differences between any two of three groups. However, significant differences (p < 0.05) were observed between control and severe OSA as well as other two types of AE (control vs. severe OSA: averaged AE, 0.53 ± 0.14 vs. 0.31 ± 0.17, maximum AE, 0.63 ± 0.14 vs. 0.48 ± 0.17, minimum AE, 0.38 ± 0.19 vs. 0.17 ± 0.16, respectively). The minimum AE was significantly higher for controls than not-severe OSA (0.38 ± 0.19 vs. 0.31 ± 0.17, p < 0.05). Pearson regression analysis showed significant, negative correlations between the minimum AE and oxygen desaturation index (ODI). Receiver Operating Characteristic (ROC) analysis revealed the optimal cutoff of the minimum AE 0.21 for differentiating patients with severe OSA from patients with not-severe and controls, with an area under the curve of 0.75, 68% sensitivity and 83% specificity.

Conclusion: AE calculated by cine-MRI was significantly smaller in patients with severe OSA, and showed good possibility as an excellent screening test to detect them. AE is an easy, quantitative index and could be obtained at an outpatient clinic with MRI, without sleep apnea specialists. The current study suggested that cine-MRI imaging could be used as a valid primary screening tool for OSA, to detect patients who would need the proper referral for further evaluation.

0368
UPPER AIRWAY COMPUTED TOMOGRAPHY FINDINGS AND NECK CIRCUMFERENCE ASSOCIATED WITH OBSTRUCTIVE SLEEP APNEA
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Introduction: The aim of this study was to determine whether alterations in Upper airway structures and in neck circumference are present in patients with Obstructive Sleep Apnea.

Methods: 327 adult subjects from Bogotá (Colombia) with diagnosis of Sleep disorders through polysomnography were selected to evaluate Upper airway by computed tomography (UACT) and to measure neck circumference. Informed consent was obtained from all individuals according to a protocol approved by the Ethical Committee of the Faculty of Medicine of Pontificia Universidad Javeriana and Hospital Universitario San Ignacio. Subjects were divided into three groups: non-apneic control group (112 individuals; apnea-hypopnea index (AHI) <5 events/hr), Obstructive Sleep Apnea (OSA) group (215 individuals; AHI ≥5 events/hr). The structures evaluated by UACT included: airway length, laryngopharynx length, mandibular plane to hyoid distance, uvula size, uvula morphology, minimum lateral dimension of the retroglottal airway, retropalatal anteroposterior/lateral dimension, retroglottal anteroposterior/lateral dimension and ANB angle. Associations between Sleep Apnea and alterations in upper airway structures and neck circumference were analyzed by Chi-square and Odd Ratio (OR) tests.

Results: The following measures showed statistically significant association with OSA: Increased neck circumference (OR = 4.92, 95% CI: 2.6-9.7, P < 0.0001), inferior hyoid bone position (OR = 2.08, 95% CI: 1.1-4.1, p < 0.0005), septum deviation (OR = 1.9, 95% CI: 1.2-3.8, p < 0.012), reduced retroglottal anteroposterior dimension (OR = 1.9, 95% CI: 1.2-3.7, p < 0.010) and increased uvula size (OR = 4.7, 95% CI: 2.2-10.2, p < 0.014).

Conclusion: These results suggest that airway collapsibility, hyoid bone position and increased neck circumference contribute to develop Obstructive Sleep Apnea in adults.

Support (If Any): This Research was funded by Colciencias (Departamento Administrativo de Ciencia, Tecnología e Innovación de Colombia) contract 369, grant 537.
I. Sleep Disordered Breathing

The study was supported by grants from the N...
tients (20%) reported mild erythema or blistering around the collar site, which quickly resolved without treatment.

Conclusion: A high proportion of patients with documented OSA showed a response to cNEP, including those with high baseline AHIs. cNEP was well-tolerated. No predictors of response were identified. Further studies are indicated.

Support (If Any): This study was supported by Sommetrics, Inc. San Diego, CA

0372

DIAGNOSING AND TREATING SLEEP APNEA IN PATIENTS WITH ACUTE CEREBROVASCULAR DISEASE: THE SLEEP TIGHT STUDY

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Introduction: The purpose of this study was to evaluate whether long-term continuous positive airway pressure (CPAP) therapy reduces vascular risk among patients with transient ischemic attack (TIA) or stroke.

Methods: The study was a randomized controlled trial among patients with TIA and stroke, comparing strategies for the diagnosis and treatment of sleep apnea (defined as an apnea-hypopnea index of ≥5 events/hour) with usual care over the course of up to 12 months of follow-up. Patients were randomized either to a control group (usual care) or to one of two intervention groups (standard or enhanced adherence protocols).

Results: Overall, 252 patients were randomized (84, control; 86, standard intervention; 82, enhanced intervention). The sleep apnea prevalence rate was 74% in the standard group, 80% in the enhanced group and 69% in the control group. In the intention-to-treat analysis among all patients, the intervention strategy was associated with an improvement in insulin resistance (mean change from baseline to final in Homeostatic Model Assessment [HOMA] ± standard deviation: 4.1 ± 24.8, control; 0.9 ± 3.0, standard, 4.0 ± 12.7 enhanced, p = 0.026). In the as-treated analysis among patients with obstructive sleep apnea with groups defined by CPAP use, an improvement in the medication-adjusted systolic blood pressure was observed with CPAP use: among patients with no or poor CPAP use the mean increase in medication-adjusted systolic blood pressure was 7.8 ± 13.9 mm Hg compared with 2.0 ± 14.4 mm Hg in patients with some or good CPAP use (p = 0.018). The mean number of hours of CPAP use per night was similar among the standard (3.9 ± 2.1 hours) and enhanced (4.3 ± 2.4 hours; p = 0.46) groups. In the as-treated analysis among patients with sleep apnea with groups defined by CPAP use, increasing CPAP use was associated with improvements in the modified Rankin Score (-0.3 ± 1.5, no/poor use; -0.4 ± 1.0, some use; -0.9 ± 1.2 good use, p = 0.024). More intervention patients had the best final neurological functioning (an NIHSS of 0-1) compared with control patients (59% versus 38%, p = 0.038). Similarly, intervention patients were less likely to suffer from daytime sleepiness (at final follow-up) than control patients (83% versus 58%, p = 0.0042).

Conclusion: A diagnosis and treatment strategy for sleep apnea that provides CPAP therapy for patients with ischemic stroke or TIA was associated with improvements in several domains of vascular risk and neurological functioning.

Support (If Any): NHLBI U34HL105285

0373

POSITIVE AIRWAY PRESSURE (PAP) USE IN OBSTRUCTIVE SLEEP APNEA (OSA) TREATMENT AS A FUNCTION OF SLEEP TIME: HOW MUCH SLEEP TIME REMAINS UNTREATED?

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Introduction: PAP use is commonly quantified as mean hours use per night. PAP dose response studies use this simplified PAP use metric as dose. Average PAP use is low with 50% of OSA adults using PAP < 4 hours/night; this may translate to significant periods of major sleep bouts absent of treatment. Objectives: (1) explore the metric of PAP use as a function of objective total sleep time (TST); (2) describe untreated sleep bout periods in PAP-treated OSA adults.

Methods: Post-hoc analysis of trial data; primary objective was to establish feasibility/effect size of a tailored intervention for PAP adherence; secondary objective was to explore PAP use as a function of TST. Newly-diagnosed OSA adults (N = 60) were enrolled/randomized with outcomes at 1-wk, 1-mo, 3-mo. Wrist actigraphy and sleep diary measures were concurrent with 1-wk PAP treatment. Complete data (n = 45) for 1-wk objective PAP use, actigraphy-derived main bout TST, and self-reported sleep onset/offset was analyzed with descriptive statistics; scatterplot and Spearman’s correlation were used to explore relationship between PAP use (mean hrs/night) and categorical PAP use as %TST.

Results: Middle-aged (51.1 ± 11.2 yrs), obese (BMI 38.1 ± 9.9 kg/m2) males (73%) with severe OSA (AHI 38.2 ± 26.8 events/hr) used PAP 6.2 ± 1.73 hrs/night at 1-wk. Mean %TST with 1-wk PAP use was 65.19 ± 13.53%. When %TST with PAP use was categorized, 4.4% (2) used PAP > 90% TST; 20% (9) used PAP > 80% TST; 28.9% (13) used PAP > 70% TST; and 84.4% (38) used PAP > 50% TST. Mean 1-wk PAP use was not associated with %TST (rho = 0.04).

Conclusion: Untreated sleep bout time in PAP-treated OSA is high, even in a relatively “adherent” cohort. Employing a metric of %TST on PAP is aligned with pharmacological dose discovery/response studies that precisely quantify serum drug levels. To precisely determine PAP dose response for specific physiologic functional outcomes, %TST on treatment may be a metric of importance.

Support (If Any): Funding by NIH/NINR (R00NR011173), American Nurses Foundation and Sigma Theta Tau International and American Sleep Apnea Association (sleep apnea educational materials). None of the funding sources contributed to study design, data collection, analysis and interpretation of the data, or dissemination of the study results.
I. Sleep Disordered Breathing

0374

CORRELATION OF DRUG-INDUCED SEDATION ENDOSCOPY FINDINGS WITH TREATMENT OUTCOME IN OBSTRUCTIVE SLEEP APNEA PATIENTS TREATED WITH ORAL APPLIANCE THERAPY IN A FIXED MANDIBULAR PROTRUSION

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Introduction: This prospective study aims to evaluate the predictive value of drug-induced sedation endoscopy (DISE) baseline findings in the prediction of treatment outcome with custom-made titratable mandibular advancement devices (OAm) in patients with obstructive sleep apnea (OSA).

Methods: One hundred OSA patients were included (83% male; age 47.6 ± 10.0 years; body mass index (BMI) 26.9 ± 3.3 kg/m²; apnea/hypopnea-index (AHI) at inclusion 21.0 ± 11.2 events/hour sleep). At inclusion a new baseline polysomnography (PSG) was obtained. All participants started OAm therapy in a fixed protrusion of 75% of the maximal mandibular protrusion. Seventy-three out of 100 patients underwent a DISE as well as a PSG with OAm. Treatment success with OAm was defined on PSG as a decrease in AHI ≥ 50% as compared to baseline PSG or AHI < 5/h; whereas deterioration was defined as an increase in AHI with OAm compared to baseline PSG.

Results: Statistical analysis with correction for BMI and AHI at baseline, revealed that a complete concentric palatal collapse during baseline DISE was positively correlated with deterioration (odds ratio (OR) 4.73; 95% confidence interval (CI) 1.08 - 20.81, p = 0.0397). The combination of a complete concentric palatal collapse with a complete oropharyngeal collapse is even stronger correlated with deterioration; OR 19.51 (95% CI 1.68 - 226.36, p = 0.0175). Collapse of the tongue base, either partial or complete, is correlated with success; OR 3.01 (95% CI 1.00 - 9.02, p = 0.0491).

Conclusion: DISE can be used to select patients for OAm therapy. The results show that a complete concentric palatal collapse at baseline is a predictor of failure and even stronger when combined with a complete oropharyngeal collapse. By contrast, tongue base collapse at baseline predicts treatment success.

Support (If Any): The study was funded by a 3 year grant of the Flemish government agency for Innovation by Science and Technology (IWT-090864).

0375

DURABILITY OF STIMULATION THRESHOLDS AND THERAPY PROGRAMMING AT 36 AND 42 MONTHS OF UNILATERAL CRANIAL NERVE XII STIMULATION FOR TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Upper Airway Stimulation (UAS) using an implantable cranial nerve XII neurostimulation system is a safe and effective therapy for CPAP-intolerant patients with moderate to severe obstructive sleep apnea (OSA). Long-term stability of stimulation programming is advantageous for patient management. Patient-specific stimulation thresholds and programming at 24 months post-implant were previously reported, and stable. We now present stimulation and programming durability at 36 and 42 months following implantation.

Methods: An implantable cranial nerve XII neurostimulation system (Inspire Medical Systems, Minneapolis, MN) used in the Stimulation for Apnea Reduction (STAR) trial allows programmable stimulation amplitude (0 to 5V in 0.1V increments), pulse width, rate and electrode polarity. Patient-specific stimulation thresholds were categorized as sensation threshold (stimulation first felt), functional threshold (bulk tongue motion achieved), and sub-discomfort (highest comfortable amplitude while awake). Patients can modify stimulation amplitude within a physician-selected range. Changes in patient-specific stimulation thresholds and therapy programming (amplitude, pulse width, and rate) were analyzed at 6-month intervals from 18 months to 42 months.

Results: At 36 months post-implant, 111 subjects were evaluated; 95 subjects at 42 months. Patient-specific stimulation thresholds (36 months/42 months) in volts were sensation 1.0 ± 0.1/0.8 ± 0.0, functional 1.6 ± 0.1/1.4 ± 0.1, and sub-discomfort 2.4 ± 0.1/2.1±0.1. Pulse width and rate were not significantly changed. In subjects with similar parameters, (n = 78), mean therapeutic stimulation amplitude was stable at 1.8V from 24 to 36 months post-implant, and modestly reduced to 1.6V at 42 months. 42 months post-implant, 60% of subjects had therapeutic amplitude within the physician-selected range provided at the 18-month visit. Remaining subjects had small amplitude changes with mean value of -0.3V.

Conclusion: UAS patient-specific stimulation thresholds and therapeutic amplitudes remain stable after 3.5 years. Programming changes in pulse width and rate were rare. Durability of programming was accomplished by targeted physician-directed amplitude adjustments and ensuring sufficient range for patient self-titration.

Support (If Any): Study was sponsored by Inspire Medical Systems

0376

ASSESSING POLYSOMNOGRAPHIC EFFECTS AND SUSTAINED BIOLOGICAL EFFICACY OF ADAPTIVE VENTILATION USING NON-TRADITIONAL SCORING APPROACHES

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Introduction: Adaptive servo ventilators (ASVs) are used for the treatment of high loop gain sleep apnea syndromes. ASVs effectively suppress traditional central apneas and Cheyne-Stokes respiration. However, the adverse result of the SERVE-HF study and clinical experience in routine practice suggest that at least in some instances, the ASVs may induce harmful or undesirable effects.
Methods: Archived polysomnograms from the Beth Israel Deaconess Medical Center sleep laboratory and ASV device data were analyzed. Besides traditional sleep stage and respiratory metrics, the following were derived: the pressure cycling arousal index (PCAI), relative hypocapnia, and patient-ventilator desynchrony, estimated from 96 polysomnograms (target: 200). Determining the PCAI required using the pressure output channel from the ASV device-cycling of pressure terminated in an arousal). Polysomnograms with end-tidal CO2 monitoring (mainstream, non-vented mask, 76 ASV studies) enabled detection of therapy-induced hypocapnia, relative to baseline wake and CPAP. Patient-ventilator desynchrony was identified by the following: 1) stacking of device-delivered breaths; 2) device rate slower or faster than native respiratory rate; 3) distortion of flow patterns. 4) atactic respiration with variability of expiratory pauses; all associated with arousals. Persistence of pressure cycling after a minimum of 3 months of therapy was evaluated using the SD card from the device and freeware (SleepyHead) viewer software.

Results: Excessive pressure cycling (PCAI over 10/hour), hypocapnia (reduced by 3 mm Hg or more) and patient-ventilator asynchrony were seen in 46%, 32% and 36% respectively, or at least one feature in 58%. Less than 75% and 50% stable breathing was seen in 44% and 56% of the 38 patients reviewed during chronic home use. Device-based AHI was less than 5/hour in all instances.

Conclusion: Adaptive ventilator have a wide range of effectiveness in the sleep laboratory or at home. These physiological signal biomarkers are readily available but not captured by traditional approaches.

Support (If Any): Beth Israel Deaconess Medical Center Chief Academic Officer’s Research Innovation Initiative

0377

UPPER AIRWAY STIMULATION: INITIAL EXPERIENCE AND OUTCOMES AT TWO ACADEMIC CENTERS

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Introduction: Obstructive sleep apnea (OSA) has dramatic quality of life and health consequences. Treatment with continuous positive airway pressure (CPAP) is first line and can alleviate these issues, but is not tolerated by many patients. Surgical therapy is an alternative to those not tolerating CPAP and upper airway stimulation therapy (UAS) is a recent addition to the surgical armamentarium. We present outcome data of patients at Thomas Jefferson University (TJU) and University of Pittsburgh (UPMC) undergoing this treatment.

Methods: We reviewed our database of patients who underwent UAS between November, 2014 and November, 2015 and recorded demographic data, pre and postoperative AHI, oxygen saturation nadir, and symptomatology. We then compared baseline to post-treatment results.

Results: Data was obtained on 40 patients. Our cohort consisted of 55% male and 45% female, with an average age of 60 years, and average BMI of 28.6. The mean time from implantation to followup polysomnography (PSG) was 2.8 months. Mean time from baseline to followup PSG was 10.8 months. Data gathered to date indicates a mean baseline AHI of 31.2 and O2 Nadir of 80.9% with standard deviations of 15.8 and 6.8 respectively. The average post-implantation AHI and O2 Nadir were 3.23 and 87.6 with standard deviations of 4.1 and 4.2 respectively. In addition, patients have shown an improvement in symptomatology. The mean pre and post-implantation Epworth Sleepiness Scores were 11.8 and 6.8 with a percent difference of 60.4.

Conclusion: For those unable to tolerate CPAP, UAS appears to provide a viable alternative producing improvement in both polysomnographic and quality of life measures.

0378

HYPOGLOSSAL NERVE STIMULATION FOR OBSTRUCTIVE SLEEP APNEA: INITIAL RESULTS AT THE UNIVERSITY OF PENNSYLVANIA

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Introduction: Hypoglossal nerve stimulation (HGNs) is a novel treatment in patients with moderate-to-severe obstructive sleep apnea (OSA) that seek alternatives to traditional continuous positive airway pressure (CPAP) therapy. In the STAR clinical trial, patients implantated with the Inspire Upper Airway Stimulation device showed a 78% reduction in apnea-hypopnea index (AHI) and an 80% reduction in oxygen desaturation events, which were sustained three years after implant. We decided to assess the initial results of HGNs conducted at the University of Pennsylvania. We hypothesized that apneics undergoing HGNs would have a significant improvement in their AHI and oxyhemoglobin saturation.

Methods: Fourteen implants were completed at the University of Pennsylvania between January-November 2015. All patients underwent baseline polysomnography (PSG) recording prior to HGNs implant, to assess initial AHI. As of December 2015, nine patients had returned for standard post-implant titration PSG to assess the optimal voltage settings and residual AHI. Baseline demographic information (BMI, age, gender, race) and PSG results were collected. Pre- and post-implant PSG data were compared using a non-parametric signed rank test to assess absolute change in total AHI.

Results: Patients undergoing HGNs implant were overweight (mean ± SD: BMI = 29.3 ± 4.1 kg/m2), middle aged (55 ± 13 years), and had severe OSA (AHI = 45.1 ± 17.6 events/hour). The mean total AHI for nine patients after implant was 13.1 ± 17.2 events/hour, representing an average decrease of 32.3 ± 22.9 events/hour [median (range) = -37.6 (-59.7, 11.3)]. Even in this small preliminary sample, the decrease after HGNs implant was statistically significant (p = 0.015). Additionally, the mean oxygen desaturation nadir increased significantly from 78% ± 11% to 89% ± 4% (p = 0.011).

Conclusion: Overall, patients that elected to undergo HGNs implant surgery at the University of Pennsylvania showed significant improvement in OSA severity based on total AHI. These preliminary data show an overall positive response to treatment and support continued use of HGNs for patients with OSA.

0379

SELECTIVE UPPER AIRWAY STIMULATION - GERMAN POST MARKET STUDY

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Introduction: Selective upper airway stimulation of the hypoglossal nerve is a novel therapy option for obstructive sleep apnea. The aim of the study is to assess safety and effectiveness of Inspire UAS in a commercial setting.

Methods: Every patient, who received an Upper Airway Stimulation System (Inspire Medical Systems, USA), has been included (Inspire System) in this multi-center prospective clinical trial (Munich, Mannheim, Lubbock, Germany).
**I. Sleep Disordered Breathing**

**0380 DOES SLEEP ENDOSCOPY PREDICT EXTENT OF UPPER AIRWAY RECONSTRUCTIVE SURGERY REQUIRED FOR TREATMENT OF OSA?**

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**Introduction:** Drug-induced sleep endoscopy (DISE) is a common technique used by sleep apnea reconstructive surgeons to assess the sites of upper airway obstruction, but it is not known whether all sites identified by DISE require direct surgical modification for successful outcome. In particular, it is not known whether tongue base or epiglottic obstruction on DISE requires treatment in addition to palatopharyngoplasty for OSA.

**Methods:** A case series retrospective analysis was performed on 31 consecutive patients with severe or moderate OSA who underwent sleep endoscopy followed by modern palatopharyngoplasty surgery (lateral pharyngoplasty and/or transpalatal advancement). Sleep study outcome was compared for patients who had tongue base or epiglottic obstruction on DISE with those who did not. Polysomnograms and portable studies were used depending on availability.

**Results:** The mean apnea-hypopnea index (AHI) was 28.6 ± 9.1/h and mean BMI was 31.9 ± 4.8 kg/m². Eighteen patients (58%) had tongue base obstruction and/or epiglottic obstruction in addition to velum and/or oropharyngeal obstruction (multisite group). Thirteen patients (42%) had velum and/or oropharyngeal obstruction only (upper pharyngeal group). These two groups were similar with regard to age, gender, body mass index, preoperative AHI, but significantly different in Friedman tongue stage (higher in multisite group, 2.07 ± 0.49 vs. 2.61 ± 0.50) and Tonsillar grades (higher in upper pharyngeal group, 1.77 ± 1.09 vs. 1.06 ± 0.54). The postop AHI for all was 16.1 ± 15.3. The AHI success rate of multisite group was not significantly different from that of the upper pharyngeal group (72.2% vs. 76.9%, P = .66).

**Conclusion:** Patients with multisite pharyngeal obstruction pattern on DISE, treated using only upper pharyngeal reconstruction have similar successful outcome as those with only upper pharyngeal obstruction pattern. Multilevel surgery may not always be needed despite multisite obstruction pattern on sleep endoscopy. Larger, prospective study is needed to confirm these observations.

**0381 LONGITUDINAL EFFECT OF HYPOGLOSSAL NERVE STIMULATION FOR OBSTRUCTIVE SLEEP APNEA ON BLOOD PRESSURE IN TWELVE PATIENTS**

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**Introduction:** CPAP therapy has been the gold standard treatment for OSA and has been shown to result in blood pressure improvements. However, adherence to CPAP therapy is problematic. Hypoglossal nerve stimulators (HNS) have been used in this patient population. In the STAR trial, HNS reduced AHI, improved quality of life and lowered daytime somnolence symptoms with persistent adherence at up to 36 months following implantation. We sought to further evaluate blood pressure as an outcome of this novel new treatment.

**Methods:** We selectively evaluated the effect of HNS on blood pressure at one of the STAR trial centers. The blood pressure of twelve patients who underwent HNS implantation was tracked at sequential follow-up visits at an academic medical center in Florida. These patients were seen at 1, 6, 12, 18, 24, 30, and 36-month intervals. During these visits, blood pressure and medication reconciliations were performed and documented. Adherence to HNS therapy was recorded.

**Results:** Statistical analyses performed on this data are remarkable for lack of significant impact on long-term blood pressure monitoring. At no interval was there a statistically significant decrease (or increase) in systolic or diastolic blood pressure readings. Baseline mean MAP was 99. There was no statistical difference in mean MAP at 6mo (99.7, P = 0.92), 12mo (97.3, P = 0.58), 24mo (97.2, P = 0.58), or 36mo (100.6, P = 0.77). No patients were lost to follow-up or had incomplete data-sets during long-term follow-up.

**Conclusion:** From this data, HNS use was not shown to have statistically significant effect on blood pressure longitudinally in patients with moderate/severe OSA. HNS use has previously been shown to improve rate of respiratory obstructions and daytime symptoms. This case series invites further long-term monitoring of health measures (ie BMI, development of diabetes, cardiac/all-cause mortality) in patients with continued use of HNS for treatment of OSA.
I. Sleep Disordered Breathing

CPAP 4-6 hours and 9 (21.4%) were using CPAP 6 hrs. At 6 months following surgery: Out of 42 preoperative, 31 (73.8%) stopped using CPAP. Out of 20 who were using CPAP more than 6 hours, 14 (70%) stopped using it. Out of 13 who were using CPAP between 4-6 hours, 10 (76.9%) stopped using CPAP. Out of 9 who were using CPAP less than 4 hours, 7 (77.8%) stopped using CPAP.

Conclusion: We conclude that significant percentage of OSA patients stop using their CPAP at 6 months compared to their adherence before surgery. This pattern could be due to significant weight loss and reduced need of CPAP pressure. Our patients used fixed pressure CPAP rather than auto CPAP, which may be the factor of this much drop in overall CPAP usage. Further study is needed to investigate the CPAP compliance in bariatric patients using fixed CPAP vs auto CPAP.

0383

DOES PRIOR CPAP USE AND INTOLERANCE AFFECT UPPER AIRWAY STIMULATION THERAPY ADHERENCE?

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Introduction: Upper airway stimulation (UAS) is a new therapy option for PAP-intolerant moderate-to-severe obstructive sleep apnea (OSA) patients. PAP intolerance is managed by identifying root causes, and adjusting PAP therapy accordingly. We examined whether prior PAP intolerance would affect UAS therapy adherence.

Methods: A total of 126 participants received an implanted upper airway stimulation system (Inspire Medical Systems, Minnesota, USA) in a prospective phase III trial. Participants were grouped into major categories. Participants could have had multiple reasons for intolerance. Self-reported daily UAS therapy adherence was collected on a longitudinal basis through 24-months post implant. UAS therapy adherence was calculated for each of the intolerance categories.

Results: There were a total of 119 reasons for PAP intolerance, reported from 75 (60%) participants who had provided detailed reasons for PAP intolerance at baseline. In descending order, the most common PAP intolerance categories were sleep disturbance from PAP (insomnia, awakenings, fatigue) (48% of all reasons, n = 53 participants), upper airway side effects (nosebleeds, sinus irritation, congestion, etc) in (22%, n = 26), cranio-facial symptoms (headaches, skin, face, eye irritation) in (13%, n = 15), psychological trauma (claustrophobia, anxiety, panic) reasons (12%, n = 16), aerophobia (2%, n = 3), and difficulty breathing (2%, n = 2). UAS patient self-reported daily adherence in these patients was 82% at 42-months post implant. UAS adherence in terms of prior PAP intolerance reasons due to sleep disturbance, upper airway side effects, cranio-facial, psychological, aerophobia, and difficulty breathing was 86%, 67%, 93%, 79%, and 67%, respectively. The remaining percentage of patients without daily use predominantly reported neglecting nightly therapy activation.

Conclusion: Long-term UAS adherence was not affected by prior CPAP intolerance. Participants who had previously abandoned CPAP maintained high adherence to UAS at 42-months post-implant.

Support (If Any): Inspire Medical Systems

0384

UPPER AIRWAY STIMULATION FOR OBSTRUCTIVE SLEEP APNEA: PATIENT REPORTED OUTCOMES AFTER 42 MONTHS OF FOLLOW-UP

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Introduction: Upper airway stimulation has been shown to be safe and effective in participants with moderate-to-severe obstructive sleep apnea in a large cohort study (STAR Trial) after 12 months of follow-up. In this report we aimed to assess patient reported outcomes after 42 months of follow-up in this population.

Methods: A total of 124 participants completed an implanted upper airway stimulation system (Inspire Medical Systems, Minnesota, USA) in a prospective phase III trial. The co-primary outcomes were AHI and ODI. The secondary outcome measures included patient reported outcomes: Epworth Sleepiness Scale (ESS) and the Functional Outcomes of Sleep Questionnaire (FOSQ). Patient reported outcomes were reassessed at 42 months post-implant.

Results: A total of 124 participants completed follow up at 12 months and 94 participants at 42 months. ESS decreased significantly from 11.6 (5.0) at baseline to 7.0 (4.3) at 12 months (p < 0.001) and 7.1 (4.7) at 42 months (p < 0.0001). Similarly, FOSQ improved significantly from 14.3 (3.2) at baseline to 17.3 (2.9) at 12 months (p < 0.001) and 17.5 (3.0) at 42 months (p < 0.001).

Conclusion: Upper airway stimulation via cranial nerve XII maintained a sustained benefit on patient report outcome measures (ESS and FOSQ) after 3.5 years of follow-up.

Support (If Any): Inspire Medical Systems, Minnesota, USA

0385

A COMPARATIVE EFFECTIVENESS TRIAL OF LAPAROSCOPIC GASTRIC BANDING VERSUS CPAP FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Continuous positive airway pressure (CPAP) is currently the first line treatment for severe obstructive sleep apnea (OSA); however, adherence limits the effectiveness of this therapy. In patients with co-morbid obesity, bariatric surgery offers an opportunity to treat OSA and simultaneously improve other obesity-related comorbidities. The effectiveness of bariatric surgery as first line treatment for OSA compared to CPAP has not previously been assessed.

Methods: We conducted a two-site randomized controlled trial of laparoscopic gastric banding surgery versus CPAP as first line therapy in patients aged 18-65 years presenting to a sleep clinic with symptomatically severe OSA and body mass index (BMI) 35-45 kg/m2. Exclusion criteria were prior OSA treatment, drowsy driving, and contraindications for gastric banding surgery. Patients were re-evaluated at 9 and 18 months following randomization. The primary endpoint was the effective apnea hypopnea index (AHI), defined as the residual AHI on treatment accounting for adherence, at 9 months. All analyses accounted for the stratified randomization scheme.

Results: Of a total of 482 patients meeting eligibility criteria, 53 (11%) consented for participation and 49 were randomized to treatment (mean age 48.8 ± 9.9 years, 57% male, mean BMI 38.9 ± 3.0 kg/m2, mean AHI 49.8 ± 27.0 events/hr). In the intention to treat analysis,
BMI at 9 months was lower with gastric banding (35.7 vs. 37.7 kg/m2, p = 0.05). Among those assigned to CPAP, the AHI on treatment was 2.2 ± 1.2 events/hr but adherence was only 3.7 ± 3.0 hrs. Nevertheless, the effective AHI was significantly lower with CPAP compared to gastric banding (10.4 vs. 21.1 events/hr, p = 0.02). In per protocol analyses, the weight loss was markedly greater with gastric banding (BMI 33.7 vs. 38.1 kg/m2, p < 0.001) but CPAP continued to be associated with a lower effective AHI (11.6 vs. 24.1 events/hr, p = 0.02) compared to gastric banding.

Conclusion: Despite suboptimal adherence, CPAP has a greater impact on eliminating exposure to apneic events during sleep as compared to laparoscopic gastric banding surgery. Further research is needed on whether bariatric procedures such as gastric bypass causing greater weight loss may be more comparable to CPAP in the treatment of OSA.

Support (If Any): NIH HL106410, UL1TR000170 and Philips Respironics.

0386
NON-SURGICAL UPPER AIRWAY REMODELING AS A TREATMENT FOR OBSTRUCTIVE SLEEP APEA
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Introduction: Obstructive sleep apnea (OSA) is a sleep disorder that involves cessation or significant decrease in airflow in the presence of breathing effort during the sleep period. Commonly, long term therapy, such as continuous positive airway pressure (CPAP) and/or oral appliance therapy, such as mandibular advancement appliances, have been utilized as treatment. However, a recent form of treatment, biomimetic oral appliance therapy (BOAT), offers an alternative non-surgical method, which can putatively resolve OSA by combined maxillo-mandibular correction, and by addressing craniofacial deficiencies. The aim of this study is to determine whether changes induced by BOAT produce a more favorable upper airway, which might result in a reduction in the severity of sleep disordered breathing.

Methods: After obtaining informed consent, five adults (1 male, 4 females; mean age 44.2 yrs. ± 9) diagnosed with mild to moderate OSA were started on treatment with FDA-cleared BOAT (mRNA appliance®). After 6 months of treatment, the apnea-hypopnea index (AHI), without the appliance in the mouth during sleep, of each study subject was reassessed by means of a home sleep study (HST). These results are similar to BOAT findings reported elsewhere.

Results: The mean AHI for the sample prior to treatment was 18.5 hr ± 6.2. Following 6 months of BOAT, the mean AHI decreased significantly (p = 0.015) to 7.1 hr ± 4.2 with no appliance in the mouth when the follow-up HST was performed. Thus, a mean decrease in the AHI of 38% was achieved with no appliance in the mouth in the follow-up sleep study. These results are similar to BOAT findings reported elsewhere.

Conclusion: Biomimetic oral appliance therapy may provide a useful form of therapy for the resolution of OSA. While the mid-treatment results of this pilot study look promising, long term follow-up of this cohort, as well as further studies using larger sample sizes, are warranted.

Support (If Any): Cortes Advanced Dentistry, New York, NY 10019, BioModeling Solutions, Inc. Beaverton, OR 97006, Sleep Disorders Institute, New York, NY 10019

0387
TONGUE STABILIZATION APPARATUS FOR OBSTRUCTIVE SLEEP APNEA: A SYSTEMATIC REVIEW AND META-ANALYSIS
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Introduction: A Tongue Stabilization Apparatus (TSA) anteriorly displaces the tongue with suction forces while patients sleep. It requires no power supply and provides a non-surgical treatment option for patients with Obstructive Sleep Apnea (OSA). Our objective was to conduct a systematic review of the international literature for polysomnography and sleepiness data as treatment for adult OSA.

Methods: Two authors independently and systematically searched PubMed/MEDLINE, Scopus, and the Cochrane Library through December 9, 2015. We followed guidelines set within the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Results: Eighteen studies with 214 patients met criteria. Nine studies (138 patients) evaluated outcomes based on AHI. Within these studies, the overall means ± standard deviations (M ± SD) for AHI decreased from 33.5 ± 21.9/hr to 14.4 ± 17.8/hr (57% reduction), p < 0.0001. Random effects modeling demonstrated a mean difference of -17.0/hr (95% confidence intervals [CI]: -12.55, -21.36), overall effect z = 7.54, p < 0.00001. AHI standardized mean difference (SMD) = -1.09 [95% CI: -0.67, -1.51], p < 0.00001, (Cohen’s effect: large). Four studies (46 patients) reported LSAT, which improved from 80.5 ± 19.4 to 86.4 ± 5.9. Random effects modeling demonstrated an LSAT MD of 6.31 (95% CI: 0.04, 12.57), overall effect z = 1.97. LSAT SMD was 0.55 [95% CI: 0.09, 1.00], p = 0.02 (Cohen’s effect: medium). Five studies (119 patients) reported Epworth sleepiness scale (ESS), which decreased from 11.1 ± 4.5 to 8.4 ± 4.2, p < 0.0001. Random effects modeling demonstrated a MD of -3.21 [95% CI: -2.32, -4.1], overall effect z = 7.06, p < 0.00001. ESS SMD = -0.86 [95% CI: -0.21, -1.51], p = 0.009, (Cohen’s effect: large).

Conclusion: Tongue stabilization apparatus has improved polysomnography and sleepiness in adult OSA patients, with an overall reduction in AHI by 57%, increase in LSAT by 6.3 oxygen saturation points and decrease in ESS by 3.2 points

0388
MANDIBULAR ADVANCEMENT DEVICE TREATMENT ACCEPTANCE AND EFFICACY IN MILITARY VETERANS
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Introduction: Acceptance of positive airway pressure (PAP) treatment of obstructive sleep apnea (OSA) in military veterans is poor, ranging from 45 to 57%. This may be due to comorbid claustrophobia, anxiety and post-traumatic stress disorder (PTSD). Untreated OSA may perpetuate symptoms of these disorders by increasing adrenergic tone. We hypothesize that there will be a greater acceptance of oral appliances in these patients who could not tolerate PAP, which may improve PTSD symptoms.

Methods: Mandibular Advancement Device (MAD) Treatment of Obstructive Sleep Apnea in Military Veterans is a study to examine the efficacy of oral appliances in improving subjective and objective outcomes in OSA patients who previously were not able to tolerate PAP. We report preliminary data here from those patients who have completed assessment both, before and after device use.
Results: Of 56 enrolled patients, 25 completed the study protocol by December 2015, including baseline polysomnogram (PSG), fitting for a MAD, and follow-up with dental medicine. Of these, 72% (18/25) tolerated MAD, and underwent repeat PSG, whereas 28% (7/25) of participants discontinued MAD as they either felt the device was ineffective (n = 2, 8%), had side effects (n = 3, 12%) or preferred CPAP therapy (n = 2, 8%). Of those using MAD, 55% (n = 10) had an improvement in their oxygen desaturation index by at least 50% from pre-treatment ODI and to less than 10/hour and 83% (n = 15) reported improved sleepiness by the Epworth Sleepiness Scale. The average ESS in these 18 patients fell from 9.5 ± 5.8 pretreatment to 4.9 ± 3.9 with oral appliance use. PTSD was reported in 15/18 (83%) of the patients, and 8/15 (53%) reported improved symptoms of PTSD with oral appliance use.

Conclusion: Mandibular advancement devices may be better accepted by veterans that cannot tolerate PAP, and they may be effective in improving their sleep apnea, subjective sleepiness and symptoms of PTSD.


0389
COST EFFECTIVENESS OF THE THORNTON CUSTOM MASK FOR COMBINATION THERAPY TREATMENT FOR OSA
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Introduction: The purpose of this study was to investigate the cost of the Thornton Custom Mask (CM) used in combination therapy to treat OSA in patients who presented to a dental sleep center. The longevity and cost of the CM over 5 years have yet to be determined.

Methods: The CM is a CPAP face mask that is fabricated from an impression of the face. This CM is then connected to the post attached to an oral appliance. This strapless CPAP face mask features a CPAP interface with mandibular stabilization. A retrospective chart review of 75 CM patients on combination therapy from 2006-2012 was conducted in 2015 to determine the current therapeutic disposition. All 75 patients were contacted by phone and interviewed.

Results: Current status (2015): Number (total 75 patients), Unable to contact 19 (56 remaining), Still wearing Custom mask 44 (78% of contacted patients), Back to stock CPAP 5 (10%), Lost weight/OSA resolved 3 (4%), Surgery/OSA resolved 2 (4%), BAD CPAP side effect 1 (2%), Deceased 1 (2%). Device: Stock mask*, Initial $: $150, Annual $: $800 (mask/tubing), 5 yr cost: $4150. Device: CM, Initial $: $3600, Annual $: $80.00 (tubing), 5 yr cost: $3650. *AirFit™ F10 Full Face Mask.

Conclusion: The longevity of this device makes the initial cost of the device comparable to stock CPAP mask when considered how long this mask lasts. The actual life span of these masks have yet to be determined since they are still functioning after 9 years in some of these patients. Not only is a CM effective in the long term in combination therapy, especially those on the severe end of the spectrum, but is also cost effective. The CM should continue to be considered when other therapeutic methods of treating OSA have failed or when CPAP pressures or the CPAP mask are intolerable to the patient.

0390
VERIFICATION OF SELF-MOLDABLE MANDIBULAR REPOSITIONING APPLIANCES EFFICIENCY IN ELDERLY PATIENTS, MAXILLARY COMPLETE DENTURES USERS, IN TREATMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME. A PILOT PROJECT
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Introduction: Introral devices already have their space in the treatment of OSA. These devices act in the upper airway by repositioning the structures adjacent to the collapse region - namely the soft palate, the base of the tongue and the posterior wall pharynx - in order to increase the light thereof. These devices are removable, modelled individually according to the anatomical and physiological conditions of the patient, and are used exclusively for sleeping. The application of these devices in patients with full dentures often creates difficulties, specifically in the adaptation of the metal clasps, which may cause wear, scratches, and even fractures on the acrylic prosthesis. The rise in the market of self-moldable thermoplastic devices dates back to 20 years ago, and today we find some devices with a high degree of technical sophistication.

Methods: The intention is to conduct a pilot project to see if the application of pre-assembled, thermoplastic, resilient appliances, without any metal clasps, and that are self-moldable on dentures, can be a solution to the treatment of OSA, especially in elderly patients. Additionally, the pilot will test if the use of the ApneaLink Plus device for domestic polygraphies is feasible for the same type of patient. Patients: The chosen participants were four elderly patients, upper denture users, with a suspected diagnosis of OSAS. Appliances: pre-assembled, thermoplastic, self-molding, adjustable devices, called APNEA RX (Manufactured by Apnea Sciences Corporation, California / USA and distributed in Brazil by Lumiar Health Builders Hospital Equipment LTD. Domestic Polygraphies: the polygraphies were performed with the usage of ApneaLink Plus (Manufactured by ResMed Germany Inc and distributed in Brazil by Lumiar Health Builders Hospital Equipment LTD. Sessions were held before and after applying the intra-oral device (3 weeks apart).

Results: Apnea/Hypopnoea Index avg reduced from 9 to 6 e/h; min sat O2 avg increase from 79% to 82% and Epworth Sleepiness Scale avg reduced from 15 points to 9.

Conclusion: There was improvement in all evaluated items and, according to the accounts of patients, snoring was eliminated. Patients demonstrated ability to handle the devices (ApneaLink Plus and APNEA RX), with the latter having adapted particularly well to removable prostheses. In view of these observations we conclude that intraoral, self-moldable devices can be an effective alternative to elderly patients with removable prostheses. Nonetheless, conducting a study with a larger population would be important to consolidate these observations.

0391
OUTCOMES OF ORAL APPLIANCE THERAPY FROM TWO DENTAL SLEEP MEDICINE PRACTICES
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Introduction: The 2015 Clinical Practice Guideline (CPG) on oral appliance therapy (OAT) urges sleep clinicians to take patient preference into consideration when prescribing treatment for obstructive
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sleep apnea (OSA). We report outcomes from two dental medicine practices that adhere to the CPG update.

Methods: Two dental sleep medicine practices shared data on consecutive patients receiving OAT for OSA. Patient characteristics, symptom and disease severity, and outcomes of OAT were compared between practices using t-tests. Descriptive statistics report the combined response to OAT.

Results: Patients from the two sleep medicine practices (n = 18 and n = 11) were very similar for age (53.8 ± 12.8 vs 58.5 ± 14.2 years, p = 0.33), BMI (27.9 ± 4.0 vs 28.4 ± 4.4 kg/m², p = 0.75), Epworth Score (10.6 ± 3.6 vs 7.6 ± 4.3, p = 0.07) and prior CPAP experience (61 vs 64%, p = 0.90) as well as for a variety of presenting complaints. Disease severity by apnea-hypopnea index (AHI) was similar between groups (21.3 ± 12.2 vs 24.6 ± 13.9 events/hr, p = 0.51) as was response to therapy (decrease of 18.0 ± 12.1 vs 17.1 ± 13.5 events/hr, p = 0.88). For the entire group, the most common presenting complaints were snoring (90% of patients), witnessed apneas and unrefreshing sleep (52% each), gasping/choking and difficulty staying asleep (45% each), and excessive sleepiness (34%). For the entire group, OAT improved AHI a mean of 17.6 ± 13.7 events/hr and lowest O₂ saturation improved a mean of 3.2%. Of the entire group, 93% of cases improved and 52% had complete resolution of OSA by AHI. Of severe cases, resolution occurred in 50%, moderate 47%, and mild 83%. Only one mild and one moderate case did not change categories.

Conclusion: Using the new CPG recommendations, OAT improves OSA in the vast majority of cases and provides resolution of disease in half, even when OSA is categorized as severe.

B. Clinical Sleep Science

0392 PREDICTION OF OUTCOME WITH ORAL APPLIANCE THERAPY FOR OBSTRUCTIVE SLEEP APNEA USING A MANDIBULAR POSITIONING HOME SLEEP TEST

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Introduction: Selecting favorable candidates for oral appliance therapy (OAT) for treating obstructive sleep apnea (OSA) remains a significant challenge. We have evaluated the accuracy of a mandibular positioning home sleep test (mp-HST) in identifying responders to this therapy.

Methods: Participants (n = 132; ODI > 10 hr-1) underwent a two-night study with a computer-controlled mp-HST that responded to respiratory events detected in real time. All received a custom oral appliance (SomnoMed G2). The results of the mp-HST were analyzed using a prospectively established predictive algorithm, and each participant was predicted to experience therapeutic success (outcome ODI < 10hr-1) or failure. To examine the predictive utility of clinical features we applied multiple linear regression and logistic regression with and without the mp-HST algorithm. Final model selection was based on cross-validated prediction error characterized by mean square error for linear regression and areas under ROC curves for logistic regression.

Results: Predictive parameters of the mp-HST were: sensitivity: 83%; specificity: 83%; positive predictive value: 93%; negative predictive value: 65%. The selected model for linear regression prediction was the combined baseline ODI and mp-HST algorithms. For the logistic regression the best predicting model included only the mp-HST algorithms, and not any clinical features.

Conclusion: Results were similar for the two statistical predictive approaches, indicating that prediction of success or failure relied on the algorithmic test prediction alone. The mp-HST algorithm was retrospectively refined and applied prospectively in studies on 37 new participants. The predictive accuracy improved substantially (sensitivity: 81%; specificity: 100%; positive predictive value: 100%; negative predictive value: 67%). We conclude that the mp-HST predicts outcome with OAT with accuracy that enables selection of patients with OSA for this therapy. Incorporation of clinical features into the mp-HST algorithms add little to the accuracy of the selection of OAT responders.

0393 CONTINUOUS NEGATIVE EXTERNAL PRESSURE (CNEP) REDUCES RESPIRATORY IMPAIRMENT DURING CONSCIOUS SEDATION

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Introduction: Sedatives and opiate analgesics administered during endoscopy are associated with increased collapsibility of the upper airway. This may lead to respiratory impairment, with potentially serious clinical consequences. We evaluated the ability of a novel intervention, continuous negative external pressure (cNEP), to lessen the occurrence of apneas and impaired oxygenation during a commonly performed gastrointestinal procedure.

Methods: Consecutive eligible patients undergoing colonoscopy for cancer screening were enrolled in this pilot study. The initial 24 patients served as controls (no-cNEP group), while the next 30 received cNEP (cNEP group). cNEP was delivered by a soft silicone collar placed over the anterior neck. The collar was then connected to an external vacuum source. The primary outcome measure was the frequency of respiratory impairment (RI), defined as either 1) a decline from baseline of > 4% in oxygen saturation, or 2) an episode of apnea lasting > 20 sec.

Results: The no-cNEP group experienced a mean of 3.50 episodes of RI, compared with a mean of 1.92 in the cNEP group, a reduction of 45% (p = 0.022). Apneas of at least 20 sec duration occurred in 74% of the no-cNEP group and 28% of the cNEP group (p = 0.002). Differences in > 30 sec apneas were even greater between groups. As expected from its mechanism of action, obstructive apneas were reduced by more than ten-fold with cNEP, whereas there were no differences in the occurrence of central apneas. While 42% of the no-cNEP group received increased supplemental oxygen, this was true for only 10% of the cNEP group (p = 0.01). Adverse events were limited to mild and transient erythema at the contact site of the collar with the skin.

Conclusion: Sedation-related respiratory impairment is significantly reduced by cNEP, which is well tolerated by the patient. cNEP may also have applications in other situations where obstructive apneas occur, such as OSA.

Support (If Any): This study was supported by Sommetrics, Inc. San Diego, CA

0394 CCK ANTAGONISTS FOR OSA TREATMENT

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Introduction: Available pharmacological treatments for obstructive sleep apnea (OSA) are very limited as surgery and CPAP are still first line treatments. The need of new therapeutic approach in this disorder is relevant because of the low adherence and compliance to CPAP. The
neuropeptide cholecystokinin (CCK), identified within nodose gangli-
on neurons, has been proposed to act in regulating upper airway motor
and respiratory rhythm generating neurons, suggesting, together with
other observations, that CCK antagonists may be a potentially useful
treatment for OSA. This prompted us to investigate if highly potent
and selective CCK1 (Dexloxioglumide [DEX]) and CCK2 (Itriglumide
[ITRI]) antagonists could be potentially effective treatments for OSA.

**Methods:** Randomized, double-blind, placebo-controlled, 3-arm
cross-over (William design) study. Treatment periods lasted 14 days
each with a 7-day wash-out in between. On first and last day of each pe-
riod all patients underwent ambulatory polysomnography (PSG) moni-
toring. Primary efficacy criterion was Apnea-Hypopnea Index (AHI).

**Results:** 12 patients were randomized to receive ITRI (300mg/day),
DEX (400mg/day) and placebo and completed the study. Mean age
was 50 years, mean BMI 27.2 ± 2.2. AHI did not show significant
change after ITRI (41.6 ± 15.2 at the End of Treatment vs 47.1 ± 18.1
at baseline), DEX (44.2 ± 18.4 vs 40.8 ± 16.4) and placebo (42.9 ± 22.3
vs 50.4 ± 22.4). No significant effect was found for any other respira-
tory and PSG variables, except for a reduction in snoring events
(-48.6 ± 145.3 for ITRI, -35.6 ± 90.4 for DEX and 28.7 ± 96.9 for place-
bio), which reached statistical significance with ITRI during the REM
sleep stage (Dunnet p-value = 0.01). Neither adverse events, nor serious
adverse events occurred.

**Conclusion:** DEX and ITRI failed to reduce AHI compared to placebo.
No changes were induced in the sleep structure by either treatment.
A positive effect was found on snoring events/hour of sleep, which might
be worth exploring in patients with simple snoring, possibly including
higher doses.

**Support (If Any):** Rottapharm Biotech

**I. Sleep Disordered Breathing**

**0395**

**NON-SURGICAL, UPPER AIRWAY REMODELING FOR OBSTRUCTIVE SLEEP APNEA IN ADULTS WITH CRANIOFACIAL DEFICIENCIES**

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**Introduction:** Obstructive Sleep Apnea (OSA) is the most common
form of sleep disordered breathing. The causes of OSA vary, and in-
clude decreased pharyngeal muscle tone, craniofacial obesity, and cran-
iofacial deficiencies amongst others. Current methods used to manage
these characteristics include continuous positive airway pressure
(CPAP) therapy and/or mandibular advancement appliances. However,
both of these methods are life-long therapies, which may not be ap-
pealing to certain patients. Therefore, the aim of this study is to test
the hypothesis that biomimetic oral appliance therapy (BOAT) can be
used in patients who have craniofacial deficiencies for upper airway
expansion to provide optimal functioning and reduce the need for life-
long therapy.

**Methods:** This pilot study included 3 adults: 1 female and 2 males
(mean age 40 yrs.) diagnosed with mild to moderate OSA who were
treated with FDA-cleared BOAT (mRNA appliance®). Prior to treat-
ment the craniofacial region was imaged using 3D cone-beam CT scans.
After 22 months of treatment, the apnea hypopnea index (AHI) of each
study subject was reassessed, without the appliance in the mouth dur-
ing sleep, by means of a home sleep study (HST). In addition, the upper
airway volume was reassessed by a follow-up 3D cone-beam CT scans
and upper airway analysis.

**Results:** For case 1, the mean AHI decreased from 11hr-1 to 7hr-1.
Simultaneously, the upper airway volume (from the posterior nasal
spine to the epiglottis) prior to treatment was 9.28cm3 and increased to
15.9cm3, representing a 42% increase in upper airway volume. For case
2, the AHI decreased from 22.9hr-1 pre-treatment to 12hr-1 post-treat-
ment, while the upper airway volume increased from 16.7cm3 prior to
 treatment to 20.5cm3 post-treatment, showing a 19% increase in upper
airway volume. For case 3, the mean AHI decreased from 27hr-1 to
7hr-1. The upper airway volume prior to treatment was 19.7cm3 and
increased to 25cm3 representing 27.3% increase in the upper airway
volume.

**Conclusion:** This preliminary study putatively suggests that decreases
in AHI maybe associated with non-surgical, upper airway remodeling
for obstructive sleep apnea in adults with craniofacial deficiencies.
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Acknowledgements: We would like to thank Dr. [insert name] and all the sleep technicians from Tainan Hospital, Department of Health Executive Yuan, Taiwan for their kindness in supporting this study.

B. Clinical Sleep Science

0397 POLYSOMNOGRAPHIC OUTCOMES IN ADULTS WITH TONSILLAR HYPERTROPHY
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Introduction: The relationship between tonsillar hypertrophy and obstructive sleep apnea (OSA) has been well studied in children, but less so in adults. The aim of this study is to assess correlations to polysomnographic results in adults with Brodsky palatine tonsil scores of 3+ or 4+.

Methods: Adult patients with Brodsky palatine tonsil score ≥ 3+ were evaluated with polysomnography (PSG) or Home Sleep Apnea Testing (HSAT) for presence and severity of OSA. The following clinical data was collected: age, sex, race, body mass index (BMI), and co-morbid conditions.

Results: 10 patient have been studied to date, and 9/10 complained of witnessed snoring. Diagnostic PSG in 5 patients showed: total sleep time (TST) apnea hypopnea index 29.64 +/- 43.5, TST respiratory disturbance index (RDI) 40.7 +/- 38.6, supine RDI 56.6 +/- 56.7, and REM sleep RDI 50.2 +/- 56.7. HSAT in 5 patients showed: respiratory event index with 3% oxygen desaturation (REI1) 23.5 +/- 26.5, and supine REI 28.1 +/- 29.6. Across all 10 diagnostic studies oxygen saturation nadir was 82.9 +/- 5.93, and hypoxic burden (time with oxygen saturation below 90%) was 6.11% +/- 11.2%.

Conclusion: To date all patients studied had either TST AHI or REI3 > 5. Patients and data will continue to be enrolled, and assessed.

0398 MYOFUNCTINAL THERAPY FOR OSA TREATMENT
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Introduction: Myofunctional therapy for OSA treatment consists in muscle work in oropharyngeal region and functional work of stomatognatic system which goal is to enlarge the diameter of upper airway. The structures worked in therapy are tongue, soft palate, uvula, pharyngeal and suprahyoid muscles. Buccinator and orbicularis oris are also worked to facilitate lip seal and nasal breathing. The goal of the study is compare the AHI results before and after myofunctional therapy.

Methods: The sample consisted of three female patients and four males, including five with light apnea and two with moderate apnea, ages between 40 and 65 years old. The patients were evaluated by multidisciplinary team: otolaryngologists (clinical evaluation, nasolaryngoscopy, Mallampati classification and Epworth’s Sleepiness Scale) and speech therapists (structures and functions, especially breathing). They did myofunctional therapy sessions which goal was to enlarge the diameter of upper airway through muscle strengthening of oropharyngeal region and functional fit of nasal breathing. The stretching and relaxation of cervical region, nasal hygiene with saline and buccinators and orbicularis oris muscle strengthening were prioritized. Mobility and strengthening exercises focused on tongue and soft palate were performed, followed by respiratory exercises. After myofunctional therapy a new polysomnography was made for comparison of the results and reapplied the Epworth Sleepiness Scale (ESS).

Results: At the end of therapeutic proposal it was observed in seven patients better head posture; good lip seal, favoring the nasal breathing; strengthening of tongue and palatal muscles and better tongue position. Polysomnography: Patient 1: Early AHI: 10/h - Final AHI: 5.3/h. Patient 2: Early AHI: 5.2/h - Final AHI: 2.9/h. Patient 3: Early AHI: 7.7/h - Final AHI: 3.2/h. Patient 4: Early AHI: 17.2/h - Final AHI: 13.2/h. Patient 5: Early AHI: 15/h - Final AHI: 5.6/h. Patient 6: Early AHI: 21.5/h - Final AHI: 1.4/h. Patient 7: Early AHI: 13.2/h - Final AHI: 5.1/h. At ESS six patients had significant decrease and one keep the same punctuation, but report improved sleep quality.

Conclusion: Myofunctional therapy proved effectiveness in AHI decrease of studied patients. New studies are necessary, with biggest sample, different levels of AHI and a long-term follow-up.

0399 THE EFFECTS OF THRLEH INEspiratory MUSCLE TRAINER (TIMT) INTERVENTION IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME ON QUALITY OF LIFE, DEPRESSION AND SLEEPINESS SCORE
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Introduction: Currently, research on the effects of TIMT intervention on OSAS are insufficient. Therefore, the main aim of this study was to investigate the effects of it on quality of life (QOL), depression, and sleepiness in OSAS patients.

Methods: 19 newly diagnosed OSAS participants (age: 48.16 ± 11.63 years; body weight: 75.00 ± 9.97 kg; BMI: 31.90 ± 26.06 kg/m2) were recruited into the study. Each participants underwent three months of TIMT intervention (with minimum of 30 minutes training per day). The intensity of the training begin with 50-60% of the maximum inspiratory pressure. Evaluations on basic characteristics, QOL (using WHOQOL-Bref), depression level (using Taiwanese Depression Scale) and sleepiness score (using Epworth Sleepiness Scale) were evaluated before and after one month and three months of the intervention.

Results: Comparing to the baseline AHI, no significant difference found after three months of TIMT intervention (pre vs post: 23.53 ± 6.07 vs 25.11 ± 8.71 events/hours). However, the average QOL improved significantly from 58.90 ± 9.73% to 61.89 ± 9.90% after one month and reached 65.28 ± 9.35% after three months of interventions. Similarly, significant improvement were found in their physical domain (baseline: 58.50 ± 10.21; one month: 65.39 ± 8.35; three months post intervention: 68.00 ± 9.78) and also in social domain (Tw) (baseline: 60.22 ± 11.77; one month: 59.89 ± 10.15; three months post intervention: 66.64 ± 10.53). Besides that, the depression score reduced significantly after one month of intervention (baseline vs one month post intervention: 12.06 ± 7.70 vs 8.28 ± 4.50; p < 0.05). In addition, sleepiness score showed significant reduced after three months of TIMT intervention.

Conclusion: Based on the current results, TIMT intervention showed to be effective in improving the quality of life of OSAS patients. On the other hand, it helps in reducing depression and the sleepiness level of the patients.

Support (If Any): Acknowledgements: We would like to thank Dr. Cheng-Yu Lin and all the sleep technicians from Tainan Hospital, Department of Health Executive Yuan, Taiwan for their kindness in supporting this study.
I. Sleep Disordered Breathing

0400
CLINICAL ASSESSMENT OF A TRIAL PERIOD WITH A SLEEP POSITION TRAINER IN PATIENTS WITH POSITIONAL SLEEP APNEA


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**Introduction:** Positional obstructive sleep apnea (POSA) is defined as supine apnea/hypopnea-index (AHI) ≥ 2x non-supine AHI and 10-90% supine sleep. The objective of this study is to calculate the overall effectiveness of a sleep position trainer (SPT) and to determine factors that influence the decision of POSA patients to continue SPT therapy after a trial period.

**Methods:** The SPT is a small chest-worn device that vibrates when supine position is detected. The vibration stops when the patient turns to a non-supine position. A total of 105 POSA patients, diagnosed on polysomnography, underwent a two-night sleep study using a portable sleep monitor (PSM). In 83 patients (81% men, age 50 ± 10 years, BMI 28 ± 4 kg/m² and AHI 13 ± 9/hour) POSA was confirmed. Patients received the SPT for a trial period of two or four weeks. During the last nights of the trial period patients used SPT combined with PSM. Patients could decide whether or not to purchase the SPT after discussion of the PSM results. As a measure of therapeutic effectiveness, the mean disease alleviation (MDA) was calculated, being the product of the therapeutic efficacy (reduction time supine) with the adjusted compliance, divided by 100.

**Results:** After the trial period, 29 patients continued treatment with SPT. The three most common reasons for treatment discontinuation were: intolerance (n = 19), ineffectiveness (n = 13) and finding the treatment too expensive (n = 5). In the continuing patients, supine position reduced with 71 ± 31% together with an adjusted compliance of 98 ± 5%. The mean MDA in this group is 70 ± 29%. In 48% of patients AHI reduced with more than 50%.

**Conclusion:** In the group who purchased the SPT treatment for POSA was effective. The authors conclude that a trial period with SPT is of utmost importance in order to avoid that patients not benefitting from the therapy would purchase the SPT.

0401
THE SHORT-TERM OUTCOME OF A POSITIONAL DEVICE (SLEEP POSITIONAL TRAINER) FOR POSITIONAL SLEEP APNEA: A RANDOMIZED, CONTROLLED TRIAL

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**Introduction:** The therapy of positional sleep apnea has been CPAP or devices that prevents sleep supine such as the tennis ball technique. During the few last years vibrational devices has been tested and proved to be of some effect for positional sleep apnea but none of the studies has used a control group for comparison. We performed this study.

**Methods:** Open, randomized controlled trial with 2 groups i.e. a vibrational device i.e a sleep positional device (SPT) (Night Balance) that used the device in 2 months and a control group without any therapy. All participants had a cardio-respiratory test at entry and after 2 months and also completed ESS and other sleep related questions. The definition of positional sleep apnea was a total AHI of 10 or more and an AHI-supine of 10 or more and AHl-supine x2 of the AHI non-supine and an AHI non-supine lower than 10 with no upper limits of total AHI. Sleep time supine should be between 10 and 90% of total sleep time. **Results:** The mean age was 52 years (SD,11) (SPT) vs. 53 years (SD,13) for controls and there were 76 % males in the SPT group and 73 % in the control group. The total AHI at entry and after 2 months in the SPT group was 18 (SD,10) and 10 (SD,9), respectively versus 21 (SD,9) and 18 (SD,10) in the control group. The AHI supine was 35 (SD,17) in the SPT group and 38 (SD,15) in the control group at entry. The supine sleep time was 47% (SD,22) and 17% (SD,18) in the SPT group at entry and after 2 months, respectively. In the control group the supine sleep time was 48% (SD,20) at entry and 39% (SD,21) after 2 months.

**Conclusion:** Overall, there was significant reduction in both total AHI and supine sleep time after 2 months use of this SPT device and no significant changes in the control group. The dropout of 28.8% in the SPT group and 19.6% in the control group is in the same range as with CPAP.

**Support (If Any):** Maribo Medico A/S Denmark and Nigh Balance, the Netherlands provided the SPT devices (Night Balance) free of charge.

0402
LONG TERM COMPLIANCE WITH COMMERCIALLY AVAILABLE PRODUCTS FOR POSITIONAL OBSTRUCTIVE SLEEP APNEA

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**Introduction:** A significant number of OSA patients have positional sleep apnea (i.e. only present when sleeping in the supine position). Traditionally, positional therapy was done using makeshift methods such as the tennis ball technique. Unfortunately, compliance tends to be poor with this method. Recently there has been renewed interest in positional therapy using newer commercial devices such as the Zzoma positioner. This study seeks to establish long term compliance with these devices.

**Methods:** Self-reported compliance data was obtained via telephone survey 1-2 years after a positional therapy pilot program had ended. This program provided positioners (mostly Zzoma positioners) to patients who after their initial sleep study were categorized as having positional sleep apnea. Before the positioners were actually dispensed to the patients for long term use, a treatment study with the positioner was done to acclimate the patient to the therapy and to check efficacy.

**Results:** Of the 44 patients where pre- and post-positioner data was available, positional therapy reduced overall AHI from a baseline of 15.4 ± 12.4 to 3.4 ± 2.9 (P value < 0.01). 82% of patients achieved an AHI < 10 and 50% reduction in AHI from baseline. Of the 28 patients who agreed to participate in the telephone survey, only 5 (18%) reported regular nightly use of their positioners. Despite the initial trial to check efficacy and tolerability, the most common reason given for non-compliance was comfort (17 out of 23 patients who discontinued positional therapy stated that sleep became too uncomfortable to continue using a positioner).

**Conclusion:** While being highly efficacious in treating the subset of patients with positional sleep apnea, commercially available positioners have poor compliance rates. Similar to other treatment modalities for OSA such as PAP therapy, sleep medicine practitioners should carefully follow compliance of positional therapy and be prepared to provide alternative treatment options.
I. Sleep Disordered Breathing

THE IMPACT OF PSYCHOSOCIAL DETERMINANTS ON LIKELIHOOD OF SEEKING SLEEP APNEA TREATMENT
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Introduction: The prevalence of obstructive sleep apnea (OSA) among blacks is not fully captured at the community level partly because of their unwillingness to seek initial assessment of the presence and severity of OSA. We hypothesized that psychosocial factors such as anxiety and self-efficacy might affect the likelihood of seeking clinical consultation for OSA.

Methods: Data were collected from 340 participants (mean age = 59 ± 13 years, 71% female, and 45% with annual family income < $10K) who participated in the Metabolic Syndrome Outcome (MetSO) trial. This is an NIH-funded clinical trial of Blacks with metabolic syndrome who were at risk for sleep apnea. During initial interviews, patients provided socio-demographic, health risks, and history of chronic diseases. Logistic regression analysis was utilized to assess the relationship between psychosocial variables (anxiety, depression, self-efficacy, sleep apnea knowledge and stage of change level) and participants’ likelihood of adhering to physician-recommended OSA care.

Results: Results showed anxiety and treatment self-efficacy was significant predictors of the likelihood of adhering to recommended OSA consultations with a sleep clinician. Individuals with anxiety (BAI score ≥ 8) were 3.26 times more likely (95% CI = 1.07-9.94, p < 0.05) than individuals with minimal or no anxiety to adhere. With every unit increase in the treatment self-efficacy score, individuals were 13% more likely (95% CI = 1.05-1.21, p = 0.002) to adhere to recommendations. Of interest, knowledge of OSA was not a significant predictor of adherence behavior (OR = 1.02, 95% CI = 0.82-1.26, NS). Individuals with depressed moods were 66% less likely to adhere (95% CI = 0.11-1.08, p = 0.06).

Conclusion: Blacks with anxiety and/or are characterized by a high degree of self-efficacy are likely to adhere to physician-recommended OSA care. These two factors should be considered in health education programs to increase participation in OSA screening initiatives.

Support (If Any): This work was supported by funding from the NIH (ROI MD 0041), the NINDS (U54NS081765) and the NHLBI (R24HL113135).

0403
ADAPTIVE SERVO-VENTILATION IN MULTI-ETHNIC SAMPLE OF PATIENTS WITH AND WITHOUT CONGESTIVE HEART FAILURE
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Introduction: Adaptive Servo-Ventilation (ASV) is associated with increased mortality in patients with congestive heart failure and reduced ejection fraction. We evaluated the characteristics of patients on ASV therapy for central sleep apnea referred to a tertiary sleep center in South Florida.

Methods: We performed a retrospective chart review of ASV therapy for central sleep apnea from 2009-2015. We obtained demographic, vascular risk factors and reports of Congestive Heart Failure, Automatic Implantable Cardioverter-Defibrillator, Ejection Fraction, New York Heart Association Class and Polysomnography variables. Differences across sex, race-ethnic were compared with Chi-square and ANOVA. We used Spearman correlations to evaluate the bivariate associations with central apneas in our sample.

Results: A total of 56 participants with ASV were identified. The mean age was 61 ± 14 years, 79% men, 42% Hispanic/Latino, 18% non-Hispanic Black, and 29% non-Hispanic white. Hypertension was seen in 68%, diabetes 20%, coronary heart disease 36%, and heart failure in 29% (mean ejection fraction of 38%). The mean AHI was 50.4 ± 25.2 with a mean central apnea index of 17.4 ± 23.2. Men, compared to women had increased frequency of hypertension (75% vs 41%, p = 0.03), with no sex differences in demographic or cardiovascular risk factors. Compared to non-Hispanic whites, Hispanics were older (mean age 70 vs 56) and had an increased central apnea index (26 vs 6). Participants with heart failure had increased frequency of AICD and coronary heart disease (p < 0.001), with no differences in age, sex, ethnicity, BMI, ESS, hypertension, diabetes and dyslipidemia, AHI, central and obstructive apneas and arousals. Among patients with heart failure, the only significant association observed was between the ejection fraction with negative correlation with central apnea index (rho = -0.535; p = 0.22)

Conclusion: Age and ethnicity and the ejection fraction may explain the severity of central apneas in a diverse sample of patients with adaptive servo-ventilation.

0405
DESCRIPTION OF THE ADAPTIVE SERVO VENTILATION SAFETY RECALL AT A SINGLE, LARGE, ACADEMIC SLEEP CENTER
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Introduction: In May 2015, a field safety notice was issued for chronic heart failure patients treated for central sleep apnea with adaptive servo ventilation (ASV) based on results of the SERVE HF study. Given its scope and novelty, we sought to review responses to the safety notice in our center.

Methods: Retrospective review of the processes used to identify at-risk patients and outcomes of contacts with these patients.

Results: 747 potentially at-risk patients since 2005 were identified through searching of our institution’s diagnostic and billing databases. Manual chart review yielded 204 at-risk patients who were contacted primarily via a letter vetted by our Legal and Public Affairs teams, which advised immediately stopping ASV and contacting us for further guidance. Of these, 195 (189 males [97%]; mean age 74 years) were alive and still using ASV and 103 (53%) patients responded either via phone or visit in our Center. 29 patients underwent additional testing (ex: polysomnography with positive airway pressure [PAP] titration; echocardiography). Ultimately, 62 patients continued on ASV and 35 patients stopped ASV for another PAP modality, oxygen, positional therapy, some combination thereof, or no therapy. Of those that underwent additional testing, 14 (48%) patients discontinued ASV. Follow up data was unavailable for 6 patients. Qualitative analyses of the provider-patient interactions suggests that patient perceived benefit from ASV and the prior polysomnogram results on CPAP had strong bearing on decision-making regarding additional testing and therapy decision making. Of those that continued using ASV, 5 (8%) expired from July-December 2015.

Conclusion: The ASV field safety notice posed unique challenges in identifying and communicating with at-risk patients in a large academic sleep center. Through a collaborative approach we identified at-risk patients of whom only 53% responded to our contact. Of these, 60% ultimately continued on ASV.
PHASE 1 STUDY OF A NOVEL INTRANASAL POSITIVE EXPIRATORY AIRWAY PRESSURE DEVICE TO TREAT MODERATE SEVERITY OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnoea (OSA) is a condition characterised by repetitive occlusion of the upper airway during sleep. Continuous Positive Airway Pressure (CPAP) is the gold standard for treating OSA. Despite efficacy, variable patient compliance limits the effectiveness of this therapy. External nasal expiratory valves are a commercialised product, that increase resistance on expiration increasing upper airway pressure similarly to CPAP. These have shown efficacy in Randomised Control Trials but widespread usage is limited by poor comfort and tolerability. A novel prototype device has been developed, (RH003 NBV001 Rhinomed) is an internally applied nasal dilator and expiratory pressure valve designed to stent the anterior nasal airway and provide positive expiratory airway pressure, pneumatically splitting the upper airway. This device is potentially superior to externally applied valves with placement of the device in the anterior airway potentially improve device stability and enhance inspiratory flow. This phase 1 pilot study assesses the efficacy and tolerability in a series of 20 patients with moderate severity OSA.

Methods: 12 subjects have been recruited to date from sleep disordered breathing clinics with moderate severity obstructive sleep apnoea (AHI 15-29). They were evaluated for a week with a diary to evaluate baseline sleep and snoring. Subjects then trialed the device on night eight using nocturnal polysomnography to evaluate their sleep apnoea whilst wearing the RH003 NBV001. Fourteen days supply of RH003NBV001 was then provided to the patients to trial at home a diary and actigraphy to assess tolerability. Baseline subject characteristics, demographics and comorbidities were collected. Data analysed using paired t-test.

Results: Twelve subjects underwent repeat polysomnography using the PEEP device. Average age 51 (S.D. 15), BMI 31 (SD 5). There was a mean improvement of 5.6 (p 0.023) although two subjects failed to respond. Of the subjects who had a fall in AHI 5 had a fall in AHI of > 50% or to less than 5. The device was well tolerated with 80% usage.

Conclusion: Results demonstrate improvement in OSA severity and the device was well tolerated. More patients will be recruited to better identify factors that determine responders from non-responders.

Support (If Any): Financial support by Rhinomed.

CPAP THERAPY, VITAMIN D AND BONE TURNOVER MARKERS - A RANDOMIZED CONTROLLED TRIAL

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Introduction: Vitamin D deficiency has been associated with diabetes, hypertension and incident stroke, all of which are also overrepresented in patients with obstructive sleep apnea (OSA). In addition, studies have shown vitamin D deficiency to be more common in OSA patients compared with controls. The aim of this study was to investigate whether continuous positive airway pressure (CPAP) treatment could modulate serum vitamin D (25-hydroxyvitamin D (25OHD)) and bone turnover markers (collagen type 1 cross-linked C-telopeptide (CTX), osteocalcin and N-terminal propeptide of type 1 collagen (PINP)) in a randomized controlled trial.

Methods: Sixty-five otherwise healthy CPAP naïve male OSA patients (age = 49 ± 12 years, apnea-hypopnea-index (AHI) = 39.9 ± 17.7 events/h, body mass index = 31.3 ± 5.2 kg/m2) were randomized to receive either real (n = 34) or sham (n = 31) CPAP for 12 weeks. At 12 weeks, all participants received real CPAP for an additional 12 weeks.

Results: After 12 weeks of CPAP (real vs sham) there were no between group differences for any of the main outcomes (25OHD: -0.80 ± 5.28 ng/ml (mean ± SE) vs. 3.08 ± 3.66 ng/ml, p = 0.42; CTX: 0.011 ± 0.014 ng/ml vs. -0.004 ± 0.009 ng/ml, p = 0.48; osteocalcin: 1.13 ± 1.12 ng/ml vs. 0.46 ± 0.75 ng/ml, p = 0.80; PINP: 2.07 ± 3.05 µg/L vs. -1.05 ± 2.13 µg/L; p = 0.48). The results remained also in subgroup analyses (vitamin D deficient patients, CPAP compliant patients, patients with severe OSA or sleepy patients). However, the 24 week analysis, in the whole group, showed increased vitamin D in patients with severe OSA (9.56 ± 5.11 ng/ml, p = 0.045) and in sleepy patients (14.0 ± 4.69 ng/ml, p = 0.007). Also, there was a significant increase in osteocalcin at 24 weeks (3.27 ± 1.06 ng/ml, p = 0.01) in compliant patients.

Conclusion: Twelve weeks of CPAP did not increase vitamin D or modulate any of the bone turnover markers compared to sham. However, it is plausible that CPAP may have late beneficial effects on vitamin D levels and bone turnover markers in selected groups of OSA patients.
I. Sleep Disordered Breathing

significant importance on driving variables. Future research should study larger samples.

Support (If Any): FQRSC, SAAQ, FRQS

0409

BEHAVIOUR OF AUTO-ADJUSTING POSITIVE AIRWAY PRESSURE DEVICES DURING WAKE. BENCH TEST STUDY

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Introduction: Auto-adjusting positive airway pressure (APAP) devices are designed to keep delivered PAP pressures low, and theoretically more comfortable, until obstructive events dictate pressure increases. False or unnecessary pressure increases could result in discomfort for the patient and disruption from sleep. Additionally, some devices now contain automatic algorithms to sense sleep onset and delay pressure increases until this time. However no studies have looked at the behaviour of APAP devices during wake.

Methods: We developed a bench model to accurately simulate the respiration of a typical patient during wake. The model consisted of normal breathing (16bpm @ 500ml VT) for 45 minutes with randomly inserted typical events to represent changes in breathing rate, tidal volume and swallowing, as typically found prior to sleep onset. We tested this patient model on several commercially available APAP devices.

Results: There was considerable variation during the simulated wake period. Additionally, some devices incorrectly increased delivered pressure based on non-obstructive events. The APAP pressures (in cmH2O) after 45 minutes of simulated wake for each device were: Apex XT Auto: 6.9; BMC Remsmaart: 4.6; Fisher & Paykel Icon Auto (SensAwake setting on): 11.2cm; Fisher & Paykel Icon Auto (SensAwake setting off): 14.5; ResMed AutoSet for Her (Auto Ramp setting on): 4.8; ResMed AutoSet for Her (Auto Ramp setting off): 5.2; ResMed AirSense 10 (Auto Ramp setting on): 5.4; ResMed AirSense 10 (Auto Ramp setting off): 5.8; Respironics Remstar Auto: 6.5; Sefam Dreamstar: 4.0; Weimann Prisma20A: 11.7; Weimann Somnobraclance: 11.8.

Conclusion: These results suggest that APAP device behaviour during wake may influence patient’s comfort by increasing pressure, and stress the importance of monitoring the behaviour of the APAP devices during patient treatment.

Support (If Any): This work was carried out within the framework of a ResMed-University of Barcelona contract aimed at bench testing automatic CPAP devices

0410

CPAP MACHINE INACCURACY IN DETECTING RESIDUAL OBSTRUCTIVE SLEEP APNEA

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Introduction: There is mounting evidence that treatment of OSA may reduce the risk of medical complications. Despite the growing number of novel treatments for OSA, continuous positive airway pressure (CPAP) remains the gold standard. Newer generation CPAP machines monitor both compliance and the degree of residual, untreated respiratory disturbances. However, prior studies have shown that residual OSA may be common despite the use of CPAP. We sought to determine the accuracy of the apnea-hypopnea index (AHI) as measured by CPAP machines when studied simultaneously with a home sleep testing device in patients suspected of having residual OSA.

Methods: Over a 12 month period, 92 patients with suspected residual OSA underwent a single night of home sleep testing using the WatchPAT 200 (Itamar Medical, Israel) while simultaneously using CPAP. All patients were tested because of clinical suspicion of incompletely treated OSA despite CPAP use. Clinical criteria for this suspicion included significant weight gain, residual daytime sleepiness or new or worsening medical comorbidities. CPAP and WatchPAT data were then analyzed and compared.

Results: The CPAP machines registered an AHI in the normal range (mean AHI 2.1, range 0-5.5) for all 92 patients. Simultaneous WatchPAT testing revealed that 31 patients had an elevated AHI (mean 10.8, range 0-27) and RDI (mean 16.5, range 7-33). In 20 patients, the mean REM AHI was 17.6, range 9-34. There was no correlation between these discrepancies and the CPAP settings, machine brand, compliance, treatment duration or OSA severity.

Conclusion: WatchPAT AHI was significantly higher than CPAP AHI in some patients with suspected residual OSA. CPAP machines may be unreliable in detecting residual OSA. WatchPAT may be useful to evaluate clinically suspected, residual OSA in the setting of a normal CPAP AHI.

0411

INTERMITTENT POSITIVE PRESSURE STIMULATION WITH TRILOGY VS BIPAP IN THE MANAGEMENT OF OSA PATIENTS THAT FAIL CPAP THERAPY

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Introduction: Sleep apnea patients that fail to respond to CPAP therapy have very few options. Some of these patients respond to BiPAP therapy. The aim was to document the response to intermittent positive pressure stimulation (IPPS) in these patients

Methods: Patients diagnosed with obstructive sleep apnea syndrome (OSA) were titrated with CPAP. Twelve patients failed to reduce their apnea hypopnea index (AHI) below 10/hour and were evaluated for BiPAP or IPPS using a portable ventilator (Triology). One other patient with an AHI of 7/hr was included in this study for chocking and gasping episodes at night with loud snoring and excessive daytime sleepiness. An overnight PSG with BiPAP titration was performed the first half of the night and IPPS via Trilogy the rest of the night.

Results: Six patients responded well to BiPAP and 2 patients had partial response only (AHI between 7-10). The lowest AHI was over 40/hr on CPAP titration in 5 patients and over 50/hr in 2 patients on BiPAP. Nine patients responded well to Trilogy. One patient had partial response to trilogy and one patient that failed was unable to sleep secondary to ventilator alarm. The 4 patients that failed BiPAP did respond to Trilogy

Conclusion: We conclude that patients that fail both CPAP and BiPAP titration should be evaluated with IPPS. This therapy has shown to be effective even in patients with very severe obstructive sleep apnea syndrome alleviating respiratory and cardiac issues and preventing recurrent hospital admissions
B. Clinical Sleep Science

**0412**

**EFFECT OF CPAP AND OXYGEN ON OBSTRUCTIVE SLEEP APNEA: ELECTROCARDIOGRAPH-BASED CARDIOPULMONARY COUPLING ANALYSIS**

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**Introduction:** Tracking the biological effectiveness of treatment with continuous positive airway pressure (CPAP) is challenging, with subjective, polysomnographic, and device-computed data approaches. The electrocardiogram (ECG)-based cardiopulmonary coupling (CPC) analysis is a new method for assessing and tracking sleep quality and phenotyping sleep apnea. High frequency coupling (HFC) is the marker of stable breathing and sleep.

**Methods:** This is a substudy of the Heart Biomarker Evaluation in Apnea Treatment (HeartBEAT) study. The subjects were divided into three treatment groups: healthy lifestyle and sleep education (HLSE), nocturnal supplemental oxygen (NSO), and CPAP. We generated CPC parameters using the ECG available in the home sleep studies.

**Results:** The baseline and 12 week ECG-based sleep spectrogram could be computed in 214 subjects (mean age 62.1 ± 7.4 years, male 72%). The mean body mass index was 34.2 ± 6.6 kg/m², and mean apnea-hypopnea index (AHI) was 24.9 ± 8.2. AHI responders (drop to 5 or less) in HLSE, NSO, and CPAP groups were 2 (2.7%), 6 (8.5%), and 21 (30.4%) respectively. Using CPC increases of at least 5% (responders), 24/74, 29/71, and 24/69 showed improvement. Using HFC reductions of more than 5% to identify a reverse-responder (worse with treatment), there were 27/74, 28/71 and 33/69 in HLSE, NSO and CPAP groups. In the NSO group, very low frequency coupling (VLFC, a marker of REM or wake) was marginally increased after 12 weeks (14.6 ± 7.7% vs. 16.6 ± 7.2%, P = 0.041). In CPAP group, VLFC was increased (11.4 ± 5.9% vs. 17.1 ± 7.0%, P < 0.001) and narrow band elevated-low frequency coupling (e-LFCNB, a marker of pathologically elevated respiratory cheomereflex activation, was decreased, 3.9 ± 6.5% vs. 2.0 ± 4.3%, P = 0.02).

**Conclusion:** Substantial residual disease occurs after treatment with CPAP in patients enriched with cardiovascular disease and comorbidities. Various therapies have complex effects on disease, and not all are desirable.


**0413**

**USING A NOVEL CPAP DELIVERY PLATFORM TO IMPROVE COMPLIANCE IN PATIENTS DIAGNOSED WITH OSA AND CO-MORBID PTSD**

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**Introduction:** Anywhere from 11.9 to 90.0% of patients diagnosed with Post Traumatic Stress Disorder (PTSD) have co-morbid obstructive sleep apnea (OSA). PTSD patients diagnosed with OSA and prescribed continuous positive airway pressure (CPAP) are often non-compliant with therapy. PTSD patients have high rates of insomnia and wake after sleep onset at baseline, which may contribute to their CPAP intolerance. We hypothesized that a new, wake-sensing algorithm (Sensawake) that lowers pressure when wake is detected would increase comfort, improve sleep quality and increase CPAP adherence in patients with co-morbid PTSD.

**Methods:** We conducted a prospective, randomized, single-blind, cross-over study to compare standard auto-set CPAP to auto-set CPAP with the Sensawake feature added. Patients diagnosed with OSA and PTSD who are CPAP naive were approached for enrollment. Four weeks after randomization, patients crossed-over to the other treatment group, with final follow-up at eight weeks. Patients filled out clinical sleep questionnaires (ESS, ISI, FSS and FOSQ-10) at baseline and at each follow-up visit. Variables were defined using mean and standard deviation and median with interquartile range as appropriate. All statistical analyses were performed using SPSS IBM 22.1 software program.

**Results:** We enrolled eight patients with co-morbid PTSD who were initiating CPAP for the first time to treat OSA. Five patients were randomized to having Sensawake on, and three had it off to start the 8 week trial. Mean age and body mass index (BMI) were 37.6 ± 8.9 and 30.1 ± 2.7 respectively. Mean AHI was 23.5 (6.7 - 76.1) and the majority (5/8 (62.5%)) had moderate-to-severe disease. Average McCord score was 50.0 ± 13.1, and 78 (87.5%) had moderate-to-severe PTSD. All patients had an Epworth Sleepiness Score (ESS) ≥ 11, and 4 had moderate to severe insomnia. At 4 weeks, patient’s average AHI with Sensawake on was 1.8 (0.6-18/85/hr, down from 19.6 (7.9-63.1)/hr on initial PSG. After 4 weeks with Sensawake on the patients used their machines for 5.0 ± 1.9 hours per night, ESS dropped from 12 ± 6.0 to 4.0 ± 2.6 and FOSQ went from 24 ± 9.0 to 31.3 ± 2.5.

**Conclusion:** Initial data from our study show that Sensawake is well tolerated and that it normalizes AHI. Adherence rates are significantly higher that what has been previously in the literature for patients with co-morbid PTSD. Significant improvements in symptoms were also noted.

**Support (If Any):** Fishel Paykel provided 50 CPAP machines and a $5000 stipend for travel. They helped design the study but have had no role in data analysis.

**0414**

**APNEA BURDEN: A DECISION ANALYSIS FRAMEWORK FOR EXTENDING COVERAGE TO PAP-USERS NOT MEETING STANDARD COMPLIANCE CRITERIA**

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**Introduction:** Although positive airway pressure (PAP) is the gold standard treatment for obstructive sleep apnea (OSA), many patients find compliance challenging; insurance criteria require > 4 hours per night on > 70% of nights. Prior work revealed that while some patients exhibit immediate resumption of OSA during off-PAP sleep, other patients exhibit a delayed resumption over days. Home monitoring is predicted to inform “benefit” more than routine usage data by assessing each OSA patient’s apnea burden phenotype.

**Methods:** The decision tree (TreeAge software) compared standard of care with an alternative model based on objective home monitoring to define individual apnea burden (apnea hypopnea index as a weighted average of on-PAP and off-PAP time). The adult population is assumed to use PAP but not meet standard compliance criteria. In the standard of care arm, non-compliant patients are offered alternative therapy (dental appliance or surgery). In the intervention arm, a portion of patients with low apnea burden despite partial PAP use are allowed to remain on PAP therapy. We used Markov cycles for mortality and cardiovascular events over a 10 year time-horizon and different willingness to pay (WTP) thresholds.

**Results:** At low costs of home monitoring ($150 per person), the intervention was cost-effective even at low WTP of $10,000 per quality adjusted life year (QALY), as long as the probability of immediate OSA resumption was < 70%, and this held for annual costs of untreated OSA from $100-2000/yr. Interestingly, for lower WTP, and higher cost alternative therapies (e.g., surgery), the apnea burden approach was broadly...
favored because it saves some patients from seeking more expensive alternatives to PAP.

Conclusion: Apnea burden assessment is a cost-effective alternative to standard compliance monitoring, given plausible ranges of key variables. Clinical trials validating home-monitoring and apnea burden phenotyping are needed to assess real-world application of this approach.

Support (If Any): Department of Neurology, Massachusetts General Hospital

0415
IMPACT OF EARLY INITIATION OF CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) FROM THE INITIAL SLEEP EVALUATION ON CPAP COMPLIANCE

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Introduction: Studies have shown that Continuous Positive Airway Pressure (CPAP) compliance is established in the early course of the treatment. However, there has been only a few studies done looking for factors that would affect the early CPAP compliance before the initiation of CPAP. We hypothesize that early CPAP compliance can be improved if the duration between the initial sleep evaluation and the CPAP start date is minimal.

Methods: We did a retrospective review of the clinic follow up data sheet and patient’s chart for a period of 1 year. Only patients with a new diagnosis of Obstructive Sleep Apnea (OSA), who had at least 3 initial clinic follow up visits or at least 6 months of CPAP usage were included. Patient’s sex, Apnea Hypopnea index (AHI), CPAP start date, follow up visit dates and compliance data were documented. The CPAP start date was obtained and recorded using a CPAP set up form.

Results: 58 patients met our inclusion criteria. 36/58 patients had CPAP start date less than 3 months and 2 weeks (average 100 days) from the initial visit, out of which 31 (86.1%) were compliant and 5 (13.9%) were non-compliant with CPAP. 22/58 patients had CPAP start date more than 3 months and 2 weeks from the initial visit, out of which 11 (50%) were compliant and 11 (50%) were non-compliant with CPAP. The results were statistically significant with p value < 0.005.

Conclusion: Our study shows that if the duration between initial evaluation and CPAP start date is minimal, early CPAP compliance can be increased significantly. We presume that this would give patients more effective teaching which in turn will improve early CPAP compliance. Effective communication with the DME company for early CPAP set up date should be emphasized.

0416
COMORBID MILD TRAUMATIC BRAIN INJURY AND POST-TRAUMATIC STRESS DISORDER DECREASE ADHERENCE TO POSITIVE AIRWAY PRESSURE IN VETERANS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Adherence to positive airway pressure (PAP) therapy for obstructive sleep apnea (OSA) can be challenging. Among US Veterans, OSA is often comorbid with traumatic brain injury (TBI), and/or post-traumatic stress disorder (PTSD). Since disrupted sleep may worsen functional outcomes in both TBI and PTSD, it is important to understand how these comorbid diagnoses may modulate adherence to PAP and treatment outcomes.

Methods: Participants diagnosed with OSA and prescribed PAP therapy were consented at a single institution over a 6-month period at the time of the overnight sleep study. Baseline and follow-up symptom data were assessed using validated questionnaires on sleep, quality of life, and mood (Epworth, ISI, FOSQ-10, NIH PROMIS Global Health-10, PHQ-9, PCL-5, and Rivermead). Sleep-related symptoms and differences in adherence to PAP therapy were analyzed using two-way Analysis of Variance (ANOVA).

Results: At the time of data analysis, adherence data at 6 weeks after the start of PAP therapy was available for 8 participants with TBI, 17 with PTSD, 12 with both TBI and PTSD, and 30 with neither condition. During the first week of PAP therapy, adherence did not significantly differ among groups. However, after 6 weeks of PAP use, those with comorbid mild TBI and PTSD showed significantly decreased PAP use across all days, compared to participants with neither condition (159 ± 37 minutes versus 235 ± 27 minutes, respectively, p = 0.02).

Conclusion: Data analysis at this early stage suggests greater difficulty in adherence to PAP therapy in Veterans with comorbid mild TBI and PTSD, compared with those with neither condition. Adherence problems at the later time points of PAP therapy may indicate learning or motivational challenges in this vulnerable population; specific interventions addressing these barriers may improve treatment response. Ongoing analyses will examine 3, 6, and 12 month PAP adherence and symptom outcomes.

Support (If Any): VA OAA Nursing Postdoctoral Fellowship to KBW; VA CDA # IK2 BX002712, the American Sleep Medicine Foundation, and the Portland VA Research Foundation to MML.

0417
PREFERRED FOLLOW-UP METHOD OF POSITIVE AIRWAY PRESSURE MANAGEMENT IN A VETERAN POPULATION

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Introduction: The American Academy of Sleep Medicine (AASM) and Department of Veterans Affairs (VA) are increasingly promoting the use of telesleep medicine to improve patient access amidst growing patient volumes and shortage of sleep providers. PAP (positive airway pressure) modem technology has potential to improve compliance, allow timely management, and increase user satisfaction given greater access to patient data. There is scant data on veterans’ attitudes toward this technology and its utilization within a patient-centered model of care.

Methods: We conducted an in-person, anonymous survey on consecutive veterans presenting for initial device setup and training to the VA PAP clinic between December 2014 and July 2015. Surveys assessed patient demographics, follow-up preferences (modem, mail-in data card, or undecided), and value placed on factors such as convenience, information privacy, and recommendation from provider or other persons - all rated on a scale of 1 (least) to 7 (most important).

Results: A total of 444 respondents completed all survey items. Respondents were primarily male (91%). The mean age was 51.7 (range 20-92). Commute times to VA PAP clinic were within 30 minutes (25%), 30-60 minutes (43%), or more than 60 minutes (32%). Median responses on values were convenience (6), information privacy (5), provider recommendation (5), and recommendation from other persons (4). The majority (47%) of veterans preferred modem, 38% preferred mail-in, and 15% were undecided. Multinomial logistic regression showed
that veterans’ value rating of convenience was significantly associated with modern preference (unadjusted RRR 1.56, 95% CI 1.32 - 1.84, p < 0.001). This association remained significant after adjusting for value ratings of privacy, value, and demographic variables (adjusted RRR 1.67, 95% CI 1.40 - 1.99, p < 0.001).

Conclusion: The majority of surveyed veterans prefer follow-up by data transmission via PAP modem, and this preference is significantly associated with a value on convenience independent of other assessed values and demographics.

Support (If Any): The views expressed here are those of the authors and do not reflect the position or policy of the Department of Veterans Affairs.

0418
ADHERENCE TO POSITIVE AIRWAY PRESSURE THERAPY WITH A STRUCTURED ADHERENCE PROGRAM
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Introduction: Adherence can be influenced by patient and disease characteristics, therapy titration procedures, therapy technology and side effects, and psychological and social factors. Without structured interventions to address therapy issues, adherence to CPAP can be low.

Methods: A retrospective evaluation of a structured Adherence Management program for patients with OSA was undertaken. The aim of the study was to compare adherence in a cohort of structured intervention patients to a random group of non-program patients. Patients included in the analysis were either in a structured Adherence Management program (N = 4383) or were randomly selected from a database (EncoreAnywhere, Philips Respironics, USA) (N = 54,455). In the Adherence Management group, participants were contacted within the first 5 days of treatment and were “coached” based on the level of adherence seen in EncoreAnywhere, using a proprietary, tailored behavior program. The control group was matched based on the first day of treatment of the Adherence Management patients. To be included in the analysis, all patients had to have a modem on their device and have been entered into the EncoreAnywhere database for 90 days. The Adherence Management participants were treated between March of 2013 and December of 2014.

Results: Adherence at 30 days was significantly higher in the Adherence Management group with respect to average hours of use on all days (5.3 ± 2.4 vs. 4.4 ± 2.7 hrs/night, p < 0.001). At day 90, based on CMS adherence criteria, 63.1% in the control group were adherent compared to 79.5% in the adherence management group (p < 0.001).

Conclusion: A structured Adherence Management program tailored to patient-reported problems and therapy use can have a favorable impact through the first 90 days of treatment. Further evaluation comparing the Adherence Management protocol to a typical home care provider standard of care is warranted.

Support (If Any): This study was supported by Philips

0419
OBSTRUCTIVE SLEEP APNEA SEVERITY AND PAP COMPLIANCE IN ATRIAL FIBRILLATION PATIENTS
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Introduction: Obstructive Sleep Apnea (OSA) is highly prevalent in patients with atrial fibrillation and successful treatment has been shown to reduce morbidity in this high-risk group. This study evaluates the effect of OSA severity on treatment compliance.

Methods: Database search for all active patients in 2014 with a diagnosis of both atrial fibrillation and OSA was performed. EMR records were reviewed for sleep study variables (Apnea-hypopnea index -AHI), the prescribed PAP device, and PAP compliance. The OSA diagnoses were categorized into 3 categories based on the patients’ AHI. An AHI of > 5 to 15 was considered “Mild”. An AHI of 15 to 30 was considered “Moderate”. An AHI of 30 or more was considered “Severe”. PAP therapy compliance data at 3 months was reviewed. Patient was characterized as compliant if PAP device usage of 4 or more hours for 70% or more of the nights was present. Chi-square test was performed to compare the three OSA groups for compliance.

Results: A total of 192 patients met inclusion criteria. Mild OSA was observed in 35 patients, moderate OSA in 52 patients and severe OSA in 105 patients. Among patients who were started on therapy, 95% were on CPAP and 10% were on BiPAP. There was a statistically significant difference in PAP compliance across OSA severity groups (Mild 45% vs Moderate 61% vs Severe 67%, P-value 0.03).

Conclusion: Severe OSA patients were more compliant with PAP as compared to mild OSA patients; there is a significant upward trend in compliance with increasing OSA severity. As even mild OSA can affect atrial fibrillation outcomes, barriers to treatment compliance in this group need to be evaluated.
0421
DOES EXPIRATORY MOUTH LEAK DURING CPAP TITRATION PREDICT NON-ADHERENCE IN OSAS PATIENTS?

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Introduction: The aim of this study is to compare Expiratory Mouth Leak (EML) during CPAP titration in the adherent and non-adherent OSAS patients.

Methods: Retrospective analysis was done for 29 patients who had moderate-to-severe OSAS and received full night of PSG recording and CPAP titration. Twenty-nine patients (age: 63.2 ± 12.5 [mean ± SD] years, body mass index [BMI]: 25.7 ± 4.9 kg/m2) were divided into adherence group (n = 16, F1;M15) and non-adherence groups (n = 13, F2;M11) according to the cut-off criteria with an average CPAP usage > 4 hours per night for the first 30 days. Sleep and respiratory variables were scored according to the standard method for the diagnostic and CPAP titration PSG data. For the data on the CPAP titration night, EML was scored as ‘truncated’ expiratory CPAP flow with a nasal mask. EML Period (EMLP) was assessed as the percentage of total sleep time. In addition, 4 types of EML with arousal (post-event EML), during-event EML, Spontaneous Arousal (SpAr) related EML and EML pre SpAr) were counted and index per hour of sleep was calculated.

Results: Adherence and non-adherence groups did not differ for age, sex, and BMI. Adherence group used CPAP significantly longer (5.4 ± 0.8 hours per night) compared to non-adherence group (2.3 ± 1.0 hours per night) (p < 0.001) although CPAP pressure did not differ between the two groups. Two groups did not differ for sleep and respiratory variables on the diagnostic PSG and CPAP titration nights. However, SpAr related EML occurred more frequently in non-adherence group (1.34 ± 1.16/hour) than in adherence group (0.47 ± 0.38/hour) (p = 0.014). No significant difference was found for other types of EML with arousal and EMLP.

Conclusion: Frequency of SpAr related EML can be associated with a low CPAP adherence in OSAS patients

Support (If Any): The study was supported by JSPS KAKENHI Grant Number 15K19260 and TEIJIN HOME HEALTHCARE LIMITED.

0422
DIFFERENTIAL CHARACTERISTICS OF WOMEN AND MEN ADHERENT AND NON-ADHERENT TO TREATMENT FOR SLEEP APNEA

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Introduction: Obstructive sleep apnea, known to be common among older adults, goes mostly unrecognized, particularly among women. In a prospective study, we recruited older adults, not previously suspected of having sleep apnea, from two family medicine clinics. The present report describes gender differences and similarities in treatment adherence at 2-year follow-up.

Methods: Participants were 31 older women and men (n = 19 and 12, respectively, mean age = 58) who were diagnosed with sleep apnea in the course of the larger study (n = 180). At recruitment, they underwent polysomnographic screening and completed the Sleep Symptom Checklist (SSC), a 21-item survey of a broad range of symptoms that fall into 4 subscales: Insomnia, Daytime Distress, Sleep Disorders, and Psychological Distress. The 31 participants who reached the 2-year follow-up were asked about treatment adherence.

Results: In the larger study, 75% of women and 85% of men received a sleep apnea diagnosis. Their apnea/hypopnea indices (AHI) were similar (women = 29 and men = 34). For those participating in the present 2-year follow-up, women generally had a higher AHI at recruitment than men (37 vs. 24, respectively). At follow-up, more women had adhered to treatment than men (47% vs. 25%, respectively). There were no differences in AHI between adherers and non-adherers regardless of gender. In general, the women had reported worse symptoms on the SSC at recruitment: Adherent women had worse Sleep Disorder symptoms at recruitment than non-adherers and all men. There were no differences in SSC scores between male adherers and non-adherers.

Conclusion: Of those available for follow-up, women had more severe AHI and reported symptoms at recruitment, as compared with men. Importantly, a greater percentage of women were found to have adhered to treatment. This study signals the need for greater awareness of and attention to sleep apnea screening and treatment for women in primary care.

Support (If Any): Canadian Institutes of Health Research
Conclusion: Excellent 1 month CPAP compliance can be achieved in older adults with equivalence clinical outcomes when delivered as part of a patient focused protocol focusing on the first four weeks of therapy. This was much higher than that reported in the Predict study suggesting that the method of CPAP initiation is a key component of treatment success in this age group.

Support (If Any): University of Otago, Wellington Research Grant

0424
IMPLEMENTATION OF A GROUP INTERVENTION FOR CPAP ADHERENCE IN A VA BEHAVIORAL SLEEP MEDICINE CLINIC
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Introduction: Sleep apnea is prevalent in U.S. military veterans and associated with significant morbidity and mortality. Although CPAP is an effective treatment for sleep apnea, many patients are non-adherent due to psychological factors (e.g., claustrophobia/anxiety, low motivation). We investigated the clinical effectiveness of a CPAP adherence intervention for veterans.

Methods: Veterans were referred to the Durham VAMC Behavioral Sleep Medicine clinic by their Sleep Apnea provider or other medical provider for assistance with CPAP adherence. Fourteen group cohorts between September 2012 and July 2015 were evaluated. Groups were 1-hour weekly sessions (4 or 6 weeks), consisting of an average of 7 participants (range = 3 - 13). The intervention, delivered by CBMS psychologists, focused on graded exposure therapy for CPAP-related claustrophobia, but also included educational, motivational, and cognitive-behavioral components. Outcomes included self-report questionnaires (Epworth Sleepiness Scale [ESS] and Likert ratings of the importance of using CPAP and self-confidence in using CPAP) and objective CPAP usage data from Respironics Encore Pro® database when available.

Results: Ninety seven veterans (88% male; mean age = 60.1 years, SD = 8.4, mean AHI = 34.8, SD = 27.2) attended an average of 75% of sessions. Repeated measures analyses on treatment completers showed significant improvement from baseline to follow up on ESS (n = 32), but not other outcomes. Veterans rated the importance of using CPAP highly both before and after treatment. Self-confidence ratings increased in 72% of treatment completers. Of those with Encore Pro® data (n = 23), 52% increased the percentage of nights they used CPAP (from 32.0% to 67.4%) and 57% increased the average number of hours of nightly CPAP use from 3.2 hrs. to 4.5 hrs.

Conclusion: These preliminary analyses suggest the potential utility of a group-based CPAP adherence intervention. Ongoing data collection will allow further inferences regarding objective CPAP usage and refinement of the intervention.

Support (If Any): This material is the result of work supported with resources and the use of facilities at the Durham VA Medical Center, and was supported in part by CDA Award (#09-218) from the United States (U.S.) Department of Veterans Affairs Health Services Research and Development Service. The contents do not represent the views of the U.S. Department of Veterans Affairs or the United States Government.

0426
PAP ACCEPTANCE DEPENDS ON TYPE OF DIAGNOSTIC STUDY IN VETERANS
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Introduction: Previous studies show that the adherence rates to PAP are poor in OSA patients. However, there is little known about the factors that predict PAP acceptance among individuals diagnosed with OSA. This study examined whether type of diagnostic sleep study (i.e., in-lab baseline, at-home baseline, in-lab split) predicted the likelihood of picking up a PAP device.

Methods: Undiagnosed veterans (N = 491; mean age = 51.83, SD = 13.48; 92.6% male; 58.3% white, 41.7% black) completed either an in-lab baseline, at-home baseline, or in-lab split study. Logistic re-
PAP-NAP: ANOTHER APPROACH TO IMPROVE CPAP TOLERANCE AND COMPLIANCE

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Introduction: The treatment with PAP remains the gold standard approach in patients with sleep disorder breathing. There are multiple challenges that interfere with the long-term success of this therapy. Therefore, it would be helpful to find another approach to improve the success of this therapy. We describe Pap-Nap as a successful approach to overcome these challenges.

Methods: The patient completes a Mental Imagery Selective Survey (MISS-7) and a Nasal Obstructions Symptoms Evaluation (NOSE). The questionnaires are reviewed and an interview is conducted to verify the patient has followed pre PAP-Nap instructions. Cognitive behavioral therapy (CBT) techniques are used for mask and pressure desensitization. Once patients reach a level of comfort with mask and pressure, sensors are applied, patient is escorted into the bed, and assumes a sleeping position with mask on and pressure set low for comfort. A modified PSG montage is used. The study is initiated and the PAP-Nap titration begins. After “lights out” PAP-NAP is treated as a mini-titration. Pressure changes to achieve optimal airflow are made while considering patient comfort, which usually results in smaller increases in pressure. The PAP-NAP last 60-120 min. Exposure to PAP therapy with a working head start towards identifying optimal pressures is the goal.

Results: A total of 80 patients were diagnosed with sleep disorder breathing between 2013 and 2015 and underwent Pap-nap protocol. There were 25 Patients lost for follow-up. There were 44 patients that became tolerant and compliant with the CPAP. Meanwhile, 11 patients did not tolerate CPAP and were treated with an alternative therapy. This indicated that 80% of CPAP intolerant patients were successfully treated with this approach.

Conclusion: Pap-nap protocol is an effective approach to treat patients who are intolerant to CPAP. The efficacy of this approach is well maintained over time.
0430
DOES A PAP-NAP EXPERIENCE IMPROVE CPAP ADHERENCE?
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Introduction: The benefits of continuous positive airway pressure (CPAP) are limited by poor adherence to therapy. A deliberate mask fitting during a daytime appointment with a nap opportunity while wearing CPAP (PAP-Nap) may boost patient confidence in using CPAP at home. We hypothesized that patients experiencing a PAP-Nap would demonstrate improved CPAP adherence.

Methods: Information on demographics, anthropometrics, and symptoms was collected from a convenience sample of patients in a single sleep facility. CPAP adherence was measured by embedded recorders in CPAP-devices. All patients received prescribed CPAP and orientation to CPAP from the same vendor. Comparisons were made using t-tests between patients who had and those who had not received PAP-Naps.

Results: PAP-Nap patients (n = 10) were similar to Non-PAP-Nap patients (n = 13) for age (45.3 ± 6.1 vs 46.8 ± 15.9 years, p = 0.79), % men (60% vs 85%, p = 0.20), BMI (30.5 ± 5 vs 31.3 ± 6.4 kg/m², p = 0.87), fatigue (10-point scale, 5.8 ± 1.3 vs 5.7 ± 3.1, p = 0.96), Epworth score (24-point scale, 11.2 ± 5.3 vs 7.9 ± 3.9, p = 0.11), and apnea-hypopnea index (43.1 ± 26.2 vs 31.1 ± 17.3 events/hour, p = 0.20) and CPAP level (9.2 ± 2.0 vs 8.7 ± 2.4 cmH₂O, p = 0.62). CPAP adherence did not differ between groups, specifically % of nights worn (PAP-Nap 86.7 ± 22.6 vs Non-PAP-Nap 82.2 ± 17.6%, p = 0.59) and average hours on days used (5.7 ± 1.7 vs 6.1 ± 1.5 hours, p = 0.54).

Conclusion: The PAP-Nap experience did not correlate with improved CPAP adherence in this sample of patients. A randomized, controlled trial may be necessary to demonstrate the value of a PAP-Nap experience. Additional variables not measured in this sample should be considered in future trials.

0432
CPAP ADHERENCE IS ASSOCIATED WITH IMPROVED VIGILANCE IN MODERATE TO SEVERE OSA PATIENTS
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Introduction: Obstructive Sleep Apnea (OSA) is a serious medical condition with adverse effects on health and cognitive function. The prevailing treatment for OSA is positive airway pressure (PAP), but benefits depend on regular use. Our goal was to investigate the relationship between PAP adherence and sustained attention in OSA patients.

Methods: Treatment adherence was determined from PAP usage data. Participants in the Self-Management (SM) group were provided standard education about their diagnosis and treatment at baseline in combination with self-management education, whereas participants in the Usual Care (UC) group were provided with standard education only. Follow-up visits were held one and six months from start of treatment. Standardized questionnaires and a sustained attention test (Psychomotor Vigilance Task) were administered to participants at study visits.

Results: There was a significant between-group difference in terms of PAP adherence at one-month time point (UC = 2.8h; SM = 3.9h; p < 0.01), with participants in the SM group using their PAP units an average of 1.1h more per night than participants in the UC group at one-month. The SM group used their machines 0.4h more on average at the six-month time point (UC = 2.5h, SM = 2.9h), but the difference was not statistically significant. PVT RT did not differ significantly at 1-month (UC 396 ± 186, SM 350 ± 139 (p = 0.08)), but RT differences were significant at 6-month (UC 366+174,309+77 (p 500ms) differed significantly between groups at 1-month (R² = 0.07, p < 0.005) and 6-month (R² = 0.12, p < 0.005).

Conclusion: Our results suggest that PAP adherence is associated with significant improvements in vigilance as early as one month after treatment and this effect persisted at six months. Our data support the hypothesis that treatment adherence provides greater symptom alleviation as well as attentional improvements in moderate to severe OSA patients.
LONG-TERM FOLLOW-UP OF SLEEP APNEA SYNDROME (SAS) PATIENTS IN A SINGLE-CENTER (ONSLEEP REGISTRY)
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Introduction: Sleep Apnea Syndrome (SAS) is precisely diagnosed by overnight polysomnography (PSG). If it is indicated, SAS patients could be properly treated by using Continuous Positive Airway Pressure (CPAP). However, the prognosis of patients with SAS, apnea-hypopnea index (AHI) ≥ 5, and the benefits of CPAP treatment in such patients, have not been investigated in a large patient cohort. CPAP treatment has been recommended to those with AHI ≥ 15, yet clear evidence for the most appropriate level of AHI at which to start CPAP is lacking.

Methods: We enrolled all subjects (n = 10,856) who were evaluated by PSG, during September 1990 to December 2010, at the Nakamura Clinic, Okinawa, Japan (the ONSLEEP registry). Outcomes of these patients were confirmed by medical charts, letters, and telephone calls. Follow ups were from the date of PSG to the last visit of 2014, dates of response to mail or telephone, or death - whichever came first. We excluded those who already used CPAP or devices to assist respiration at baseline, those who were lost to follow-up after PSG, those with central type SAS and those age less than 20 years old.

Results: We analyzed a total of 8,176 patients with SAS after PSG (79% men; mean age 51.1 years). The total follow-up period was 45,250 patient-years and the mean observation period was 5.5 years. During the observation period, 356 patients died and the death rate was 7.9 per 1,000 patient-years: 8.9 (AHI 5 to less than 15), 12.2 (AHI 15 to less than 30) and 20.0 (AHI ≥ 30) in those without use of CPAP treatment; and 6.6, 5.1 and 6.8, respectively, in those using CPAP (n = 4,607). Causes of death were: cardiovascular disease (33%), malignancies (23%), infections (14%), respiratory disease (10%), a traffic accident (1%), others (9%), and unknown (10%).

Conclusion: The present study supports the strategy of CPAP treatment, at least for severe SAS patients.

PREDICTORS OF LONG-TERM USE OF CONTINUOUS POSITIVE AIRWAY PRESSURE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA IN A SINGLE INSTITUTION IN OKINAWA
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Introduction: The Japanese national health insurance to reimburse continuous positive airway pressure (CPAP) therapy for the treatment of obstructive sleep apnea (OSA) stipulated an apnea-hypopnea index (AHI) ≥ 20/hr and required the monthly institutional visit since 1998. Thereafter, the number of CPAP user has soared. But the investigations is lacking.

Methods: We analyzed a total of 8,176 patients with SAS after PSG (79% men; mean age 51.1 years). The total follow-up period was 45,250 patient-years and the mean observation period was 5.5 years. During the observation period, 356 patients died and the death rate was 7.9 per 1,000 patient-years: 8.9 (AHI 5 to less than 15), 12.2 (AHI 15 to less than 30) and 20.0 (AHI ≥ 30) in those without use of CPAP treatment; and 6.6, 5.1 and 6.8, respectively, in those using CPAP (n = 4,607). Causes of death were: cardiovascular disease (33%), malignancies (23%), infections (14%), respiratory disease (10%), a traffic accident (1%), others (9%), and unknown (10%).

Conclusion: The present study supports the strategy of CPAP treatment, at least for severe SAS patients.
**0436**

**STRATEGIES TO IMPROVE PAP COMPLIANCE IN VETERANS: EXPERIENCE FROM VAMC, MILWAUKEE**

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**Introduction:** Obstructive Sleep Apnea (OSA) is a common disorder in veterans with reported prevalence of up to 36%. Untreated OSA is associated with loss of productivity, higher risk of motor vehicle accidents and increased morbidity and mortality. Positive Airway Pressure (PAP) therapy is recommended as first line treatment for OSA in adults. However, compliance to PAP therapy remains a major challenge in clinical practice. Veterans Affairs Medical Center (VAMC), Milwaukee implemented new PAP program in Oct 2013 targeted at improving compliance. Outcomes of this intervention are presented here.

**Methods:** This is a retrospective chart review study. We compared patterns in compliance between Jan-Jun in 2013 and Jan-Jun in 2014; High compliance is defined as usage ≥ 4hrs for at least 70% of nights. Base-line PAP program included: (A) Individual in-hospital setup, or in-home setup by vendor; (B) Oral education about OSA; (C) Instruction at time of set-up to mail data card in one month; (D) Addressed envelopes for data card mail-in at time of set-up. New PAP program included: (A) Individual in-hospital setup, or in-home setup by vendor; (B) Oral as well as written patient education about OSA; (C) Written sleep hygiene education; (D) Quarterly calls to DME vendors by a VA respiratory therapist to ensure uniformity in services provided through in-hospital and in-home setup; (E) “Reminder calls” to veterans in one week and “reminder calls” in three weeks for data card mail-in; (F) Pre-paid addressed envelopes for data card mail-in.

**Results:** 1) Data card return rate increased from 55% in 2013 to 93% in 2014; 2) High compliance increased from 48% in 2013 to 82% in 2014

**Conclusion:** Individualized PAP program strategies and closer follow-up are associated with improved PAP compliance in veterans.

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**0437**

**ASSOCIATION OF CPAP ADHERENCE WITH OSA PATIENTS’ ACTIGRAPHIC DAYTIME ACTIVITY**

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**Introduction:** Obstructive sleep apnea (OSA) is a significant cause of excessive daytime sleepiness (EDS). OSA patients who struggle to stay awake during the day are at risk of motor vehicle and other work-related incidents. Positive airway pressure (PAP) is the gold-standard OSA treatment. Given that self-reported sleep/wake (S/W) habits are commonly inquired when assessing EDS, the goal of our study was to examine whether the use of PAP improves the ability to stay awake during the day based on objective actigraphic measures of daytime activity.

**Methods:** 58 Veterans diagnosed with OSA (AHI ≥ 10 events/h) underwent Polysomnography (PSG) before and after PAP therapy to evaluate changes in sleep architecture. A subgroup of 39 participants also wore an ActiWatch (AW) before initiating PAP. 16 completed actigraphy after 1 month of PAP use ($8 \pm 2.26$ AW days pre-PAP, $8 \pm 3.43$ AW days post-PAP). All subjects used autoPAP and compliance was obtained from device downloads.

**Results:** While the change in daytime activity (wake state duration) pre- and post-PAP use was not significant ($p = 0.357$), we found a strong positive correlation ($r = 0.633$) between the change of patients’ activity (16.5% increase) and PAP adherence (4.41 ± 1.57 h/day). This finding suggests that greater PAP adherence is associated with greater daytime activity, possibly due to a reduction in daytime sleepiness.

**Conclusion:** Self-reported health assessments used by clinicians may be unreliable and subject to bias. PAP card downloads include compliance parameters and approximate sleep times. Actigraphy tracks a patient’s sleep/wake patterns continuously for 24-hours a day for up to several weeks in their home environment. The use of actigraphy to improve PAP adherence by providing objective measures of activity levels is a novel approach to personalized OSA care and warrants further investigation.

**Support (If Any):** Department of Veterans Affairs Clinical Services Research and Development
0439
THE INFLUENCE OF RACE AND DEPRESSION ON THE TRAJECTORY OF PAP USE DURING THE FIRST 12 WEEKS OF TREATMENT
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Introduction: Studies have shown that blacks use positive airway pressure (PAP) 1 hour less than whites. In addition, a higher burden of mental health symptoms has been reported in black relative to white veterans. However, limited research has examined the association of race and depression in the trajectory of PAP use. Our aim was to determine if depression influenced the trajectory of PAP adherence differentially in black relative to white veterans.

Methods: Consecutive PAP-naive OSA patients (n = 234, 41% black) attended the Miami VA sleep clinic to receive PAP (52% CPAP, 30% APAP, 18% Bilevel PAP) and complete baseline questionnaires. Depression diagnosis was per chart review evidence of active treatment in the 6 months preceding PAP initiation. Patients returned for follow-up and adherence download. Outcomes were weekly averages of PAP use (mins). Models were fitted for the initial 12 weeks of treatment and time-centered at week 1. We used longitudinal multi-level modeling to characterize the influence of race by depression on the trajectory of this outcome. Models were adjusted for relevant covariates (age, Charlson Index, OSA severity, insomnia, PAP type, and pressure).

Results: During the first week, blacks without depression had less average PAP use compared to white veterans without depression (181 vs 268 mins, p < 0.01). Initially, the relationship between race and PAP adherence did not vary by depression status. However, the rates of change of PAP use differed significantly between blacks and whites based on depression status. Over the 12 weeks, blacks with depression showed a significantly steeper decelerating trajectory of PAP use than whites with depression.

Conclusion: These data demonstrate that although depression influences blacks and whites equivalently in initial PAP adherence, blacks with depression have a more rapid decrement in adherence over time. Concurrent interventions targeting depression symptoms may be an important addition to comprehensive care for sleep apnea.

0440
PROSPECTIVE PREDICTORS OF PAP USER PROFILES AMONG VETERANS WITH OBSTRUCTIVE SLEEP APNEA
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Introduction: In a previous report, we identified three classes of positive airway pressure (PAP) users labeled Attempters, Adherers and Non-Adherers based on their adherence profile. Additionally, we identified potentially modifiable retrospective predictors of class membership in a sample of subjects with variable PAP treatment length. This study aimed to replicate our previous findings using baseline predictors and adherence averages from the initial two weeks of PAP therapy among newly diagnosed veterans with OSA.

Methods: In this sample of 205 veterans, latent profile analysis (LPA) was used to derive CPAP user profiles based on these indicators: average nightly use, % nights of CPAP use, and % nights > 4 hours. Baseline predictors included age, BMI, AHI, PAP pressure, medical comorbidities, a mood disorder diagnosis, a post-traumatic stress disorder diagnosis, daytime sleepiness, night-time insomnia symptoms, sleep satisfaction, risk perception, outcome expectation and self-efficacy.

Results: We replicated our previously reported three class solution comprised of Non-Adherers (35 minutes nightly use, 27% of nights used, 5% of nights used > 4hrs), Attempters (166 minutes nightly use, 82% of nights used, 30% of nights used > 4hrs) and Adherers (386 minutes nightly use, 97% of nights used, 84% of nights used > 4hrs). Prevalence of these three classes were 31%, 37% and 32%, respectively. Participants increased their odds of being a Non-Adherer if they had 1) more daytime sleepiness, 2) more insomnia symptoms, 3) more satisfaction with sleep pattern, and 4) less of an expectation of a useful PAP outcome. In contrast, age, BMI, AHI, PAP pressure, mood disorder, PTSD were not related to any PAP user group.

Conclusion: With this replication, which used indicators from the first two weeks of PAP therapy, the classes of PAP users previously identified appear to be stable. Furthermore, we identified new predictors of class membership.

0441
VETERANS WITH LOW INSOMNIA AND FATIGUE LEVELS ARE LESS LIKELY TO ACCEPT PAP THERAPY
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Introduction: Although PAP machines can effectively treat OSA, some individuals never accept one after being diagnosed. While studies have explored the determinants of PAP adherence, little is known about factors that predict PAP acceptance. This study examined whether insomnia and fatigue predicted the likelihood of picking up a PAP device.

Methods: Veterans (N = 491; mean age = 51.83, SD = 13.48; 92.6% male; 58.3% white, 41.7% black) newly diagnosed with OSA completed the Insomnia Severity Index (ISI) and the Fatigue Severity Scale (FSS) on the night of their PSG. Multiple logistic regression analyses were conducted to determine the effect of veterans’ insomnia and fatigue symptoms on the likelihood of accepting a PAP machine. Models were adjusted for age, BMI, Charlson score, mood disorder, PTSD, type of diagnostic study, and daytime sleepiness.

Results: Overall, 13.2% of veterans never picked up a PAP machine after being diagnosed with OSA. Findings showed that the interaction of ISI and FSS (OR = .997, 95% CI: .994-1.00, p = .022) were associated with the likelihood of picking up a PAP machine. This interaction indicated that the relationship of insomnia with PAP acceptance depended on the level of fatigue. For low levels of insomnia, those with high fatigue were more likely to accept a PAP than those with low fatigue (94% vs 81%). However for those with high levels of insomnia, both those with high and low fatigue were equally likely to accept PAP (89% vs 90%).

Conclusion: These findings suggest that higher levels of subjective symptoms (i.e., fatigue, insomnia) increase the odds of these veterans returning to the clinic to receive a PAP machine. Objective sleep parameters (i.e., AHI, PAP pressure) and medical/psychiatric diagnoses have no influence on PAP acceptance. Thus, accepting PAP therapy may be, from the patients’ perspective, a method to reduce the discomfort of their subjective symptoms.
0442
### PHYSIOLOGICAL AND PSYCHOLOGICAL FACTORS INFLUENCING CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) USE IN WORLD TRADE CENTER (WTC) RESPONDERS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

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**Introduction:** OSA is highly prevalent among WTC first-responders, but adherence to CPAP is often poor. In an ongoing study of nasal pathology and OSA and the effect of Cflex on adherence, we looked for correlations between prior physiological (AHI4%/RDI, gender, age, and treatment pressure) and psychological (subjective daytime sleepiness, insomnia, and depressed mood) factors and adherence to CPAP at one month.

**Methods:** Subjects with OSA (AHI4% > 5/hr or AHIlall > 15/hr) were recruited from the WTC Health Clinic. CPAP therapy was initiated at home with 3 or more days of autotitration, followed by fixed CPAP, randomly with/without Cflex. To date, 219 subjects (age 34-75, 27 female, AHI4% = 16.5 ± 14.7, RDI = 32.3 ± 16.4, ESS = 8.7 ± 5) have completed a one-month treatment period. Mood and insomnia were assessed by questionnaire and subjective daytime sleepiness by Epworth Sleepiness Scale (ESS). CPAP adherence was assessed by %days ≥ 4 hrs used in the last 2 weeks of treatment, and average use hours on all days or averaged on days CPAP was used. Independent sample t-tests were used to compare groups.

**Results:** Subjects used CPAP for ≥4hrs on 23.1 ± 30.7% (mean ± SD) of days used; average use-hours on all days were 1.8 ± 2.3 hrs; and average use-hours on days CPAP was used were 2.6 ± 2.3 hrs. Prior to CPAP, 35% of participants had significant sleep onset and/or maintenance insomnia. 31% had significant depressed mood scores. CPAP adherence did not differ between groups based on gender, severity of OSA, CPAP pressure > 10, ESS, or insomnia complaints. As in other studies, older age correlated weakly with CPAP adherence (r = 0.21, p < 0.01). Lower CPAP adherence may be associated with prior depressed mood (2.3 ± 2.3hrs vs 2.7 ± 2.3 hrs) but this did not reach significance (p = .24).

**Conclusion:** CPAP adherence in these predominantly mild OSA subjects from a non-sleep-clinic population was poor and was not predicted by available physiological or psychological variables.

**Support (If Any):** CDC/CDC/NIOSH/01OH010415, K24HL109156

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0443
### CHRONIC PAIN IS ASSOCIATED WITH POOR PAP ADHERENCE

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**Introduction:** Non-adherence to Positive Airway Pressure (PAP) is the primary barrier to effective treatment of Obstructive Sleep Apnea (OSA). Finding modifiable comorbidities which reduce PAP adherence may help to identify treatment targets. One such comorbidity is chronic pain. Previous research has indicated that pain and sleep is bidirectional: Interrupted sleep may limit improvement in pain and chronic pain interferes with consolidated sleep. Little is known about the relationship between chronic pain and PAP adherence. The goal of the current study was to examine the influence of a pain diagnosis on the trajectory of PAP adherence over 12 weeks.

**Methods:** PAP-naïve OSA patients (N = 390; 93% male; Mean age = 54, SD = 12; 55% CPAP, 30% auto-PAP, 15% bilevel PAP) at the Miami VA Sleep Clinic completed baseline measures and returned 12-weeks later for a download. Chronic pain diagnosis was obtained through medical chart review. Longitudinal multilevel modeling was used to characterize the influence of a pain diagnosis on the trajectory of adherence over time. Covariates included age, AHI, PAP type and pressure, nighttime insomnia symptoms, and active medical and psychiatric diagnoses.

**Results:** At week 1, average PAP use was lower for pain patients compared to non-pain patients independent of covariates (254min vs. 220min; p = .035). However, a decelerating trajectory of PAP use did not vary between groups. This parallel pattern indicated that the 34-minute difference seen at week 1 remained through the first 12 weeks of PAP treatment.

**Conclusion:** These findings suggest pain patients used PAP significantly and persistently less than non-pain patients. In OSA patients, chronic pain appears to be an additional impediment to PAP adherence. In these comorbid OSA/chronic pain patients, improvement in chronic pain may be limited in the context of partially treated OSA. Given these considerations, future research should seek to elucidate the interrelationships among pain, sleep apnea, and PAP adherence.

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0444
### DOES CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT FOR OBSTRUCTIVE SLEEP APNEA IMPROVE MOOD IN PATIENTS WITH COMORBID CLINICAL DEPRESSION?

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**Introduction:** Obstructive sleep apnea (OSA) and depression are highly prevalent and comorbid conditions. While there is some evidence that CPAP improves depressive symptoms in unselected patients, there is limited data regarding the effectiveness of CPAP therapy for OSA patients with major depressive disorder (MDD). This study aimed to determine whether CPAP improves clinical outcomes in patients with OSA and MDD.

**Methods:** To date, 40 participants have been recruited from patients attending a sleep laboratory clinic for treatment of OSA. Participants were randomized to one of 3 groups: treatment as usual (TAU; N = 14), intensive CPAP program (CPAP; N = 11) or a wait-list (N = 15). Participants in the TAU and CPAP groups were treated with CPAP for 4 months. All participants completed the Center for Epidemiological Studies-Depression (CES-D) scale and the Epworth Sleepiness Scale (ESS) at baseline, 1, 2 and 4 months. A structured clinical interview for depression (SCID) was done at baseline and 4 months. Due to low numbers in this 2-month interim analysis, the TAU and CPAP groups were combined (n = 10), and compared i) from baseline to post-CPAP, and ii) to the WL group (n = 9) at follow-up.

**Results:** At baseline, 8 of 27 participants (29.6%) who were assessed with the SCID had a current diagnosis of MDD, with 12 of 27 participants (44.4%) having a past depressive episode. After 2 months of CPAP, there was a reduction in ESS (7.3 to 4.8, p = 0.016) and CES-D (15.6 to 8.5, p = 0.008), but no change in the WL group (7.3 to 7.5, p = 0.86). There was a significant difference in ESS (p = 0.030) and CES-D (p = 0.030) scores between the groups at follow-up.
B. Clinical Sleep Science

I. Sleep Disordered Breathing

**Conclusion:** MDD is prevalent in our sample of OSA patients. Preliminary findings indicate that CPAP significantly improves daytime sleepiness and depressive symptoms. Ongoing data collection will reveal whether these improvements translate into long-term clinical changes in depression outcomes.

**Support (If Any):** Austin Medical Research Fund and The Australian National Health and Medical Research Council (APP1036292).

**0445**

**LOWER LEVEL OF AIRFLOW MASK MEETS CPAP EFFICACY**

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**Introduction:** Adherence to continuous positive airway pressure for those with OSA is suboptimal, limiting the impact of this highly effective therapy. Reasons for low adherence include physical complaints (skin irritation, eye puffiness, and headache/sinus problems) as well as aesthetic complaints (bulky masks, intimacy issues). A novel mask interface that seeks to improve patient compliance by reducing the above complaints, while maintaining the efficacy of standard PAP therapy.

**Methods:** The FRESCA Medical (San Clemente,CA) nasal mask was used with standard PAP equipment. Unlike standard PAP, this new technology requires lower levels of airflow to maintain upper-airway patency. This study was single-blinded randomized crossover study using clinical software. Forty-seven consenting subjects from 8 clinical laboratories were enrolled. Compliant nasal-PAP users were provided 8 hours sleep opportunity, one night on standard mask at prescribed pressure, one night on new nasal mask, at same pressure. Subjects were excluded if they did not sleep > 4 hours. If leak was > 5 cm/H2O, a third night was allowed. A blinded RPSGT scored studies using Medicare criteria (≥4% desaturation), primary outcomes are AHI and ODI.

**Results:** Of 47 subjects (33M) mean age of 51 years, mean BMI 30.4 kg/m². Thirty-six subjects were included in primary analysis. Eleven subjects were excluded for incomplete data. Baseline OSA severity of the 36 subjects included all levels, with CPAP levels ranging from 6-14 cm/H2O. On standard interface mean AHI &ODI were 2.4 ± 6.0 &1.1 ± 2.0, respectively. On the new nasal mean AHI &ODI were 3.0 ± 4.8 &1.4 ± 2.0, respectively. New nasal pillow demonstrated non-inferiority with p-values for AHI (0.002) & ODI (< 0.001).

**Conclusion:** This novel mask technology demonstrates non-inferior treatment for OSA based on AHI &ODI, across a range of severity. Longer term studies are needed to ascertain whether the new interface can improve patient comfort, and improving compliance for this important therapy.

**Support (If Any):** Fresca Medical

**0446**

**TREATING VERY MILD SLEEP APNEA OR SUSPECTED UARS WITH AUTO-CPAP: A COMMUNITY CLINIC’S EXPERIENCE**

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**Introduction:** The question addressed is whether treating subjects with very mild obstructive sleep apnea (OSA) or suspected upper airway resistance syndrome (UARS) with auto-titrating continuous positive airway pressure (APAP) is worthwhile in terms of improvement in daytime symptoms and sustained compliance.

**Methods:** Symptomatic subjects with an AHI of less than 10 and/or significant evidence of airflow limitation on a Level 3 sleep study were offered a four-week trial of APAP therapy. Compliance data, Epworth Sleepiness Score (ESS), 90% APAP pressure, and AHI on therapy were obtained at one month and one year.

**Results:** One hundred and five patients with an AHI less than 10 and/or significant airflow limitation and who started on APAP between September 16th, 2012 and March 31st, 2014 were followed. The subjects were 65 males/40 females with a mean age of 49 ± 13 years, BMI of 33 ± 5.7, Epworth score of 12 ± 4.0, AHI of 6.5 ± 2.4, and a resisted breathing index (RBI) of 19 ± 16%. Seventy-three patients (70%) continued after the one-month trial. At one year, 53% of the original cohort was still using therapy. Compliance was 21.6 ± 7.8 days/month with a mean hourly use of 6.2 ± 1.3 hours. ESS declined to 4.3 ± 2.4 and mean 90% APAP pressure was 9.1 ± 2.6 cm H2O. Subjects who continued therapy were statistically older, required a higher 90% APAP pressure, and had more improvement in ESS. There was no discrimination between people who continued and those who did not in terms of initial ESS, AHI or RBI.

**Conclusion:** A large proportion of symptomatic subjects with very mild OSA or suspected UARS improve significantly and is compliant if treated with APAP therapy. The relatively high 90% APAP pressure levels suggest that there is significant airway obstruction in these individuals during sleep.

**Support (If Any):** RANA Respiratory Care Group supplied RRT time in kind for data collection.

**0447**

**SEARCHING FOR AN ACCURATE NASAL-CPAP ALGORITHM IN OBSTRUCTIVE SLEEP APNEA: APPARENTLY NOT A POSSIBILITY**

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**Introduction:** Since nasal-CPAP’s (Continuous Positive Airway Pressure) introduction in 1981 researchers have sought algorithms to predict adequate pressure for Obstructive Sleep Apnea (OSA). The factors influencing optimal nasal-CPAP pressure are not well studied. The purpose of this study is to assess predictors of optimal nasal-CPAP pressure in OSA to determine if such an algorithm is even a possibility.

**Methods:** A retrospective sample of in-lab sleep studies from January 2012 to July 2015 at our institution was collected. Studies were interpreted by a board-certified sleep specialist. We randomly selected 250 of 330 patients. Inclusion criteria were age greater than 18, diagnosis of OSA requiring nasal-CPAP, and completion of the second night of nasal-CPAP titration or split night titration study. In total, 154 patients were studied. Factors including age, ethnicity, respiratory disturbance index (RDI), CPAP pressure, oral anatomy, BMI, neck circumference, palatal asymmetry, retrognathia, alcohol use, tonsillar enlargement, saturation and other comorbidities were studied. Cochran-Mantel-Haenszel chi-squared test was used for statistical analysis.

**Results:** In total, 75 patients were male (49%) and 79 were female (51%). We found a positive correlation between higher nasal-CPAP pressure and severity of sleep apnea based on RDI (P-value of 0.0002). Of the patients who required a median nasal-CPAP pressure greater than 12 cm H2O, 61.25% had a RDI greater than 30; 26.3% had a RDI of 15-30; and 26.3% had a RDI of 15-30. Of the patients requiring a median nasal-CPAP pressure less than 12 cm H2O, 30.1% had a RDI greater than 30; 28.8% had a RDI of 15-30; and 41.1% had a RDI of 15-30. Other predictors of higher nasal-CPAP were: elevated BMI (P-value 0.0007), large neck circumference (P-value 0.0078), median saturation less than 79% (P-value less than 0.0001), hypertension (P-value 0.0359) and diabetes mellitus (P-value 0.0005). The other factors noted were not helpful in predicting pressure. Although only 8 patients with palatal asymmetry were analyzed, none required high nasal-CPAP pressures.
Conclusion: Factors that predict higher nasal-CPAP pressure include: severity based on RDI, high BMI and neck circumference, median hemoglobin saturation less than 79%, and hypertension and diabetes (perhaps related indirectly to BMI). Unfortunately, these factors predict only a trend and do not account for many outliers requiring lower pressure. Accurate algorithmic prediction of pressure needs from history and physical and sleep parameters is not a possibility for all patients.

0448
PSYCHOMOTOR VIGILANCE TEST IS ASSOCIATED WITH SUBJECTIVE, BUT NOT OBJECTIVE, DAYTIME SLEEPINESS IN SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) has been shown to be associated with impaired sustained attention and excessive daytime sleepiness (EDS). Psychomotor vigilance task (PVT), which is a well-established assay for sustained attention, has been suggested as an easy-to-use, inexpensive alternative to the multiple sleep latency test (MSLT) to measure EDS associated with OSA. However, few studies have examined the association between PVT and objective and subjective EDS in OSA patients.

Methods: We studied 58 OSA patients (53.7 ± 7.0y, 63.8% male) who underwent 8-hour in-lab polysomnography for 4 consecutive nights. Eight trials of PVT were administered on the 4th day in every 2 hours from 8:00 to 22:00. The primary variables assessed in PVT were the median reaction time (RT), frequency of lapses, duration of the reciprocal of the 10% slowest RTs and the mean of the 10% fastest RTs. Objective and subjective daytime sleepiness were assessed on the same day by MSLT and Epworth sleepiness scale (ESS), respectively. Linear regression models were adjusted for age, gender, BMI, AHI, depressive and anxious symptoms, while ESS and MSLT were adjusted for each other in these regression models.

Results: ESS scores were significantly associated with longer median RTs (β = 0.30, p = 0.02), higher frequency of lapses (β = 0.35, p = 0.01), lower transformed scores of 10% slowest (β = -0.28, p = 0.04) and higher scores of 10% fastest RTs (β = 0.25, p = 0.06). No significant association was observed between MSLT and PVT (all p values > 0.4).

Conclusion: Our findings suggest that PVT is associated with subjective but not objective daytime sleepiness and, thus, cannot replace MSLT in clinical and research settings. Our findings further suggest that MSLT assays physiologic sleep propensity associated with impaired arousal mechanisms (e.g., increased interleukin-6 and decreased cortisol) in OSA patients, while the ESS captures the subjective complaint of daytime sleepiness/fatigue resulting from impaired sustained attention (i.e., PVT).

Support (If Any): NIH R01 HL64415

0449
ALZHEIMER’S DISEASE AND OBSTRUCTIVE SLEEP APNEA: A META-ANALYSIS

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Introduction: There is increasing interest in the association between obstructive sleep apnea and Alzheimer’s disease. Our objective was to synthesize the available evidence that measured apnea hypopnea index using polysomnography in patients with and without Alzheimer’s disease.

Methods: We included observational studies that objectively measured the presence of obstructive sleep apnea (OSA) using polysomnography. The research was performed according to PRISMA guidelines.

Results: Of 1,214 studies identified, 6 studies met eligibility criteria involving 296 subjects. Naturally occurring group contrasts of individuals with and without Alzheimer’s disease were performed in order to make comparisons of apnea-hypopnea index (AHI) and proportion of individuals with OSA in these respective groups. Meta-analysis of the studies revealed that Alzheimer’s disease was associated with greater AHI (pooled standardized mean of differences [SMD] 0.94, 95% Confidence Intervals [CI] 0.22, 1.66; Z = 2.56; P = 0.01). There was high heterogeneity for AHI amongst these studies (I2 = 87%; P < 0.0001). Sensitivity analysis performed by removal of one outlier study removed the heterogeneity (I2 = 23%; P = 0.27) but did not materially change the results (SMD 0.50, 95% CI 0.20, 0.81; Z = 3.23; P = 0.001). Proportion of individuals with OSA diagnosed with a threshold AHI of 5 or more per hour was greater in patients with than without Alzheimer’s disease (Odds Ratio 4.5; 95% CI: 2.4, 8.5; Z = 4.73; P < 0.0001). There was low heterogeneity for proportion of individuals with Alzheimer’s disease who suffered from OSA amongst these studies (I2 = 31%; P = 0.21).

Conclusion: The synthesized evidence suggests that there was a large effect size for the association between Alzheimer’s disease and obstructive sleep apnea. The nature of this association needs to be further explored.

Support (If Any): PCORI-HIS-1306-2505; HL095799; 1R21CA184920

0450
SYMPTOMLESS MULTI-VARIABLE APNEA PREDICTION INDEX ASSESSES OSA RISK AND ADVERSE OUTCOMES IN ELECTIVE SURGERY

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Introduction: Obstructive sleep apnea (OSA) increases the risk of postoperative complications. With the exception of bariatric surgery, routine preoperative screening for OSA is not prevalent in the Penn Medicine network. Combining body mass index (BMI), age and gender, the symptomless-multivariable apnea prediction (sMVAP) score assesses OSA risk. We examined whether sMVAP is associated with adverse post-surgical outcomes, and compared bariatric surgery with other surgical groups.

Methods: We reviewed 2011-2014 data from 40,432 elective-in-patient surgeries within Penn Medicine. We performed logistic regression, conditional on hospital and surgery type, to assess association between sMVAP and: previous diagnosed OSA; current hypertension; extend length of stay (ELOS;top 10%); any mechanical ventilation (MV); intensive-care-unit days (ICU); and pulmonary embolism, acute respiratory distress syndrome or aspiration pneumonia respiratory complications (RC).

Results: The sample had 51.6% men, with mean ± SD age and BMI of 59.0 ± 15.1 years and 30.0 ± 7.8 kg/m2, respectively. sMVAP was associated with a higher likelihood of diagnosed OSA (p < 0.0001), validating its utility, as well as current hypertension (p < 0.0001) and all adverse outcomes (p < 0.0001). Compared against the bottom quintile, the top sMVAP quintile had higher odds of adverse outcomes (all p < 0.0001). For ELOS, MV, ICU, and RC, the respective odds ratios (95% CIs) were: 1.83 (1.62-2.07), 1.74 (1.61-1.87), 1.44 (1.32-1.58), and 1.85 (1.37-2.49). Compared to age-, gender- and BMI-matched patients having bariatric surgery, sMVAP was more strongly associated with...
adverse outcomes in non-bariatric surgical groups, including: (1) ELOS in orthopedics (p < 0.0001), gastrointestinal (p = 0.024), neurosurgery (p = 0.016), and spine (p = 0.016); (2) any ICU in orthopedics (p = 0.0004), gastrointestinal (p < 0.0001), and ORL/OMS/ENT (p = 0.0102); and (3) RC in orthopedics (p = 0.037).

**Conclusion:** Higher sMVAP scores correlate with increased risk for select adverse post-surgical outcomes. Stronger associations for specific surgery groups, in particular orthopedics, when compared to bariatric surgery suggest that preoperative screening and treatment for OSA may be appropriate.

**Support (If Any):** MML/JL:NIH-T32HL07713

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**0451**

**SLEEP-DISORDERED BREATHING-INDUCED SYSTOLIC BLOOD PRESSURE VARIABILITY: AN INDEPENDENT PREDICTOR OF INCREASED CARDIOVASCULAR RISK AND TARGET ORGAN DAMAGE**

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**Introduction:** A LIFE sub-study published recently in Journal of Hypertension (September 16, 2015) confirmed blood pressure variability as an independent predictor of cardiovascular events and target organ damage. Our objective was to show direct correlation between severity of sleep-disordered breathing/snoring and frequency of variability/elevations in systolic blood pressure thereby suggesting an increase in risk of cardiovascular events and target organ damage as a consequence.

**Methods:** Polysomnographic recording of snoring, apnea, hypopnea and continuous blood pressure measurement (with pulse transit time, PTT) was performed in 25 consecutive subjects (previous high index of suspicion for sleep-disordered breathing) irrespective of prior history of hypertension or anti-hypertensive medications. PTT was standardized using cuff-based blood pressure measurement at the beginning and at the end of each sleep study. Studies have shown PTT to be a reliable non-invasive method compared to cuff-based measurement of blood pressure. Polysomnograms were cross-scored by two experienced RPSGT technicians and reviewed by sleep Physician. Only systolic blood pressure elevations immediately following apnea, hypopneas and snoring were counted for this study.

**Results:** Strong correlation was found between severity of sleep-disordered breathing as measured by Apnea Hypopnea Index (Mean AHI 34.7, SD 28.26) and systolic blood pressure variability/elevations per hour of sleep (Mean 14.18, SD 18.82). Strong correlation was found between snore index (Snores/hour of sleep) (Mean 188.05, SD 132.84) and elevations/variations in systolic blood pressure (Mean 43.62, SD 42.39).

**Conclusion:** OSA and snoring cause measurable (by polysomnography) increase in variability/elevations of systolic blood pressure during sleep. Severity of sleep-disordered breathing determined severity of blood pressure variability/elevations irrespective of previous history of hypertension or medications. Peak systolic blood pressure correlated with severity of sleep-disordered breathing. Long-term multi-centric studies may be needed to establish the risk of cardiovascular events and target organ damage caused by blood pressure variability associated with sleep-disordered breathing.

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**0452**

**NO CHANGE IN HOME SLEEP TESTING PARAMETERS IN AMBULATORY ORTHOPEDIC SURGICAL PATIENTS WITH AND WITHOUT OSA: A PROSPECTIVE OBSERVATIONAL STUDY**

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**Introduction:** Obstructive sleep apnea (OSA) is an independent risk factor for perioperative complications. Suitability of ambulatory surgery in patients with OSA or at risk for OSA remains controversial. This study addresses the fundamental question of what sleep changes occur in the postoperative setting to ambulatory patients. To date, no prospective study examining the fundamental changes in sleep parameters among ambulatory surgical patients has been conducted.

**Methods:** Consecutive adults scheduled for elective ambulatory orthopedic surgery were recruited. Study subjects completed the STOP BANG questionnaire and three unattended 5-channel Home Sleep Test (HST): baseline within a month before surgery, night of surgery (NOS), and third night after surgery (POD3). Study participation and all study data were blinded to the surgical and anesthesia teams. The primary outcome was post-operative adverse outcomes including unplanned admission, difficult airway management, post-operative respiratory failure, and arrhythmias.

**Results:** Two hundred three subjects were recruited. One hundred sixty completed the baseline HST (68% male, mean age 39 ± 11.2, BMI 28 ± 4.5), 133 completed both the baseline and NOS and 123 completed all three. Eighty nine percent of enrolled subjects received general anesthesia. Eighty seven percent of enrolled subjects used opioids for post-operative pain management. AHI, ODI, SPO2 nadir, and CT90 at baseline were 4.9 ± 8.4, 3.5 ± 7.0, 0.85 ± 0.6, and 0.05 ± 0.13, respectively and on NOS were 4.7 ± 8.2, 3.4 ± 6.4, 0.85 ± 0.6, and 0.08 ± 0.15, respectively. There was a statistically significant improvement observed for AHI and ODI for those with baseline AHI < 5 (AHI baseline 2.0 ± 1.5, NOS 1.4 ± 1.4 p < 0.002; ODI baseline 1.6 ± 1.5, NOS 1.0 ± 1.2 p < 0.001). There were 20 unplanned admissions with 1 due to hypoxemia and 6 due to the recognition of an existing history of OSA prompting admission for observation. No mortality, acute respiratory failure, or readmission observed. There was no difference in adverse events between patients with the preoperative dx of OSA and those without the dx or risk for undiagnosed OSA. AHI, ODI, SPO2 nadir, and CT90 did not change significantly for those with AHI > 5 or > 15.

**Conclusion:** This study advances the understanding of sleep changes that occur with ambulatory surgery in both patients with and without OSA. These findings suggest that ambulatory orthopedic surgical patients with an existing diagnosis of OSA or those with clinical risk factors for OSA may not be at increased risk for perioperative complications and/or adverse outcomes and may not require extended observational periods or more intensive monitoring post-operatively.
I. Sleep Disordered Breathing

0453
RELATIONSHIP OF TONGUE STRENGTH, GRIP MUSCLE STRENGTH, PEAK EXPIRATORY FLOW AND 6-MIN WALKING DISTANCE IN MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA SYNDROME SUBJECTS
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Introduction: This study was developed to investigate the influences of tongue strength (TS), grip muscle strength (GS), peak expiratory flow (PEF) and 6-min walking distance (6MWD) on subjects with moderate to severe obstructive sleep apnea syndromes (OSAS).

Methods: The polysomnography (PSG) was used to diagnose the severity of OSAS. The subjects were divided into two groups based on the apnea hypopnea index (AHI) index (times/h): moderate OSAS group and severe OSAS group. The TS, GS and PEF were measured in resting. Subjects were instructed to walk as far as possible in the designed pathway for 6MWD.

Results: The moderate OSAS group (n = 31, age = 50.03 ± 10.78 years; body mass index = 26.81 ± 4.36 kg/m²; AHI index = 27.07 ± 5.18; TS anterior = 40.81 ± 10.19 kPa; TS elevation = 48.40 ± 13.54 kPa; GS = 31.31 ± 9.76 kg; PEF = 400.01 ± 142.85 L/min; 6MWD distance = 549.91 ± 82.95 meters; mean ± SD) and the severe OSAS group (n = 43, age = 52.04 ± 11.49 years; body mass index = 27.53 ± 3.96 kg/m²; AHI index = 50.67 ± 17.42; TS anterior = 44.44 ± 11.37 kPa; TS elevation = 51.19 ± 13.52 kPa; GS = 37.24 ± 11.22 kg; PEF = 475.18 ± 102.92 L/min; 6MWD distance = 556.18 ± 59.24 meters) were compared based on the AHI severity. In this study, factors on sex, age, height, body weight, and BMI were similar in both groups. We found positive correlation between GS and AHI severity ($r = 0.268$, $P = 0.022$), PEF and AHI severity ($r = 0.296$, $P = 0.010$).

Conclusion: The results of this study showed the importance of the airway musculature of the pharyngeal, and the grip muscle strength (peripheral muscle strength) on the OSAS subjects. This may account for genioglossus activation could be reduced with positive airway pressure during quiet breathing based on the hypothesized “neuromuscular compensatory mechanism” to maintain or improve airway patency during wakefulness.

Support (If Any): This study was funded by the Shu-Zen Junior College of Medicine and Management, under contract SZPT10403008 and Gary & Amy Foundation.

0454
ROLE OF CLINICALLY RELEVANT FATIGUE AND SLEEPINESS AS PREDICTORS OF SLEEP DISORDERED BREATHING IN A LARGE CLINIC-BASED SAMPLE
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Introduction: Although sleep disordered breathing (SDB) predictors are known, further study is needed in the clinical setting to improve diagnostic rates, particularly with attention to understudied fatigue symptoms. We hypothesize that abnormal Fatigue Severity Scale (FSS) and Epworth Sleepiness Scale (ESS) scores predict SDB in a large clinic-based sample.

Methods: Cross-sectional analysis was conducted from an electronic database of first-time self-report of FSS and ESS scores of 12,108 adults (age ≥ 18) presenting to Cleveland Clinic Sleep Disorders Center (1/8/2008 to 9/28/2012). Of these, 6,217 had complete data including FSS, ESS, and apnea-hypopnea index (AHI) from first polysomnogram done within one year of the self-report date. SDB was defined as AHI ≥ 5; FSS and ESS were the main predictors of interest. Multivariate logistic regression models included age ≥ 65, sex, race (Caucasian/African-American/Other), estimated median household split (> $53,944), fatigue (FSS ≥ 36) and sleepiness (ESS ≥ 10). Odds ratios (OR) with 95% confidence intervals were calculated.

Results: Mean age was 49.4 ± 14.1 years, 46.7% were female, 73.9% were Caucasian and 18.4% were African-American. Percent of population with AHI ≥ 5 was 83.9. Mean FSS score was 42.2 ± 14.7 and mean ESS score was 9.9 ± 5.4. In the multivariate model, fatigue was 32% less likely (i.e., protective) (OR = 0.68, 0.67-0.69) and sleepiness was not significantly associated (OR = 0.98, 0.85-1.14) with SDB. Female gender was associated with a 68% reduced odds (OR = 0.32, 0.28-0.38), African-American race was associated with an approximately 50% increased odds (OR = 1.47, 1.08-2.00), and age ≥ 65 was associated with a 3.5-fold increased odds (OR = 3.55, 2.12-4.83) of SDB.

Conclusion: This all-patients model indicates that neither fatigue nor sleepiness was predictive of SDB; in fact, fatigue was protective of SDB. This suggests that fatigue symptoms are more associated with non-SDB diagnoses in a sleep center clinical sample.

Support (If Any): This analysis was made possible by Knowledge Project clinical collection of self-reported outcomes within the Cleveland Clinic.

0455
ASSESSMENT OF RESIDUAL EXCESSIVE SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA TREATED BY CONTINUOUS POSITIVE AIRWAY PRESSURE
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Introduction: Continuous positive airway pressure (CPAP) is the gold standard treatment for obstructive sleep apnea, as it improves not only nocturnal ventilatory symptoms but also excessive daytime sleepiness. However, at least 6% of treated patients still present with residual excessive sleepiness. Our hypothesis is that this subgroup of patients have a more severe profile before treatment.

Methods: a total of 202 patients were consecutively recruited from a sleep clinic in Brazil. We included patients with age between 30 - 65 years and apnea-hypopnea index (AHI) > 20 events/h. Patients with other sleep disorders, using psychoactive medication and shiftworkers were excluded. All patients underwent clinical interview, fulfilled the Epworth sleepiness scale and were submitted to a baseline full polysomnography and CPAP titration polysomnography. After one year, patients were re-evaluated, and those with CPAP use > 4 hours/night and excessive sleepiness had their CPAP pressure increased by 2 cmH2O for one month to rule out insufficient titration.

Results: Excessive sleepiness at baseline was more frequent in male, and they were significantly younger, had higher body mass index, neck circumference, total sleep time, sleep efficiency, arousal index, AHI and percentage of time below 90% of SaO2, compared with non-sleepy patients. They also presented lower sleep onset latency, N3 stage percentage and mean SaO2. After one year of CPAP treatment, there were no significant differences between sleepy and non-sleepy groups, and the only significant predictor was baseline Epworth score.

Conclusion: Baseline sleepiness is better explained by more severe obstructive sleep apnea profile, while residual sleepiness was only significantly associated with more severe baseline sleepiness, assessed by the
Epworth Scale. This suggests that residual excessive sleepiness may be better explained by a specific syndrome - the CPAP resistant syndrome.

Support (If Any): AFIP - Associação Fundo Incentivo à Pesquisa

0456
SHOULD THE EPWORTH SLEEPINESS SCORE BE USED TO PRIORITIZE SERVICES FOR SUSPECTED OBSTRUCTIVE SLEEP APNEA?
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Introduction: The demand for Obstructive Sleep Apnea (OSA) assessment is rising in most developed countries. In New Zealand clinical prioritisation tools typically use the Epworth Sleepiness Score (ESS) from primary care GP to determine urgency. The re-test reliability has not been assessed clinical referral pathway. We suspected that introduction of a maximum elective waiting times (2012) would lead to higher ESS scores at referral and greater variability. We aimed to compare ESS along a clinical pathway from GP referral, clinic assessment (FSCA) and sleep laboratory before and after 2012 maximum waiting times project

Methods: Referrals over a 4 month period in 2012 and 2014 retrospectively recorded patient demographics, ESS, referral source, level of socio-economic deprivation (NZ Depo6). Data was analysed using SPSS Statistics (version 20.0, SPSS, Chicago, IL, USA) and Bland-Altman Analysis to assess reproducibility and level of Discrepancy of the ESS. Publically funded referrals (via DHBs) were compared with private referrals who acted as a control group.

Results: The ESS score between GP referral and FSCA demonstrated no consistent pattern with large variability for 2012 (95% CI 0.1 ± 4.2) and 2014 (95% CI -0.4 ± 4.4). The overall test-retest reproducibility of this ESS study found 21% of patients produced an ESS difference between sequential ESS scores of 5 or more.

Conclusion: The ESS was highly variable within our clinic population across a referral pathway with suspected OSA suggested suggesting it should carry a lower weighting for clinical prioritisation. We did not find any systematic bias (ramping up) of scores primary care referrers following introduction of the 2012 maximum waiting list project.

Support (If Any): University of Otago, Summer Studentship (Fisher and Paykel)

0457
INTERACTION BETWEEN APOE GENOTYPES, SLEEPINESS AND COGNITIVE FUNCTIONS IN OBSTRUCTIVE SLEEP APNEA PATIENTS
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Introduction: Many studies have suggested an association between APOE-4 alleles and sleep apnea. Cognitive impairment in sleep apnea patients has also been related to APOE genes. Up to the present, no study has assessed the interaction between APOE genes, cognitive impairment and daytime sleepiness in sleep apnea patients

Methods: Twenty-one patients, 11 females and 10 males, aging 33-79 years, underwent polysomnography, APOE genotyping, clinical interview and neuropsychological evaluation including Wechsler Adult Intelligence Scale subtests, Wechsler Abbreviated Scale of Intelligence, Rey-Osterrieth Complex Figure, Stroop Word Color Test, Trail Making Test, Rey Auditory Verbal Learning Test and Iowa Gamblig Task. Patients with apnea/hypopnea index ≥ 15 were included. The sample was divided by Epworth sleepiness scores: Epworth < 10 or ≥ 10. Patients presenting E3/E4 alleles were compared to patients with E2/E4 and E3/E3 alleles for both Epworth score groups. Differences between groups were assessed by one-way ANOVA.

Results: Four patients presented E2/E4 genotype, 3 patients E3/E3 and 14 patients E3/E4. There were no differences in cognitive performance among APOE groups for patients with Epworth < 10. Patients with E3/E4 genotype and Epworth ≥ 10 presented lower Processing Speed indices, lower scores in Wechsler Coding and Symbol Search subtests and lower scores in Rey Auditory Verbal Learning Test compared to those from other APOE groups (p < 0.05).

Conclusion: Patients with higher sleepiness scores and APOE E3/E4 presented worse visuomotor scores, reduced processing speed and higher learning interference compared to combined E3/E3 and E2/E4 groups. No differences were detected in patients with lower Epworth scores. Cognitive functions may be influenced by APOE genotypes and sleepiness in sleep apnea. Influence of APOE genotypes on cognitive performance may depend on sleepiness.

Support (If Any): FAPESP

0458
THE USE OF MAGNETIC RESONANCE IMAGING PERFUSION STUDIES TO MEASURE CEREBRAL BLOOD FLOW CHANGES IN OBSTRUCTIVE SLEEP APNEA BEFORE AND AFTER TREATMENT
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Introduction: Obstructive sleep apnea (OSA) is a hypoxic condition that often causes decreased cerebral blood flow (CBF). While subjective and clinical evidence points to improved neurophysiological function after a period of CPAP treatment, little objective evidence exists to explain this phenomenon. This study aims to illustrate the regenerative and angiogenesis processes objectively using MRI perfusion studies before and after a period of six weeks of CPAP therapy.

Methods: Ten patients with newly confirmed OSA were scheduled to receive one MRI scan prior to the initiation of CPAP therapy and another scan six weeks after treatment initiation. Histogram analysis of the perfusion values, whole-brain perfusion maps, and region of interest values were performed. Baseline cerebral perfusion of pre-CPAP OSA patients was compared that of age- and gender-adjusted controls.

Results: Preliminary MRI perfusion studies revealed 25% lower baseline CBF in OSA patients (n = 3) compared to the average age- and gender-adjusted population. Post-CPAP therapy data is limited at the present time.

Conclusion: From our preliminary MRI perfusion study results it appears that OSA sufferers have lower than average baseline cerebral perfusion, which may show improvement after CPAP therapy. Additional follow-up perfusion scans are required to adequately assess for objective long-term CBF improvement after CPAP therapy. When obtained, this data may add to knowledge regarding the pathophysiological changes seen in OSA as well as the physiologic mechanisms for the benefits noted in CPAP therapy.

0459
THE SLEEPINESS RESPONSE TO SLEEP APNEA AND ITS RELATION WITH COGNITIVE PERFORMANCE
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Introduction: Apnea/hypopnea index and daytime sleepiness are not strongly correlated, suggesting that additional mechanisms are contributing to neuropsychological symptoms of sleep apnea. In order to understand these mechanisms we created an index comparing sleepi-
I. Sleep Disordered Breathing

Dickson DA, Rumble ME, Benca RM

years, underwent polysomnography, clinical interview and neuropsychological evaluation that included Wechsler Adult Intelligence Scale subtests, Wechsler Abbreviated Scale of Intelligence, Rey-Osterrieth Complex Figure, Stroop Word Color Test, Trail Making Test, Rey Auditory Verbal Learning Test (RAVLT) and Iowa Gambling Task. Patients with apnea/hypopnea index ≥ 15 were included. A ratio between Epworth Sleepiness Scale score and apnea/hypopnea index (E/A ratio) was calculated for each patient in order to assess its sleepiness response to the respiratory disturbance. The sample was divided in terciles according to E/A ratio so that the higher tercile presented more sleepiness for the same apnea/hypopnea index compared to the lower terciles. Differences between terciles were assessed by One-way ANOVA.

Results: Patients with higher E/A ratios showed lower RAVLT scores in the first three trials compared with those lower E/A ratios (p < 0.05). They also showed less proactive interference when compared to the lower terciles (p < 0.05). There was no significant correlation between scores of Epworth Sleepiness Scale and apnea/hypopnea index in this sample.

Conclusion: Sleep apnea patients showed very dissimilar sleepiness scores for similar apnea/hypopnea indexes. Those with higher E/A ratios showed more difficulty in memory evocation during the first trials than those with lower E/A ratios what resulted in lower proactive interference when learning a second list of words. Increased sleepiness response to sleep apnea is associated with impairment of memory evocation in sleep apnea patients.

Support (If Any): FAPESP

0460

INSOMNIA WITHIN THE CONTEXT OF OBSTRUCTIVE SLEEP APNEA: ASSOCIATION BETWEEN INSOMNIA PROFILES AND DYSFUNCTIONAL BELIEFS ABOUT SLEEP

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Introduction: Evidence suggests that insomnia is quite common in OSA patients, but few studies have evaluated the distinct profiles of specific insomnia symptoms (i.e. difficulties initiating sleep (DIS), difficulty maintaining sleep (DMS), and early morning awakenings (EMA)) within these patients. Of particular clinical interest is whether these insomnia profiles within OSA patients differ on common cognitive-behavioral therapy for insomnia (CBT-I) treatment targets, such as dysfunctional beliefs about sleep. Such differences may have treatment implications for not only insomnia, but also OSA as insomnia has been identified as a risk factor for positive airway pressure (PAP) therapy non-adherence. This study explored insomnia symptom profiles within an OSA patient sample and how these profiles differentiated on dysfunctional sleep-related beliefs.

Methods: This study included 453 patients (68% male) 18 years or older with OSA, who completed the Insomnia Severity Index (ISI) and Dysfunctional Beliefs About Sleep Scale (DBAS).

Results: Four latent profiles were identified: “Little/No Insomnia” (n = 186) with little to no insomnia complaints; “DMS” (n = 123) with DMS and EMA; “DIMS” (n = 50) with DIS and DMS with little to no EMA; and “DIMS+” (n = 94) with DIS, DMS, and EMA. The DIMS+ group reported greater worry about sleep relative to the Little/No Insomnia, d = .77, and DMS groups, d = .55. Similarly, the DIMS+ group reported greater dysfunctional medication beliefs in comparison to the Little/No Insomnia, d = .52, and DMS groups, d = .44. The DIMS group reported more worry only in comparison to the Little/No Insomnia group, d = .48.

Conclusion: The present findings revealed several insomnia symptom profiles that may have diagnostic and treatment implications. The most symptomatic profile (DIMS+) demonstrated greater dysfunctional sleep-related beliefs, indicating that this group would likely benefit from the addition of CBT-I to the treatment process with potentially improved outcomes for both insomnia and OSA.

0461

ESOPHAGEAL FUNCTIONAL CHANGES IN LARYNGOPHARYNGEAL REFLUX DISEASE: ARE THEY INFLUENCED BY OBSTRUCTIVE SLEEP APNEA SYNDROME?

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Introduction: The coexistence of OSAHS and LPR was extremely high. However, the potential cause and effect relationship between the two diseases remains unclear. The objective of this study is to investigate the changes in esophageal function in LPR patients, and to determine whether OSAS affects esophageal function-dependent LPR.

Methods: Thirty-four LPR patients and 10 controls underwent high-resolution impedance manometry. Polysomnography was applied simultaneously with 24-hour combined esophageal multichannel intraluminal impedance and pH (MII-pH) monitoring.

Results: Eleven of the LPR patients (32.4%) were OSAS negative (Group 1), and 23 (67.6%) were OSAS positive (Group 2). Significant differences were found in the amplitude of mid one esophagus (P = 0.020) between Group 1 and the control, which parameter (15 cm above the lower esophageal sphincter) correlated with the oxygen desaturation index (P = 0.018, R = 0.499) and the lowest oxygen saturation (P = 0.013, R = -0.509) in Group 2.1

Conclusion: Esophageal functional changes exist in LPR patients. Linear correlations were found between the changed parameters and the severity of OSAS. OSAS may affect LPR by affecting esophageal function.

Support (If Any): This study was supported by the National Natural Science Foundation of China (grant number 81170902)

0462

REM-RELATED SLEEP APNEA AND CARDIOVASCULAR RISK

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Introduction: Sleep apnea severity, characterized by an increasing Apnea-Hypopnea-Index (AHI), correlates with increased incidence of cardiovascular morbidity. A subgroup of patients with obstructive sleep apnea (OSA) has respiratory events predominantly during REM sleep. Given the relatively low proportion of REM sleep to total sleep time, these patients often have low overall AHI. It remains unclear whether exclusively REM-related OSA is associated with increased incidence of cardiovascular complications despite a low overall AHI. This study assesses the cardiovascular risk in patients with exclusively REM-related OSA.

Methods: Data was obtained on 4455 adults enrolled in the Sleep Heart Health Study who had previously undergone polysomnography and been prospectively followed for cardiovascular complications such as coronary artery disease, myocardial infarction, or stroke up to ten years after the initial sleep study. OSA was defined by AHI%
I. Sleep Disordered Breathing

4.8/h in participants with REM-related OSA, 9.5/h in participants
was 11.52 ± 6.49. The mean scores of the Beck Depression Inventory
with NREM-related OSA, and 20.6/h in participants with overall OSA
B. Clinical Sleep Science

Conclusion: REM-related sleep apnea is associated with an increased
risk of cardiovascular complications despite an overall low AHI that
might not prompt treatment consideration.

Support (If Any): Supported by funding from the NIH R01MD007716
and U54NS081765.

0463 CHARACTERISTICS OF EMOTION AND PERSONALITY IN
OBSTRUCTIVE SLEEP APNEA PATIENTS WITH INSOMNIA
SYMPTOMS: ANALYSIS OF MINNESOTA MULTIPHASIC
PERSONALITY INVENTORY
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Introduction: Obstructive sleep apnea-hypopnea syndrome (OSAHS)
and insomnia are two of the most common sleep disorders in the general
population. Because OSAHS patients with insomnia may have difficulty in adapting to the sleep breathing medical equipment, it is
necessary to pay special attention to the diagnosis and treatment of
comorbid insomnia. This study is to investigate the emotion and personality in OSAHS patients with insomnia complaints by using Minnesota Multiphasic Personality Inventory).

Methods: We reviewed the results of the standardized questionnaires
assessing sleep-related variables, MMPI, and polysomnographic find-
ings of the patients diagnosed as OSAHS.

Results: 145 subjects were 49.05 ± 11.83 years of age. The mean Respiratory Disturbance Index was 33.57 ± 19.91 and the mean score of ISI
was 11.52 ± 6.49. The mean scores of the Beck Depression Inventory (BDI) and Minnesota Multiphasic Personality Inventory-2 were within
normal ranges. We divided the patients into two groups based on the
scores of the ISI, OSAHS with insomnia (n = 109) and OSAHS with-out insomnia (n = 36). OSAHS patients with insomnia symptoms had
significantly higher scores of hypochondriasis, hysteria, psychasthenia,
schizophrenia, paranoia and psychopathic deviate scales and BDI than
those without insomnia.

Conclusion: Our results suggest that insomnia complaints are very
common in OSAHS patients and the psychological problems are more
frequently found in OSAHS patients with insomnia symptom than those without it.

0464 BRAIN METABOLITES AS MARKERS OF VIGILANCE
FAILURE IN OBSTRUCTIVE SLEEP APNEOA
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Introduction: Obstructive sleep apnoea (OSA) is associated with
driving impairment and accident risk. However, not all patients are im-
paired and identifying individuals at risk is clinically challenging. To
help address this problem we used magnetic resonance spectroscopy
(MRS) to examine brain metabolite levels to identify potential markers
to differentiate phenotypes of OSA patients who are vulnerable vs
resistant to vigilance failure.

Methods: Fifty-eight OSA patients underwent overnight polysomnog-
raphy (PSG) followed by a 28h extended wakefulness challenge during
which driving simulator and psychomotor vigilance (PVT) were exam-
ined. 1-2 weeks before or after the extended wakefulness experiment, 45
of the 58 patients had a successful MRS/MRI scan. Based on a com-
bination of median split data from driving simulator crash and PVT
lapse occurring following extended wakefulness, patients were defined
as vulnerable (n = 15) or resistant (n = 30) to vigilance failure. Baseline
anthropometric, PSG variables, and brain bioenergetics (MRS) in the
left-orbitofrontal cortex (LOFC), anterior cingulate cortex (ACC) and
hippocampus (Hipp) were compared between the vulnerable and resis-
tant patient groups. Differences between groups were assessed using
unpaired t-tests and Mann-Whitney U tests.

Results: Compared to resistant patients, vulnerable OSA patients
exhibited greater sleepiness, more severe OSA and hypoxemia (all
p < 0.05). Furthermore, the vulnerable OSA group showed lower levels
of ACC glutathione (2.0 ± 1.1 vs 3.0 ± 1.9, p = 0.029), LOFC glutamate
(10.9 ± 3.3 vs 13.4 ± 4.3, p = 0.034) and LOFC aspartate (18.3 ± 1.7 vs
23.4 ± 1.5, p = 0.029). There was also a trend towards lower LOFC
creatine level in the vulnerable patients (9.2 ± 0.6 vs 10.7 ± 0.3), but this
did not reach statistical significance (p = 0.052).

Conclusion: Baseline PSG and MR spectroscopy may provide useful
markers of vulnerability to vigilance failure and driving impairment in
OSA patients. Further work is necessary using functional imaging,
diffusion and fibre tracking to establish brain regions responsible for
vigilance control and failure in clinical OSA populations.

Support (If Any): This work has been funded by the National Health
and Medical Research Council of Australia (NHMRC).

0465 POLYSOMNOGRAPHY AND CARDIOPULMONARY
COUPLING IN SUBJECTS WITH OBSTRUCTIVE SLEEP
APNEA SYNDROME WITH COMORBID INSOMNIA
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Introduction: To characterize polysomnography (PSG) and cardio-
pulmonary coupling (CPC) analysis between patients with obstructive
I. Sleep Disordered Breathing

Methods: subsequent 200 OSA patients (apnea-hypopnea index, AHI ≥ 5/ h) were enrolled. According to chief complain at initial interview, patients were divided into OSA with insomnia (OSA-I) and OSA only (OSA-O). Sleep parameters and CPC (cardiopulmonary coupling) analyses were obtained in all subjects. Sleep spectrum was decomposed into high-frequency coupling (HFC), low-frequency coupling (LFC), and very low frequency coupling (VLFC), which indicate stable, unstable sleep, and rapid eye movement sleep, respectively.

Results: In OSA-I, female proportion was significantly higher (38.9 % vs. 6.8 %) and older (56.4 y vs. 44.6 y) and slimmer (body mass index, BMI 24.4 vs. 26 kg/m2) than OSA-O. OSA-O reported to be sleepier (Epworth sleepiness scale 10.0 vs. 6.8), however, mood status was not different (Beck depression inventory, 8.4 vs. 9.6) than OSA-I. In OSA-I sleep latency was longer and sleep efficiency was lower than OSA-O. Despite higher arousal index and AHI in OSA-O, wakefulness after sleep onset was greater in OSA-I. LFC duration was greater in OSA-O (45.0%) than OSA-I (40.4%), however, it was not significant after adjusting AHI. In correlation analyses, LFC was positively associated with AHI and arousal index, and negatively correlated with lowest SaO2 after adjusting age, gender, and BMI in both groups. HFC showed the opposite results to LFC with the same PSG parameters.

Conclusion: OSA-I demonstrated poorer sleep quality regarding PSG parameters in spite of more severe respiratory related disturbances than OSA-O. CPC parameters are limited in terms of characterizing OSA subjects with or without insomnia. It needs to explore factors associated with poor sleep quality rather than respiratory disturbances in OSA subjects complaining of insomnia-related symptoms.

Support (If Any): This research was supported by Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Science, ICT & Future Planning, Republic of Korea (No. 2014 R1A1A3049510) and by Samsung Biomedical Research Institute grant (#OTX0002111).

0466
SLEEP RELATED BREATHING DISORDER AND WAKE-UP STROKE

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Introduction: Current literatures indicate that sleep-related breathing disorders (SRBD) increase a risk of cardiovascular disease including ischemic stroke. However, the association of SRBD and occurrence of ischemic stroke is not well studied. In this study, we examined whether preexisting SRBD affects the onset of an acute stroke using history taking about habitual sleep.

Methods: We prospectively investigated patients consecutively who were admitted with acute ischemic stroke from October 2013 to March 2015. We collected data on symptoms suggesting SRBD during the month preceding the onset of stroke using the Korean version of the Berlin questionnaire reported by caregivers or patients. Stroke data including time of onset, demographics, risk factors, and etiologic subtypes were also collected. Based on the time of onset, strokes were classified as wake-up stroke and non-wake-up stroke respectively. Logistic regression analysis was used to determine the factors associated with wake-up stroke.

Results: Among 277 ischemic strokes, 63 of which were wake-up strokes and 167 were non-wake-up stroke. A prior history of observed or self-recognized sleep apnea was the only risk factor of wake-up strokes based on univariable analysis (odds ratio 2.144; 95% confidence interval 1.069-4.303). Multivariate analysis showed that a prior history of apnea was associated with wake-up stroke (odds ratio 2.166; 95% confidence interval 1.043-4.495), whereas atrial fibrillation was negatively associated with wake-up stroke (odds ratio 0.341; 95% confidence interval 0.123-0.947). Subtypes of stroke were not different between groups depending on the time of onset and SRBD.

Conclusion: SRBD was associated with wake-up stroke. This suggests that SRBD might determine the onset of stroke. Direct injury to the brain such as hypoxia, hemodynamic changes, hypercoagulability, paradoxical embolization, and plaque disruption associated with vibration may be a plausible mechanism for SRBD-associated acute ischemic stroke.

0467
PERIPHERAL AND CENTRAL BLOOD PRESSURE IN SUBJECTS WITH AND WITHOUT OBSTUPTIVE SLEEP APNEA AND TYPE 2 DIABETES

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Introduction: Obstructive sleep apnea (OSA) and type 2 diabetes (T2DM) are both established cardiovascular risk factors that promote atherosclerosis and increase arterial stiffness. We sought to determine whether the combination of OSA and controlled T2DM is associated with increased peripheral and central blood pressure (BP), compared with either disease alone.

Methods: Subjects aged 18-70 were categorized as controls, T2DM-only, OSA-only, or OSA+T2DM. T2DM was defined as fasting glucose ≥ 126 mg/dL and/or hypoglycemic medication/s, and glycated hemoglobin < 8%. OSA was defined as a 4% apnea-hypopnea index (AHI) ≥ 10 events/hour. Brachial BP was measured in all subjects, followed by pulse wave analysis using applanation tonometry (Sphygmocor, AtCor Medical). Estimated central BP was calculated using an in-built generalized transfer function. The augmentation index (AIx) was corrected to a heart rate of 75 beats/minute. Measurements were performed in the fasting state at the same time of day for all subjects.

Results: Descriptive variables for the four groups were as follows in the controls, T2DM-only, OSA-only, and OSA+T2DM groups respectively: male gender 48%, 35%, 48% and 62%; mean ± SD age 43 ± 14, 49 ± 7, 52 ± 10, 55 ± 9 years; body mass index (BMI) mean ± SD 30.6 ± 6.3, 31.2 ± 5.2, 35.0 ± 6.0, 35.6 ± 6.9 kg/m2, AHI mean ± SD 2.8 ± 2.3, 4.5 ± 2.8, 23.8 ± 16.9, 24.7 ± 16.8 events/hour. Peripheral systolic BP was significantly different across groups (193.3 ± 14.4, 123.4 ± 16.4, 129.6 ± 15.3, 134.4 ± 16.5 mmHg; p = 0.01), as was central systolic BP (112.9 ± 12.4, 111.5 ± 14.4, 115.0 ± 11.9, 123.3 ± 16.7 mmHg; p = 0.02). There were no significant differences in peripheral or central diastolic BP or AIx. The difference in peripheral systolic BP persisted after adjustment for age, gender, and BMI (p = 0.04).

Conclusion: The combination of OSA and T2DM is associated with a significantly higher peripheral systolic BP than either disease alone, or neither disease. These findings of synergy suggest OSA and T2DM may impact arterial stiffness through distinct pathways.

Support (If Any): National Institutes of Health HL110350, HL127307, and American Heart Association 14SDG20160000.
0468
IMPACT OF OBSTRUCTIVE SLEEP APNEA ON CLINICAL OUTCOMES IN PATIENTS WITH ACUTE CORONARY SYNDROME: A META-ANALYSIS OF PROSPECTIVE STUDIES

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Introduction: Emerging evidence showed the presence of obstructive sleep apnea (OSA) in patients with cardiovascular diseases was an independent predictor of cardiovascular mortality and was associated with a significant increase in major adverse cardiovascular events. Moreover, the prevalence of obstructive sleep apnea in subjects with cardiovascular disease is higher than in the general population. However, in patients presenting with acute coronary syndrome (ACS), the relationship between OSA and cardiovascular outcomes remains unclear.

To assess whether moderate to severe OSA in ACS patients increase the risk of adverse cardiovascular events, we summarized the results of prospective cohort studies in a meta-analysis.

Methods: We searched the Pubmed and Embase databases, Cochrane library, and references of relevant original papers and review articles (up to October 2015), and included all prospective studies which provided a relative risk (RR) and 95% confidence interval (CI) for major outcomes in patients with cardiovascular disease. Pooled RRs and 95% CIs of these outcomes were estimated by meta-analysis. Heterogeneity among studies was evaluated using Q test.

Results: We identified 7 prospective studies including 1,136 individuals in whom 143 adverse cardiovascular events. The prevalence of OSA in ACS patients ranges from 35.3% to 66.4%. OSA was associated with a 2.23-fold risk for adverse events (RR = 2.23; 95% CI, 1.44-3.43; P < 0.001), with no between-study heterogeneity. Moreover, we observed the adverse health consequences appeared much stronger during the long-term follow-up period. ACS patients with moderate to severe OSA demonstrated a 1.54-fold higher risk of poor prognosis with an extended follow-up period of more than 30 days, whereas they were not at an increased risk with short-term follow-up period of 30 or less than 30 days (RR = 1.39, 95% CI, 0.71-2.73; P = 0.34).

Conclusion: These results suggest that moderate to severe OSA is associated with poor prognosis of ACS patients, especially the long-term prognosis.

0469
MILD OBSTRUCTIVE SLEEP APNEA: SLEEPY VS. NON SLEEPY PATIENTS

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Introduction: Some MILD Obstructive Sleep Apnea (OSA) patients are sleepy and some not. The aim of this study was to compare demographic, polysomnographic, and sleep behavior data of Sleepy vs. Non-Sleepy MILD OSA patients according to the Epworth Sleepiness Scale (ESS).

Methods: 483 consecutive MILD (Apnea Hypopnea Index (AHI) ≥ 5 ≤ 15) adult OSA patients who underwent a complete polysomnographic (PSG) evaluation. ESS data were available in 439 (90.9%), of those 161(36.6%) were Sleepy (ESS > 10) and 278 (63.3%) were Non-Sleepy (ESS ≤ 10).

Results: Sleepy MILD OSA patients did not differ from Non-Sleepy in Age, Gender, BMI and the percentage of hypertension. Similarly, in most PSG parameters, no significant differences were observed between these two patients’ populations. Sleepy patients had a significantly longer Total Sleep Time (TST), a higher number of arousals and a larger Periodic Limb Movements (PLMI) and Periodic Limb Movements Arousal Index (PLMAI) indices. A higher percentage of Sleepy patients slept less than 6 hours / night during working days. The level of alertness during daytime was significant lower in these patients. Moreover, a significant higher percentage of Sleepy patients felt sleepy during daytime hours and slept during the day on weekends. A logistic regression model showed that TST, the number of arousals but mainly sleeping during day at weekend, are significant determinants of daytime sleepiness in MILD OSA.

Conclusion: In MILD OSA, Sleepy and Non-Sleepy patients share similar demographic features and most of PSG parameters. Nevertheless, the sleepy patients have a longer TST, a higher number of short arousals but mainly, a larger portion of the sleepy patients sleep during the day at weekends. These results suggest that daytime sleepiness in MILD OSA is related principally to their sleep behavior (insufficient sleep time) rather than to their polysomnographic characteristics.

0470
PAIN RATINGS AND PAIN SENSITIVITY IN OBSTRUCTIVE SLEEP APNEA PATIENTS: RELATIONSHIP WITH POLYSOMNOGRAPHIC MEASURES

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Introduction: In chronic pain patients, the presence of OSA was associated with lower pain sensitivity, suggesting hypalgesia. However, in severe OSA patients CPAP therapy reduced pain sensitivity, and opposing effects of sleep fragmentation and hypoxemia were proposed. Presently, pain measures were related to PSG variables in adult patients referred for OSA evaluation.

Methods: Twenty-five patients (19-59y.o., 12 women; no neurological or endocrine conditions; 12 reported chronic pain, 10 received medication or other pain therapy) completed Chronic Pain Grade Scale (CPGS), Brief Pain Inventory (BPI) and forearm pressure pain threshold (PPTh) on the PSG evening. The following morning, 14 patients completed PPTh and “pain now” CPGS item. Pain intensity and functional impact scores for the preceding 6 months (CPGS) and 24 hours (BPI) were derived. All measures were ranked due to skew. Pain scores were separately regressed on PSG measures, controlling for age and BMI.

Results: Mean AHI = 27.9 ± 38.0. On both CPGS and BPI, lower pain intensity and functional impact were associated with higher AHI, lower SpO2 nadir, and longer time below SpO2 90% (p values ranged < 0.001 to 0.031). Lower BPI scores were also associated with higher 4% oxyhemoglobin desaturation index (ODI, both p < 0.015), while lower pain sensitivity on PPTh was related to lower SpO2 nadir (p = 0.025). However, higher morning “pain now” rating, relative to evening, was associated with higher AHI (p = 0.026) and ODI (p = 0.045). No relationships between pain and sleep architecture variables were observed.

Conclusion: These preliminary data suggest a hypalgesic effect of respiratory event frequency and associated oxyhemoglobin desaturations on long-term (CPGS) and short-term (BPI) retrospective pain measures, as well as on the pressure pain sensitivity in the morning. However, ratings of pain in the morning provide evidence for an acute hyperalgesic effect. Due to a small sample size to date, interactions between explanatory and subject variables were not yet explored.
**0471**

**SIGNIFICANT CHANGES IN SLEEP ARCHITECTURE IN OSA PATIENTS FOLLOWING SHORT-TERM TREATMENT WITH POSITIVE AIRWAY PRESSURE**

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**Introduction:** Obstructive sleep apnea (OSA) has many detrimental effects on physical health and cognitive function. Positive airway pressure (PAP) helps to improve sleep quality through the reduction of respiratory arousals, but recent evidence suggests that a surprising number of patients still report suboptimal sleep quality while on PAP therapy. A closer look at the literature reveals few studies that systematically investigate changes in sleep architecture following treatment with PAP. The findings of existing studies appear mixed, with one study showing no significant changes in sleep architecture. The goal of this study was to closely examine the nature of changes in sleep architecture with PAP, specifically whether there was a greater proportional increase in REM or deep sleep.

**Methods:** Participants underwent full in-lab polysomnography (PSG) before and after short-term treatment with PAP. In-office visits were held at baseline and shortly after treatment. Participants were shown adherence data downloaded from their PAP machines and also underwent a series of questionnaires to track treatment progress.

**Results:** Participants exhibited the following changes in sleep architecture following short-term treatment with PAP: stage N1 (-5.8%; p = 0.0001); stage N2 (-0.7%; p = 0.79, n.s.); stage N3 (+1.6%; p = 0.53, n.s.); and stage REM sleep (+4.9%; p = 0.006).

**Conclusion:** Our study suggests that treatment with PAP results in a significant increase in REM sleep, which would appear to be due to reduction of stage N1 sleep. This provides converging evidence that PAP treatment significantly improves sleep architecture. However, in contrast to one study that found an increase in N3, our study showed an increase in REM sleep instead. Future research needs to examine factors associated with the increases in N3 and/or REM sleep in patients treated with PAP to better understand improvements in sleep quality, which is the ultimate goal of any therapy for OSA.

**Support (If Any):** Department of Veterans Affairs.

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**0472**

**OBSTRUCTIVE SLEEP APNEA AND DEPRESSIVE MOOD: MEDIATING EFFECT OF SUBJECTIVE EXCESSIVE DAYTIME SLEEPINESS**

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**Introduction:** Researchers have reported high prevalence of depression in obstructive sleep apnea (OSA) patients but the mechanism is still unclear. Excessive daytime sleepiness is one of the common symptoms among obstructive sleep apnea and depression. In this study, we examined the role of subjective excessive daytime sleepiness in the relationship between OSA (including AHI, sleep fragmentation and hypoxemia) and depressive mood.

**Methods:** We analyzed the data from 490 OSA patients recruited in Taipei Medical University Hospital. The data included OSA related variables (including AHI, arousal index, lowest blood oxygen desaturation, mean average blood oxygen desaturation obtained through polysomnography), Beck Depression Inventory-II (BDI-II) score and Epworth Sleepiness Scale (ESS) score. For BDI-II, we further divided the items into somatic dimension and cognitive-affective dimension to obtain subscale scores.

**Results:** Using stepwise linear regression, AHI was found to be the only OSA related variable that could predict BDI-II total score (β = .092, t = 2.046, p = .041). We further examined the relation of AHI, BDI-II score and ESS using hierarchical linear regression. Our results showed that AHI could predict ESS score (β = .303, t = 7.036, p < .001), BDI-II total score (β = .092, t = 2.046, p = .041), and BDI-II somatic dimension score (β = .107, t = 2.377, p = .018). Furthermore, ESS score could predict BDI-II total score (β = .403, t = 9.715, p < .001), and both cognitive-affective dimension (β = .344, t = 8.106, p < .001) and somatic dimension (β = .408, t = 9.868, p < .001) scores. After controlling the ESS score, the prediction of AHI to BDI-II total score (β = -.034, t = -.759, p = .448) and BDI-II somatic dimension score (β = -.019, t = -.426, p = .670) was no longer significant. 16.0% and 16.3% of the variance in BDI-II total score and BDI-II somatic dimension score, respectively, could be explained by AHI through the mediation effect of ESS score.

**Conclusion:** A complete mediation effect of subjective excessive daytime sleepiness was found on the relation of severity of OSA and depressive mood. Our results indicated the depressive symptoms in OSA patients are more somatic in nature and might be more associated with excessive daytime sleepiness.

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**0473**

**THE EFFECT OF SLEEP APNEA SEVERITY ON NEUROPSYCHOLOGICAL FUNCTION IN PEOPLE WITH ACUTE TETRAPLEgia AND OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** Tetraplegia causes obstructive sleep apnea (OSA) acutely, and remains highly prevalent for years after injury. OSA is known to impair neuropsychological (NP) function in able-bodied and chronic tetraplegia populations. This study investigated the effect of acutely induced OSA severity on NP function in incident cases of tetraplegia.

**Methods:** 104 patients with acute tetraplegia participated across 11 international sites. Polysomnography was performed, and NP cognitive testing consisting of the Paced Auditory Serial Addition Task (PASAT), the Symbol Digit Modalities Test, the Rey Auditory and Verbal Learning Task, and the Digit Span (DS) forwards and backwards tests. Multivariate stepwise linear regressions were used to investigate the variability in NP function explained by OSA severity, the arousal index, ≥4% desaturation index, and demographic and medical covariates.

**Results:** OSA severity was a significant predictor of performance on the PASAT (p < .001) and DS forwards (p < .001). Age and pre-morbid intelligence were frequent significant contributors across cognitive performance.

**Conclusion:** In patients with acute tetraplegia, having an AHI ≥ 30 was significantly associated with poorer attention, information processing, and immediate recall. However, memory was largely unaffected. The effect of OSA severity on performance was typically as large as the known effect of increasing age. Higher pre-morbid intelligence and being younger may lessen the effects of OSA on performance; however, these factors were insufficient to counter the damage done to cognitive function by OSA. We hypothesize that a generally lower pre-morbid intelligence coupled with a high prevalence of severe OSA in this tetraplegic sample may have revealed a significant relationship between OSA and NP dysfunction not observed in able-bodied samples with more “cognitive reserve”. These findings have important, specific implications for skill acquisition during rehabilitation after cervical spinal
cord injury and further, this model of “acute onset” OSA may provide general insights into the time course of OSA-related NP dysfunction. **Support (If Any):** Proudly supported by the Traffic Accident Commission, and National Health and Medical Research Council, Australia.

**0474**

**EVALUATING BASELINE CHARACTERISTICS AND OUTCOMES IN HYPOVENTILATION SYNDROMES ASSESSED IN THE SLEEP CENTER**


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**Introduction:** Recognizing differences in baseline characteristics and therapy response for different hypoventilation syndromes may assist in management by sleep specialists. **Methods:** We retrospectively evaluated hypoventilators diagnosed at our sleep center (Kaiser Permanente, Fontana) from 2009 to 2014, assessing baseline characteristics, therapy response, and clinical and healthcare utilization outcomes. **Results:** 113 hypoventilators were evaluated: 93 obesity hypoventilation syndrome (OHS), 30 COPD, 9 neuromuscular weakness (NMW), 6 other. Significant (p < 0.05) baseline characteristic differences at time of PSG diagnosis were: 1) COPD patients were older than OHS (63 ± 9 vs 57 ± 14); 2) OHS had higher BMI versus COPD and NMW (45.7 ± 10.7 vs 38.8 ± 9.3 vs 24.4 ± 5.7); 3) pulmonary function showed greater obstruction in non-obese COPD versus obese COPD (FEV1 37.3 ± 15.0% vs 52.6 ± 19.2%); 4) OHS had more severe OSA (AHI 45.1 ± 46.4 vs 25.2 ± 35.2 COPD vs 19.4 ± 27.0 NMW). Therapies initiated were bilevel PAP (72%), CPAP (25%) and O2 only (4%). Important clinical outcomes include decreases in blood pressure and serum bicarbonate levels (HCO3). Pre-therapy blood pressure averaged 127.6 ± 12.5 / 72.1 ± 10.9 across all groups, with post-therapy reductions by 3.2 ± 11.0 systolic and 2.0 ± 8.9 diastolic (p < 0.05). HCO3 decreased by 1.1 ± 3.0, most prominently in OHS with 1.5 ± 2.7 reduction (P < 0.01). There were 15 deaths during 30-month follow-up period. Total office visits (OV) were assessed for 58 patients with objective usage. Adherent (Medicare criteria) and non-adherent patients both showed a gradual increase in OV 2 years before, and decrease 2 years after, initiating therapy. Adherents showed lower OV throughout versus non-adherents (“before” 1.2 vs 1.7; therapy initiation 2.4 vs 3.4; “after” 1.3 vs 2.0 OV/month) but was non-significant. Pattern was similar for hospitalization rates. **Conclusion:** Baseline characteristics differ between types of hypoventilation. Therapy results in decreases in blood pressure and serum bicarbonate. Those adherent to therapy have lower frequency of office visits, significance to be determined with inclusion of additional patients.

**0475**

**A CLINICAL PATHWAY TO IMPROVE RECOGNITION OF OBESITY HYPOVENTILATION SYNDROME IN HOSPITALIZED PATIENTS**

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**Introduction:** Obesity hypoventilation syndrome (OHS) is a major medical condition that remains under-diagnosed in hospitalized patients leading to delayed intervention. Insufficient awareness and a lack of simple screening process has contributed to underrecognition. **Methods:** We retrospectively collected data from October 2014 to February 2015 and prospectively screened obese patients (BMI ≥ 30) from August 2015 to November 2015 with STOP questionnaire, and serum bicarbonate (≥ 27 mEq) on admission for the identification of potential hypercapnic patients. We excluded patients with chronic obstructive pulmonary disease, neuromuscular diseases or chronic opioid use, and those in whom elevated serum bicarbonate may be explained by metabolic causes: chronic diuretic therapy or vomiting. In the prospective arm, we implemented the protocol to increase OHS recognition: for the obese patients with unexplained elevated bicarbonate, a blood gas analysis (BGA) was recommended to confirm the diagnosis of OHS. **Results:** We retrospectively collected data for 403 patients and prospectively screened 387 patients. After applying exclusion criteria, the number of patients with considered OHS, was similar in retrospective and prospective cohorts, 31/291 (10.6 %) and 27/273 (9.8 %) in “STOP positive” and significantly higher (p < 0.05) then 6/112 (5.3 %) and 5/114 (4.4 %) in “STOP negative” groups. The mean age was 64.6 and 62.6 years, mean BMI 36.8 and 37.8, 40 % and 48 % were males, in retrospective and prospective cohorts of patients with elevated bicarbonate level (before applying exclusion criteria) respectively. The BGA performed in 11 clinically suspected OHS in the prospective arm. After the implementation of the protocol, the recognition of OHS increased. There was 1 patient with clinically recognized OHS after hospital admission in retrospective and 10 patients in the prospective parts. The BGA, when performed, confirmed the diagnosis of OHS. **Conclusion:** There is a significant burden of unrecognized OHS. Our study supports that screening obese patients with STOP questionnaire and serum bicarbonate ≥ 27 mEq is a simple strategy for a busy hospitalist for recognizing patients with high risk for OHS. Our prospective arm demonstrated increased recognition of OHS.
and minimum oxygen saturation were significantly lower in group A ($\bar{x} = 85.1\%$ and $\bar{x} = 71.4\%$, respectively) than in group B ($\bar{x} = 89.3\%$ and $\bar{x} = 80.1\%$, respectively) with a p value of 0.006 for mean oxygen saturation and 0.007 for minimum oxygen saturation.

**Conclusion:** Sleep restriction could be a factor that lessens the effects of respiratory sleep disorders by avoiding over exposure to intermittent hypoxia. The effects of sleep restriction through rotational shiftwork and OSA require a particular interest in future research.
B. Clinical Sleep Science

0477
HOME DIM LIGHT MELATONIN ONSETS IN DELAYED SLEEP PHASE DISORDER
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Introduction: The dim light melatonin onset (DLMO) is the gold standard in the measurement of circadian timing in humans. However, the accurate assessment of the DLMO is often limited to the clinic/laboratory setting, where staff has to monitor sample collection. Here we tested for the first time a novel kit for unattended home saliva sampling in patients with a circadian rhythm disorder. The kit included objective measures of compliance to (1) dim light via a photosensor, (2) correct sample timing with a monitoring device, and (3) a streamlined labeling system to reduce sample-labeling errors.

Methods: Thirty-two adults (18-52 years) meeting ICSD-2 criteria for delayed sleep phase disorder (DSPD) participated in a 10-day protocol. Each subject participated in back-to-back home DLMO and laboratory DLMO assessments twice, in counterbalanced order, with 5 days between the assessments on their usual sleep schedule.

Results: The average light intensity during the home DLMO assessments was 5.7 lux, and subjects received ≤ 50 lux for ≥ 98% of the 8.5 hour home DLMO assessments. Most subjects were able to collect half-hourly samples within 5 minutes of the scheduled sample times. Cross checking of light recordings and sample times with salivary melatonin results revealed 83% of home DLMOs were not affected by light or sampling errors. The average home DLMOs occurred only 10.2 minutes before the laboratory DLMOs. The home and laboratory DLMOs were highly correlated (r = 0.93, p < 0.001).

Conclusion: Patients with DSPD can complete home DLMO assessments with reasonable compliance to light and sampling requirements. The majority of home DLMOs were unaffected by light or sampling errors, and they compared favorably with the laboratory DLMOs. These results suggest that with the addition of objective markers of compliance, the accurate assessment of the DLMO outside of the clinic/laboratory in patients with DSPD is possible. This should reduce cost and increase the availability of DLMO assessments.

Support (If Any): R01 AT007104 to HJB.

0478
HOW WELL DO CIRCADIAN QUESTIONNAIRES CORRELATE WITH THE DIM LIGHT MELATONIN ONSET?
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Introduction: The dim light melatonin onset (DLMO) is the gold standard marker of central circadian timing in humans, and is often used to time circadian treatments such as bright light or exogenous melatonin. However, the collection of the DLMO is time consuming and expensive and not yet available to all clinicians. Two circadian questionnaires, the Morningness-Eveningness Questionnaire (MEQ) and the Munich ChronoType Questionnaire (MCTQ) are often used to estimate diurnal preference and chronotype, respectively, as surrogates of circadian timing. Here, in the largest sample to date, we examined the relationships between the DLMO, MEQ score and MSFsc (temporal midpoint of sleep on work-free days corrected for sleep debt on workdays, derived from MCTQ).

Methods: Sixty participants (18-62 years), 36 healthy controls and 24 people with delayed sleep phase disorder, slept freely at times of their choosing for a week before completing both questionnaires and participating in a baseline phase assessment to determine their DLMOs.

Results: The DLMOs ranged from 18:30 to 02:38, and correlated significantly with both the MEQ score (r = -0.70, p < 0.001) and MSFsc (r = 0.68, p < 0.001). The MEQ score explained 49% and MSFsc explained 47% of the variance in the DLMO, respectively. We observed about a 4-hour range in the DLMO at each given MEQ score and MSFsc.

Conclusion: Diurnal preference (MEQ) and chronotype (MCTQ) assessments correlated significantly with the DLMO. Nonetheless, the range in DLMO around a given MEQ score and MSFsc suggests some imprecision. Therefore, neither questionnaire should be used exclusively to time circadian treatments. Both questionnaires will be compared on the specific behaviors they assess, secondary outcomes (e.g. social jetlag from MCTQ), completion time and subject burden, scoring difficulties, and whether alarm clock use confounds the assessment of chronotype.

Support (If Any): R01 HL083971 and R01 AT007104 to HJB and TK is funded by STW grant P10-18/12186.

0479
CIRCADIAN PHASE AND PHASE ANGLE DISORDERS IN PRIMARY INSOMNIA
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Introduction: The timing of sleep is a key contributor to its quantity and quality. Sleeping at an inappropriate circadian phase may cause abnormalities similar to that reported in some types of insomnia. We aimed to identify the prevalence of circadian phase and phase angle abnormalities in insomnia patients.

Methods: Seventy-nine patients meeting the Research Diagnostic Criteria for Primary, Psychophysiological, Paradoxical, and/or Idiopathic Childhood Insomnia (46F, 35.5 ± 12.3 years (M ± SD) and 21 controls (14F, 34.4 ± 11.8 years) participated in a cross-sectional, multi-center study. Participants kept a sleep log for seven days. Circadian phase was assessed from salivary Dim Light Melatonin Onset (DLMO) time during a 12-hour laboratory visit.

Results: As compared to controls, insomnia patients tried to initiate sleep at the same clock time (24:17 ± 1:17 h versus 24:13 ± 1:30 h, respectively; p = 0.84), but had a later average and wider range of DLMO times (20:56 ± 1:55 h, 18:17 - 01:21 versus 22:02 ± 2:02 h, 17:11 - 04:52, respectively; p = 0.04). Consequently, insomnia patients slept at an earlier circadian phase than controls (phase angle, DLMO - bedtime -2:13 h (± 1:43) versus -3:10 h (± 1:08), respectively; p = 0.008), of whom 10% tried to sleep at or before DLMO (compared to 0 controls), and 22% tried to sleep within an hour after or before DLMO (compared to 6% of controls).

Conclusion: A substantial proportion (10-22%) of insomnia patients initiate sleep at too early a circadian phase, implicating a circadian etiology for their insomnia. Outpatient circadian phase assessments should be considered to improve differential diagnoses in insomnia and to inform the development of appropriately-timed circadian-based treatments.
**B. Clinical Sleep Science**

II. Circadian Rhythms Sleep-Wake Disorders

Support (If Any): The study was funded by an investigator-initiated research grant from Philips Respironics to SWL. JAS was supported by an Australian Postgraduate Award from Monash University. EEF was supported by a National Heart, Lung and Blood Institute fellowships in the program of training in Sleep, Circadian and Respiratory Neurobiology at Brigham and Women’s Hospital (NHLBI; T32 HL079010).

0480

ENDOGENOUS CIRCADIAN RHYTHM IN VASCULAR FUNCTION AND CARDIOVASCULAR RISK

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Introduction: Adverse cardiovascular (CV) events occur more frequently in the morning especially within three hours of awakening. It is possible that these events could be triggered by the CV changes associated with: (1) the long period of immobility during sleep; (2) the CV stresses associated with awakening and initiation of active behaviors; or (3) the endogenous circadian system. Vascular endothelial function (VEF) is an excellent prognostic marker of CV function.

Methods: We tested whether there is an endogenous circadian rhythm in VEF. So far, data have been collected in 6 healthy participants (age 50 ± 6 yr, BMI 25 ± 4 kg/m², 3 men) throughout a 5 day ‘forced desynchrony’ protocol. The protocol incorporated 10 cycles of identical, recurring 5h 20m behavioral cycles (2h 40m sleep opportunity; 2h 40m wake periods) in dim light and constant temperature. All activities and meals were the same throughout each wake period. At each scheduled awakening (i.e., every 5h 20m), VEF was estimated from brachial artery flow-mediated dilation.

Results: The preliminary results in the 6 participants suggest that the circadian system contributes to lower VEF during the susceptible morning period.

Conclusion: If these preliminary results hold with a larger subject group and in individuals with preexisting CV vulnerability, we would conclude that the endogenous rhythm in vascular function may contribute to the observed early morning peak in CV events.

Support (If Any): This work is partially supported by the National Space Biomedical Research Institute through NCC 9-58. This work is partially supported by the Medical Research Foundation of Oregon. This work is partially supported by NIH/NHLBI IR01HL125893-01A1.

0481

EFFECTS OF SHIFT WORK ON SLEEP, MOOD AND QUALITY OF LIFE, AND FACTORS ASSOCIATED WITH SHIFT WORK DISORDER

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Introduction: Shift work is associated with unwanted consequences of the mental and physical health, and it needs to be decided which factors are involved in the occurrence of the shift work disorder (SWD). The aims of present study was to examine effects of shift work on sleep, mood and quality of life compared to non-shift work, and to find risk and protective factors for SWD in shift workers.

Methods: Responses were obtained from 1807 workers at an university hospital in Seongnam, Korea, including 957 shift workers and 850 non-shift workers. Self-reported questionnaires about circadian typology, resilience, insomnia, excessive sleepiness, fatigue, depression, anxiety and quality of life were administered. SWD was defined as complaints of insomnia and/or excessive sleepiness related with their shift work schedule.

Results: There were significant differences in age, sex, education, marriage status, number of family and medical illness between shift workers and non-shift workers. The shift workers showed more eveningness (44.9% vs 16%, p < 0.001) and had lower resilience (58.27 ± 12.66 vs 64.53 ± 13.34, p < 0.001) than non-shift workers. In addition, shift workers had more severe fatigue (47.36 ± 0.47 vs 42.04 ± 0.5, p < 0.001), depression and anxiety symptoms (14.21 ± 0.18 vs 13.1 ± 0.19, p < 0.001) and slightly lower sleep quality (6.12 ± 0.09 vs 5.52 ± 0.1, p < 0.001) and quality of life (24.06 ± 0.12 vs 24.94 ± 0.13, p < 0.001) compared to non-shift workers. The prevalence of SWD was 42% and logistic regression analyses showed that risk factors associated with SWD were female (OR = 3.80, 95%CI = 1.06-13.58), spending more days in night work per month (OR = 1.11, 95%CI = 1.05-1.18) and eveningness chronotype (OR = 1.39, 95%CI = 1.02-1.91), while resilience (OR = 0.98, 95%CI = 0.97-0.99) was a protective factor against SWD.

Conclusion: The shift workers had health problems including severe fatigue, depressive and anxious symptom, insomnia and low quality of life. Considering risk and protective factors for SWD found in the present study, efforts to improve adaptation to night work such as light exposure at night and development of personal resilience are needed for decreasing occurrence of SWD.

0482

COMPARISON OF SLEEP PARAMETERS AND RESILIENCE BETWEEN SHIFT-WORK AND NON SHIFT-WORK NURSES

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Introduction: The aim of this study is to compare the sleep status, resilience and the 5 subcategories of resilience between shift-work nurses and non-shift-work nurses who had been working at university hospital.

Methods: The subjects were 338 nurses (265 shift-work nurses and 73 non-shift work nurses) who had been working at St. Vincent’s hospital, College of Medicine, The Catholic University of Korea. Data were collected by self-questionnaires of Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Korean Connor-Davidson Resilience Scale (K-CD-RISC). We compared the sleep parameters, such as total sleep time, subjective sleep quality, sleep efficiency, daytime sleepiness, general sleep condition, the resilience and it’s 5 subcategories (self-efficacy, leadership and trust in one’s instincts, positive acceptance of change and secure relationships, a sense of control and tenacity, spiritual influences) between shift-work nurses and non-shift-work nurses.

Results: There was no significant difference in total sleep time, but the subjective sleep quality and general sleep condition were significantly lower in shift-work nurses. Also, daytime sleepiness was more severe and sleep efficiency was lower in shift-work nurses compared to non-shift-work nurses. However the total score of K-CD-RISC showed no significant difference between two groups.

Conclusion: This study suggest that shift-working nurses have poorer sleep quality and more severe daytime sleepiness than non-shift-work nurses. Nevertheless, we could not find significant differences in resilience and its subcategories between two groups. More comprehensive and in-depth studies to find sleep-related problems and their influences affecting medical service providers will be needed.
0483
SPLIT WORK SCHEDULES AND FACTORS THAT IMPACT SLEEP DURATION IN THE UNITED STATES INLAND WATERWAY INDUSTRY
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Introduction: Shiftwork is often associated with shorter sleep duration compared to day workers. In the maritime industry, crew members are often required to work split schedules in which there are two work and two rest intervals during a 24-hour period. The aim of this study was to determine characteristics that differentiated short, moderate, and long sleepers while on a split schedule.

Methods: Participants were recruited from companies operating in the United States inland waterways that were using a split work schedule 6 hours on, 6 hours off, 6 hours on, 6 hours off for up to 30 consecutive days. A total of 136 crew (mean age 47.2 years, all male) working a split schedule recorded every sleep episode in an online sleep diary for two weeks while working on a vessel and then for another two weeks while at home, they also completed the standard shiftwork index (SSI). While on the vessel sleep duration was calculated for each sleep period and then summed for each 24-hour day. The sample was then split into 3 groups based on average daily sleep duration while on the vessel. Groups included the shortest 20% of sleep durations, longest 20% of sleep durations and the remaining 60% were considered moderate sleepers. Groups were compared with analysis of variance, Fischer exact or t-test on key items from the SSI.

Results: While on the split work schedule, short sleepers slept less than 6.6 hours/day, long sleepers slept greater than 8.6 hours/day and moderate sleepers slept between 6.6-8.6 hours/day. There was no significant difference in daily sleep duration between the 3 groups while at home (all groups about 7.5 hours/day). Domestic conflict/stress (p = 0.001), general health (p = 0.03), somatic anxiety (p = 0.04) and fatigue (p = 0.02) were significantly worse for short compared to long sleepers.

Conclusion: These data suggest that crew are not inherently short or long sleepers but that factors related to the work environment and schedule impact the sleep of individual crew differentially. By identifying factors that impact sleep duration targeted interventions can be developed to improve sleep while working split schedules.

Support (If Any): DTOS59-06-G-00039

0484
CIRCADIAN MISALIGNMENT AND COGNITIVE FLEXIBILITY IN NIGHT SHIFT WORKERS
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Introduction: Circadian misalignment can impact health and performance, and is of particular concern for shift workers, whose work schedules may be at odds with their endogenous sleep-wake rhythms. Impairments in cognitive performance have been observed as a result of circadian misalignment; however, these observations have been limited generally to vigilance and reaction time. Less is known regarding on-task cognitive performance. The task-switching paradigm is often used to measure executive control of cognition, particularly in attentional flexibility. In this paradigm, trials involving varying task-rules are completed in quick succession. Some trials employ the same task-rule as the previous trials (“repeat” trials), whereas others employ a different task-rule (“switch” trials). Switch trials require the individual to cognitively switch task-rules, and therefore should result in longer reaction times compared to repeat trials (i.e., “switch cost”). Larger switch costs are indicative of increased effort in set switching, and therefore reduced cognitive flexibility. Successful task-switching performance also requires adequate inhibition of prior task rules, which can be measured by reaction time on trials returning to the same task-rule after a switch trial, compared to performance following successive switch trials (i.e., “set inhibition”).

Methods: Twenty-one overnight night shift workers (13 female) participated in a larger study examining the consequences of circadian misalignment on health. Circadian phase was evaluated using dim-light salivary melatonin onset (DLMO). DLMO at or after 6am was considered full circadian alignment. Cognitive flexibility was evaluated using a computerized task-switching paradigm.

Results: A multiple linear regression indicated that switch-costs increased linearly with increasing circadian misalignment due to earlier DLMOs (β = .54, p < .01), controlling for sex and age as covariates. No significant effect was detected with set-inhibition.

Conclusion: Results indicate that cognitive flexibility is related to circadian alignment, with better alignment associated with increased flexibility. This offers further insight into the cognitive vulnerabilities related to circadian misalignment that may impact risk for errors, accidents, and injuries, particularly for shift workers.

Support (If Any): Funding for this study was provided by TEVA pharmaceutical industries

0485
PREVALENCE AND DURATION OF ON-SHIFT SLEEP IN FIREFIGHTERS: A PRELIMINARY REPORT
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Introduction: U.S. fire departments most often schedule 24- or 48-hour shifts. Extended duration shifts may increase risk of negative safety outcomes. On-shift sleep could sustain or restore performance. The prevalence of on-shift sleep in firefighters has not been systematically reported. We sought to assess the amount of sleep obtained while on-shift.

Methods: A workplace-based sleep disorders screening and education program was tested at 66 fire departments nationally. Firefighters were administered a questionnaire that captured individual demographic characteristics and screened for sleep disorders. A random sample of firefighters at 4 departments were invited to participate in physiologic monitoring. Participants wore wrist actigraphy (Motionlogger, Ambulatory Monitoring, Ardsley, NY) and completed daily diaries of sleep and work. Intervals of work were isolated and sleep overlapping work was assessed. We defined extended shifts as shifts ≥ 24 hours in duration. We estimated the number of sleep episodes, duration of each episode, and total minutes of sleep on-shift. The study protocol received institutional ethics approval.

Results: Eighty-three firefighters completed physiologic monitoring for 816 work shifts. The mean age was 37 years (SD: 8y), 90% were male, and 35% screened positive for a sleep disorder. Median shift length was 15 hours (IQR: 9-24h). On-shift sleep was obtained for 61% of all shifts. Extended duration shifts accounted for 45% of shifts (n = 367). Nearly a quarter of extended shifts were completed with < 6 hours of sleep (n = 88) and sleep was absent for 10%. The median number of sleep episodes on extended shifts was 2 (IQR: 1-3), with median duration 4.2 hours per episode (IQR: 3.2-6.6h). Median total sleep on extended shifts was 7.4 hours (IQR: 6.1-9.5h).
B. Clinical Sleep Science

Conclusion: On-shift sleep is common, but is often obtained in multiple, short episodes. One in ten extended duration shifts were completed without sleep. Results are preliminary and analysis is ongoing.

Support (If Any): This project was supported by FEMA Assistance for Firefighters Grants EMW-2007-FP-02197 and EMW-2008-FP-02566, and by NIH 5T32HL007901-18.

0486

USE OF SLEEP AND WAKE PROMOTING DRUGS IN NORTH AMERICAN POLICE OFFICERS: ASSOCIATIONS WITH MENTAL HEALTH, PERFORMANCE AND SAFETY

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Introduction: Sleep deficiency is associated with adverse consequences, including poor health and performance. Emergency service personnel are at increased risk of chronic sleep deficiency given that many work nights or extended shifts. The use of sleep-promoting and wake-promoting drugs is common in shift-workers; however, relatively few studies have examined the relationship between use of these drugs and adverse outcomes. This study examined the prevalence of use of sleep- and wake promoting drugs in North American police officers, and assessed the relationships between use of these drugs and measures of mental health, performance, and safety.

Methods: A total of 4957 police officers in North America completed a survey which assessed: demographics, sleep behavior, use of sleep- and wake-promoting drugs, mental health status, work-related performance, and safety. The study protocol received institutional ethics approval from Partners Human Research Committee.

Results: Approximately one-in-five police reported use of a sleep-promoting (21.6%) drug, or use of a medication that listed sleepiness as a side-effect (19.5%) in the past month. Approximately 5% of police officers reported use of a wake-promoting drug other than caffeine in the past month. Use of sleep-promoting drugs was associated with motor vehicle near misses (p < .001), fatigue-related errors (p < .001), and stress and burnout (both p < .001), compared with non-users. Use of wake-promoting medication was associated with increased daytime sleepiness (p < .001), motor vehicle near misses and increased propensity to doze while driving after a work-shift (p < .001), and fatigue-related work errors.

Conclusion: We showed that sleep-promoting and wake-promoting drugs, which are commonly used countermeasures in shift workers, are associated with poorer mental health, performance, and safety outcomes in police officers. Additional research is needed to characterize the interrelationships between patterns of use of sleep- and wake-promoting drugs and the individual-level sleep-wake impairments caused by the shift-work schedule.

Support (If Any): This study was supported by grant 2004-FSBX-0001 and grant 2010C-10002 from the National Institute of Justice, Office of Justice Programs, US Department of Justice; grants R01OH008496 and R01 OH009403 from the Centers for Disease Control and Prevention. Dr Ogeil is the recipient of a Margaret Hamilton traveling scholarship (Turning Point) and an NHMRC early career fellowship (Australia).

II. Circadian Rhythms Sleep-Wake Disorders

0487

SIMULATED NIGHT SHIFT DISRUPTS CIRCADIAN RHYTHMS OF IMMUNE FUNCTIONS IN HUMANS

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Introduction: Recent research has unveiled a circadian regulation of the immune system in rodents. Yet, little is known about rhythms of immune functions in humans and how they are affected by circadian disruption. Here, we assessed rhythms of cytokine secretion by immune cells and tested their response to simulated night shifts.

Methods: Nine healthy subjects (22.8 ± 3.6 years old; 1 woman) were studied individually in time isolation for 6 days. Peripheral blood mononuclear cells were collected from each participant kept in constant posture over 24 h under a day-oriented schedule (baseline) and after 3 days under a night-oriented schedule (night shift). Monocytes and T lymphocytes were stimulated ex vivo with lipopolysaccharide and phytohemagglutinin, respectively.

Results: At baseline, a bimodal rhythmic secretion was detected for different cytokines, namely IL-1β, IL-6, and TNFα: a night peak was mainly due to a higher responsiveness of monocytes and a day peak was partly due to a higher proportion of monocytes. A rhythmic release was also observed for IL-2 and IFNγ with a nighttime peak due to a higher cell count and responsiveness of T lymphocytes. Following night shifts, except for IL-2, cytokine secretion was still rhythmic but with peak levels phase advanced by 4.5-6h, while the rhythm in monocyte and T lymphocyte numbers was not shifted.

Conclusion: These results suggest distinct mechanisms of regulation between responsiveness to stimuli and cell numbers of the human immune system. On a night-oriented schedule, only cytokine release was partially shifted in response to the abrupt change of the sleep-wake cycle. This led to a desynchronization of the different rhythmic immune parameters, which might contribute to the increased risk of infection, cardiovascular, metabolic disorders, and cancer reported in shift workers.

Support (If Any): Canadian Institutes of Health Research

0488

SLEEP, CIRCADIAN PHASE POSITION, AND LIGHT EXPOSURE PATTERNS IN SHIFT WORKERS WITH AND WITHOUT SLEEP COMPLAINTS

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Introduction: It is generally assumed that sleep complaints typically associated with shiftwork are closely tailored to circadian phase position during the night shift and to sleep quality/quantity. Environmental light is also a strong predictor of sleep and circadian outcomes. We compared sleep, circadian phase, and light exposure between shift workers with sleep complaints vs. without sleep complaints.

Methods: 25 shift workers aged 29.1 ± 3.7 years (19 men) completed the Pittsburgh Sleep Quality Index (PSQI) to assess subjective sleep quality (sleep complaints), and wore actigraphs during 4 consecutive night-shifts to measure sleep and light exposure. 24h-light patterns and patterns of light during waking hours (in time relative to sleep offset) were calculated. To assess circadian phase position, dim-light melato-
nin onsets were assessed before the first night-shift (pre-DLMO) and after the last night-shift (post-DLMO). Mixed models were used for statistical analysis.

**Results:** Participants with sleep complaints (PSQI > 5; n = 15, 60%) had later pre-DLMOs (21:19 ± 00:58 vs. 20:18 ± 00:31; p < 0.05), when compared to individuals without sleep complaints (PSQI ≤ 5; n = 10, 40%), with no difference in post-DLMOs. Both 24h and waking hours light patterns showed that individuals with sleep complaints were exposed to higher light levels than participants reporting no sleep complaints (p < 0.05 and p < 0.01, respectively), more particularly in the 4-hours following sleep offset. Sleep parameters, years of shiftwork, sex, and age were similar between the two groups.

**Conclusion:** Sleep complaints could not be attributed to objective (actigraphic) sleep quality/quantity. Furthermore, the presence of sleep complaints was not explained by circadian phase position, as workers with sleep complaints presented ≈1h-later circadian phases when beginning night-shifts; plus they were more exposed to light in the evening, which is also conducive for better adjustment. These results emphasize that sleep complaints constitute a complex notion; a comprehensive assessment, including tools measuring insomnia, psychopathology, depression, and pain are needed to comprehend shift workers’ perceptions on sleep quality.

**Support (If Any):** This work was supported by CIHR operating Grants (MOP 82707) to M.H. and by CIHR F.Bantting and C.Best, and FRSQ fellowships to J.S.M.

**0489**

**VARIABLE HABITUAL SLEEP CHARACTERISTICS IN SHIFT WORKERS ARE ASSOCIATED WITH AVERSE METABOLIC OUTCOMES**

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**Introduction:** Shift work, a risk factor for health problems including increased risk of weight gain, obesity, insulin resistance, metabolic syndrome and diabetes, results in major disruptions of sleep-wake homeostasis and the circadian system. Many of the adverse health consequences of shift work are thought to ultimately result from sleep and circadian disturbances.

**Methods:** Following two weeks of ambulatory monitoring, subjects underwent an in laboratory assessment of cardio-metabolic risk including a 3-hour 75 g oral glucose tolerance test. Participants were defined as traditional workers (day) with work hours between 7am and 7 pm and as non-traditional workers (shift) with work hours outside of 7am to 7pm.

**Results:** 42 traditional (T) and 26 non-traditional (NT) workers were studied. Two weeks of habitual life actigraphy revealed that night to night variability in bedtime, time in bed, sleep start/onset, sleep period time (from sleep onset to end of sleep), total sleep time (excluding all awakenings) was significantly greater in the NT than T group (all variability comparisons, p = 0.0001). Both groups of workers were short sleepers with total sleep time under 6 hours per night on average. Fasting glucose level was higher in the NT vs. T group (104 ± 35 vs 91 ± 9 mg/dl, p = 0.035) and the NT group had lower HOMA - β, a measurement of steady state beta-cell function (67 ± 56 vs 100 ± 77 %, p = 0.055). Moreover, a greater proportion of participants in the NT vs. the T group had abnormal glucose tolerance (45% vs 18%, p = 0.023).

**Conclusion:** This study provides evidence that shift workers experience more night to night variability in sleep characteristics than day workers and have lower glucose metabolism. Thus, this variability may contribute to the observed adverse metabolic consequences known to be associated with shift work.

**Support (If Any):** This study was funded by Grant Number R01 OH099482 from the The National Institute for Occupational Safety and Health.

**0490**

**SLEEP TIME AND HOSPITALIST PERCEPTION OF CARE**

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**Introduction:** In 2000, the Institute of Medicine estimated that almost a 100,00 people die each year from medical errors mostly in the hospital setting. Cognitive performance during a period of sleep loss is directly related to length of time awake as well as circadian time with tasks most affected by sleep loss including those that are long and monotonous such as an 8 or 12hr Hospitalist shift. For adults, adequate sleep time is between 7 to 9hrs. In this study, we conducted a survey amongst hospitalists regarding how their sleep time affects perception of care provided.

**Methods:** We surveyed practicing hospitalist across 4 mid-western states in varying settings. Respondents completed a 5-page survey with 43 questions related to type of shift (7-on 7-off days, nights, other), timing of shift and patient load per shift. Sleep characteristics as well as perceived impact of sleep time on medical decision making were asked.

**Results:** 200 surveys were sent through emails and 21(10%) were returned. Of the respondents, 15 were males and 6 were females.12(57%) were on days only, 3(14%) nights only and rest were days and nights. Average sleep time was < 7hrs(62%) and 7-9hrs(38%) in the 24hrs preceding a shift start. 15(75%) respondents reported feeling sleeping during their shift. For those respondents sleeping less than 7hrs, 30% felt it affected making a correct diagnosis most of the time, 50% felt it led to medication errors and communicating with patients and family while 70% said it affected completing their task on time.

**Conclusion:** Reducing medical errors in the hospital setting requires that frontline providers such as Hospitalists are able to self-identify potential contributors to errors. Reduced sleep time is perceived by Hospitalists to impact on the quality and safety of care provided to patients.

**0491**

**MORNING BRIGHT LIGHT ADVANCES PEAK GAIT PERFORMANCE AND SLEEP PHASE IN MULTIPLE SCLEROSIS WITH DELAYED SLEEP PHASE SYNDROME**

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**Introduction:** Multiple Sclerosis (MS) is a neurological disease that impairs motor and sensory function including walking ability. Delayed Sleep Phase Syndrome (DSPS) is a sleep-wake circadian rhythm disorder characterized by difficulty initiating nocturnal sleep at a desired time combined with a tendency to sleep late the next day. Standard treatment of DSPS involves morning bright light therapy. A patient seen in clinic with MS and comorbid DSPS reported an unusual ability for enhanced walking ability within the three hours prior to her natural sleep onset time. The purpose of the study was to determine if morning bright light treatment could advance not only her sleep phase but also her pre-sleep peak gait performance.

**Methods:** A single female subject, age 54, with advanced MS and DSPS was studied. Data was collected for a 24-hour baseline period and over a twelve week treatment period. Treatment involved one hour of morning light box exposure beginning 30 minutes after morning.
II. Circadian Rhythms Sleep-Wake Disorders

0492
CHARACTERIZATION OF THE SLEEP DISRUPTION, MELATONIN CIRCADIAN RHYTHMS, AND GENETIC MUTATIONS IN A COHORT OF SMITH-MAGENIS SYNDROME PATIENTS
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Introduction: Severe sleep disturbances are virtually universal in Smith-Magenis syndrome (SMS) patients and impacts directly the behavior and functioning of SMS patients and also greatly impacts the life of parents and family. We sought to characterize the sleep disruption, melatonin circadian rhythms, and genetic mutations associated with this rare disorder.

Methods: A 4-week study that was inclusive of three, 36-hour, inpatient plasma melatonin and cortisol assessments was conducted. Participants were fitted with an actigraphy watch to monitor daily activity and a cytogenetic sample was collected at baseline. Other assessments included daily diaries for sleep and behavior parameters.

Results: Eight participants, aged 7 to 35, with SMS and a history of sleep disturbances were evaluated. A severely fragmented nighttime sleep period and periods of no or little daytime activity were observed. The melatonin circadian rhythm was entrained to an abnormal phase with peak secretion occurring during the daytime. In most patients (N = 6), very low levels or no melatonin was produced during the nighttime. Chromosomal Microarray Analysis confirmed an SMS diagnosis and identified a deletion in in chromosome 17, including the RAI1 gene that is associated with SMS, with the average size of the deletion spanning at least 3.617 Mb.

Conclusion: SMS patients showed an abnormal daytime secretion pattern of plasma melatonin, however their cortisol circadian rhythm appeared to be entrained to a normal phase. Patients also exhibited severely fragmented nighttime sleep. The size and location of the chromosome 17 deletion in individual patients did not appear to be associated with the amount of melatonin secretion or the severity of the nighttime sleep disturbance. The sleep disturbance, which is believed to be the strongest predictor of maladaptive behaviour in SMS individuals, constitutes a major challenge to the patients and their families. Circadian regulation of the abnormal melatonin rhythm in SMS patients may improve the clinical sleep-wake problems.

Support (If Any): Vanda Pharmaceuticals

0493
GLAUCOMA, MELATONIN SECRETION, AND DEPRESSIVE SYMPTOMS: CROSS-SECTIONAL FINDINGS FROM THE HEIJO-KYO COHORT
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Introduction: Glaucoma is a common ocular disease with progressive optic neuropathy. Recently, it was reported that glaucoma induces dysfunction in the intrinsically photosensitive retinal ganglion cells, a primary photoreceptor. Accumulating biological evidence suggests that circadian disruption causes depressive symptoms. However, few studies reported the association between glaucoma and depressive symptoms in large populations.

Methods: In this cross-sectional study comprising 734 elderly individuals (mean age, 71.5 years), we assessed glaucoma status using current therapy information and a standardized self-reported questionnaire. Depressive symptoms were measured using the short version of Geriatric Depression Scale (GDS) questionnaire, and depressed mood was defined as GDS score ≥ 6.

Results: The prevalence of depressed mood was significantly higher in the glaucoma group (n = 55) than that in the non-glaucoma group (n = 679) (23.6% vs. 15.5%, P = 0.036, respectively). Multivariate logistic regression analysis revealed that significantly higher odds ratio (OR) for depressed mood was observed in the glaucoma group than the non-glaucoma group (OR, 2.02; 95% confidence interval, 1.03 to 3.96; P = 0.042) and that this association was independent of potential confounding factors, such as aging, gender differences, melatonin secretion, hypertension, and physical inactivity.

Conclusion: Our study demonstrated that self-reported glaucoma status was significantly associated with depressive symptoms in a general elderly population, which was independent of endogenous melatonin levels.

0494
CORRELATION BETWEEN SATELLITE-DERIVED NIGHTTIME RADIANCE AND SLEEP QUALITY IN THE POPULATION OF CALIFORNIA
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Introduction: Nighttime source of artificial light are known to disrupt melatonin secretion and have been linked to disturbed sleep patterns. The objective of this study was to analyze the distribution of nighttime radiance emissions from artificial lights derived from satellite as a covariate of measures of sleep quality for the population of California.

Methods: Sleep quality data were collected by telephone interviews using the Sleep-EVAL system. In addition to sleep quality, the interviews covered several topics including sleeping habits, sleep disturbances, medical and mental disorders. The target population was the adults (18 years and older) living in California, USA, representing 24 million of inhabitants. A total of 3,104 subjects participated in the survey (participation rate 85.6%). Nighttime light emissions have been collected by the Defense Meteorological Satellite Program’s Operational Linescan System (DMSP/OLS) sensors for the period corresponding to the date of the interviews. We extracted the radiance calibrated nighttime lights for the period of the interviews, corresponding to an approximately 10 km radius surrounding the interview addresses.

Results: Sleep quality was significantly but inversely associated with an increased nighttime radiance (p = 0.02). However, the correlation between nighttime lights and sleep quality displayed gender and age specificity.
II. Circadian Rhythms Sleep-Wake Disorders

**0495**
VALIDATION OF THE KOREAN MUNICH CHRONOTYPE QUESTIONNAIRE

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**Introduction:** The Munich Chronotype Questionnaire (MCTQ) measures sleep-wake behavior on work and free days. The purpose of the current study was to validate the Korean version of the MCTQ.

**Methods:** 346 college students (mean age 24.8 ± 5.07, female 85.5%) answered completed the MCTQ, in addition to other self-report questionnaires about insomnia (Insomnia Severity Index; ISI), chronotype (reduced Morningness-Eveningness; r-MEQ) and daytime sleepiness (Epworth Sleepiness Scale; ESS). We used mid-sleep on free days (MSFSC) and mid-sleep on free days corrected for sleep debt on work days (MSFSC) as a parameter for determining chronotype.

**Results:** Chronotype based on the MCTQ was divided into three groups: extreme evenness (n = 33, 9.5%), neither (n = 310, 89.6%), and extreme morningness (n = 3, 0.9%), which had a 91.33% consistency with rMEQ scores determining chronotype. Results indicated that rMEQ scores were significantly negatively correlated with MSFSC (r = -0.54) and MSFSC (r = -0.56) assessed by the MCTQ. Additionally, MSFSC was significantly positively correlated with ISI (r = 0.31) but not with ESS scores. We examined MSFSC, mid-sleep, rise time, sleep duration, sleep efficiency of work and free days by age group (20s and 30s). Participants in their 20s (MSFSC = 5.61 ± 1.46) had significantly more evenness tendencies than those in their 30s (MSFSC = 4.38 ± 1.19; p < .001). Mid-sleep time of participants in their 20s was more delayed than 30s in both work days and free days. Specifically, mid-sleep time on work days of 20s was 4:44 (± 1:15); 30s was 3:41 (± 0.48) and mid-sleep time on free days of 20s was 5:58 (± 1:30), 30s was 4:37 (± 1:15).

**Conclusion:** These results demonstrate the validity of the Korean MCTQ and provide an adequacy of the Korean MCTQ for 20-30s. Lastly, we need to validate the Korean MCTQ in other age group.

**0496**
THE EFFECTS OF DELAYING SCHOOL START TIME ON SLEEP AND EMOTION OF KOREAN ADOLESCENTS

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**Introduction:** Recently, middle schools and high schools of Gyeonggi province in Korea delayed the school start time. Delayed times were 40 minutes for middle school and 60 minutes for high school. The aim of this study is to investigate the effects of delaying school start time on sleep, emotion and behaviors of middle school students.

**Methods:** 144 middle school students aged 14 through 15 were recruited from one middle school located in Suwon city of Gyeonggi province. All subjects fulfilled the questionnaires about demographic data, sleep quality, daytime sleepiness, overall mood and behaviors in school. We used Pittsburgh Sleep Quality Index, Daytime Sleepiness Scale modified for middle school students, and questions about overall mood and behaviors in school answered on 10 point visual analog scale basis.

**Results:** Results indicated that average bed time was 23:58, average wake up time was 7:24. Average wake up time was delayed about 40 minutes compared to previous studies. Average total sleep time was 6 hours 54 minutes. Subjects reported 0.9 in sleep quality and 2.1 in daytime dysfunction based on PSQI. There were significant improvements in subjective happiness, numbers of taking breakfast, number of being late for school, concentration on class, overall peer relationship, vitality, and degree of wishing to go to school.

**Conclusion:** Middle school Students wake up later, feel happier, take breakfast more frequently, get less late for school, more concentrate on class, improve peer relationship, and feel more vital. Delaying school start time might have positive impacts on their sleep quality and school life quality.

**Support (If Any):** Korean Society of Sleep Medicine

**0497**
DREAM NEGATIVITY IS ASSOCIATED WITH THE EVENNESS CHRONOTYPE AMONG NIGHTMARE SUFFERERS

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**Introduction:** We previously demonstrated links between nightmares (NM) and eveningness in a large internet cohort of female respondents, a result subsequently replicated and extended to males in 2 independent population studies. We assessed if this link is also discernible in prospectively measured dreams among NM sufferers.

**Methods:** 53 subjects (36F) recalling 2+ NM/wk (M = 24.3 ± 4.1yrs) and 53 controls (CTL: 37F) recalling < 1 NM/mo (M = 23.9 ± 4.4yrs) were recruited by advertisements. All subjects completed 2-week home logs noting bedtime, waketime, TST and recalled dreams, and evaluating intensities (1-9 scales) of Negative and Positive emotions, Fear, Distress During (DistressD) and Distress After (DistressA) each dream, similarity to typical NMs, and whether the dream woke them up (yes/no). They also self-rated their chronotype on item #19 of the Morningness-Eveningness Questionnaire (MEQ); response choices were Definitely Morning, Rather (more) Morning, Rather (more) Evening, or Definitely Evening. Analyses used a 2x4 MANOVA with Group (NM, CTL) and Chronotype (DM, RM, RE, DE) as independent measures and 2-week averages of the variables listed above as dependent measures.

**Results:** Multivariate main effects for Chronotype (Hotellings-T = 0.572, F(27,266) = 1.88, p = .007) and Group (T = 1.014, F(9,90) = 10.14, p < .000001) were due entirely to expected univariate differences in, for Chronotype, bedtime (p = .016), waketime (p = .0002) and TST (p = .002), with evening greater than morning types and, for Group, all measures except the latter 3 (all p < .05) with NM greater than CTLs on all dream negativity indicators. However, a Gp x Chronotype trend (T = 0.413, F(27,266) = 1.36, p = .118) revealed 4 univariate interactions (all p < .05), i.e., Negative emotion, Fear, DistressD and DistressA. For all 4 measures, dream negativity was higher with increasing eveningness for the NM, but not the CTL, group.

**Conclusion:** Day-to-day dream negativity is elevated for NM sufferers and a function of eveningness only for that group. The habitually later bedtimes and waketimes and longer TSTs of evening types are not sufficient to explain this robust relationship.

**Support (If Any):** Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada


**0498**

EFFECTS OF LITHIUM ON CIRCADIAN RHYTHM COMPARED WITH THOSE OF QUETIAPINE XR IN PATIENTS WITH BIPOLAR DEPRESSION


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**Introduction:** Bipolar disorder has been known to be associated with chronobiological disruption. Prior studies reported lithium might have an effects on circadian rhythm including phase delay. In the current study, we compared the effects of lithium on circadian rhythm with those of quetiapine XR in patients with bipolar depression in the 8 weeks prospective trial.

**Methods:** An open-label, randomized comparison of sleep-activity and depressive symptoms between 8-week lithium monotherapy and quetiapine XR monotherapy for bipolar depression was conducted. Each assessment consisted of Hamilton Depression Rating Scale (HDRS)-17 and self-reported Pittsburgh Sleep Quality Index (PSQI). Actigraphy-measured parameters of the circadian rhythm were examined using cosinor analysis.

**Results:** A total of 28 patients (35.9 ± 10.5 years; gender: male 12, female 16) with bipolar depression were analyzed. There was no significant difference of age and gender between the lithium group (16 patients) and the quetiapine XR group (12 patients). To examine the circadian rhythms, we compared the acrophase in each group. Acrophase of the lithium group got significantly delayed at weeks 1, 2, 4, 6 and 8 compared with baseline (16:22 ± 1:14, 17:20 ± 0:29, 17:33 ± 0:39, 18:27 ± 0:45, 18:42 ± 0:30, 19:04 ± 0:28, p = 0.008). Acrophase in the quetiapine XR group were more advanced than those of lithium group at every weeks (p = 0.001), and did not show change of phase in sequence at weeks 1, 2, 4, 6 and 8 compared with baseline (13:50 ± 0:46, 15:54 ± 0:24, 14:05 ± 1:28, 16:12 ± 0:36, 16:23 ± 0:27, 15:38 ± 0:24). In both groups, HDRS-17 scores were significantly decreased at weeks 1, 2, 4, 6 and 8 compared with baseline.

**Conclusion:** In current study, both lithium and quetiapine XR were effective in treating bipolar depression. The current results suggested that lithium had effects of delay phase in the acrophase in patients with bipolar depression, while quetiapine XR treatment did not.

**Support (If Any):** Funding for this study was provided by AstraZeneca (D1443C00031).

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**0499**

THE EFFECTS OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA VS. WAITLIST CONTROL ON CIRCADIAN ACTIVITY RHYTHMS IN MALE AND FEMALE SUBJECTS WITH PTSD

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**Introduction:** Circadian Activity Rhythms (CAR) have been shown to be altered in mental illness, including PTSD. CAR variables such as mean activity in the 24-hour cycle, cycle amplitude, and interdaily stability of activity have been shown to have implications for health outcomes, including mortality. The impact of Cognitive Behavioral Therapy for Insomnia (CBT-I) on CAR has not yet been studied.

**Methods:** CAR data were collected for male and female PTSD subjects (N = 39) randomly assigned to 8 weeks of standard CBT-I or waitlist control group (ClinicalTrials.gov identifier: NCT00881647) using standard actigraphy. Activity was measured over 7 24-hour cycles (1 week) pre-treatment, and then for 56 24-hour cycles (8 weeks) during active treatment or waitlist control period in all subjects. Activity data were collected using the proportional integration mode (PIM). CAR variables were calculated from a 24-hour cosinor analysis. Weekly averages of CAR variables were analyzed with a linear mixed model to estimate treatment and treatment by time effects.

**Results:** A total of 343 weeks of actigraphy measures were available for 39 subjects. There was a significant effect of treatment on change in mesor (B = 122 units per week, p = 0.02) indicating an advantage of CBT-I as compared to waitlist control for increasing mean activity level. Effects for amplitude were in the same direction but non-statistically significant (B = 92 units per week, p = .12). Analysis of interdaily stability demonstrated a positive effect of CBT-I relative to waitlist control on interdaily stability of activity (B = .01 change per week , p = .029). There were no significant effects of treatment or time by treatment on acrophase timing.

**Conclusion:** This is the first study demonstrating effects of CBT-I on CAR. These findings indicate another manner in which CBT-I may improve health and functioning. Future research is indicated to better understand the effects of treatments on CAR and implications for health outcomes.

**Support (If Any):** This project was supported by grants from the National Institute for Mental Health (TCN: 5R01MH073978-04, 5R34MH077667-03) and the Mental Illness Research and Education Clinical Center of the US Veterans Health Administration.

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**0500**

USING CHRONOTYPE TO PREDICT DISTRESSING SYMPTOMS IN LUNG CANCER SURVIVORS

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**Introduction:** Chronotype informs individual variation in circadian rhythmicity. Circadian disruptions expressed as sleep-wake disturbances in adult patients with cancer reportedly influence quality of life. The most distressing symptoms that effect quality of life include pain, fatigue and insomnia. Evidence show that these symptoms are strongly correlated with circadian rhythm disruptions in the general population. Circadian disruption is associated with poor prognosis and early mortality in cancer patients. A study was performed to assess if chronotype is a predictor of distressing symptoms in lung cancer survivors (LCS).

**Methods:** Logistic regression model was used to predict the relationship between early and late chronotype with pain, fatigue and insomnia in LCS. Participants were ≥ 6 weeks after surgery, stage I-III non-small cell lung cancer, clinically and psychiatrically stable. Dependent variables early or late chronotype were assessed with Morningness-Eveningness Questionnaire (MEQ). Independent variables pain (physical well-being - FACT-L), fatigue (functional well-being - FACT-L) and insomnia (PSQI) were assessed with self-reported surveys, and sleep diary.

**Results:** Data collected on seven participants as part of this ongoing study were 71% male, mean age of 65 years old. Fatigue and pain accounts for 47% of variation in insomnia (R2 = .47). Further analysis include distribution of individual chronotype and statistical model to predict variation in chronotype. Nagelkerke R2 will explain the variation in the dependent variables. Wald test will determine statistical significance for each independent variable.
Conclusion: Understanding the relationship between chronotype and distressing symptoms in LCS will inform about the preferred time to deliver interventions for symptom management. Delivering interventions at the best times according to chronotype will improve circadian function, sleep and performance, improving quality of life in LCS.

Support (If Any): Oncology Nursing Society (ONS)

0501 DELAY, DIMINUTION, AND ATTENUATION IN THE CIRCADIAN ACTIVITY RHYTHMS OF WOMEN WITH FIBROMYALGIA

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Introduction: Little is known regarding circadian activity rhythms (CAR) of patients with fibromyalgia (FMS) and how these compare to control populations. Since activity levels, in general, tend to be lower in FMS patient population, appropriate control groups would include only control subjects with comparatively attenuated activity. We hypothesized that FMS patients would exhibit worse CAR and more delayed rhythms when compared to age-matched and activity-matched controls.

Methods: This study included 14 female FMS patients (Age = 36.41±14.4 yrs) and 14 age-matched and activity-matched (reported < 30 minutes per day, physical activity weekly) control subjects. All subjects underwent 7-day actigraphy evaluation. Rhythm amplitude, mesor (mean activity level), acrophase (time of the day of the peak of the activity curve), and R2 (model fit/robustness of rhythm) were derived from the actigraphy data using a 24 hr cosine model that was fitted independently for each participant. Independent t-tests were used to evaluate group differences.

Results: There were significant differences in amplitude, acrophase, and R2 between patients and controls. As expected, there were no differences in mesor (mean activity level) (p = 0.27), indicating similar activity levels between patients and controls. FMS patients exhibited significantly lower amplitude (0.85 vs. 0.95, p = 0.014) and lower R2 (0.42 vs. 0.49, p = 0.031). Finally, FMS patients also exhibited significantly more delayed acrophase (16:30 vs. 15:30, p = 0.015).

Conclusion: These preliminary results suggest that patients with FMS have more disturbed rhythms when compared to controls who were matched for both age and activity levels. Model fit (R2) was stronger for controls, indicating stronger rhythm robustness in controls compared to FMS patients. To our knowledge, this is the first study to show that patients with FMS exhibit considerably more delayed acrophase when compared to the control group. Future studies should assess CAR and evaluate its clinical implications in this patient population.

Support (If Any): Islamic Azad University of Qom

0503 LIGHT EXPOSURE AT NIGHT AND THE RISK OF INSOMNIA: A LONGITUDINAL STUDY OF THE HEIJO-KYO COHORT

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Introduction: Chronic circadian misalignment between the internal and environmental rhythms is associated with the disruption of suprachiasmatic nucleus function, possibly resulting in insomnia. In laboratory settings, light at night (LAN) suppresses melatonin secretion, delays the internal biological rhythm, and reduces sleepiness. Previous epidemiological studies have suggested an association between nighttime light levels and sleep quality; however, a longitudinal effect of LAN on sleep quality has never been explored in human populations.

Methods: This longitudinal study was conducted in the HEIJO-KYO cohort. At baseline survey among 1092 elderly individuals (mean age, 71.9 years), we measured bedroom light intensity at 1-min intervals and subjective sleep quality using the Pittsburgh Sleep Quality Index (PSQI). Of these, subjective sleep quality in 1006 participants (92.1%) was followed up (median duration, 24 months). Association between bedroom light intensity at baseline and changes in the PSQI score was evaluated with multivariate linear regression models.

Results: Median LAN intensity at baseline was 0.7 lux (interquartile range, 0.1-3.3). Compared with the lowest quartile group of LAN (Q1), the highest quartile group of LAN (Q4) exhibited significantly worsened sleep quality (score difference, 0.45; 95% confidence interval, 0.04-0.87; P = 0.033). In multivariate model adjusted for potential confounding factor (age, gender, body mass index, duration in bed, physical activity, day length, and melatonin secretion), higher LAN intensity (Q4 vs. Q1) was significantly associated with subsequent worsened sleep quality (score difference, 0.49; 95% confidence interval, 0.07-0.91; P = 0.021).

Conclusion: In a community-based elderly population, LAN increases the risk of insomnia, and that was independent of several potential confounding factors including melatonin secretion.
AN OBJECTIVE, SEVERE SHORT-SLEEP INSOMNIA DISORDER PHENOTYPE IS ASSOCIATED WITH REDUCED BRAIN CREATINE LEVELS AND IMPAIRED METABOLISM: AN IN VIVO MAGNETIC RESONANCE SPECTROSCOPY ASSESSMENT

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Introduction: Insomnia is associated with impaired GABA/creatinine concentrations (Winkelman et al., 2008); however the direction of the association relative to healthy good sleeping controls (GSC) is unclear. From PSG, two discrete objective groups of insomnia have been proposed: severe-short (SSI) and long (LSI) sleep duration insomnia. We hypothesized SSI patients would have increased brain metabolism compared to LSI patients and GSC.

Methods: Patients with Insomnia Disorder (n = 31) completed PSG and were empirically grouped into SSI (n = 12) or LSI (n = 19). Patients and SSI group vs. GSC (both p < .05, d = 0.80-0.97). Aspartate and glutamine displayed similar mean reductions in SSI compared to LSI groups (both p < .05, d = 0.80-0.97). A single super metabolite variable (SMV) was formed from the four related metabolites (creatinine, aspartate, glutamate and glutamine) using the raw coefficients of the MANCOVA. ANCOVA of the SMV was highly significant (F(2, 40) = 9.72, p < .001; η² = .327). Comparisons revealed differences between LSI vs. SSI (p < .001, d = 1.41) and SSI vs. GSC (p < .01, d = 1.22). SMV was positively correlated with total sleep duration (r = .31, p < .01, Figure 2) and negatively correlated with wake time after sleep onset (r = -.15, p < .01). No overall differences were found between Insomnia Disorder and GSC (Wilks’ λ (.943), F(4, 36) = .579; p = .680; η² = .057).

Conclusion: Severe SSI is associated with attenuated brain metabolism and creatine concentrations in the LOCC relative to both LSI and GSC. No overall differences were found between heterogeneous Insomnia Disorder and GSC. Creatine and related metabolites combined into a single SMV effectively discriminate SSI from LSI and GSC. Metabolism was correlated with objective insomnia severity (sleep duration and wake-time after sleep onset). Creatine appears unstable in SSI patients possibly due to sleep fragmentation.

Support (If Any): National Health and Medical Research Council (NHMRC, Australia) Centre for Integrated Research Understanding of Sleep (CIRUS), 571421; and NeuroSleep, 1060992.

MEMORY, AROUSAL, AND PERCEPTION OF SLEEP

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Introduction: Previous research has shown that sleep misperception is associated with greater cortical arousal. While no mediating processes have been tested, mesograde amnesia has been found to be attenuated by greater cortical arousal. The goal of the present study was to examine the relationships between cortical arousal, memory, and perception of sleep.

Methods: Twenty-six healthy adults (mean age 20.08, SD = 2.59, 53.8% female) completed one night of polysomnography. EEG included Fp1/2, F3/2/4, C3/2/4, Pz, and O1/2. Participants were awaken after the first five minutes of contiguous N2 sleep in the third NREM period. They were kept awake for 15 minutes, and then allowed to resume sleeping. Stimuli (audio recordings of words) were presented every 30 seconds for the entire awakening and transition back to sleep, identified as the first sleep spindle or K complex. In the morning, participants estimated the duration of this awakening and completed recovery testing. Cortical arousal was quantified using spectral EEG analysis. Memory was operationalized as percent of stimuli recognized from the first ten minutes of the awakening. Perception was operationalized as the ratio of subjective to objective wake duration.

Results: Greater global delta power during the 5 minutes prior to awakening was correlated with poorer memory, r(26) = -.45, p < .05 and longer perceived awakening duration, r(26) = .43, p < .05. Better memory was correlated with lower ratio of subjective to objective awakening duration, r(26) = -.43, p < .05.

Conclusion: To our knowledge, this is the first study to test the relationships between arousal, memory, and sleep perception. Greater delta power during sleep prior to awakening was associated with both poorer memory for the first ten minutes of awakening and longer subjective length of awakening relative to objective length. Poorer memory was associated with longer subjective perceived awakening relative to objective awakening length, suggesting memory may mediate this relationship.

Support (If Any): University of Arizona GPSC grant RSRCH-512FY’15

SYMPATHETIC NEURAL AND CARDIOVASCULAR CONTROL IN CHRONIC INSOMNIA

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Introduction: Evidence is accumulating to suggest that insomnia is associated with heightened cardiovascular risk, but underlying physiological mechanisms remain unclear. The present study examined sympathetic neural and cardiovascular regulation in clinically diagnosed insomniacs and controls. Consistent with the hyperarousal theory of insomnia, we hypothesized that insomniacs would demonstrate higher sympathetic neural outflow, blunted baroreflex control, and augmented neural cardiovascular reactivity to stress when compared to matched controls.
METHODS: Seventeen subjects (10 insomniacs, 7 controls; 37 ± 4 years; body mass index, 25 ± 1 kg/m2) participated in an overnight laboratory polysomnography to exclude obstructive sleep apnea and other sleep disorders, two weeks of at-home actigraphy, and an overnight laboratory visit with an autonomic function test the subsequent morning. The autonomic function test included simultaneous recordings of heart rate (HR; electrogastrogram), beat-to-beat blood pressure (Portapres), and muscle sympathetic nerve activity (MSNA; microneurography) during 10 min supine baseline and 2 min cold pressor test (CPT).

RESULTS: Resting blood pressure and HR were not different between insomniacs and controls, although HR tended to be higher in insomniacs (58 ± 2 vs. 64 ± 3 beats/min; p = 0.087). Systolic arterial pressure (SAP) reactivity to CPT was augmented in insomniacs compared to controls (A10mmHg vs. Δ6mmHg; p = 0.046). In contrast, the HR reactivity to CPT was blunted in insomniacs compared to controls (Δ9mmHg vs. Δ20mmHg; p = 0.031). Valid microneurography recordings are currently available in a subset of subjects (10 insomniacs, 4 controls), and preliminary analyses suggest that resting MSNA burst frequency and burst incidence are similar between groups, but that a blunting of basal sympathetic baroreflex sensitivity may be present in insomniacs compared to controls (-4.2 ± 0.7 vs. -7.2 ± 1.2 bursts/100 heart beats/mmHg; p = 0.035).

CONCLUSION: Our current findings support growing evidence of increased cardiovascular risk and hyperarousal with insomnia.

SUPPORT (If Any): Merck Investigators Studies Program.

INSOMNIA WITH SHORT SLEEP DURATION IS ASSOCIATED WITH INFLAMMATION IN ADOLESCENTS

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INTRODUCTION: Several studies have examined the association between insomnia and short sleep duration with elevated inflammation in middle-aged adults. However, no study to date has examined the joint effect of insomnia and short sleep duration on inflammation in adolescents.

METHODS: 421 adolescents (17.0 ± 2.2y, 53.9% male) from the Penn State Child Cohort, a representative general population sample, underwent a 9-hour polysomnography (PSG) recording and physical examination. Insomnia was defined by a self-report of difficulties falling and/or staying asleep, while PSG short sleep duration was split into ≥ 8, 8-7, and ≤ 7 hours of sleep. A single fasting blood draw was collected in the morning and assayed for CRP via ELISA. SDB was defined as AHI ≥ 5. ANCOVA assessed the association of insomnia, objective short sleep duration, and their interaction with CRP levels, while adjusting for age, gender, race, body mass index, SDB, periodic limb movements and history of caffeine, alcohol, tobacco, and drug use.

RESULTS: A significant interaction (p < .01) indicated that objective short sleep duration modified the association between insomnia and CRP levels. Elevated CRP was observed in adolescents with insomnia and ≤ 7 hours of sleep (1.91 ± 0.18 mg/L) as compared to controls or insomniacs with ≥ 8 hours of sleep (0.86 ± 0.13 mg/L and 1.09 ± 0.15 mg/L, respectively) or controls with ≤ 7 hours of sleep (0.77 ± 0.13 mg/L; all p-values < .01).

CONCLUSION: Insomnia with objective short sleep duration is associated with elevated inflammation in adolescents. Future studies should examine the role of systemic inflammation in predicting cardiometabolic abnormalities in this insomnia phenotype as early as adolescence.

SUPPORT (If Any): NIH’s R01 HL63772, R01 HL97165, UL1 TR00127, C06 RR16499

THE NATURAL HISTORY OF INSOMNIA: DOES THE 3RD P OF THE 3P MODEL DIFFERENTIATE BETWEEN RECOVERY FROM ACUTE INSOMNIA TO CHRONIC INSOMNIA?

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INTRODUCTION: According to the 3P model of insomnia, the variable that mediates the transition from acute to chronic insomnia is “sleep extension”, the behavioral tendency to expand sleep opportunity to compensate for sleep loss. As part of an on-going study of the natural history of insomnia (please see companion abstract in this volume), we evaluated how Time in Bed (TIB) varies at baseline and from baseline good sleep to acute insomnia in three subject groups.

METHODS: 539 subjects (from a national cohort) were prospectively assessed with sleep diaries over 6 months. Definitive outcomes were available for three subject groups: Stable Good Sleepers (GS, n = 394), Good Sleepers that transitioned to Acute Insomnia and then recovered (GS-AI-REC, n = 36), and Good Sleepers that transitioned to Acute Insomnia and then to Chronic Insomnia (GS-AI-CI, n = 31). The GS phase for all subject groups and the AI phase for the GS-AI-REC vs. GS-AI-CI groups were evaluated for differences in TIB. TIB was averaged over each phase per subject and analysis of variance was used to examine the differences in TIB across groups within each phase. A Bonferroni correction was used for pairwise comparisons.

RESULTS: During the good sleep phase, the GS group had shorter TIB than the GS-AI-REC group and the GS-AI-REC and GS-AI-CI groups did not significantly differ for baseline TIB. During the Acute Insomnia phase, the GS-AI-REC exhibited reduced TIB and the GS-AI-CI group exhibited increased TIB (as compared to their GS phases).

CONCLUSION: These results are consistent with the 3P model, i.e., that extending sleep opportunity may mediate the AI-CI transition. Further, the data suggest that shorter TIB may be a protective factor against the incidence of AI and that restriction of TIB during AI may be protective against the development of CI. These data are preliminary. Analyses are on-going.

SUPPORT (If Any): Perlis: NIH R01AG041783 & Ellis: Economic and Social Research Council (RES-061-25-0120-A)

CHANGES OF BRAIN ACTIVITIES TO SLEEP-RELATED STIMULI AFTER COGNITIVE BEHAVIOR THERAPY IN PATIENTS WITH PSYCHOPHYSIOLOGICAL INSOMNIA

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INTRODUCTION: Cognitive behavior therapy is essential treatment for psychophysiological insomnia of which pathophysiology is involved with the conditioning of sleep situations with insomnia (or arousal). In current study, we compared brain activities to sleep related pictures and sounds between before and after cognitive behavior therapy in patients with psychophysiological insomnia for understanding neurobiological mechanism of Cognitive Behavior Therapy for Insomnia (CBT-I).
Methods: Thirteen patients with psychophysiological insomnia on ICSD-2 (45.3 ± 6.0y, 9 females) underwent brain fMRI while viewing blocks of insomnia sleep-related/matched control pictures and listening to blocks of sleep-related sound/matched white noise before and after CBT-I consisting of 5 sessions without medications. A whole-brain VBM analysis was used for comparing differences of neural activity to sleep related stimuli and neutral stimuli between two groups.

Results: Compared to before CBT-I, insomnia patients after treatment showed decreased differences in brain activities to sleep-related and neutral pictures in right mid temporal (MINI coordinates x = 51, y = -32, z = -2, cluster size = 28), right lingual (MINI coordinate x = 17, y = -88, z = -14, cluster size = 38, uncorrected p < 0.001). In brain activities to sound stimuli, differences in right superior temporal (MINI coordinate x = 47, y = -14, z = -8, cluster size = 59), right inferior occipital (MINI coordinate x = 41, y = -76, z = -10, cluster size = 22), and left precentral (MINI coordinate x = -41, y = -4, z = 48, cluster size = 26 uncorrected p < 0.001) were decreased after CBT-I.

Conclusion: The current results suggest changes of brain regional responses to sleep related stimuli in psychophysiological insomnia after CBT-I. Especially, brain regions with the changes in current results were associated with emotion or sensory processing.

Support (If Any): This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education(NRF-2013R1A1A2062517

0510
ALTERED REGIONAL BRAIN ACTIVITY TO SLEEP-RELATED STIMULI IN PATIENTS WITH PSYCHOPHYSIOLOGICAL INSOMNIA
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Introduction: Psychophysiological insomnia is known to be learned insomnia characterized by anxiety associated with sleep situation. Conditioning of sleep situations with insomnia (or arousal) plays a major role in the pathophysiology. In current study, we aimed to investigate brain activity to sleep-related stimuli consisted of pictures and sounds in patients with psychophysiological insomnia.

Methods: Twenty one patients with psychophysiological insomnia on ICSD-2 (INS group: 46.4 ± 9.0y, 16 females) and 22 healthy good sleepers (GS group: 43.6 ± 7.0y, 16 females) underwent brain fMRI while viewing blocks of insomnia sleep-related/matched control pictures and listening to blocks of sleep-related sound/matched white noise. A whole-brain VBM analysis was used for comparing differences of neural activity to sleep related stimuli and neutral stimuli between two groups.

Results: Compared to GS group, INS group showed increased differences in brain activities to sleep-related and neutral pictures in left posterior cingulate (MINI coordinates x = -1, y = -49, z = 16, cluster size = 316), left lingual (MINI coordinate x = -25, y = -80, z = -14, cluster size = 111), and right precentral (MINI coordinate x = 7, y = -46, z = 6, cluster size = 132, uncorrected p < 0.001). In brain activities to sound stimuli, INS group showed increased differences in left superior temporal (MINI coordinate x = -55, y = -32, z = 12, cluster size = 125) and right superior temporal (MINI coordinate x = 57, y = -14, z = 4, cluster size = 94, uncorrected p < 0.001).

Conclusion: The current results provide differential brain regional responses of psychophysiological insomnia from those of good sleepers to sleep related stimuli. Especially, brain regions with increased differences in current results were associated with emotion, sensory processing or intrinsic control networks.

Support (If Any): This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2013R1A1A2062517)

0511
THE ASSOCIATION BETWEEN INSOMNIA, SLEEP VULNERABILITY TO STRESS AND PHYSIOLOGICAL STRESS REACTIVITY
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Introduction: Sleep vulnerability to stress has been known as a predisposing factor for insomnia, and can be measured by the Ford Insomnia Response to Stress Test (FIRST). Though the score of FIRST was found to be associated with arousal measured by subjective scales, its association with physiological reactivity to stress is still not fully established. The study aims to examine the associations between subjective sleep vulnerability to stress and physiological reactivity to stress.

Methods: 63 non-insomniac adults and 13 chronic insomnia patients (CI) were recruited from communities. The non-insomniac subjects were divided into two groups based on the FIRST score (cutoff = 19), with 33 of them in the low vulnerability group (LF) and 30 in the high vulnerability group (HF). All subjects were given a speech task as a stress challenge. The indices of ANS reactions, including skin conductance (SCR), peripheral temperature (SKT), and heart rate (HR), were recorded throughout the experimental procedure. The ratio of change of the measure during stress phase divided by the measure in baseline phase was calculated as the index for reactivity.

Results: SCR and HR showed no significant difference in their reactivities to stress among the groups. In contrast to our hypothesis, low vulnerable individuals showed a near-significant tendency of greater reduction in SKT (-0.024 ± 0.019) responding to stress events than chronic insomnia patients (p = 0.055). High vulnerable individuals showed no difference from both groups.

Conclusion: The results did not support the hypothesis that insomnia patients and high vulnerable individuals would have higher ANS stress reactivity than low vulnerable individuals. The findings that low vulnerable individuals showed more ANS stress reactivity indicate that sleep vulnerability to stress may be more related to cognitive arousal as measured by subjective ratings. This finding raises the possibility that high vulnerable individuals may be similar to the “autonomic restrictors” reported in GAD patients, with higher cognitive arousal but lower ANS arousal. This possibility requires further studies to identify.
THE ASSOCIATIONS BETWEEN SUBJECTIVE AND OBJECTIVE ACTIGRAPHIC SLEEP ARE DIFFERENT FOR INDIVIDUALS WITH LOW AND HIGH SLEEP VULNERABILITY
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Introduction: Previous studies have found a lack of consistent relationship between objective measures of sleep and subjective reports of sleep quality and daytime functioning in insomnia patients. It was also reported that individuals have high vulnerability to transient insomnia might have similar personality trait as those with persistent insomnia. It is of interest to see whether this inconsistency is associated with the trait of high sleep vulnerable or more a characteristic of individuals with chronic sleep disturbance.

Methods: 56 subjects were recruited and divided, based on ICSD-3 criteria and their scores on the Ford Insomnia Response to Stress Test, into three groups: a chronic insomnia group (CI; N = 27, mean age = 34.63), a high vulnerability group (HV; N = 15, mean age = 34.53), and a low vulnerability group (LV; N = 14, mean age = 31.71). All participants wore an actigraphy recorder and kept a daily log to rate their subjective sleep quality (5 point represents the best quality) and daytime sleepiness (5 point represents the most sleepiness) for a week. Objective sleep efficiency (SE), sleep onset latency (SOL), total sleep time (TST), and wake time after sleep onset (WASO) were derived from actigraphic data for analyses.

Results: The results show no significant difference in TST among these three groups, and no significant difference in WASO and SOL between HV and LV. CI reported highest daytime sleepiness and lowest sleep quality, followed by HV. Regression analysis shows that subjective sleep quality ($r^2 = .127, p = .002$) and daytime sleepiness ($r^2 = .338, p < .001$) of HV groups can be predicted by objective WASO and TST, while none of these objective variables can predict subjective sleep quality ($r^2 = .056, p = .141)$ and daytime sleepiness ($r^2 = .039, p = .284$) in LV groups. For CI individuals, only TST shows significant but low predictability for their subjective sleep quality ($r^2 = .045, p = .041$) and daytime sleepiness ($r^2 = .043, p = .048$).

Conclusion: In consistent with previous studies, the present study shows discrepancies between objective evaluation of sleep and subjective evaluation of sleep quality and daytime functioning. However, HV individuals demonstrated the highest association between objective sleep measures and subjective ratings, indicating that the discrepancies may be due to the over-concern about sleep in insomnia patients. LV subjects surprisingly showed the lowest association between objective measures and subjective ratings. This may be attributed to a ceiling effect of their subjective ratings with good sleep quality and low daytime sleepiness (Skewness = -.80 and .82, respectively).

SLEEP REACTIVITY DURING RETURN TO SLEEP AFTER MID-NIGHT AWAKENING
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Introduction: Sleep reactivity is associated with polysomnographic changes in response to stressors and subsequent development of insomnia. While chronic insomnia is associated with lower parasympathetic control, the relationship between sleep reactivity and parasympathetic control has not been reported. The purpose of this study was to examine whether sleep reactivity is associated with parasympathetic control in response to a sleep-related stressor.

Methods: Participants were twenty-three healthy young adults (56.5% female, age = 20.17 ± years, SD = 2.74). Participants were required to adhere to a fixed eight-hour sleep schedule for three nights before in-laboratory polysomnography. Prior to lights-out, physiological signals were recorded for two five-minute baseline periods of resting wakefulness. Participants were woken after the first five minutes of contiguous N2 sleep in the third NREM period. Participants were kept awake for 15 minutes and then allowed to return to sleep. Parasympathetic control was operationalized using respiratory sinus arrhythmia (RSA). Sleep reactivity was operationalized using the Ford Insomnia Response to Stress Test (FIRST) with a cutoff of 14 or higher identifying high sleep reactivity.

Results: In a multiple linear regression, the interaction between baseline RSA and sleep reactivity was significantly associated with RSA when returning to sleep, F(1, 19) = 4.56, p < .05. Relative to baseline, high sleep reactivity was associated with lower RSA when returning to sleep (b = .66, SE = .29, t = 2.24, p < .05), while low sleep reactivity was associated with higher RSA when returning to sleep (b = 1.39, SE = .18, t = 7.72, p < .001).

Conclusion: To our knowledge, this is the first study to examine the relationship between sleep reactivity and parasympathetic control in response to a sleep-related stressor. Individuals with high sleep reactivity had relatively low parasympathetic control when returning to sleep after an experimental awakening from sleep. People with high sleep reactivity may benefit from interventions to increase parasympathetic control during awakenings from sleep.

Support (If Any): University of Arizona GPSC grant RSRC-512FY’15

SELF-REPORTED INSOMNIA SEVERITY IS ASSOCIATED WITH DECREASED PRECUNEUS AND MEDIAL FRONTAL GRAY MATTER VOLUME AMONG COMMUNITY-DWELLING ADULTS: A VOXEL-BASED MORPHOMETRIC STUDY
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Introduction: This study aims to 1) examine relationship between self-reported sleep problem and gray matter volume within a community-based sample; 2) relate changed gray volumes with participant’s neuropsychological function.
Methods: In 92 community-dwelling adults (38 male; mean age = 48.43 years, SD = 15.00, range = 22-77), sleep problems were assessed using Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS). The participants were also measured by a battery of neuropsychological tests, which assess long term memory, working memory, executive function and attention. MRI images of the brain were obtained from all the participants. Dartel-VBM method was used to examine the relationship between self-reported sleep problem and gray matter volume (GMV).

Results: Self-reported insomnia severity was significantly with reduced gray matter volume in bilateral precuneus and medial frontal gyrus at cluster level FWE corrected p < 0.05. PSQI total scores, ESS total scores, and sleep duration were not associated with GMV after corrected. Region of interest analyses showed that bilateral orbital frontal (r = -0.23 for left; r = -0.31 for right) and left hippocampus (r = -0.24) negatively related with insomnia severity. Furthermore, delay logical memory positively related with left med prefrontal gyrus (r = 0.24); verbal fluency positively related with bilateral precuneus (r = 0.21 for bilateral) and orbital frontal (r = 0.23 for left; r = -0.34 for right); attention related with bilateral precuneus (r = 0.26 for bilateral).

Conclusion: This large community-based study demonstrated insomnia severity was associated reduced gray matter volume. Furthermore, our data indicated that decreased gray matter volumes were associated with poorer performance on cognitive measures.

Support (If Any): This study was supported by grants from the National Science Fund China Outstanding Investigator Award (81088001), the Beijing Training Project for the Leading Talents in S & T (Z1511000031502) the Knowledge Innovation Project of the Chinese Academy of Sciences (KSCX2-EW-J-8), and the CASSAFEA International Partnership Program for Creative Research Teams (Y2CX131003).

0515

DOES THINKING KEEP PEOPLE AWAKE? OR DOES IT MATTER WHAT THEY ARE THINKING ABOUT? SELF-DIRECTED COGNITIONS ASSOCIATED WITH INSOMNIA AND INSUFFICIENT SLEEP


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Introduction: Cognitive arousal may interfere with sleep initiation and/or maintenance and, when sufficiently intense and/or enduring, may result in acute (and/or chronic) insomnia. Cognitive arousal, however, likely entails both positive-affect and negative-affect cognitions. It is possible that both are related to insomnia severity, in which case the affective component may be less relevant. In order to evaluate this, negative-affect and positive-affect mental activity were assessed for their association with insomnia severity.

Methods: Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used (age 22-60; N = 1007). Self-directed cognition was measured using items from the Rumination and Reflection Questionnaire, assessing the likelihood that individuals ruminate on things, play back past events, rehash events in their mind, love exploring their “inner” self, have a philosophical outlook, or meditate on things. The first three are considered negative and the latter three are considered positive. Insomnia was assessed with the insomnia severity index and categorized as none (0-7), mild (8-14), or moderate-severe (≥ 15). Sleep duration was assessed with the NHANES question (typical weekday/workday) and categorized as short (< 6h), normal (7-8h), or long (≥ 9h). Covariates included age, sex, education, race/ethnicity, and depressed mood.

Results: Rates of endorsement were as follows: rumination (57.4%), playing back (67.4%), rehashing (60.6%), exploring inner self (52.14%), philosophical outlook (46.08%), and meditating (46.58%). Multinomial logistic regression analyses showed that ruminating was associated with moderate-severe insomnia (OR = 3.86, p = 0.006). Playing things back was associated with both mild (OR = 2.66, p = 0.017) and moderate-severe (OR = 8.29, p = 0.001) insomnia. Ruminating was also associated with mild (OR = 3.06, p = 0.008) and moderate-severe (OR = 2.98, p = 0.023) insomnia. Exploring the “inner” self, having a philosophical outlook, and meditating on things (all of the positive cognitions) were not associated with insomnia. After adjusting for covariates, short sleep was associated with ruminating (OR = 2.41, p = 0.011) and rehashing (OR = 2.40, p = 0.016). These were mediated by insomnia.

Conclusion: Negative self-directed cognitions were associated with short sleep and insomnia symptoms, but positive ones were not.

Support (If Any): The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216. Dr. Perlis is supported by R01AG041783.

0516

METABOLIC SIGNATURE OF INSOMNIA IN BLOOD SERUM

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Introduction: Insomnia disorder is highly prevalent and associated with a range of negative sequelae, but its pathophysiology is poorly understood. Improved biochemical understanding of insomnia could significantly advance efforts at prevention, diagnosis and treatment. We undertook an investigation of insomnia using a metabolomics approach.

Methods: Patients with insomnia disorder and age and sex-matched good sleeper controls (N = 10 per group) were followed over two days. Blood samples were collected every 2 hours for 48 hours. Extracted blood sera were subjected to nuclear magnetic resonance (NMR) spectroscopy based quantitative metabolic profiling followed by multivariate statistical analysis. Partial least square based multivariate regression modeling was used to determine whether a nighttime (11:00 PM to 7:00 AM) metabolic signature of insomnia could be identified.

Results: The sample had a mean (SD) age of 35.1 (6.76) years old and was 60% female. The mean score on the Insomnia Severity Index was 14.60 for the patient group and 1.50 for controls. There were significant differences (OPLS-DA regression CV-ANOVA p < 10-5 ) in the nighttime metabolic composition of patients with insomnia and controls. There was some variation in effects between the first and second nights. However, seven metabolites, mostly suggestive of energy metabolism, were consistently different between groups on both nights. In addition, unique sets of metabolites were found to increase or decrease in a linear pattern overnight (using OPLS regression, CV-ANOVA p < 10-5 for all models) for control and insomnia groups, including several central carbon metabolic pathway components and amino acid metabolites.

Conclusion: These data provide metabolic insights into the pathophysiology of insomnia and indicate that the disorder may be associated with dysregulation of energy metabolism. The results also indicate that a metabolic signature of insomnia can be identified that could have value as a diagnostic or therapeutic biomarker.

Support (If Any): This work was supported by an investigator-initiated research grant from Merck, Inc.
PHASE RELATIONSHIP BETWEEN SLEEP TIMING AND MELATONIN RHYTHM IN INSOMNIA PATIENTS
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Introduction: Previous studies suggested that a misalignment of the habitual sleep schedule to the endogenous circadian rhythm may lead to sleep complaints of insufficient or nonrestorative sleep. We aimed to measure the sleep timing and melatonin rhythm in insomnia patients and normal control subjects, and to compare their phase relationship between the two groups.

Methods: Eighty-six patients with insomnia disorder and 142 normal controls (NC) were recruited from three Public Health Centers in a rural area of Korea from 2013 until 2015. Insomnia disorder was diagnosed as the existence of one or more complaints among the difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, and non-restorative sleep for three or more days per week. The actigraphy recording for 7 days was conducted at home for each subject. Five hourly saliva samples were obtained starting from 3 hours prior to sleep onset measured by actigraphy. The dim light melatonin onset (DLMO) was defined as the time which the melatonin level was 4 pg/ml. Finally, DLMOs were determined in 59 insomnia patients (Age: 61.37 ± 11.93 years) and 39 NC (Age: 55.72 ± 14.19 years). The sleep parameters and the phase angle (PA) between the sleep onset (SO) and DLMO were compared using ANCOVA controlling for age. Stepwise regression analysis was done to investigate factors influencing bedtime, wake time, sleep latency, and wake time after sleep onset (WASO).

Results: Insomnia patients did not show significant differences in SO and DLMO, but significantly shorter PA between SO and DLMO compared to NC (p < 0.05). Regression analysis showed that the DLMO and PA (SO-DLMO) were significant predictors of bedtime (r2 = 0.46, p < 0.01) and of WASO (r2 = 0.20, p < 0.01).

Conclusion: Insomnia patients had no difference in the sleep timing and melatonin rhythm from those of NC, but had shorter PA than NC. The circadian phase as well as the phase relationship between the sleep timing and circadian phase predicted the bedtime and change in sleep maintenance.

Support (If Any): Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2013R1A1A2009888).

THE EFFECT OF NEGATIVE AFFECT ON CRAVING OF HYPNOTICS IN LONG-TERM HYPNOTIC USERS AS MEASURED BY ATTENTIONAL BIAS
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Introduction: Most hypnotics are indicated for short-term use but prolonged use is very commonly in clinical settings. This study examined the phenomenon of craving in hypnotic use by measuring attentional bias with event-related potential (ERP), as well as the effect of negative emotion state on craving.

Methods: Thirteen long-term hypnotic users (≥ 6 months) were included in this study. They came to the sleep laboratory for two nights for two experimental conditions -- an experimental night in which negative affect was induced by giving negative comments on their performance on a cognitive task and a control night with exactly the same procedure except that the negative comments was replaced by neutral comments. For both nights, assessment of craving and emotional status and recording of ERPs induced by pictures related to hypnotic use, sleep and neutral pictures were conducted.

Results: The amplitudes of P300 and SPW for sleep related pictures and hypnotic related pictures were significant larger than those of neutral pictures in both baseline condition (F(3, 670) = 67.993, p < .001) and stressful condition (F(3, 670) = 57.038, p < .001). Also, the amplitude of P300 to sleep related and hypnotic related pictures are positively correlated with subjective craving for hypnotic drugs (r = 0.572 to 0.878 according to different electrode sites) in both conditions. Moreover, subjective craving showed a tendency to be higher in the experimental condition (F(1,12) = 4.234, p = 0.062).

Conclusion: Long-term hypnotic users demonstrated an attentional bias toward sleep-related and hypnotic-related pictures. Negative affect however did not increase the attentional bias, but showed a tendency to increase subjective craving. The results suggest attentional bias as an automatic process that might be independent from situational factors, and is related but represent different process from subjective craving.

Support (If Any): The study is supported by the Ministry of Science and Technology, Taiwan.

INSOMNIA-SPECIFIC RUMINATION IS RELATED TO EMOTION DYSREGULATION IN INSOMNIA DISORDER
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Introduction: Maladaptive cognition, including insomnia-related rumination, has been shown to contribute to the development and maintenance of insomnia. Rumination is considered to be a process of perseverative thinking about past-oriented feelings and problems. In the context of affective disorders, it is typically regarded as a dysfunctional emotion regulation strategy. Emotion dysregulation has been related to the development and maintenance of insomnia. Thus, the aim was to study the possible association between sleep-related rumination and emotion dysregulation in insomnia.

Methods: The study consisted of 55 subjects who met the diagnostic criteria for Insomnia Disorder (ID) (DSM-5) and 30 healthy controls (H). Insomnia Severity Index (ISI), Daytime Insomnia Symptom Response Scale (DISRS), Emotion Regulation Strategies (ERS), Beck Depression Inventory (BDI), Zung Self-Rating Anxiety Scale (SAS) were administered. Differences in means between ID and H groups were assessed using t-test or Mann-Whitney U/Wilcoxon test. Univariate and multivariate regression analyses were then performed.

Results: Subjects with ID (F 25, mean age 44±1) presented higher ISI, DISRS, BDI and SAS scores than H subjects (F 22, mean age 45±1) (respectively ISI:17.4±2 vs 4.2±0.5 p < .01; DISRS: 48.8±2.2 vs 22.1±2.3, p < .05; BDI: p < .05; SAS: p < .05). They also showed higher scores in DERS (79.4±28.1 vs 55.7±11.8, p < .05). Considering all the variables, insomnia-related rumination was best determined by DERS (co-eff. = .36, p = .03). Rumination was related to difficulties in emotional acceptance (B = 1.5, p = .001), in engaging in problem-solving (B = 1.4, p = .002), in impulse control (B = 1.4, p = .002), and to lack of emotional clarity (B = 1.2, p = .04).
Conclusion: Insomnia-related ruminating is associated with emotion dysregulation in insomnia, especially in problem-solving, impulse control, and emotional acceptance and clarity. Subjects with insomnia may have a reduced ability to successfully regulate negative emotions and to engage in problem-solving, increasing the likelihood of engagement in ruminating. We may consider it as a dysfunctional emotion regulation strategy in insomnia. The psychological treatment of insomnia should also be focused on insomnia-specific ruminating.

0520
THE ROLE OF ATTACHMENT STYLE IN STRESS PERCEPTION AND REACTIVITY IN INSOMNIA DISORDER
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Introduction: According to cognitive theories, unhelpful cognitions may contribute to the development and maintenance of insomnia. Interpersonal theories in insomnia have been studied less. Attachment theory is one of the integrative theories that can be used as a cognitive-interpersonal framework for understanding the development and maintenance of insomnia. Attachment insecurity (vs. security) is associated with a vulnerability in response to stress. Because stress perception and reactivity are crucial for insomnia, according to the stress diathesis model, the aim was to study their possible association with attachment style.

Methods: The study consisted of 45 subjects who met the diagnostic criteria for Insomnia Disorder (ID) (DSM-5) and 35 healthy controls (H). Insomnia Severity Index (ISI), Attachment Style Questionnaire (ASQ), Perceived Stress Scale (PSS), Ford Insomnia Response to Stress Test (FIRST) were administered while controlling for psychiatric symptoms. Differences in means between ID and H groups were assessed using t-test or Mann-Whitney U/Wilcoxon test. Univariate and multivariate regression analyses were then performed.

Results: Subjects with ID (F 23, mean age 45±1.3) presented higher ISI, PPS, and FIRST scores than H subjects (F 20, mean age 46±1.2) (respectively ISI:16.4±5 vs 4.2±1.7 p < .01, PPS: 17.1±8.7 vs 10.1±2.3 p < .05, FIRST: 23.6±6.9 vs 15.2±2.3). They also showed higher scores in ASQ fearful (27.5±1.5 vs 16.5±0.6, p < .05) and preoccupied styles (26.5±0.6 vs 13.5±0.7, p < .05). Considering all the variables, PPS was best determined by ASQ preoccupied (coeff. = .39, p = .003), and FIRST by ASQ fearful (coeff. = .61, p = .004).

Conclusion: Attachment dynamics are theorized to shape the schemas and expectations an individual has of others. Subjects with insomnia show insecure attachment style, they seem uncomfortable with relationships or they depend on them. Insecure attachment in insomnia seems to negatively influence stress perception and reactivity and may contribute to the development and maintenance of insomnia. An interpersonal approach should be considered as part of the psychological treatment for insomnia.

0521
SLEEP SYSTEM SENSITIZATION: EVIDENCE FOR CHANGING ROLES OF ETIOLOGICAL FACTORS IN INSOMNIA
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Introduction: Prior literature on insomnia risk factors has largely focused on premorbid vulnerabilities, with less attention given to the evolution of such vulnerabilities in response to insomnia onset. This study evaluated whether the sleep system becomes sensitized as a consequence of insomnia development. Further, we also tested the impact of sleep system sensitization on depression and anxiety.

Methods: The study involved three annual waves of data collection from a large cohort. Participants were adults with no lifetime history of insomnia or depression at baseline, who developed insomnia at the 1-year follow-up (N = 262). Sleep reactivity was measured using the the Ford Insomnia Response to Stress Test (FIRST), whereas as depression and anxiety were assessed using the QIDS and BAI respectively. The sample was split into two groups based on baseline FIRST scores using a ≥ 16 cut-point representing low and high sleep reactivity.

Results: Insomniacs with low premorbid sleep reactivity reported large increases in sleep reactivity from baseline to 1-y follow-up (t = 7.26, p < .001, Cohen’s d = 1.25). Overall, 68.3% of insomniacs with low pre-morbid sleep reactivity were re-classified as having high sleep reactivity at the time of insomnia onset. Notably, results showed that sleep reactivity at 2-y follow-up was significantly higher than baseline, even after insomnia remission (t = 3.10, p < .01, Cohen’s d = .70). Finally, analyses revealed that increases in FIRST scores predicted greater depression (partial r = .24, p < .001) and anxiety (partial r = .26, p < .001) at insomnia onset. Notably, the impact of sleep system sensitization on depression was stable at 2-y follow-up (partial r = .19, p = .01).

Conclusion: Data supported sleep system sensitization as a consequence of insomnia development in individuals with low premorbid sleep reactivity. Harmful effects of sleep system sensitization may extend beyond risk for future insomnia, and may result in increased vulnerability to depression and anxiety.

Support (If Any): This study was supported by an NIH Grant R01 MH082785 to Dr. Christopher L. Drake.

0522
IS WAKE-SLEEP PERCEPTION DIFFERENT BETWEEN PATIENTS WITH INSOMNIA AND PATIENTS WITH SLEEP APNEA OR EXCESSIVE DAYTIME SLEEPINESS?
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Introduction: To investigate if there is wake-time misperception in patients with insomnia and the correlation between sleep and wake misperception

Methods: Patients who underwent night polysomnogram(PSG) at Dankook University hospital for any reasons were enrolled. For wake-time perception, estimated 1min duration was measured before light off and after light on when performing PSG. They were told to count 1min in their heads without a clock and tell when it was 1min. Patients were grouped depending on the chief complaint such as insomnia or sleep apnea or excessive daytime sleepiness (EDS). Estimated sleep latency (SL) and total sleep time (TST) were also asked next morning of PSG. Night PSG data was reviewed as well as questionnaire including insomnia severity index (ISI), Epworth sleepiness scale (ESS) and Beck depression inventory (BDI).

Results: A total of 231 patients (44.1 ± 13.8, male 177) were enrolled including 15 insomnia, 155 sleep apnea, 14 EDS and 47 others. Estimated 1min before light off (elmin-off) at night was shorter than one in the morning(elmin-on) (61.0 ± 22.8sec vs. 64.2 ± 22.2, p < .001). More patients with insomnia reported elmin longer than 60sec (57.1% vs. 47.7%). Mean elmin was not significantly different between groups although it was slightly longer in patients with insomnia. No correla-
tions was observed between eNBP and difference of cSL and SL or eTST and TST.

**Conclusion:** Our study showed the circadian variation of wake-time misperception. Wake-time misperception was not evident in patients with insomnia. Further research with more patients is required with more time span.

### 0523
**POLYSOMNOGRAPHIC ASSESSMENTS OF SLEEP QUALITY AMONG NOISE EXPOSED WORKERS**

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**Introduction:** Because of abrupt and harmful effects on quality of life, in recent decades, noise induced hearing loss has become one of the most extensively studied occupational diseases. In addition to its effect on hearing, noise is also one of the most commonly encountered stressors in today’s environment. Noise exposed workers complained mostly of nervous irritability, lessened capacity for work, palpitation and sleeplessness. As we known, the common assessment tool in these sleep quality related studies was questionnaire. The objective evaluation methods, e.g. over-night polysomnography and autonomic nervous system function test and stress-related biomarkers, were not applied popularly.

**Methods:** Our study was a prospective and cross-over design to document the changes in the nocturnal sleep architecture of workers exposed to loud occupational noise during daytime. In addition, it aimed to evaluate effects of noise stress on their sleep quality.

**Results:** These results showed that there were 40 noise-exposed workers (20 male, 20 female) completed the whole protocol. The average age was 45.1 years. The average employment was 10.0 years. The characteristic of hearing status among these workers was high-tone hearing impairment. The workplace noise was continuous and variable pattern. The personal noise exposure level (TWA_8h) was 72.9 dBA. For sleep, the significant risk factors were daily personal exposure level, daytime cortisol level, hyperactive autonomic function. For deep sleep percentage, the significant risk factors were age and daily personal exposure level.

**Conclusion:** Our major finding was that noise-exposed workers with hyperactive autonomic function revealed poor quality sleep, including poor sleep efficiency and less deep sleep percentage.

### 0524
**THE COLLEGE SLEEP ENVIRONMENTAL SCAN: DEVELOPMENT AND INITIAL OUTCOMES**

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**Introduction:** In college students, disturbed sleep exacerbates mental and physical illnesses, increases accident risk, and decreases academic performance. Accordingly, the American College Health Association cited increased sleep as one of its Healthy Campus 2020 public health initiatives. Although environmental scans exist for a variety of campus issues including alcohol safety, environmental stewardship, and openness to GLBT students, there are no such scans available for assessing how environmental factors on campus impact students’ sleep. To address this concern, we developed The College Sleep Environmental Scan for residential colleges to use to assess how their institution’s policies, programming, and structures contribute to or impede healthy sleep.

**Methods:** The College Sleep Environmental Scan includes 11 sections: Residence Housing, Residence Policies, Campus Facilities, Campus Sales, Vending Machine Sales, Programming, Student Health, Accommodations, Assessment, Academics and Sleep Education. To date, > 40 colleges and universities have completed the scan.

**Results:** Results indicate that there is ample room for improvement in institutions’ facilities, policies, programming to create campus environments more conducive to healthy sleep. E.G, a majority of residence halls do not have dimmable hallway lights or night time temperature reduction; > 90% sell energy drinks and > 50% sell caffeine pills in campus stores, but fewer than 20% sell eye masks or blackout curtains. Only a third of universities surveyed regularly assess sleep during health history intakes during clinical visits, and only two thirds reported having a referral relationship with a sleep clinic. 75% of respondents indicated that completing the scan led them to rethink the campus sleeping environment to a great extent.

**Conclusion:** These data provide important normative and formative data for universities to consider when evaluating how to make institution-wide changes to address poor sleep, one of the top five impediments to academic success in college students.

### 0525
**PERIOD 3 GENE POLYMORPHISM AND SLEEP ADAPTATION TO STRESSFUL URBAN ENVIRONMENTS**

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**Introduction:** Inadequate sleep contributes to the mental and physical health conditions that disproportionately burden minorities living in stressful urban environments. Individual differences that influence adaptations to the sleep disruptive effects of these environments are understudied. The Period 3 (PER3) gene has a common variable number tandem repeat (VNTR) polymorphism in its coding region that has been shown to influence diurnal preference and response to sleep loss. The purpose of this study was to investigate the relationship between the VNTR PER3 polymorphism and sleep adaptation to stressful urban environments.

**Methods:** 75 male and female Black participants living in neighborhoods with high rates of violent crime were selected based on converging criteria for good or poor sleep from the Insomnia Severity Index (ISI), and estimates of typical sleep duration and sleep efficiency. Other assessments included the Fear of Sleep Index (FOSI) and City Stress Inventory (CSI). DNA was extracted from blood samples then analyzed for the 4- or 5- VNTR alleles using polymerase chain reaction (PCR).

**Results:** 57% of people with at least one 4-repeat allele were in the poor sleeper group, versus 25% of those without the allele (q2 = 4.172, p = .041). FOSI andCSI were also significantly associated with sleep quality category. In a regression model with all three variables, only FOSI was a significant predictor of sleep quality group (beta = .287, p = .014). FOSI scores were significantly higher among those with the 4-VNTR allele (t = -2.657; p = .013)

**Conclusion:** Genetic contributions to diurnal preference appear to influence sensitivity or resilience to the effects of stressful urban environments on sleep.

**Support (If Any):** R21MD007633, ULIRR031975
0526
SLEEP DURATION AND DECREASED SOCIAL SUPPORT FROM FAMILY, FRIENDS, AND SIGNIFICANT OTHER: INFLUENCE OF INSOMNIA AND PERCEIVED STRESS LEVEL

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Introduction: Social support has been implicated in both physical and mental health. This study examined an association between social support and short sleep, and the potential roles of insomnia and stress.

Methods: Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used. SHADES is a community-based study of adults in southeastern Pennsylvania (N = 1007). Sleep duration was assessed using the NHANES question (typical weekday/workday) and categorized as very short (≤ 4h), short (5-6h), normal (7-8h, reference), or long (≥ 9h). Social support was measured using the Multivariable Scale of Perceived Social Support (MSPSS), which includes a total score and subscales for family, friends, and significant other. Potential mediating variables included Perceived Stress Scale (PSS) and Insomnia Severity Index (ISI) scores. Covariates included age, sex, education, race/ethnicity, and body mass index. Multinomial logistic regression examined relationships between sleep duration and MSPSS total and subscale scores, adjusted for covariates, with and without the inclusion of mediators.

Results: After adjusting for covariates, sleep duration was associated with decreased social support. Very short sleepers demonstrated lower total (B = -2.8, p < 0.0001), family (B = -1.5, p = 0.006), friend (B = -1.8, p < 0.0001), and significant other (B = -2.5, p < 0.0001) scores. Similarly, short sleepers demonstrated lower total (B = -3.4, p < 0.0001), family (B = -1.3, p < 0.0001), friend (B = -1.1, p < 0.0001), and significant other (B = -1.0, p < 0.0001) scores. Long sleepers demonstrated lower total (B = 1.0, p = 0.0001) and significant other (B = 1.0, p = 0.0001) scores. Linear relationships were mediated by ISI scores for total and subscale scores and by PSS for family and friends scores only. Partial mediation was found for total (48%) and significant other (34%) scores. Mediation by ISI remained after accounting for PSS scores for total, family, and significant other scores. B = -1.8, p < 0.0001, and significant other (B = -2.5, p < 0.0001) scores. Similarly, short sleepers demonstrated lower total (B = -3.4, p < 0.0001), family (B = -1.3, p < 0.0001), friend (B = -1.1, p < 0.0001), and significant other (B = -1.0, p < 0.0001) scores. Long sleepers demonstrated lower total (B = -4.8, p = 0.003), family (B = -2.3, p = 0.001), and significant other (B = -1.6, p = 0.025) scores. Linear relationships were mediated by ISI scores for total and subscale scores and by PSS for family and friends scores only. Partial mediation was found for total (48%) and significant other (34%) scores. Mediation by ISI remained after accounting for PSS scores for total, family, and significant other scores.

Conclusion: Short sleepers experience (or perceive) less social support, likely through pathways implicating insomnia and stress. This may be one of the reasons why short sleep is linked to morbidity and mortality.

Support (If Any): The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216.

0527
SLEEP OF COMMON DOGS WITHIN THE UNITED STATES BY BREED, AGE, AND WEIGHT AND ITS IMPLICATIONS ON HUMAN SLEEP

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Introduction: People generally seek to have a well-behaved dog that enhances their life without creating new potential problems such as poor sleep at night. Prospective pet owners who wish to select a dog breed based on how well the dog is expected to sleep have not had access to objective data. The goal of this project was to provide dog owners and health care providers of future dog owners with this objective data.

Methods: FitBark is a consumer device linked via wireless technology to a smartphone application and website designed to track dog activity via an accelerometer attached to a dog collar. The device is available worldwide. De-identified data was accessed from the FitBark database. Thirty-five adult dogs (≥ 12 months) with the largest number of daily records available from March through November 2015 for some of the most common breeds in the United States were used for further analysis of sleep. Sleep efficiency, defined as (number of rest minutes / 240 minutes) x 100, was obtained for the dogs between 1am and 5am. Sleep efficiency was also correlated with dog size and age. Sleep efficiency > 85% was considered as good sleep.

Results: Average weight and sleep efficiency for the dogs were as follows: Labrador Retriever (average weight 69lb) 89%, Beagle (29lb) 88%, Golden Retriever (74lb) 88%, Maltese (12lb) 87%, Australian Shepherd (39lb) 86%, Chihuahua (12lb) 85%, Shih Tzu (17lb) 83%, Yorkshire Terrier (8lb) 82%. Additional statistical analysis is forthcoming. Correlations between sleep and dog weight will be provided.

Conclusion: Over the age of 1 year, most of the commonly owned dog breeds maintained good sleep efficiency. There is a trend that larger dogs sleep better.

0528
THE EFFECT OF DOGS IN THE BEDROOM ON HUMAN SLEEP

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Introduction: Our recent survey revealed that 49% of the patients seen at a Sleep Disorders Center had pets, with 56% of pet owners allowing their pets to sleep in the bedroom. No study to date has assessed whether a dog in the bedroom disturbs their owners’ sleep with objective data. This project was designed to evaluate the sleep of humans and dogs occupying the same bedroom to inform counseling efforts for patients desiring a home environment conducive to sleep.

Methods: After I.R.B. and I.A.C.U.C. approval, 30 healthy adult volunteers and their dogs were enrolled from August through November, 2015. Exclusion criteria included: dog owners with a diagnosed sleep disorder, > 1 pet in the bedroom, and a dog < 6 months old. Human volunteers wore a Respirronics Actiwatch© and their dogs a FitBark© (validated dog accelerometer) for 7 nights. The human subjects also kept a sleep diary.

Results: Human subjects (90% female) on average were 42 years old (± 14 SD) with a B.M.I. of 24 (± 6). Mean dog age was 5 (± 3) years with an average weight of 13 (± 10) kg. There were varied dog breeds. Average actigraphy data revealed: 479.4 (62.3) minutes time in bed (TIB), 406.4 (61.6) minutes total sleep time (TST), 81% (5.6) sleep efficiency (SE) and 73 (26.6) minutes wake after sleep onset (WASO). Dog accelerometer activity during the human sleep period was characterized as:
rest, active and play minutes. Dogs were active a mean of 60.6 (± 31.7) minutes, playing 1.4 (± 1.6) minutes and resting 418 (± 71) minutes during the human sleep period. Dog SE (time in rest phase) was 87.1 (± 6.2)%.

Conclusion: Humans with a single dog in their bedroom maintained satisfactory sleep efficiency. A dog’s presence in the human bedroom may not be disruptive to human sleep as previously suspected.

Support (If Any): Mayo Foundation.

0529
SUSCEPTIBILITY TO SMOKING DURING THE DAY AND ITS RELATIONSHIP WITH INSOMNIA AND SLEEP DURATION
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Introduction: Although nicotine has stimulant and sleep disruptive properties, very little is known about the vulnerability to smoking through the day and its association with sleep continuity disturbances. In this investigation we tested for a relationship between this vulnerability to smoking and abnormalities of sleep duration and insomnia symptoms.

Methods: Data were assessed as part of the Sleep and Healthy Activity Diet Environment and Socialization(SHADES) study, a community-based study of N = 1007 adults aged 22-60 in the Philadelphia area. Insomnia was assessed with the Insomnia Severity Index and categorized as none (0-7), mild (8-14), or moderate-severe (≥ 15). Sleep duration was assessed using the NHANES question (weekday/workday sleep) and categorized as very short (≤ 4hrs), short (5-6hrs), normal (7-8hrs), and long (≥ 9hrs). Smoking status was self-reported. Participants were asked what times of day they are likely to smoke: early morning (5am-8am), morning (8am-11am), nontime (11am-2pm), afternoon (2pm-5pm), early evening (5pm-8pm), evening (8pm-11pm), late evening (11pm-2am), and/or late night (2am-5am). Smoking status and timing of smoking were evaluated relative to sleep duration and insomnia using multinomial logistic regression, adjusted for age, sex, race/ethnicity, education, and body mass index.

Results: Smokers are more likely to exhibit mild (OR = 2.41, p < 0.0005) and moderate-severe (OR = 2.87, p < 0.0005) insomnia, as well as very short (OR = 1.88, p = 0.032) and short (OR = 1.54, p = 0.031) sleep. Smoking during late evening (OR = 4.56, p = 0.002) and late night (OR = 5.95, p = 0.002) were associated with moderate-severe insomnia. Similarly, smoking in the late evening was associated with short sleep (OR = 2.29, p = 0.024).

Conclusion: Smokers were more likely to exhibit insomnia symptoms and short sleep duration. Smoking during/near the sleep period was particularly associated with sleep symptoms. This smoking behavior may be related to an underlying anxiety in those with insomnia and inadequate sleep hygiene in those with short sleep duration, though this was not tested.

0530
HEAVY SMOKING DECREASED CSF LACTATE LEVELS AND DISTURBS ITS ROLE IN SLEEP
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Introduction: Lactate is a product of glycolysis by astrocytes and can be generated as a primary metabolic energy source by neurons. Nicotine consumption alters cerebral metabolism and the function of lactate and can impact the sleep-wake cycle. In the present study, we measured the concentration of lactate in cerebrospinal fluid (CSF) and peripheral blood to investigate the role of lactate in sleep quality that is caused by heavy smoking.

Methods: In the present study, 174 males were recruited (n = 99 controls, 30.19 ± 9.289 years old; n = 75 heavy smokers, 34.23 ± 10.24 years old). Cerebrospinal fluid lactate (LAC) and serum lactate (LAS) levels were measured by spectrophotometry and a portable gas generator, respectively. All of the subjects completed the Pittsburgh Sleep Quality Index (PSQI) for sleep quality. The smokers also answered the Chinese version the Fagerstrom Test for Nicotine Dependence (FTND).

Results: All PSQI scores, with the exception of PSQI Component 3, were significantly higher in heavy smokers (HSs) than in controls (all p < 0.05). LAC levels, but not LAS levels, were significantly lower in HSs than in controls (p < 0.01). LAC levels were positively correlated to PSQI Component 2, Component 4, Component 5, and Component 7 scores in controls (all p < 0.05). Thus, heavy smoking affected the modulatory role of LAC in sleep.

Conclusion: Nicotine disturbs the modulatory role of LAC in sleep.

Support (If Any): This work was partially supported by the National Science Foundation of China (No. 81100993, 81303311, 81571297, 81271475, 81541036, and 81560229), Beijing Natural Science Foundation (No. 7152074), and the Opening Project of Zhejiang Provincial Top Key Discipline of Pharmaceutical Sciences.

0531
A DECADE OF SLEEP QUALITY IN CANADA
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Introduction: Inadequate or poor quality sleep is a recognized public health issue. The objective of this study was to characterize and compare the prevalence of poor sleep in the Canadian population in 2002 and 2012 and identify sociodemographic and psychosocial predictors of poor sleep.

Methods: Canadian participants between the ages of 20 and 80+ from the Canadian Community Health Survey (CCHS) Cycles 2000-2002 (n = 34,220) and 2011-2012 (n = 23,068) were included. Participants responded to the question “How often do you have trouble going to sleep or staying asleep?” Participants who indicated “most of the time” or “all of the time” were classified as having poor sleep. Change in prevalence was assessed using chi square analyses.

Results: The unadjusted prevalence of trouble sleeping increased from 15.6% in 2002 to 17.1% in 2012 (p < .001). There was a significant effect of sex with women, but not men, reporting an increase in difficulty sleeping from 2002 to 2012 (17.4% vs. 19.9%, p < .001). Across the 10 year span, the largest increases in sleep difficulty occurred for participants between the ages of 40 and 59 (16.6% vs. 19.9%; p < .001) but not
for participants between 20 and 39 years (12.3% vs. 12.3%; \(p = .95\)) or 60 and 80+ years (18.3% vs. 18.8%; \(p = .40\)). The increases in sleep difficulty for the 40 to 59 year age group was significantly moderated by sex, with women accounting for the change. There was no significant difference for men across age groups.

**Conclusion:** Canadians experienced an increase in the prevalence of poor sleep between 2002 to 2012. This trend appears to be due, in part, to the increased sleep difficulty experienced by women in midlife. Analyses are ongoing to fully understand the reasons for this difference. Prevention and intervention programs for this vulnerable group may be warranted.

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**0532**

**INSOMNIA SYMPTOMS ARE ASSOCIATED WITH EPIGENETIC AGE ACCELERATION IN THE WOMEN’S HEALTH INITIATIVE STUDY**

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**Introduction:** Sleep disturbances are associated with increased vulnerability to age related morbidity and mortality risk. Preliminary cross-sectional epidemiological data have linked sleep disturbances to shorter leukocyte telomere length (LTL), a proposed marker of biological aging, suggesting that accelerated biological aging may be a potential mechanism through which sleep influences disease risk. However some have raised concerns that LTL is an incomplete measure of biological aging. Recent publications demonstrate that epigenetic biomarkers of aging (e.g. the epigenetic clock) capture aspects of biological aging, e.g. a measure of epigenetic age acceleration in blood was found to be prognostic of mortality.

**Methods:** Using the Women’s Health Initiative sample, we determined DNAm age on 2,078 women (age M(SD) = 64.5(7.1)) with baseline DNA methylation measurements and self-reported insomnia symptoms (restlessness, difficulty falling asleep, waking during the night, trouble getting back to sleep, and early awakenings). DNAm age was calculated based on 353 CpGis derived from the Infinium HumanDNA-Methylation450 BeadChip array using established methods (Horvath 2013 PMID: 24138928).

**Results:** After adjusting for age, race, education, BMI, and snoring, we found that accelerated DNAm age was present in those with insomnia symptoms, B(SE) = 1.02(0.37), \(p = 0.005\). Examination of the number of insomnia symptoms revealed a graded effect \((P = 0.007)\), such that women with no insomnia symptoms were epigenetically younger than those with 1-2 symptoms \((mean\ difference\ in\ DNAm\ age = 1.17\ years,\ P = 0.002)\), 3-4 symptoms \((mean\ difference\ = 1.10\ years,\ P = 0.01)\), and 5 symptoms \((mean\ difference = 1.77\ years,\ P = 0.005)\).

**Conclusion:** Sleep disturbances were related to accelerated aging at the biological level using a highly reliable epigenetic marker of biological age. These cross-sectional findings need to be replicated in a prospective design to determine whether sleep disturbances increase risk for morbidity and mortality through accelerating the rate at which the basic biology of the organism ages.

**Support (If Any):** The RODAM study was supported by the European Commission under the Framework Programme (grant number 278901).

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**0533**

**IS INSOMNIA RELATED TO CARDIOVASCULAR DISEASE INCIDENCE IN A SAMPLE OF COMMUNITY-DWELLING GHANAIANS?**

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**Introduction:** Past research indicates that insomnia symptoms, defined as an inability to initiate or maintain sleep, may be associated with cardiovascular disease (CVD). In many low- and middle-income countries, urbanization and changing lifestyles have contributed to a rapidly growing burden of non-communicable disease, such as CVD. The present study assessed whether insomnia symptoms were associated with CVD in a sample of community-dwelling Ghanaian adults.

**Methods:** Data were collected by structured questionnaires from a community-based sample of 263 participants (\(\geq 25\) years) in Ghana, randomly selected from among participants in the Research on Obesity and Type 2 Diabetes among African Migrants (RODAM) study. Insomnia symptoms were assessed with three items: 1) having difficulty falling asleep, 2) having difficulty staying asleep, and 3) having problems waking up too early. Insomnia was coded as experiencing one or more of these symptoms. Incident CVD was measured using the Rose questionnaire. We used multiple logistic regression to test the association between insomnia and CVD, adjusting for age and sex.

**Results:** The mean age of the sample was 47.3 years \(\pm 11.5\), 41.1% were men, 44.9% had never been to school or attended only elementary school. Over 59% of the sample reported having one or more insomnia symptoms and 24% had CVD. After adjusting for age and sex, having insomnia symptoms was positively associated with having CVD, and this association approached significance \((adjusted\ OR = 1.78,\ p = 0.063)\). This relationship was reduced after adjusting for comorbid conditions \((adjusted\ OR = 1.66,\ p = 0.110)\).

**Conclusion:** Our results indicate that insomnia may be related to having incident CVD, and that this relationship may be accounted for by comorbid conditions, which might confound the relationship between sleep and CVD. Nevertheless, assessing and treating insomnia may have important implications for managing CVD. This may be particularly important given the growing burden of chronic diseases in sub-Saharan Africa.

**Support (If Any):** The RODAM study was supported by the European Commission under the Framework Programme (grant number 278901).
end/vacation time over the past week, combined with a 5/2 weighted average for weekday/weekend sleep, and dichotomized at < 7 (74% of sample) and ≥ 7 hours. To broadly evaluate differences between men and women t-tests for continuous variables and chi-square tests for categorical variables were evaluated.

**Results:** Short sleepers were younger (p = 0.045), had worse sleep quality (p < 0.0001), reported greater sleep debt (p < 0.0001) despite less sleep need (p < 0.0001). Short sleepers were less likely to wake up refreshed (p = 0.002). If they had difficulty sleeping, they were more likely to report just getting up and starting their day (p = 0.007). If they were having trouble sleeping over a period of time, they were less likely to try to make more time for sleep (p = 0.014). Short sleepers were more likely to argue in bed (p-0.035). Short sleepers were less likely to report that medical conditions affect their sleep (p = 0.014), that they make enough time for sleep (p = 0.007), that it is important to keep a healthy bedtime (p = 0.001), and that sleep was important for health (p = 0.027). Short sleepers were more likely to report that lying in bed with eyes closed was as good as sleep (p = 0.039) and that turning up the volume while driving was an effective countermeasure to sleepiness (p = 0.035).

**Conclusion:** Overall, short sleepers reported worse quality sleep and greater sleep debt despite reduced sleep need. They also reported more unhealthy sleep-related beliefs and practices.

**Support (If Any):** NIH (R01MD007716, R01HL78566, U54NS081765, and R01HL095799).

### 0535

**A SLEEP PROFILE OF GRANDPARENTS RAISING GRANDCHILDREN FROM KIN TECH: A RANDOMIZED CONTROLLED TRIAL**

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**Introduction:** One in ten grandparents live with their grandchildren. Coresident grandparents face unique stressors related to trauma, health and environmental risks that are different than those that occur in households with two parents. These grandparents may suffer a greater sleep burden. We continue to expand on their sleep profile.

**Methods:** We identified grandparent sleep behavior using a modified self-report sleep questionnaire from 12 month follow up KIN-Tech data, the only randomized control trial funded by the US Children's Bureau investigating caregiver and child health and sleep.

**Results:** 100 middle-aged (m = 46 years), single (65.7%), African-American (46%), low income (m = $24,000) grandparents (88% female) caring for younger children (50% < 5 years) participated. Forty-one percent of caregivers reported that their sleep was troubled and caregiving for children impacts their sleep. Total sleep time was 5.5 hours, 57% were short sleepers (less than 6 hrs) and 6% were long sleepers (more than 8 hrs), with 16% diagnosed with sleep apnea by a physician and another 20% suspect they may have sleep apnea. 25% of caregivers take sleep aids and 24% reported using benzodiazepines. All long sleepers reported taking benzodiazepines [p < .001]. Caregivers have an average of 45 minutes sleep onset latency with 35% reporting sleep efficiency less than 85%, spending an average of 7 hours time in bed. 31% of caregivers have fallen asleep not on purpose out of bed more than once per weekday and 25% on weekends. 44% of caregivers reported napping at least once per five days. 7% work shift-work or have done all night shifts.

**Conclusion:** Although limited knowledge exists about sleep for grandparents raising grandchildren, these results suggest that grandparents are self-reporting higher rates of sleep problems and sleep aid use. More research is necessary to better delineate objective sleep measures of grandparents to promote healthy sleep for themselves and the children in their care.

**Support (If Any):** This Project is funded by a demonstration project from the US Children’s Bureau Child Welfare/TANF Collaboration in Kinship Navigation Program Grant #: HHS-2012-ACF-ACYF-CF-0510 (90CF0050). CHI CW/TANF Kinship Interdisciplinary Navigation Technologically-Advanced Model (KIN-Tech), Juvenile Welfare Board of Pinellas County, Children’s Board of Hillsborough County, and the United Way of Tampa Bay. Support appreciated from Patient-Centered Outcomes Research Institute PCORI (IHP2 PI00781).
TROUBLE SLEEPING INSIDE: THE PREVALENCE AND PREDICTIVE FACTORS OF INSOMNIA IN PRISON POPULATIONS

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Introduction: Around 30% of the non-incarcerated population have insomnia. Yet, no research has provided a reliable prevalence rate in incarcerated populations or explained the potential reasons for insomnia in UK prisons. The study aim was to establish the prevalence of insomnia and its relationship with demographic, clinical and forensic factors in prisoners.

Methods: A cross-sectional study was conducted with 237 prisoners from two male prisons and one female prison in the UK. The Pittsburgh Sleep Quality Index (PSQI) examined sleep quality and the Sleep Condition Indicator (SCI) was utilised to identify possible DSM-5 insomnia disorder (ID). Self-report measures including the Brief Psychiatric Rating Scale (BPRS), the Dysfunctional Beliefs and Attitudes About Sleep scale (DBAS-16) and the Prison Environment Sleep Questionnaire (PESQ) were also completed.

Results: Descriptive statistics revealed 88.2% of prisoners had poor sleep quality indicated by a PSQI total score of > 5. SCI revealed 61.2% of prisoners had possible ID denoted by a score of < = 16. A logistical regression analyses indicated physical ill-health history (OR = 3.26, 95% CI: 1.37-7.73, p < .01), female gender (OR = 2.47, 95% CI: 1.23-5.00, p < .05), greater endorsement of dysfunctional beliefs about sleep (OR = 1.51, 95% CI: 1.24-1.84, p < .001), poor sleep hygiene (OR = 1.09, 95% CI: 1.03-1.16, p < .005) and PESQ scores (e.g. uncomfortable mattress, prison-related noise, extreme temperatures) (OR = 1.06, 95% CI: 1.02-1.10, p < .005) gave significantly increased odds of having insomnia.

Conclusion: For the first time an accurate prevalence rate and predictive factors of insomnia in UK adult prisons have been established. The study shows that insomnia is highly prevalent in prisons, with female prisoners experiencing particularly poor sleep. Physical ill-health, poor sleep hygiene and dysfunctional beliefs and attitudes about sleep in addition to prison environmental factors all significantly predict insomnia. Based on this study, developing treatments to improve poor sleep in this vulnerable population is paramount.

INCIDENCE OF INSOMNIA IN A POPULATION-BASED SAMPLE OVER A 5-YEAR PERIOD

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Introduction: Despite substantial cross-sectional evidence on insomnia prevalence, there are relatively few longitudinal studies on incident insomnia. The present study aimed to estimate the incidence of insomnia in a population-based sample of good sleepers followed over a 5-year period.

Methods: Participants were 2184 adults (M = 46.0 years, SD = 15.0; 57.6% female) without insomnia at baseline. They completed annual postal evaluations for five consecutive years that included assessments of insomnia symptoms, sleep quality, sleep patterns and habits, as well as sleep medication use. Following each evaluation, participants were classified as either good sleepers (i.e., remained good sleepers throughout the 1-year period) or insomnia incident cases (i.e., developed insomnia syndrome since the previous assessment).

Results: Survival analysis reveal that yearly incidence rates for insomnia syndrome ranged from 1.9% to 3.2%, with a cumulative incidence rate of 13.4% for the 5-year period. The probability of remaining a good sleeper over 5 years steadily decreased from 97.2% to 86.6%. Incidence of new insomnia cases was slightly lower (1.9% to 2.8%, cumulative incidence rate of 13.4% for the 5-year period). The probability of remaining a good sleeper over 5 years steadily decreased from 97.2% to 86.6%

Conclusion: These findings indicate that yearly incidence rates of new insomnia cases are very substantial in the general population. A better understanding of how insomnia evolves over time and what risk factors contribute to trigger an episode is vital for developing effective prevention and treatment programs.

Support (If Any): Research supported by the Canadian Institutes of Health Research (MOP42504) and by the Fonds de recherche du Québec - Santé (32207)
0540  
PERSISTENCE OF INSOMNIA OVER A 5-YEAR PERIOD IN A, POPULATION-BASED SAMPLE
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Introduction: Insomnia is a significant public health problem which is associated with negative long-term outcomes (e.g., depression, hypertension). Despite its pervasiveness, there is little information about the natural history of insomnia, particularly over long intervals. Such information is important to identify at-risk individuals and design effective prevention programs. The aim of the study was to estimate the rates of persistent insomnia and remission and document the most common insomnia trajectories.

Methods: Participants were adults selected from a larger population-based sample (M = 48.4 years, SD = 14.7; 66.8% female) who presented with subsyndromal insomnia (n = 1020) or insomnia syndrome (n = 600) at baseline. They completed standardized sleep and insomnia questionnaires at five annual follow-up assessments. Rates of persistent insomnia and remission and trajectories were computed for each subgroup separately.

Results: Persistence rates among participants with insomnia syndrome at baseline were 87.4%, 73.3%, and 62.9% at 1-, 3-, and 5-year follow-ups, respectively, whereas these rates were 66.8%, 41%, and 30.3%, respectively, among participants with subsyndromal insomnia at baseline. Cumulative remission rates in participants with subsyndromal insomnia were almost double those of participants with insomnia syndrome at 1-year (33.2% vs. 12.6%), 3-year (59.0% vs. 26.7%), and 5-year follow-ups (37.1% vs. 70.0%). Examination of the most common 1-year trajectories over the 5-year follow-up period revealed that participants with subsyndromal insomnia at baseline had a significantly greater relative risk to improve (i.e., become good sleeper) rather than worsen (i.e., become syndrome) (RR = 2.43) over the subsequent year. Conversely, for participants with an insomnia syndrome, there was a greater relative risk (RR = 2.11) to remain syndrome than to improve over the next year interval.

Conclusion: These findings indicate that insomnia is often a persistent disorder, particularly among individuals with insomnia syndrome at baseline. Future research is needed to identify mediators and moderators that influence the course of insomnia.

Support (If Any): Research supported by the Canadian Institutes of Health Research (MOP42504) and by the Fonds de recherche du Québec - Santé (32207).

0541  
LONGITUDINAL COURSE OF INSOMNIA DISORDER AND ITS ASSOCIATION WITH INCIDENT DEPRESSION: A PRELIMINARY REPORT FROM THE HONG KONG FAMILY STUDY OF INSOMNIA
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Introduction: Increasing studies suggest that insomnia runs a persistent course and is a risk factor of new incident of depression. However, only few studies have employed diagnostic interview to ascertain the diagnoses of insomnia and depression. In this study, we aimed to explore the 5-year course of insomnia disorder as determined by clinical interview based on ICSD-2 criteria and its impacts on new incidence of major depressive episode as determined by M.I.N.I interview.

Methods: This is an on-going study from the Hong Kong Family Study of Insomnia. A total of 247 participants (mean age (SD) = 34.0 (16.0), 56.1% female) were followed-up by March 2015. Among them, 27.9% had insomnia disorder at baseline.

Results: The persistence rate of insomnia was 33.8% while the new incidence of insomnia was 8.9%. Further analyses on bidirectional association between insomnia disorder and depressive episode showed that 1) insomnia at baseline was a significant predictors of new onset depression (9.8% for insomnia at baseline and 3.2% for non-insomnia at baseline, p = 0.028). However, baseline depression was not a significant predictor of new onset of insomnia (10.0% for depression at baseline and 8.8% for non-insomnia at baseline, p = 0.69).

Conclusion: Insomnia disorder is a persistent problem in the community-based sample. While insomnia disorder is a risk factor of new incident depression, the baseline depression did not predict incident insomnia.

Support (If Any): This project is supported by Health and Medical Research Fund (Reference number: 11120811), Hong Kong SAR, China. The funding body has no role in conception, design, conduct, interpretation and analysis of the study or in the approval of the publication.

0542  
INSOMNIA COMPLAINTS: PREVALENCE AND ASSOCIATED FACTORS IN AN ADULT BRAZILIAN POPULATION
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Introduction: Considering the high prevalence of insomnia complaints in general populations and high association with medical disorders, the objective of this study was to estimate the prevalence of insomnia complaints according to gender, age and morbidities in an adult sample of Campinas City population.

Methods: It is a population-based, cross-sectional study, developed with data from the Campinas Health Survey carried out in 2014/2015. In this study we analyzed data from the sample of 1998 individuals 20 years old or more (mean age 45 years; 54.8% female). Prevalence and confidence intervals for the dependent variable (insomnia complaints) were estimated according to independent variables. Insomnia complaints presence was considered when there were difficulties in initiating and maintaining sleep. Differences were tested by Chi-square test. Prevalence ratio was estimated by multiple Poisson regression, adjusting for gender and age. The analyses were performed with svy commands of STATA 11.0.

Results: The prevalence of insomnia was 40.8% (women 47.1%; men 33.1%; p < 0.001). Prevalence rises according to age: 33.3% for 20 to 39 years old while was 51.4% for 80 years old or more. Factors that were significantly associated with Insomnia in multiple regression were: 2 to 4 chronic diseases (PR = 1.3); 5 or + chronic diseases (PR = 1.5); 2 to 4 health problems (PR = 1.9); 5 or + health problems (PR = 2.8); cardiac arrhythmia (PR = 1.4); rhinitis (PR = 1.2); sinusitus (PR = 1.4); tendinitis/REL/WRMD (PR = 1.3); back pain (PR = 1.3); migraine (PR = 1.4); cholesterol high levels (PR = 1.2); regular and bad health self-evaluated (PR = 1.6; 1.8). Variables that were not associated with Insomnia in this study were: hypertension; diabetes mellitus; myocardial infarction; cerebral vascular accident; arthritis/rheumatism; osteoporosis.

Conclusion: This study demonstrated high prevalence of insomnia complaints in Campinas/Brazil population. The research also con-
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0543
PREVALENCE AND QUALITY OF LIFE CORRELATES OF INSOMNIA AND OTHER SLEEP DISORDERS IN A NATIONAL SAMPLE OF COLLEGE STUDENTS
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Introduction: As a demographic group, college students have particularly poor sleep; approximately one third have scores over 10 on the Epworth Sleepiness Scale and more than two thirds are categorized as poor sleepers by the PSQI. Sleep disorders, which can emerge during young adulthood but are often un- or misdiagnosed, negatively impact health-related quality of life. In order to better understand how insomnia and other sleep disorders are related to BMI, stress, anxiety, depression, and substance abuse in this population, we analyzed responses from the Spring 2011 American College Health Association-National College Health Assessment II.

Methods: Respondents (undergraduates ages 18-25) from the Spring 2011 ACHA-NCHA II survey were classified as within the last 12 months diagnosed with insomnia (n = 3260), diagnosed with another sleep disorder (n = 1368), diagnosed with both (n = 748), or having neither diagnosis (n = 98,126). Within those classifications, we also compared treated against diagnosed but non-treated students for differences in health related quality of life variables.

Results: Within the last 12 months, 3.9% of college students had been diagnosed with insomnia, with 69% of those receiving treatment and 21% had been diagnosed with another type of sleep disorder, with 67% of those receiving treatment. Estimates indicate an additional 15% of those receiving treatment. College students who had been diagnosed with insomnia and/or another sleep disorder were significantly more likely to have higher self-reported levels of stress, anxiety, hopelessness, binge drinking, non-medical use of prescription sedatives and stimulants and higher BMIs than college students without either diagnosis [F(2, 103262) > 54.283, p < 0.01, in all cases].

Conclusion: These findings highlight the importance of inter-professional education among university health care providers regarding the recognition, treatment and management of sleep disorders in college students.

0544
EPIDEMIOLOGY OF MID-SLEEP TIME AMONG PEOPLE WITH INSOMNIA: AGE, RACE, AND GENDER
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Introduction: Delayed sleep phase has been implicated as a contributing factor to insomnia. However, little epidemiological data exist characterizing sleep phase among people with insomnia (PWI). This study aimed to examine differences in sleep phase (using mid-sleep-time, MST, as a phase reference point) by age, race, and gender among PWI.

Methods: Using random-digit dialing, we recruited adults ages 20 to 80+. This study analyzed 14 days of self-reported sleep diary data from 119 PWI. Participants’ MST was calculated as the average midpoint between sleep onset (time-entering-bed plus latency) and sleep offset across 14 nights. Participants were classified by age as young (20-35 years), middle-aged (36-64 years), or older (65-96 years) adults. A three-way analysis of variance (ANOVA) was conducted to explore differences in MST by age, race, and gender. Post-hoc comparisons were performed with Bonferroni-adjusted alpha levels.

Results: Three-way ANOVA revealed a significant three-way interaction among age, race, and gender (F(1, 108) = 5.2, p < .05) on MST. Among Caucasians, young adults (M = 4:20 AM, SD = 1.7 hours) exhibited a significantly later average MST than middle-aged and older adults (M = 3:02 AM, SD = 1.0 hour), regardless of gender. Furthermore, Caucasian females’ average MST was approximately 1 hour later than Caucasian males’ MST across all age groups. For African Americans, there was a significant interaction between gender and age. Among middle-aged African Americans, females exhibited a significantly later average MST than males. However, among African-American older adults, females’ MST was earlier than males’ MST.

Conclusion: These results suggest that age, race, and gender interact to produce differential effects on MST among PWI. Further research is needed to explore the implications of these differences in MST as they relate to insomnia severity.

Support (If Any): Research supported by National Institute on Aging grants AG12136 and AG14738.

0545
CIGARETTE SMOKING AND INSOMNIA SYMPTOMS IN A NATIONAL POPULATION SAMPLE
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Introduction: Smoking is known to impact sleep quality, but less is known about the association between smoking patterns and insomnia symptoms in a nationally representative US population.

Methods: To evaluate the association between smoking patterns and insomnia symptoms, we analyzed data from 8866 adult participants aged ≥ 20 years in the National Health and Nutrition Examination Survey in 2005-2008. Symptoms in the past month included often or almost always having trouble falling asleep (FALL), staying asleep (STAY), and waking too early (WAKE). Participants were categorized as never smokers, former smokers, and current smokers. Current smokers were further divided into light (< 20 cigarettes/day) and heavy (≥ 20 cigarettes/day) smokers. Prevalence ratios (PR) with 95% confidence intervals (CI) of each insomnia symptom by smoking category were calculated from logistic regression analyses adjusted for sex, age, race/ethnicity, education, and self-rated health.

Results: The distribution smoking categories included never smokers (51%), former smokers (25%), light smokers (14%), and heavy smokers (10%); while FALL, STAY, WAKE, and ≥ 1 symptom were reported by 18%, 21%, 17%, and 31%, respectively. Compared to never smokers, FALL was more likely to be reported by light smokers (PR = 1.3, 95% CI: 1.1-1.5) and heavy smokers (PR = 1.7, 95% CI: 1.3-2.1), STAY by former smokers (PR = 1.3, 95% CI: 1.1-1.4) and heavy smokers (PR = 1.3, 95% CI: 1.1-1.6), and WAKE by light smokers (PR = 1.3, 95% CI: 1.1-1.7) and heavy smokers (PR = 1.5, 95% CI: 1.2-1.9). Former smokers, light smokers, and heavy smokers were more likely to report ≥ 1 symptom (PR = 1.2, 95% CI: 1.1-1.3; PR = 1.2, 95% CI: 1.1-1.3; and PR = 1.4, 95% CI: 1.2-1.7, respectively) compared to never smokers. These insomnia measures did not differ significantly between light and heavy smokers.

Conclusion: Individuals complaining of insomnia symptoms may present a good opportunity to ask about tobacco use and discuss tobacco cessation.
0546 TEMPORAL STABILITY OF THE FORD INSOMNIA RESPONSE TO STRESS TEST (FIRST)
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Introduction: The Ford Insomnia Response to Stress Test (FIRST) is a self-report tool that measures and identifies individuals with sleep reactivity (i.e., one’s vulnerability to experience situational insomnia under stressful conditions). While the use of the FIRST has grown in the field, evidence of its long-term stability is lacking. The present psychometric study investigated the temporal stability of the FIRST in a population-based sample of adults with and without insomnia.

Methods: Participants included 1,122 adults (M = 49.9 years, SD = 14.8; 38.8% male) presenting an insomnia syndrome (n = 159), insomnia symptoms (n = 152), or good sleep (n = 811). Participants completed the FIRST on three different occasions: baseline and at follow-up 6- and 12-months later. Intraclass correlation coefficients (ICC) using the FIRST total score were computed for baseline to 6-month and for baseline to 12-month intervals.

Results: Among those with an insomnia syndrome, the FIRST yielded high temporal stability for baseline to 6-month (ICC = .80) and baseline to 12-month intervals (ICC = .77). Among those with insomnia symptoms, the FIRST also yielded high and equivalent stability for both intervals (ICC = .78). Among good sleepers, stability estimates were high for baseline to 6-month (ICC = .81) and for baseline to 12-month intervals (ICC = .82).

Conclusion: Overall, sleep reactivity, as measured by the FIRST, demonstrates moderate to high temporal stability over time. These findings support the use of the FIRST as a relatively stable marker of sleep reactivity.

Support (If Any): Research supported by the Canadian Institutes of Health Research (MOP42504 and B0512201) and the Fonds de recherche du Québec - Santé (32207).

0547 THE NATURAL HISTORY OF INSOMNIA: THE INCIDENCE OF ACUTE INSOMNIA AND SUBSEQUENT PROGRESSION TO CHRONIC INSOMNIA OR RECOVERY
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Introduction: While there is a wealth of data regarding Insomnia prevalence, little is known about incidence rates for transitions from Good Sleep (GS) to Acute Insomnia (AI) and from AI to either Chronic Insomnia (CI) or Remission/Recovery back to GS. This lack of data makes it difficult to empirically define the thresholds for AI/CI and identify the factors that mediate risk for (or protect from) developing CI. As part of an ongoing study on the natural history of insomnia, the incident rates for AI and CI were tracked in a national sample of GSs.

Methods: 539 GS subjects (Age M(SD) = 54.6(11) years; 70% Female) were prospectively assessed with daily sleep diaries over 6 months. Groups were identified by “transition” (AI, CI, Remission, Recovery), defined as follows: AI: 2 consecutive weeks with frequency ≥ 3 nights/week of SL and/or WASO of severity ≥ 30min; CI: 12 consecutive weeks with same freq/severity criteria as AI; Remission: 2 consecutive weeks after AI and/or CI with ≤ 2 nights/week of SL and/or WASO of ≥ 30min; and Recovery: 12 consecutive weeks after AI and/or CI with same freq/severity criteria as Remission.

Results: The incident rate of AI was 26.9%. Of these 145 subjects, 31 (21.4%) developed CI, while 50 (34.5%) Remitted and 36 (24.8%) Recovered. There were significant group differences with respect to age, with the AI group being older than the GS, Recovery, and Remission groups. No differences were observed with respect to gender.

Conclusion: These preliminary data suggest that AI is common (affects ≥ 50% of the population/annum), but that sleep continuity disturbance is self-limiting for most individuals. A companion abstract in this volume provides data about one factor that may mediate recovery and illness chronicity.

Support (If Any): Perlis-R01AG041783

0548 A BRIEF TOOL TO DIFFERENTIATE SLEEP DISORDERS THAT PRESENT AS INSOMNIA
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Introduction: Difficulties getting to sleep and staying asleep are prevalent and commonly treated in primary care. Many sleep disorders present with insomnia complaints and treatment varies by diagnosis. This study was conducted to establish the utility of the Insomnia Symptoms Assessment (ISA) relative to diagnosis by a sleep specialist.

Methods: 388 new patients to three sleep centers were asked insomnia screening questions about difficulty sleeping. Affirmative answers to either triggered administration of the ISA using the REDCap electronic data capture tool. The patient then met with a board certified sleep specialist. ISA questions were designed to identify psychophysiological insomnia (PI), delayed sleep phase syndrome (DSPS), shift work sleep disorder (SWSD), obstructive sleep apnea (OSA), mental health (MI), chronic pain (CP), restless leg syndrome (RLS), and poor sleep hygiene (SH). The sleep specialists determined a primary diagnosis and secondary diagnosis(es).

Results: Mean age was 45.5 (18-85) years and 49.6% were female. Exploratory factor analysis (N = 259) followed by confirmatory factor analysis (N = 129) identified five factors which demonstrated good internal consistency (Cronbach’s alpha), including RLS (0.72), OSA (0.60), SWSD (0.67), DSPS (0.64) and PI (0.88). Thirty-one percent had one sleep disorder, 29.1% had two sleep disorders, 36% had three or more sleep disorders and 3.4% had no diagnosis. The ROC for these five factors was then compared to expert diagnosis. The AUCs calculated for the primary diagnosis in the entire cohort of 388 and then for 135 persons with a single diagnosis were respectively 0.971 and 0.996 for SWSD, 0.776 and 0.907 for OSA, 0.679 and 0.691 for DSPS, 0.561 and 0.719 for PI and 0.791 and 0.988 for RLS.

Conclusion: The ISA demonstrated adequate internal consistency and corresponds well to expert diagnoses. The next step is setting sensitivity / specificity cutoffs and linking this to initial treatment recommendations in primary care.
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This research is supported by two grants National Health and Medical Research Council AND HEART RATE VARIABILITY

Espie CA, Kyle SD

Theta, Alpha, Sigma and Beta-1 and 2 frequencies. A similar approach were derived and confirmed by cluster analysis. Data suggest evidence was found for three phenotypes by retaining the LSI and splitting the was employed for HRV obtained from a 2-lead ECG at sleep-onset. We hypothesized that phenotypes of insomnia would differ on neurocognitive performance.

Methods: Patients with Insomnia Disorder (DSM-V) completed a neurocognitive assessment and an overnight diagnostic sleep study was used to cluster phenotypes according to TST, Wake-time After Sleep Onset (WASO) and Sleep Onset Latency (SOL). A hierarchical cluster analysis (Ward’s method) was used to identify potential insomnia phenotypes. EEG artifact free epochs were analyzed for power spectra using a validated standard fast Fourier transform. A sleep-onset period of 10 minutes either side of AASM-defined sleep-onset was evaluated for absolute (natural logarithm transformation) spectral bands: Delta, Theta, Alpha, Sigma and Beta-1 and 2 frequencies. A similar approach was employed for HRV obtained from a 2-lead ECG at sleep-onset.

Results: Confirming previous findings, phenotypes differed substantially for each of the sleep parameters used to derive the phenotypes for the 96 patients (all p < .01). Neurocognitive measures of attention and working memory performance, sleep-onset q-EEG and HRV were examined for between phenotype differences. At least two phenotypes emerged through objective sleep parameters: LSI and SSI. At sleep-onset, differences between LSI and SSI phenotypes for HRV suggest attenuated parasympathetic activity in SSI (p < .05). New evidence was found for three phenotypes by retaining the LSI and splitting the SSI phenotype into two: SSI-A (defined by high WASO) and SSI-B (a second SSI phenotype with high SOL and medium WASO). The SSI-B phenotype performed worse than SSI-A and LSI for sustained attention (p ≤ .05). Q-EEG revealed reduced power spectra also in the SSI-B phenotype before and after sleep compared to SSI-A and LSI (p ≤ .05).

Conclusion: At least two objective phenotypes of Insomnia Disorder were derived and confirmed by cluster analysis. Data suggest evidence for both two and three phenotype solutions; with differences for neurocognitively sustained attention and sleep-onset HRV and q-EEG.

Support (If Any): National Health and Medical Research Council (NHMRC, Australia) Centre for Integrated Research Understanding of Sleep (CIRUS), 571421; NeuroSleep, 1060992 and the Cooperative Research Centre for Alertness, Safety and Productivity, Australian Commonwealth Government

B. Clinical Sleep Science

0549

PHENOTYPES OF INSOMNIA DISORDER BUILT FROM CLUSTER ANALYSIS OF OBJECTIVE SLEEP PARAMETERS REVEAL DIFFERENCES IN NEUROCOGNITIVE FUNCTIONING, QUANTITATIVE EEG AND HEART RATE VARIABILITY


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Introduction: Short sleeping patients with Insomnia Disorder (SSI) differ from long sleeping insomnia phenotypes (LSI) for medical and psychiatric co-morbidity, however there is no clear cut-off point in polysomnographic (PSG) total sleep time (TST) to differentiate between phenotypes. For the first time, this study aimed to empirically derive and confirm phenotypes of Insomnia Disorder (LSI and SSI) following PSG and to evaluate the sleep-onset period using quantitative (q)-EEG and HRV. We hypothesized that phenotypes of insomnia would differ on neurocognitive performance.

Methods: Patients with Insomnia Disorder (DSM-V) completed a neurocognitive assessment and an overnight diagnostic sleep study was used to cluster phenotypes according to TST, Wake-time After Sleep Onset (WASO) and Sleep Onset Latency (SOL). A hierarchical cluster analysis (Ward’s method) was used to identify potential insomnia phenotypes. EEG artifact free epochs were analyzed for power spectra using a validated standard fast Fourier transform. A sleep-onset period of 10 minutes either side of AASM-defined sleep-onset was evaluated for absolute (natural logarithm transformation) spectral bands: Delta, Theta, Alpha, Sigma and Beta-1 and 2 frequencies. A similar approach was employed for HRV obtained from a 2-lead ECG at sleep-onset.

Results: Confirming previous findings, phenotypes differed substantially for each of the sleep parameters used to derive the phenotypes for the 96 patients (all p < .01). Neurocognitive measures of attention and working memory performance, sleep-onset q-EEG and HRV were examined for between phenotype differences. At least two phenotypes emerged through objective sleep parameters: LSI and SSI. At sleep-onset, differences between LSI and SSI phenotypes for HRV suggest attenuated parasympathetic activity in SSI (p < .05). New evidence was found for three phenotypes by retaining the LSI and splitting the SSI phenotype into two: SSI-A (defined by high WASO) and SSI-B (a second SSI phenotype with high SOL and medium WASO). The SSI-B phenotype performed worse than SSI-A and LSI for sustained attention (p ≤ .05). Q-EEG revealed reduced power spectra also in the SSI-B phenotype before and after sleep compared to SSI-A and LSI (p ≤ .05).

Conclusion: At least two objective phenotypes of Insomnia Disorder were derived and confirmed by cluster analysis. Data suggest evidence for both two and three phenotype solutions; with differences for neurocognitively sustained attention and sleep-onset HRV and q-EEG.

Support (If Any): National Health and Medical Research Council (NHMRC, Australia) Centre for Integrated Research Understanding of Sleep (CIRUS), 571421; NeuroSleep, 1060992 and the Cooperative Research Centre for Alertness, Safety and Productivity, Australian Commonwealth Government

0550

DIMENSIONAL CHARACTERIZATION OF INSOMNIA PROFILES AMONG PATIENTS WITH AND WITHOUT OBSTRUCTIVE SLEEP APNEA: MOVING BEYOND DIAGNOSTIC BOUNDARIES

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Introduction: Obstructive sleep apnea (OSA) and insomnia disorder (ID) frequently co-occur and are typically characterized using a pre-conceived categorical approach (e.g., ID vs OSA). This study aimed to test a dimensional approach and empirically derive symptom profiles among ID patients with and without comorbid OSA.

Methods: Individuals with ID (N = 176, 62% female) completed baseline self-report questionnaires and a screening polysomnography (PSG). Latent profile analysis was used to identify symptom profiles based on scores on the Insomnia Severity Index, Glasgow Sleep Effort Scale, Fatigue Severity Scale, Beliefs and Attitudes about Sleep, Ewpworth Sleepiness Scale, Pre-Sleep Arousal Scale, mean values from a 7-day sleep log (sleep onset latency, wake after sleep onset [WASO], sleep efficiency [SE]), and PSG total sleep time (TST).

Results: Three symptom profiles emerged and were labeled “Mild Insomnia” (MI), “Sleep Maintenance Insomnia” (SMI) and “Pre-sleep Hyperarousal” (PSH). The MI subgroup (45.14% of the sample) had relative low means across most self-report variables including the highest sleep log based SE. The SMI subgroup (26.58%) was primarily characterized by high levels of daytime sleepiness, significantly high WASO, and the lowest SE across all subgroups in spite of a relatively comparable PSG TST. Finally, the PSH subgroup (28.57%) was characterized by the highest overall means on self-report instruments, particularly those measuring sleep arousal, cognitions about sleep, and daytime fatigue. Participants with greater OSA severity were more likely to belong to the MI subgroup and those of older age were more likely to belong to the SMI subgroup. Controlling for OSA severity, overweight/obese participants were more likely to belong to the PSH than the SMI subgroup (p = 0.017). Other demographic characteristics were comparable across subgroups.

Conclusion: Our approach identified three insomnia subgroups. We provide a comprehensive dimensional representation of symptoms that is easily translatable to clinical practice and may guide tailored intervention efforts.

Support (If Any): This research is supported by two grants (K23AT003678, R01HL114529) from the National Center for Complementary and Alternative Medicine (NCCAM), the National Heart, Lung, and Blood Institute (NHLBI) and the National Institutes of Health (NIH).

0551

DOES SURGICAL MENOPAUSE INFLUENCE INSOMNIA IN PERIMENOPAUSAL WOMEN?

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Introduction: Insomnia contributes to cardiovascular and metabolic disease risk. Empiric evidence consistently suggests a predisposition to insomnia in women; yet, there is a paucity of research that addresses insomnia in perimenopausal (PM) women who have undergone surgi-
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Wohlgemuth W

The most common of the 6 profiles had elevations on ISH, PSY, and IMD. The profiles can be distinguished from each other by the presence of an additional insomnia diagnoses (besides ISH, PSY, IMD). These results demonstrate a single insomnia diagnosis, to which modifiers can be added, may better match the insomnia diagnostician’s approach.

Support (If Any): National Institute of Mental Health, Grant # R01MH067057

0553

WHAT FACTORS PREDICT CHRONIC INSOMNIA IN PERIMENOPAUSAL WOMEN?

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Introduction: Insomnia in adults contributes to poor health outcomes. Women report more insomnia than men, yet research addressing insomnia in perimenopausal (PM) women is lacking. This secondary analysis was conducted to identify predictors of chronic insomnia in PM women transitioning to menopause.

Methods: A secondary analysis of survey data assessed annually over 10 years from the Study of Women’s Health across the Nation (SWAN) was completed. Four sleep items (sleep latency, wake after sleep onset, awakenings, & sleep quality) were analyzed using the American Academy of Sleep Medicine insomnia criteria. Multivariable logistic and linear regression models with a simultaneous loading procedure carrying forward significant covariates (p ≤ 0.10) were used to identify predictors of chronic insomnia.

Results: The sample consisted of PM women (n = 2582) who were middle aged (45.9 ± 2.69 years), ethnically diverse (African American 28%; Caucasian 50%; Asian 10%; Hispanic 12%) and from five U.S. regions. Participants who developed and maintained insomnia for at least two consecutive data collection points were classified as having chronic insomnia (n = 707, 27%). Significant predictors of insomnia were: night sweats (p < 0.001), perimenopausal status (p < 0.001), depression (p < 0.001), BMI (p < 0.001), age (p = 0.001) and exercise (p = 0.0394). The adjusted odds of chronic insomnia were 1.3 times greater in women who reported night sweats (95% CI 1.1, 1.4; p < 0.001); 1.5 times greater in PM women than pre-perimenopausal women (95% CI 1.3, 1.8; p < 0.001); 1.5 times greater for women depressed at baseline (95% CI 1.2, 1.9; p < 0.001).

Conclusion: Perimenopausal status, night sweats and depression were independent predictors of chronic insomnia development in PM women. Chronic insomnia prevalence was much higher in our sample than the estimated prevalence in the US general population. Screening for insomnia in PM women is imperative to potentially improve health outcomes of PM women.

0554

ACTIGRAPHY AND SLEEP DIARY MEASURES IN VETERANS WITH TRAUMATIC BRAIN INJURY: DISCREPANCY IN SELECTED SLEEP PARAMETERS

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Introduction: Sleep complaints are a significant problem following traumatic brain injury (TBI) with prevalence estimates of post-TBI sleep disturbances were found to range from 30% to 80%. Polysomnography is impractical for many study participants and results may not be representative of sleep in normal environment. Given the pos-
sible limitation of actigraphy in populations with significant sleep difficulties, the association between actigraphy and other sleep assessment tools has been an area of interest in Veterans with mental health and medical conditions. The objective was to examine the discrepancy between sleep diary and actigraphic measures of sleep in Veterans with moderate-severe post-acute TBI and to explore whether these discrepancies vary according to participant characteristics.

Methods: Nineteen male Veterans with post-acute moderate/severe TBI and insomnia symptoms as measured by the Insomnia Severity Index (ISI) were recruited from VA Medical Center in the Rocky Mountain US. Veterans completed a daily sleep diary, Ohio State University TBI Identification Method, ISI, Hospital Anxiety and Depression Scale and wore an actigraphy watch for one week. Actigraphic and diary measurements of total sleep time (TST), wake after sleep onset (WASO), and sleep latency (SL) were calculated.

Results: Bland-Altman plots were used to assess agreement between the measures. Findings suggest poor agreement between actigraphy and sleep diary measurements of TST, WASO, and SL. On average, actigraphy measured greater duration of all three sleep parameters. Discrepancies were not found to be associated with specific TBI characteristics or mood-related symptoms.

Conclusion: When measuring sleep-related outcomes among Veterans with moderate-severe post-acute TBI, no differences were found between actigraphy and self-reported sleep diary data. Knowledge regarding measure-related limitations is important for both clinical and research practice among those with moderate-severe post-acute TBI.

Support (If Any): Veterans Health Administration Rocky Mountain Mental Illness Research, Education and Clinical Center (MIRECC), Denver, Colorado

0555
HOW REPRESENTATIVE ARE INSOMNIA CLINICAL TRIALS?
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Introduction: Clinical trials of pharmacological treatments for insomnia have specific inclusion and exclusion criteria, including polysomnographic (PSG) criteria for sleep onset, sleep maintenance and sleep efficiency. The question arises as to how representative these subjects are of the broader insomnia population. We systematically counted reasons for exclusion during recruitment to a five-year NIH-funded zolpidem efficacy trial in chronic insomnia.

Methods: Persons (N = 116), aged 32-65 yrs, meeting DSM-IVR criteria for insomnia and a PSG sleep efficiency of < 85%, no other primary sleep disorders, no psychiatric diseases or drug dependency and in good health were recruited to participate in a 12 month clinical trial of nightly use of zolpidem 10 mg or placebo. Advertisements in newspapers, hospital intranet news, and hospital clinics solicited individuals with chronic difficulty falling asleep, staying asleep, or awakening too early. Screening was conducted through an initial telephone interview followed by a clinic visit that included a brief physical, medical and drug use history, laboratory blood/urine testing, psychiatric screen (SCID), and clinical PSG. All subjects screened beyond the phone screen signed an informed consent.

Results: For 116 participants 2886 telephone interviews were conducted with 25% declining after hearing study specifics. Of those with continued interest 25% reported present (within past year) mood or psychological conditions, 18% chronic unstable health problems, 14% past or present drug/alcohol abuse, and 14% did not meet DSM-IVR criteria for insomnia. Of the remaining 410, 294 (72%) were excluded. Among those excluded 30% did not report for PSG, 22% failed the PSG (i.e. AHI > 10, PLMAI > 10, or SE > 85%), 17% failed the sleep screen, and 11% a drug screen

Conclusion: These data suggest persons entering an insomnia clinical trial are a highly selected sample. They show, while insomnia is comorbid with other conditions, clinical trials are carried out in primary insomnia, which is not representative of the broader insomnia population.

Support (If Any): NIDA, grant#: R01DA17355 awarded to Dr. Roehrs

0556
LIMITATIONS OF CURRENT DIAGNOSTIC CRITERIA FOR INSOMNIA: A CASE FOR QUANTITATIVE CUT-OFFS
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Introduction: Though the nocturnal symptoms of insomnia can be quantified, current diagnostic systems do not stipulate quantitative cut-offs for sleep-onset-latency (SOL) or wake-time-after-sleep-onset (WASO). Diagnoses are based instead on idiographic patient reports of ‘difficulty’ falling/staying asleep. Therefore, we examined whether remission of insomnia per diagnostic criteria results from a normalization of quantitative sleep disturbance, or if it is simply reflective of tolerance to sleep symptoms.

Methods: This study involved a year-long prospective investigation of 649 adults (48.1 ± 11.6 y; 69.3% female) with DSM-5 insomnia. Participants completed measures of sleep disturbance, perceived sleep-related distress, daytime sleepiness, functional impairment, and workplace productivity at baseline and at follow-up one year later.

Results: 271 participants no longer met diagnostic criteria for insomnia at follow-up. However, 67% of these ‘remitters’ reported averaging < 7 hours of nightly sleep time, and 66% reported ≥ 31 minutes of SOL and/or WASO. Importantly, daytime impairment in this subgroup of remitters was no different than among individuals who met diagnostic criteria at both baseline and follow-up (i.e., chronic insomniacs). By contrast, follow-up impairment was significantly lower (F = 12.3; p < .01) among remitters whose sleep disturbance returned below empirically-derived quantitative cut-offs (both SOL & WASO < 31 minutes) than in chronic insomniacs.

Conclusion: This is the first study on the long-term course of insomnia based on the newly established DSM-5 criteria. A troubling implication of findings is that a majority of insomniacs stop meeting diagnostic criteria despite continued sleep disturbance and impairment. ‘Remission’ in these cases is attributable instead to tolerance of sleep symptoms. Our findings are therefore largely supportive of recent efforts to derive quantitative thresholds for the severity of nocturnal sleep symptoms, and to incorporate these into future diagnostic systems.

Support (If Any): This study was supported by an NIMH Grant (R01 MH082785) and an investigator initiated research award from Merck & Co, both to Dr. Drake. The NIMH and Merck had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation or review of this abstract.

0557
LONG-TERM EFFICACY OF COGNITIVE BEHAVIOR THERAPY FOR MENOPAUSAL INSOMNIA
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Introduction: Insomnia is highly prevalent among post-menopausal women. We examined the efficacy of nurse-administered Cognitive Behavioral Therapy for Insomnia (CBT-I) in comparison to Sleep Restriction Therapy (SRT) and an Information-only control (IC) condition.
III. Insomnia

Methods: Post-menopausal females (n = 88) suffering from insomnia concurrent with menopause were recruited. Participants were screened for contraindicative psychopathology and sleep disorders via Structured Clinical Interview for DSM-IV Disorders and polysomnography (PSG). All participants showed an average wake after sleep onset > 45 minutes as evidenced by two nights of PSG. They were then randomized to a 6-week CBT-I (n = 35), 2-week SRT (n = 28), or a 6-week IC condition (n = 25). Participants completed the Insomnia Severity Index (ISI) and the Fatigue Severity Scale (FSS) scales at baseline (Time-1), 1 week post-treatment (Time-2), and at a 6-month follow-up (Time-3).

Results: There were no significant between-group differences in Time-1 ISI (CBTI: 14.54 ± 3.84; SRT: 14.75 ± 3.52; IC: 15.8 ± 4.59) or FSS scores (CBTI: 32.46 ± 10.28; SRT: 33.11 ± 9.81; IC: 31.56 ± 10.40). At Time-2, the CBTI (-8.33 ± 0.96) and SRT groups (-6.54 ± 0.71) showed a significantly greater reduction in ISI scores (F = 15.93; p < .01) than did the IC group (-1.80 ± 0.64). These reductions were maintained in the CBTI group at Time-3 (-8.13 ± 1.16), and were significantly larger than corresponding changes in the IC group (F = 5.90; p < .05). With respect to FSS scores, both the CBTI (-5.39 ± 1.46) and SRT groups (-4.57 ± 1.48) showed a significantly greater reduction (F = 4.34; p < .05) at Time-2 than did the IC group (0.37 ± 1.29). There were no between-group differences in FSS change scores at Time-3.

Conclusion: These results suggest that CBT-I and SRT are both associated with a post-treatment reduction in insomnia symptoms and fatigue in women with menopausal insomnia. However, unlike SRT, CBTI-related improvements in insomnia symptoms are robust even at 6-months post-treatment.

Support (If Any): This study was supported by an NIMH Grant (R01 MH082785) to Dr. Drake.

0558 TREATMENT RESPONSE TO INSOMNIA AS A FUNCTION OF OBJECTIVE SLEEP DURATION
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Introduction: Two insomnia phenotypes have been proposed based on objective sleep duration. While insomnia with short sleep duration is presumed to be biologically rooted, with higher indices of physiological activation, insomnia with near-normal sleep duration is hypothesized to be more psychologically based. Given that each phenotype has its unique profile, it is posited that their response to insomnia therapies may also differ; however, little data has been reported on this question.

Methods: Participants were 160 adults (Mage = 50.3, SD = 20.1; 39.4% men) that met diagnosis of chronic insomnia (Mduration = 16.4, SD = 13.6). They were treated with either cognitive-behavior therapy (CBT) or CBT with medication (i.e., zolpidem) (CBT/Med) over six weeks. Objective sleep duration was based on total sleep time averaged across two baseline nights of polysomnography. The sample was divided into four groups: short sleepers (≤ 6 hours) that received CBT (n = 26) or CBT/Med (n = 25) and participants with near-normal sleep duration (> 6 hours) that received CBT (n = 54) or CBT/Med (n = 54). Participants completed sleep diaries over two weeks, the Insomnia Severity Index, Dysfunctional Beliefs and Attitudes about Sleep Scale, Multidimensional Fatigue Inventory, and the Beck Depression and Anxiety Inventories at pre- and post-treatment.

Results: MANOVAs revealed that short sleepers reported greater reduction in time awake after sleep onset and greater increase of sleep efficiency compared to those with near-normal sleep duration (p < .01), regardless of treatment they received. Conversely, participants with near-normal sleep duration showed greater improvement of daytime symptoms, worries about sleep, and sleep satisfaction (p < .01) than those with short sleep duration, irrespective of the treatment received. No significant differences were observed for depressive, anxiety, and fatigue scales.

Conclusion: These findings suggest a differential treatment response between these two phenotypes but additional research is needed to identify potential markers of insomnia phenotypes that could be matched with specific insomnia therapies.

Support (If Any): Supported by grant MH60413 from the National Institute of Mental Health and the Fonds de recherche en santé du Québec (32207).

0559 EFFECT OF COGNITIVE-BEHAVIORAL VS. PHARMACOLOGICAL TREATMENT OF INSOMNIA ON CARDIOMETABOLIC OUTCOMES: A PILOT STUDY
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Introduction: Insomnia has been associated with increased risk of cardiovascular disease. Among preclinical markers, insomnia has been associated with high blood pressure and C-reactive protein (CRP) levels. No study to date has examined the effect of pharmacological vs. cognitive-behavioral treatment of insomnia (CBT-I) in improving these clinical outcomes.

Methods: We addressed this question in a sample of 10 middle-aged men and women who received either trazodone (n = 5) or CBT-I (n = 5). Evening mean arterial pressure (MAP) and morning CRP were measured at baseline and after 3 months of treatment. Cohen’s d for paired samples assessed the effect size (ES) in change in MAP and CRP levels in each treatment group.

Results: Insomnia severity index improved largely either with Trazodone (Δ = -12.8 ± 5.0 ng/mL, t = 5.7, ES = 2.6) or with CBT-I (Δ = -13.2 ± 3.4 ng/mL, t = 8.6, ES = 3.8). Trazodone modestly-to-largely decreased MAP (ΔMAP = -3.3 ± 3.7 ng/mL, paired-t = 2.0, ES = 0.9) and CRP levels (ΔCRP = -0.6 ± 0.8 ng/mL, paired-t = 1.5, ES = 0.7), while CBT-I only slightly decreased MAP (ΔMAP = -1.7 ± 3.9 ng/mL, paired-t = 0.9, ES = 0.4) and increased CRP levels (ΔCRP = +0.2 ± 0.3 ng/mL, paired-t = 1.1, ES = 0.7). Importantly, the stronger effect of trazodone vs. CBT-I in improving MAP and CRP levels occurred primarily in insomniacs with PSG-measured short sleep duration (n = 5), in which trazodone decreased MAP and CRP levels in a clinically meaningful manner (ΔMAP = -4.0 mmHg and ΔCRP = -1.1 ng/mL), while CBT-I did not (ΔMAP = +0.4 mmHg and ΔCRP = +0.3 ng/mL).

Conclusion: These pilot data suggest that trazodone, but not CBT-I, decrease MAP and CRP levels and that this effect is primarily found in insomniacs with short sleep duration. Future clinical trials should examine this effect in large samples of objectively-defined insomnia phenotypes.

Support (If Any): NIH’s C06 RR016499, ULI TR 000127

0560 SEQUENCED THERAPIES FOR COMORBID AND PRIMARY INSOMNIA: UPDATED FINDINGS FROM AN ONGOING RANDOMIZED CONTROLLED TRIAL
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Introduction: Despite available well-supported pharmacological and cognitive/behavioral insomnia therapies, it remains unclear how these therapies can best be employed to optimize treatment outcomes. This report provides preliminary findings from a two-site randomized clini-
cal trial examining outcomes of these therapies, when employed individually and in various sequences.

**Methods:** This report considers the first 140 (70 per site) study enroll-ees (87 women; Mw = 45.6 ± 15 years old). Participants were randomly assigned to a first-stage 6-week treatment consisting of behavioral therapy (BT) or zolpidem. After initial therapy, individuals in remission continued on maintenance therapy for 12 months. Those not achieving remission were randomized to a second, 6-week treatment involving either pharmacotherapy (zolpidem or trazodone) or psychological therapy (BT or cognitive therapy-CT). Participants are re-evaluated after this second treatment and periodically through 12-month follow-ups. The primary end points reported here include Insomnia Severity Index-defined treatment response (≥ 8 point decline from baseline) and remission (score < 8) through our 3-month follow-up.

**Results:** After initial treatment, there were slightly higher rates of treatment responders (47.1% vs. 38.9%) and remitters (30.9% vs. 25%) with BT than with zolpidem. For those who did not remit following BT, the addition of zolpidem or CT as a second treatment yielded equivalent cumulative remission rates of 41.2%, and response rates of 63.2% and 66.2% respectively by our 3-month follow-up. Following zolpidem treatment, the addition of BT or trazodone yielded notably lower cumulative remission (31.9% vs. 29.2%, respectively) and response (48.6% vs. 47.2%, respectively) rates by the same follow-up time point.

**Conclusion:** Preliminary findings suggest that sequenced therapies may augment outcomes seen from initial insomnia treatments alone. Moreover, these early results suggest possible advantages of BT over zolpidem as a first stage therapy in the choice of available treatment sequences for insomnia management.

**Support (If Any):** National Institute of Mental Health Grant #s R01MH091075 and R01MH091053

### 0561 GENETIC PREDICTORS OF THE RESPONSE TO COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA (CBTI): A TRIAD STUDY REPORT

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**Introduction:** Cognitive Behavioral Therapy for Insomnia (CBTI) is efficacious for insomnia comorbid with Major Depressive Disorder (MDD). It has advantages over pharmacotherapy in side-effects and durability; however, we lack predictors of the CBTI response that might help to optimally match patients to therapy. Such predictors could decrease suffering, disability, costs, and side-effects. To this end, we tested the hypothesis that genetic polymorphisms that predispose individuals to hyper-arousal or diminished homeostatic sleep drive would predict a better response to CBTI.

**Methods:** Patients with insomnia comorbid with MDD (N = 148) who received open-label antidepressant medication were randomized to receive CBTI or an active control therapy (CNTL). Genetic polymorphisms evaluated have been associated with: 1) increased arousal in terms of greater stress-related sleep disturbance (the short allele of the serotonin-transporter-gene-linked polymorphic region [5HTTLPR] [the primary outcome]); or 2) decreased homeostatic sleep drive (the A- allele of the serotonin 2A receptor 1438 A/G polymorphism, the Val-Met genotype of the BDBF Val66met polymorphism, and the GG allele of the Adenosine Deaminase G22A polymorphism).

**Results:** Subjects with the short allele of the 5HTTLPR polymorphism (short homozygotes and heterozygotes) treated with CBTI had significantly greater improvement in insomnia severity index (ISI) score than long allele homozygotes and all those treated with CNTL (p < 0.004; response rate of 38.2% vs 5%). There was a trend for greater ISI improvement in CBTI-treated patients with the GG allele of the Adenosine Deaminase G22a polymorphism (p < 0.07; response rate of 48.5% vs 30%).

**Conclusion:** Individuals with insomnia comorbid with MDD with some genetic polymorphisms predisposing to greater arousal and decreased homeostatic sleep drive are relatively likely to improve with CBTI. This is consistent with prior work in primary insomnia patients employing sleep EEG markers of arousal and homeostatic drive. Further work is needed to evaluate the clinical utility of the promising polymorphisms identified.

**Support (If Any):** This research was supported by R01HL096492 and three linked R01 grants from the National Institute of Mental Health: MH078924, MH078961, and MH079256.

### 0562 DO PATIENTS WITH INSOMNIA AND COMORBID MODERATE TO SEVERE, PERSISTENT DEPRESSION RESPOND DIFFERENTLY TO COMBINED DEPRESSION AND INSOMNIA TREATMENT THAN DO THOSE WITH MILD TO MODERATE, LESS PERSISTENT DEPRESSION?: A REPORT FROM THE TRIAD STUDY

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**Introduction:** Managing sleep disturbances in depression is particularly important, as insomnia can negatively impact depression treatment outcomes. This study examined whether patients with severe, persistent depression respond differently to an intervention that includes targeted therapies for insomnia and depression than do those with milder, less persistent depression.

**Methods:** The sample, drawn from 150 TRIAD study participants based on a screening SCID assessment, included 71(52 female; Age = 47.1 ± 11.5 yrs.) patients with moderate to severe, persistent depression (> 2 prior episodes) and 58(41 female; Age = 44.2 ± 13.5 yrs.) patients with mild to moderate, less-persistent (< 1 prior episode) depression. Treatment consisted of 16 weeks of anti-depressant medication management plus a randomly assigned insomnia therapy (CBTI) or sham control (CTRL). The 17-item Hamilton Rating Scale for Depression (HRSD-17) and the Insomnia Severity Index (ISI) were administered at baseline, bi-weekly during treatment, and every 4 months during a 2-year follow-up. Mixed-effects linear models examined the effects for treatment assignment, depression type, and their interactions. Also, chi-square analyses compared model-predicted insomnia and depression remission rates at the 24-month follow-up for the mild and more severe depression subgroups assigned to CBTI and CTRL conditions.

**Results:** Analyses, adjusting for age, sex, employment, race, education, and current depression duration, showed significant 3-way inter-actions (treatment arm x depression severity group x time) for ISI (F(15,1126) = 1.76, p = .03) and HRSD-17 scores (F(15,1130) = 1.72, p = .04). Chi-square tests showed patients with more severe, persistent depression assigned to CBTI had significantly higher insomnia (ISI < 8) and depression (HRSD-17 < 8) remission rates (82.4% & 73.5%, respectively) than did either similarly severe patients assigned
to the CTRL therapy (10.8% & 3.9%, respectively), or the milder, less-persistent depression groups assigned to either CBTI (23.1% & 3.9%, respectively) or CTRL (12.5% & 0%, respectively; p’s for paired comparisons < .0001).

Conclusion: Results suggest that for patients with dual insomnia depression diagnosis, targeting insomnia with CBTI is particularly beneficial for those with moderate to severe, persistent depression and may enhance their chances for insomnia and depression remission.

Support (If Any): This research was supported by a three linked grants from the National Institute of Mental Health, Grant numbers MH078924, MH078961, and MH079256.

0563
CORTISOL AND HYPERAROUSAL IN INSOMNIA
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Introduction: Insomnia is a disorder of hyperarousal shown by elevated sleep latency on the Multiple Sleep Latency Test (MSLT) and other arousal measures. We have reported elevated NE in insomnia as a function of MSLT. Others have reported pre-sleep cortisol elevations in insomnia vs controls. We sought to determine whether cortisol levels, both diurnal and presleep, would also vary as a function of MSLT.

Methods: DSM-IVR diagnosed insomniacs (N = 110), aged 32-65 yrs, having a PSG sleep efficiency of 85% or less, no other sleep disorder, unstable medical or psychiatric diseases or drug dependency were recruited. On a screening MSLT 26 had MSLTs of 10 or less (Lo) and 44 of 15 min or more (Hi). Participants took 10mg zolpidem or placebo (30 min before bedtime), double-blind, nightly for 12 months. In months 1, 4, 8 and 12, urine was collected over 24 hrs in 8 hr- aliquots and assayed for cortisol (Ward Laboratories, Ann Arbor, MI). Saliva samples were collected 35 min before bedtime and the drug administration in month 1 and 8, analyzed for cortisol levels (Salimetrics, State College, PA), and compared to a control group (N = 41).

Results: Presleep salivary cortisol was higher in insomniacs than controls (2.23+/-2.12 vs 1.49+/-0.91 ug/L, p < .01), but did not differ as a function of MSLT. Nightly zolpidem reduced pre-sleep cortisol relative to placebo on both months (Zol - M1:1.51+/-0.87; M8:1.52+/-0.80 vs Pbo - M1:1.79+/-1.44; M8:1.94+/-1.48 ug/L, p < .02) with no months effects. Daytime (0700-1500 hrs) urinary cortisol was higher overall in the Hi vs Lo MSLT insomniacs (Hi: 18.6+/-10.9 vs Lo: 12.9+/-7.1 ug/L, p < .04), did not change across months, and was not reduced with zolpidem vs placebo.

Conclusion: Hyperarousal in insomnia is associated with higher daytime urinary cortisol levels, but is not affected by zolpidem. In contrast, pre-sleep salivary cortisol does not vary as a function of MSLT, but is reduced by zolpidem. These data suggest cortisol elevations have both a state and trait etiology.

Support (If Any): NIDA, grant#: R01DA17355 awarded to Dr. Roehrs

0564
AROUSABILITY OF INSOMNIA PATIENTS AND HEALTHY VOLUNTEERS IS NOT IMPACTED BY THE SLEEP-SPECIFIC DOSES OF DOXEPIN (3 MG AND 6 MG), BUT IS IMPACTED IN HEALTHY VOLUNTEERS USING ZOLPIDEM 10 MG
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Introduction: Ability to awaken to external or internal stimuli (arousability) is important. However, arousability is rarely assessed in evaluating hypnotics. An indirect approach to assessing arousability is examining sleep maintenance (SM) and relating wake-after-sleep-onset (WASO) to number-of-awakenings (NAW). Decreased NAW reflects a drug’s potential for blunting arousal response. Decreased WASO coupled with no decrease in NAW reflects ability to hasten return to sleep. To explore arousability, we evaluated the effects of doxepin (DXP; Silenor®) 3mg and 6mg (i.e. indicated for insomnia). Further, we directly evaluated Auditory Awakening Threshold (AAT) with DXP and zolpidem.

Methods: Two placebo-controlled efficacy trials and an AAT trial are reported. Study A was a 12-week trial in elderly insomniacs (DXP 3mg); Study B was a 5-week trial in adult insomniacs (DXP 3mg and 6mg). Study C was a 4-way crossover trial assessing a single dose of DXP 6mg (DXP6), zolpidem 10mg (Z10) and placebo (2 placebo conditions). AAT was evaluated at the Tmax of each active medication and its corresponding placebo.

Results: DXP 3mg (Study A and B; p < 0.0001) and 6 mg (Study B; p < 0.0001) significantly decreased WASO across the trials. Important-ly, NAW were not decreased at any dose or time point in either study. In Study C, the AAT (expressed as dB) for Z10, was significantly higher (p < 0.0001) than both PBO groups and DXP6, with a mean dB level of 102 (DXP6 83dB, average placebo 81dB). Further, 24 Z10 subjects did not awaken at max AAT (110dB; 4 subjects in all 3 other groups).

Conclusion: DXP (3mg, 6mg) improved WASO without altering NAW. Further, DX6 did not impact AAT; in contrast Z10 increased arousal threshold. These data demonstrate that DXP improved SM without impacting arousability. Further research to determine if this more broadly reflects differences between drugs that work via the sleep (agonist) versus wake (antagonist) system.

Support (If Any): Funding for this study was provided by Pernix Therapeutics.

0565
COMPARING DOCTOR-REFERRED AND SELF-REFERRED USERS OF AN INTERNET-DELIVERED CBT FOR INSOMNIA INTERVENTION: LESSONS FOR DISSEMINATION AND IMPLEMENTATION
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Introduction: Conducting RCTs is an important step in establishing the efficacy of digital health interventions; but by themselves, RCTs do little to impact public health. Assembling data from real-world implementations, alongside RCTs, can, however, collectively inform the dialogue about dissemination efforts.

Methods: Outcome and adherence data were tracked for 533 commercial users of an Internet-delivered CBT for insomnia program (161 self-referred users and 352 clinician-referred users). The online pro-
gram includes six weekly Cores that deliver CBT-I strategies. Users are prompted to complete the 7-item Insomnia Severity Index (ISI) at the start of each Core. ISI scores range from 0 - 28, and a 7-point change is considered indicative of clinical improvement. For comparison purposes, Core completion and ISI score data will also be provided for three RCTs using the same insomnia program: two pilots (that include a face-to-face assessment) and one large RCT with national recruitment (no face-to-face assessment).

Results: On average, ISI scores decreased 6.1 points between the first and last Cores completed for doctor-referred users and 6.7 points for self-referred users. Pre-to-post ISI scores dropped 9.1, 8.9, and 7.7 points between pre- and post- assessments in the 3 RCTs. Among doctor-referred users, 76% completed all six Cores or met criteria for e-attainment (stopping early but meeting criteria for no or mild insomnia per the ISI). Among self-referred users, 70% completed all six Cores or met criteria for e-attainment. In the two pilot trials, 91% and 86% completed all six Cores, and in the national RCT, 69% completed all six Cores.

Conclusion: Determining how adults in the real-world consume digital health interventions has important implications for the dissemination of digital health interventions.

Support (If Any): NIMH: IR01MH086758-01A1

0566 BARRIERS TO RECRUITMENT, RETENTION AND ADHERENCE TO INTERNET-BASED COGNITIVE BEHAVIORAL THERAPY (CBTI) IN RURAL BREAST CANCER SURVIVORS (BCS)

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Introduction: Cognitive behavioral therapy for insomnia (CBTI) is an established treatment for insomnia in breast cancer survivors (BCS), however most CBTI studies have used a predominately urban population. Rural BCS have been underrepresented in the studies, in part due to recruiting and technological challenges. This analysis will address barriers to recruiting rural BCS and their retention, attendance and adherence to CBTI related to technological challenges.

Methods: Fifteen rural BCS enrolled in a six week internet-based CBTI study. Technical difficulties and participation barriers were recorded in a treatment log. Descriptive statistics will be used to describe participant attendance and adherence, and technical difficulties will be analyzed against both study retention and participant response to evaluate for a correlation.

Results: Multiple methods were used to recruit for this study including direct provider referral, mailing from provider, breast cancer support groups, newspaper & radio advertising and community flyers. Mailing from providers and radio advertising proved the most effective recruitment tools. Infrastructure-based technical difficulties related to bandwidth were anticipated given the rural population, but existing infrastructure supported a rural video-link. Descriptive statistics will be used to analyze correlations between user-based technical difficulties and attendance and adherence to treatment.

Conclusion: Internet-based CBTI is a viable intervention for rural BCS with insomnia. Existing infrastructure in rural communities was robust enough to conduct video-link sessions over the internet. Multiple methods were necessary to reach and recruit rural BCS for inclusion in the study.

Support (If Any): F31NINR012097

0567 THE Efficacy of IndIVIDUAL 8-WeEk CBT-I for Insomnia in Recovering Alcohol Dependent Veterans

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Introduction: Insomnia is highly prevalent in individuals with Alcohol Dependence (AD) during recovery and is associated with an increased risk of relapse to drinking. Three prior studies using modified versions of Cognitive Behavioral Therapy for Insomnia (CBTI) have found that insomnia can be treated in the context of recovery in the non-Veteran population. The aim of the present study was to evaluate the efficacy of an 8-week CBT-I in Veterans recovering from AD.

Methods: Eligible Veterans were randomly assigned to receive either standard 8-week CBT-I (N = 11) or a Monitor Only (MO [n = 11]) condition and were evaluated at 3- (N = 21/22) and 6-month post-treatment (N = 18/22). The primary outcome measure was the Insomnia Severity Index (ISI). The secondary outcome measures were the percent of subjects exhibiting treatment response and mean differences between groups on the Dysfunctional Beliefs and Attitudes about Sleep scale (DBAS). GLM repeated measures models evaluated for differences between groups across time.

Results: The sample consisted of males (mean age 54.5 ± 6.9). Subjects reported 26.4 ± 26.3 days of abstinence prior to their baseline evaluation. CBT-I produced significant improvement on the ISI [F(1,9) = 5.4, p = 0.001, CBT-I Group: Pre 18.0 ± 5.9, Post 7.2 ± 4.1, Follow-up at 3 months 7.3 ± 3.3, Follow Up at 6 months 5.1 ± 4.0; and MO Group: Pre 20.0 ± 5.8, Post 16.5 ± 6.4, Follow Up at 3 months 16.0 ± 5.3, Follow Up at 6 months 16.3 ± 6.5]. 82% of the CBT-I group and 9% of the MO group exhibited treatment improvement (pre-post ISI decrease by ≥ 50%), p = 0.002. There was a trend towards improvement in the DBAS total score over time [F(1,8) = 2.1, p = 0.06]. Effect sizes (pre-post) for CBT-I and MO were as follows: CBT-I: 0.72 and MO: 0.27 for ISI; CBT-I: 0.36 and MO: -0.13 for DBAS.

Conclusion: A standard 8-week CBT-I treatment showed a large effect in reducing insomnia symptoms in Veterans during early recovery from AD.

Support (If Any): This study was funded by the Competitive Pilot Project Fund (CPPF) of the VISN-4 VA and was supported by the following grants: VA grant 1K2-CX008855 (SC); R41MD088445 (JTA); NIH K24 AA013736 (HRK); NIH K23 HL10216 & NIH R21 ES022931 (MAG); and NIH R01AG041783 (MLP).
The purpose of this pilot study was to test the feasibility and gather preliminary efficacy data on the extent of change in insomnia and chronic pain.

**Methods:** Of the 75 participants screened, 31 who met the eligibility criteria were randomized into either AA (n = 15) or usual care (UC; n = 16) groups. Feasibility of AA was measured using recruitment and retention of participants. The primary sleep outcome was the Insomnia Sleep Index (ISI) and chronic pain outcome was the Brief Pain Inventory (BPI). Symptom assessments were completed at baseline and post-treatment.

**Results:** To date, all 31 participants completed the 8-day study protocol. Participants average age was 47.3 years (SD = 9.4); most were married (94%), college graduates (78%), Caucasian (68%), on active duty or retiree status (68%) and male (55%). In the AA group, there were significant decreases in the ISI (p < 0.005; 6.5 points) and in the BPI (p < 0.05; 2 points) scores. In the UC group, there was a trend toward a decrease in the ISI score (p = 0.05; 1.5 points) but no significant decrease in the BPI score (p = 0.58; 0.5 point).

**Conclusion:** Preliminary results indicate that AA is a feasible treatment modality and can improve sleep and reduce pain compared to usual care alone. With the movement of APNs in primary care settings for assessment and treatment of insomnia and chronic pain, a treatment with a readily available safe and portable CAM modality with minimal adverse effects can ensure timely treatment.

**Support (If Any):** This research is funded by the TriService Nursing Research Program (TSNRP), Uniformed Services University (USU), HU0001-14-TS02 (P14-09); however, the information or content and conclusions do not necessarily represent the official position or policy of, nor should any official endorsement be inferred by, the TSNRP, the USU, the Department of Defense, or the U.S. Government.

**0570**

**EFFECT OF LIFESTYLE INTERVENTION ON SLEEP AMONG OVERWEIGHT MEN WITH INSOMNIA SYMPTOMS**

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**Introduction:** To investigate whether a six-month exercise or diet intervention could improve sleep and change morning fasting leptin level among overweight men with insomnia symptoms.

**Methods:** Seventy-three overweight men aged 30-65 years, with ≥ 3 months insomnia complaints were recruited to participate in a six-month exercise or diet intervention. Insomnia symptoms were classified by DSM-IV criteria. Participants were randomized into exercise (n = 24), diet (n = 28), or control group (n = 21). Exercise group received 6-month aerobic exercise intervention with 1-5 sessions per week of 30-60 mins duration. Diet group received 6-month individualized diet counseling both online and face-to-face to reduced daily energy intake of 300-500 kcal. Control group was instructed to maintain habitual lifestyle during the study period. Home-based objective and subjective sleep were measured by piezoelectric bed sensor and sleep diary for seven nights before and after intervention, respectively. Overnight fasting serum leptin were measured by ELISA. Other measurements included anthropometry and fat mass. Time-by-group differences were analyzed by ANCOVA controlling for baseline values.

**Results:** Compared to the controls, both exercise and diet groups showed shorter objective sleep onset latency (P = 0.009 and 0.001, respectively) at 6 months. Compared to the controls, reduced body weight, BMI, waist circumference, fat mass, and leptin level were found in diet group at 6 months (P = 0.048 to 0.005), but not in the exercise group. After controlling for the change of body weight, fat mass, or leptin, reduction of sleep onset latency in both exercise and diet groups remained.

**Conclusion:** Both six-month exercise and diet intervention could reduce objective sleep onset latency among overweight men with insomnia symptoms, the improvement is independent of change in body weight, fat mass, or leptin.

**Support (If Any):** Finnish Funding Agency for Technology and Innovation (TEKES 2206/31/2010) and the Chair Professor Program of Shanghai Jiao Tong University Zhiyuan Foundation (CP2014013).
INSOMNIA IMPAIRMENT INDEX, A NEW INSTRUMENT TO EVALUATE INSOMNIA OUTCOMES: TESTED IN A RANDOMIZED CONTROLLED TRIAL OF ASVAUTO VS CPAP TO TREAT CHRONIC INSOMNIA PATIENTS

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Introduction: Edinger et al. (2004) published AASM insomnia diagnostic research criteria, formalizing inclusion of daytime impairment for diagnosis of an insomnia disorder. Impairment includes: fatigue, malaise; attention, concentration, memory impairment; social, vocational dysfunction, poor school performance; mood disturbance, irritability; daytime sleepiness; motivation, energy, initiative reduction; proneness to errors, accidents; tension headaches, GI symptoms due to sleep loss; and concerns, worries about sleep. From these symptom categories, we created the Insomnia Impairment Index (III) to use in an RCT treating insomnia with PAP therapy. In our companion RCT abstract (Krakow et al.), we report on large, significant ISI score improvements following PAP use; here we report on related changes in III.

Methods: Preliminary sample included 14 insomnia patients objectively diagnosed with OSA/UARS randomized to CPAP (n = 8) or ASV-Auto (n = 6); both CPAP and ASV-Auto are manually titrated in a 4 (Very Severe) scale (maximum = 44, Cronbach’s alpha = 0.84). To evaluate insomnia outcomes, we performed a non-randomized controlled clinical trial comparing the following: 1) OSA/UARS-diagnosed SOI patients randomized to CPAP (n = 12) or ASV-Auto (n = 6), both CPAP and ASV-Auto are manually titrated in the sleep lab. The III consists of 11 questions scored on a 0 (None) to 4 (Very Severe) scale (maximum = 44, Cronbach’s alpha = 0.84). To assess concurrent validity, quality of life was measured: Q-LES-Q-SF and FOSQ-10 (higher scores reflect greater quality of life). Six-week follow-up is reported.

Results: Our total sample averaged 5.77 (2.69) PAP hours/night. All three measures showed medium to large improvement: III [18.00 (6.62) vs. 10.07 (6.33), p = .003, ρ = .77], Q-LES-Q-SF [66.96 (17.08) vs. 73.85 (17.38), p = .30, ρ = .39], and FOSQ [14.70 (1.91) vs. 16.11 (2.28), p = .09, ρ = .65]. When comparing PAP modes, ASV-Auto was superior to CPAP, demonstrating non-significant albeit clinically relevant changes (by effect sizes) in III [9.67 (5.82) vs. 6.63 (5.58), g = 0.50], Q-LES-Q-SF [10.12 (10.87) vs. 4.47 (20.67), g = 0.30], and FOSQ-10 [1.89 (2.17) vs. 1.04 (2.33), g = 0.35]. III and Q-LES-Q-SF changes correlated as a trend (p = .07, r = 0.50), suggesting concurrent validity. III and FOSQ changes showed a non-significant albeit medium-sized correlation (p = .24, r = 0.34).

Conclusion: PAP use improved daytime impairment and quality of life among insomnia patients who also experienced decreased insomnia severity. These preliminary data in a small sample suggests ASV-Auto may prove more efficacious than CPAP. The III may be useful when evaluating insomnia treatment efficacy.

Support (If Any): Maimonides Sleep Arts & Sciences

THE EFFECT OF CBT-I ON INSOMNIA IN OLDER INDIVIDUALS WITH COMORBID MILD SLEEP APNEA

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Introduction: Individuals with obstructive sleep apnea (OSA) often report comorbid insomnia. Although Cognitive Behavioral Therapy for Insomnia (CBT-I) has been shown to be efficacious for individuals with insomnia, it is unclear whether this efficacy would remain in older individuals with comorbid sleep apnea. Here we examine the effect of CBT-I on insomnia in older individuals with comorbid mild sleep apnea.

Methods: Forty-one older, community-dwelling individuals (69.8 ± 6.20 years; 33 = women) participated in a study of CBT-I in which they completed one night of in-home polysomnography (PSG) prior to receiving CBT-I treatment once per week for six weeks. Participants also completed one week of sleep diaries and the Insomnia Severity Index (ISI) (low scores = fewer insomnia symptoms) before and after treatment. Participants were divided into two groups based on PSG: “negative” (AHI = 0-5, n = 9) and “positive” (AHI = 5-15, n = 32) for mild obstructive sleep apnea. Repeated measures ANOVA was used to examine group-level differences in sleep diary-derived sleep efficiency (SE) and ISI total score from pre- to post-treatment.

Results: Participants’ SE increased from baseline to post-treatment in both OSA negative (10.1% ± 4.88%, p < 0.0001) and positive groups
III. Insomnia

(7.78% ± 5.65%, p < 0.0001), and the change observed between groups was statistically indistinguishable (p = 0.39). ISI total scores decreased from baseline to post treatment in both OSA negative (9.54 ± 12.1, p < 0.0001) and positive (13.3 ± 11.3, p < 0.0001) groups, and the change between groups was statistically indistinguishable (p = 0.27).

**Conclusion:** CBT-I improved both SE and ISI total scores in subjects with and without mild sleep apnea. The improvement in individuals with mild sleep apnea was indistinguishable from the improvement of individuals without sleep apnea. These findings suggest that CBT-I can be considered an effective treatment for insomnia in older individuals with co-occurring mild obstructive sleep apnea.

**Support (If Any):** National Institute of Mental Health grant number: 1R01MH101468-01. The Mental Illness Research, Education, and Clinical Center (MIRECC) at the VA Palo Alto Health Care System

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**0574**

LONG TERM OUTCOMES IN THE TREATMENT OF COMORBID INSOMNIA AND DEPRESSION: A REPORT FROM THE TRIAD STUDY

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**Introduction:** Both depression and insomnia are episodic disorders and the two often co-occur. Sleep quality predicts response to depression treatment among those with depression and future depressive episodes among those without current depression. It is therefore important to focus on long term benefits of treating both disorders when they co-occur. The aim of the current study was to determine whether insomnia severity at the end of treatment predicted depression symptom severity during a 24-month follow-up period.

**Methods:** The TRIAD study included 148 participants (mean age 46.6 ± 12.6 years; 73% female) with comorbid depression and insomnia, who were randomized to a 16-week treatment phase consisting of anti-depressant medication management plus one of two insomnia therapies (CBT-I or control (CTRL)) and were followed for 24 months after study treatments ended. Measures included the 17-item Hamilton Rating Scale for Depression (HRSD-17) and the Insomnia Severity Index (ISI), administered at baseline, bi-weekly during treatment, and every 4 months during follow-up. Hierarchical linear models examined if the last ISI (HRSD) score during the treatment phase predicted HRSD (ISI) scores during the follow-up phase, respectively.

**Results:** The last ISI score during treatment predicted HRSD scores during follow up (p < .003); for every one point decrease in ISI score achieved at the last measured time-point during treatment, average HRSD score during follow-up was 0.43 points lower. Treatment arm did not predict follow-up HRSD scores.

**Conclusion:** Lower insomnia severity achieved during treatment predicted lower depression severity during the two year follow up period. This result and the previously reported finding that CBT-I led to greater improvement in insomnia than CTRL highlight the importance of targeting insomnia in the management of patients with dual insomnia and depression diagnosis. Although effect size on depression was relatively small, the simultaneous treatment of both disorders appears to have positive long-term benefits in terms of depression symptom severity.

**Support (If Any):** This research was supported by a three linked grants from the National Institute of Mental Health, Grant numbers MH078924, MH078961, and MH079256.

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**0575**

DOES BODY MASS INDEX MODERATE THE EFFECTIVENESS OF COGNITIVE-BEHAVIORAL THERAPY IN INDIVIDUALS WITH COMORBID INSOMNIA AND FIBROMYALGIA?

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**Introduction:** Central sensitization in fibromyalgia (FM) and physiological hyperarousal in insomniacs share common etiologies involving structural and functional alterations in the brain. Obesity is associated with autonomic hyperarousal and structural and functional brain abnormalities. Research from our lab suggests Cognitive-Behavioral Therapy (CBT) is effective in reducing insomnia and clinical pain and may restore normal neurological structure and function. Given potentially concurrent neurological and physiological deficits in FM, insomnia, and obesity, this study examined whether Body Mass Index (BMI) moderated the effectiveness of CBT-Insomnia and CBT-Pain for comorbid insomnia and FM.

**Methods:** Adults with chronic insomnia and FM (N = 113) were randomized to waitlist-control, CBT-Insomnia, or CBT-Pain. Participants completed 2-week sleep and pain diaries and the BDI-II at baseline, post-treatment, and 6-month follow-up. Treated participants also completed the diaries during treatment. Latent-growth-curve analysis was used to model changes in symptoms. Intercepts and slopes were regressed on Treatment-Condition, BMI, and Treatment-by-BMI interaction.

**Results:** BMI moderated linear changes in morning pain sensitivity (-.71, p = .013), morning pain unpleasantness (.62, p = .051), SOL (.31, p = .066), and TST (5.07, p < .001) in CBT-Insomnia vs waitlist-control - even after controlling for baseline symptoms and mood. Except for TST, the interactions indicated greater improvements in individuals with higher BMIs. Unexpectedly, there were greater increases in TST in waitlist-control participants with lower BMIs than in those who received CBT-Insomnia and had higher BMIs. The CBT-Pain-by-BMI interactions followed similar patterns but were not significant.

**Conclusion:** FM patients with higher BMIs appear to benefit more from CBT-Insomnia. This conclusion is consistent with literature suggesting increased autonomic arousal in obese people. FM insomniacs with higher BMIs might experience especially elevated physiological arousal and thus benefit to greater degrees from interventions that restore normal autonomic activity. More extensive assessment of autonomic function, and treatments tailored to BMI associated arousal may clarify BMI’s impact on pain and insomnia treatment.

**Support (If Any):** R01AR055160

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**0576**

INSOMNIA COMORBID WITH FIBROMYALGIA: IMPROVEMENTS IN ACTigraphically- MEASURED SLEEP ASSOCIATED WITH COGNITIVE-BEHAVIORAL THERAPY LEAD TO IMPROVEMENTS IN THE COMORBID CONDITION

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**Introduction:** Research has indicated that insomnia can worsen the symptoms of comorbid medical conditions, therefore suggesting that sleep improvements following insomnia treatment could also result in an improvement of the medical condition itself. In a sample of patients with insomnia occurring comorbid with fibromyalgia (FM), we ex-
explored whether treating and improving sleep with cognitive-behavioral therapy for insomnia (CBT-I) would also exert a positive effect on pain and other FM symptoms.

**Methods:** Sixty-one individuals (59 women; ages 24-65) meeting research diagnostic criteria for insomnia and American College of Rheumatology criteria for FM were randomized to: treatment as usual (TAU; n = 21), TAU+ sham therapy (ST; n = 20), or TAU+CBT-I (n = 20). The primary sleep outcome was mean actigraphic sleep fragmentation index (SFI) at posttreatment (POST), a global indicator of sleep consolidation measured by wrist-actigraphy for a 2-week period after treatment. The severity and impact of FM symptoms were evaluated at POST with the Brief Pain Inventory (BPI) and the Fibromyalgia Impact Questionnaire (FIQ). We used mediation models and a version of the Sobel test using a nonparametric bootstrapping procedure to ascertain whether there was an indirect effect of CBT, via sleep improvement, on other FM symptoms.

**Results:** Compared to individuals receiving TAU, those receiving CBT-I showed statistically significant lower SFI at POST (p = .04). Although CBT-I had no statistically significant initial direct effect on the other FM symptoms at POST, analyses revealed its indirect effect on these outcomes, occurring through a reduction of the SFI: FIQ scores point estimate = -7.013 (95% CI = -15.65/-0.39); and BPI scores point estimate = -7.013 (95% CI = -15.65/-0.03). Similar analyses comparing the ST and TAU groups showed no statistically significant effects of treatment on the SFI and on the other FM-related measures.

**Conclusion:** Our results indicate that, in patients with FM, CBT-I can help consolidate nocturnal sleep, as measured by actigraphy. This, in turn, is associated with improvement in other FM-related symptoms, such as pain. These findings underscore the impact of sleep in individuals with FM and highlight the usefulness of CBT-I for the overall management of FM.

**Support (If Any):** National Institute of Arthritis, Musculoskeletal and Skin Diseases, Grant # R01AR052368

0577 DOUBLE-BLIND, PLACEBO-CONTROLLED, 4-WAY CROSSOVER STUDY COMPARING THE EFFECTS OF DOXEPIN 6 MG AND ZOLPIDEM 10 MG ON GAIT, BALANCE, AND COGNITIVE PERFORMANCE IN HEALTHY VOLUNTEERS

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**Introduction:** Falls are the leading cause of injury in older adults, accounting for millions of injuries. Frequency of nocturnal awakenings, sleep medication use, insomnia, and nocturia are independent risk factors for falls and hip fractures. To examine the effect of sleep medicine on gait and balance, we evaluated doxepin (DXP; Silenor®) 6mg (DXP6) and zolpidem 10mg (Z10), the highest doses indicated for insomnia. Additionally, the effects on memory were examined.

**Methods:** This 4-way crossover study assessed the effects of a single dose of DXP6 compared with matching placebo and a single dose of Z10 compared with matching placebo at the respective Tmax in adult male volunteers (n = 39). Gait, balance, and memory were assessed 4 hours postdose for DXP6 and placebo and at 1.5 hours postdose for Z10 and placebo. After awakening, subjects performed the Tandem Walk (TW), the Berg Balance Scale (BBS) and a TUG test immediately free recall while delayed recall was assessed 15 minutes after morning awakening.

**Results:** Z10, but not DXP6, showed significantly poorer performance relative to placebo on all outcome measures. Also, in a direct com-parison, performance on Z10 was impaired relative to DXP6. Measures that were significantly impaired (all p-values < 0.0001) for Z10 included TW #step-offs (500% more than DXP6), TW time to complete, BBS score, words recalled immediately and delayed (340% fewer words than DXP6).

**Conclusion:** These data indicate that doxepin at the highest hypnotic dose (DXP6) did not cause impairment in gait, balance, or memory. In contrast, zolpidem at the highest hypnotic dose had broad CNS depressant effects. Functions as diverse as memory and balance were negatively impacted by Z10 directly or indirectly through its sedative activity. Further research is needed to determine if impairment is generalizable to other medications binding at the benzodiazepine receptor but not to drugs working on transmitters mediating wakefulness such histamine.

**Support (If Any):** This study was supported by funding from Pernix Therapeutics.

0578 SUVOREXANT FOR THE TREATMENT OF INSOMNIA: ANALYSIS OF PRESCRIPTION AT UNIVERSITY HOSPITAL IN JAPAN

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**Introduction:** Suvorexant is a dual orexin receptor antagonist recently became available for insomnia treatment. As mechanism of action of suvorexant is differrent from previously available hypnotics, safety and tolerability of this medication in the clinical practice is of interest. The aim of this study was to analyze the prescription of suvorexant during the early months after the approval of the drug at a university hospital in Japan.

**Methods:** Analysis of prescription during the first seven month after the approval of suvorexant at Ehime University Hospital was conducted. Number of patients prescribed for outpatient and inpatient at each department, percentage of continued prescription, and reason for discontinuation were analyzed.

**Results:** Suvorexant was prescribed for 83 patient during the analysis period. Initial dose of suvorexant was 15mg in 39.8% and 20mg in 60.2% of the patients. 72.3% of the patients were outpatients. 33.7% for prescriptions were from psychiatry department and 18.1% from center for sleep medicine. 47.8% of inpatient prescriptions were from orthopedics. Suvorexant was continued in 67.5% of the patients. Reasons for discontinuation of prescription were insufficient efficacy or change to other hypnotics in 36.0%, no need for further medication including the improvement of symptom in 24.0%, and daytime sleepiness or fatigue in 8.0%.

**Conclusion:** Prescription during the early months after approval was mainly from psychiatry and sleep departments, and was well-tolerated for patients with insomnia. Use of suvorexant for orthopedics inpatients may be related to the safety profile of the drug.
III. Insomnia

0579 INSIGHT INTO REDUCTION OF WAKEFULNESS BY SUVOREXANT IN PATIENTS WITH INSOMNIA: ANALYSIS OF SLEEP AND WAKE BOUTS

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Introduction: In clinical trials of insomnia patients, the orexin receptor antagonist suvorexant significantly decreased wakefulness-after-sleep-onset (WASO) relative to placebo. We examined the pattern of wake and sleep bouts contributing to the overall WASO reduction.

Methods: Polysomnography recordings (at baseline, Night-1, Month-1, and Month-3) from two 3-month trials involving 1518 insomnia patients treated with suvorexant or placebo were analyzed post-hoc to evaluate wake and sleep bout characteristics and relate them to changes in WASO and self-reported sleep quality.

Results: Relative to placebo, suvorexant decreased the total number and total duration of long wake bouts (≥ 2.5 minutes) and increased the total number and total duration of short wake bouts (< 2.5 minutes). For example, total duration of long wake bouts during Night-1 decreased by 32-57 minutes, while total duration of short wake bouts increased by 2-6 minutes depending on the treatment dose and patients’ age. Reduction in total duration of long wake bouts resulted in a 53%-100% increase in the odds of self-reported good/excellent sleep quality, while increase in total duration of short wake bouts resulted in a 1%-3% reduction of these odds. The total number/duration of sleep bouts of practically all lengths increased.

Conclusion: We hypothesize that reduction of WASO by suvorexant is due to replacement of segments within long wake bouts by sleep bouts. This replacement leaves some short wake “gaps” between sleep bouts, thus increasing the total number of short wake bouts. The increase in total duration of short wake bouts is far smaller than the decrease in total duration of long wake bouts, leading to a large decrease in WASO. The positive effect of reduction in total duration of long wake bouts greatly outweighs the negative effect of increase in total duration of short wake bouts with respect to self-reported sleep quality.

Support (If Any): Merck & Co., Inc.

0580 EFFECTS OF THE HYPOCRETIN RECEPTOR ANTAGONIST ALMOREXANT RELATIVE TO ZOLPIDEM AND PLACEBO ON HIGHER COGNITIVE FUNCTION

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Introduction: Hypnotic medications can adversely affect behavior during peak concentration after dosing. Animals treated with the hypocretin receptor antagonist almorexant (ALM) have less acute cognitive impairment compared to animals treated with the GABA-A receptor modulator zolpidem (ZOL). This study aimed to confirm this difference in humans, with a focus on tests of executive function.

Methods: Healthy male and female subjects were tested with a neuropsychological battery assessing higher cognitive functioning after dosing with ALM 100mg (N = 48), ALM 200mg (N = 53), ZOL 10mg (N = 49), and placebo (PBO, N = 52) at 15:00 hours in a randomized controlled trial (ClinicalTrials.gov identifier: NCT01243060). Cognitive tests were administered after dosing: Stroop Color-Word Test (at 16:55), D-KEFS Towers Test (at 18:00), and Digit Span task (at 18:20).

Results: Stroop Color-Word scores (measure of inhibitory control) were significantly worse under ZOL (M = 43.4, SD = 11.7) than ALM-100 (M = 51.3, SD = 11.3), ALM-200 (M = 52.4, SD = 9.8), or PBO (M = 52.4, SD = 9.8), p’s < .001. Differences between either ALM group and PBO were not significant, p’s greater than .44. Stroop Word scores (measure of processing speed) were also worse under ZOL (M = 90.1, SD = 15.9) than ALM-100 (M = 104.8, SD = 18.2), ALM-200 (M = 102.3, SD = 18.6), or PBO (M = 102.7, SD = 17.7), p’s < .002. Differences between either ALM group and PBO were not significant, p’s greater than .47. Stroop Color scores (measure of processing speed) were also worse under ZOL (M = 65.9, SD = 13.1) than ALM-100 (M = 79.1, SD = 13.6), ALM-200 (M = 79.0, SD = 13.0), or PBO (M = 76.3, SD = 11.9), p’s < .001. Differences between either ALM group and PBO were not significant, p’s greater than .27. There were no group differences in performance on the Towers or Digit Span tasks.

Conclusion: The data provide support for the hypothesis that hypocretin receptor (Hcrt) antagonists produce less functional impairment than benzodiazepine receptor agonists (BzRAs) because BzRAs cause a general inhibition of neural activity whereas Hcrt antagonists specifically disfacilitate wake-promoting systems.

Support (If Any): This study was supported by USAMRMC grant W81XWH-09-2-0080. Blinded study medications were provided by Actelion Pharmaceuticals.

0581 EFFECTS OF LEMBOREXANT ON SLEEP ARCHITECTURE IN SUBJECTS WITH INSOMNIA DISORDER

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Introduction: Most insomnia medications, despite decreasing wakefulness, are associated with suppression of N3 and especially REM sleep. This report details the effects on sleep architecture of the dual orexin receptor antagonist, lemborexant, in a Phase 2 study in subjects with insomnia disorder.

Methods: The multicenter, randomized, double-blind, placebo-controlled, Bayesian-adaptive, parallel-group study enrolled subjects with insomnia disorder per DSM-5. Lemborexant (1, 2.5, 5, 10, 15, 25mg) or placebo was administered for 15 nights, 30 min before bedtime. Polysomnography was conducted at baseline and during treatment (Days 1/2, Days 14/15).

Results: 616 subjects screened; 291 randomized (64% F, mean 48 years). At baseline, for lemborexant groups combined, mean % per 8-hr time in bed of wake (N0) and stages N1, N2, N3, and REM (%) were N0: 36%; N1: 7%; N2: 37%; N3: 8%; REM: 11%. Baseline mean REM latency was 104 minutes. For means of Days 1/2, values observed for 10mg (highest dose selected for Phase 3) were N0: 13%; N1: 8%; N2: 49%; N3: 11%; REM: 18%. For means of Days 14/15, values were: N0: 14%; N1: 9%; N2: 51%; N3: 11%; REM: 17%. Lemborexant significantly shortened REM latency from baseline on Days 1/2 (diff from placebo: -15.8 min, 95%CI: -6.2-25.3 min) but not on Days 14/15 (diff from placebo: -8.6, 95%CI: -0.2-17.4 min). Lemborexant was well-tolerated, with mostly mild-modate adverse events including headache and dose-related somnolence.

Conclusion: Lemborexant did not suppress N3 or REM, and after 2 weeks of treatment, sleep architecture profiles were similar to those observed in subjects without insomnia, suggesting that lemborexant induces natural, physiological sleep. These results support the continued development of lemborexant as a treatment for insomnia.

Support (If Any): This study was funded by Eisai Inc.
III. Insomnia

0582

EFFECTS OF LEMBOREXANT ON SLEEP MAINTENANCE IN THE LATTER HALF OF THE NIGHT

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Introduction: Sleep maintenance insomnia is characterized by frequent or long awakenings, especially in the latter half of the night, and is especially common in the elderly. Many prescription medicines treat sleep maintenance difficulties suboptimally, because they do not reduce wakefulness throughout the entire night. Here we describe the effects of lemborexant, a novel dual orexin receptor antagonist, on sleep maintenance parameters.

Methods: This multicenter, randomized, double-blind, placebo-controlled, Bayesian-adaptive, parallel-group study enrolled subjects with insomnia disorder per DSM-5. Lemborexant (1, 2.5, 5, 10, 15, 25mg) or placebo was administered for 15 nights (30min before bedtime). Polysomnography (PSG) was conducted at baseline and on treatment Days 1/2 and Days 14/15. Minutes of wake after sleep onset (WASO) in the second half of the night (WASO2H) were averaged for each pair of PSGs.

Results: 616 subjects screened; 291 randomized (64% F, mean 48y). Compared to placebo, at Days 14/15, WASO2H was reduced from baseline (5 mg: mean -8min [95% CI: -3-19]; 10mg: -12min [CI, 0-24]). For subjects ≥ 55y (n = 59), decreases in WASO2H were larger (5 mg: mean -24min [CI, 4-44]; 10mg: -15min [CI, -7-37]), Lemborexant was well-tolerated, with mostly mild-moderate adverse events, including headache and dose-related somnolence.

Conclusion: Lemborexant significantly reduces the amount of time spent awake throughout the night, with effects on WASO beyond the first several hours. To provide context for these results, after 2 weeks of treatment with zolpidem tartrate extended release, which is indicated for sleep maintenance insomnia, WASO was significantly reduced for the first 5 (non-elderly) or 4 (elderly) hours of the night, and was numerically higher than placebo in the last 2 hours of the night. Lemborexant may therefore provide a unique benefit in maintaining sleep throughout the night, where patients with sleep maintenance difficulties are under-served by existing therapies.

Support (If Any): This study was funded by Eisai Inc.

0583

ELECTROENCEPHALOGRAPHIC POWER SPECTRAL DENSITY PROFILE OF THE NOVEL INVESTIGATIONAL DRUG PIROMELATINE IN PATIENTS WITH PRIMARY INSOMNIA

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Introduction: Recent studies highlight the association of insomnia, particularly the symptoms of poor sleep quality and reduction in slow wave sleep (SWS), with cognitive decline and Alzheimer’s disease. Insomniacs show elevated levels of high frequency (beta power) and reduction of slow frequency (delta power) electroencephalographic (EEG) power spectral density (PSD). Similar changes reported in Alzheimer’s disease patients have been linked to poor performance of the glymphatic system and beta amyloid clearance from the brain. Piromelatine, a novel investigational drug, has been developed for the treatment of patients with neurological disorders and insomnia. Piromelatine is a combined M1/M2 and 5HT1A/D receptors agonist.

Methods: In phase Ia, Ib, and Phase-II studies in insomnia patients, piromelatine had good tolerability and safety profiles, and significant, dose dependent, improvements in sleep maintenance based on objective assessments (polysomnography): wake after sleep onset (WASO), sleep efficiency, and total sleep time improved with no detrimental effects on next-day psychomotor performance and memory.

Results: A comparison of the electroencephalographic PSD profile of piromelatine and placebo revealed that piromelatine treatment for 4 weeks (20 and 50mg) significantly reduced beta power (p < 0.05). The main effect on beta power was observed during the second third of the night, in parallel to improvement in sleep maintenance, evidenced by a reduction of wake after sleep onset (WASO). In a subset of elderly insomniacs (> 65 years), piromelatine (20mg) treatment significantly enhanced non-rapid eye movement sleep delta power (P < 0.05).

Conclusion: The effect of piromelatine is unique, as currently marketed hypnotics drugs either increase sigma and beta power and decrease delta power (GABAAa receptor modulator) or have no effect on spectral power (dual orexin receptor antagonist). Piromelatine demonstrates promise for the treatment of insomnia and may as well have potential in neurological disorders such as Alzheimer’s disease that have been associated with greater high frequency and less low frequency PSD bandwidths. The decrease in EEG beta activity, a marker of cortical arousal, may be potentially useful as a surrogate marker of piromelatine effects on sleep maintenance.

Support (If Any): This research was supported by Neurim Pharmaceuticals Ltd., Tel Aviv, Israel.

0584

CORRELATION ANALYSIS OF SLEEP PARAMETERS MEASURED BY POLYSOMNOGRAPHY AND SUBJECTIVE SLEEP QUALITY

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Introduction: We examined the correlation between sleep assessed objectively by polysomnography (PSG) and patient-reported sleep quality (SQ) using clinical trial data from two insomnia drug development programs.

Methods: PSG recordings (at baseline, Night-1, Month-1, and Month-3) from two 3-month clinical trials involving 1518 insomnia patients treated with suvorexant or placebo were analyzed post-hoc to evaluate within-subject correlations between PSG parameters and SQ. PSG recordings from 882 primary insomnia patients and 815 good sleepers (at baseline and Night-1) for 3 clinical trials in which patients were treated with gaboxadol or placebo, were similarly analyzed.

Results: Strikingly similar magnitudes and patterns for the correlations were observed between PSG parameters and SQ for the pooled data from each development program. Total sleep time had the highest correlation with SQ. The correlation between other PSG parameters and SQ was proportional to their contributions to total sleep time. Correlations between PSG parameters and SQ were higher for subjects with insomnia than for good sleepers, and slightly higher for females than for males. Delta band power was positively, and other frequency bands negatively, correlated with SQ.

Conclusion: Most PSG endpoints were correlated with SQ, but likely through their contributions to total sleep time, which underscores that the duration of sleep in its entirety sleep is important. The pattern of correlation for spectral band power and SQ is consistent with the hypo-
**0585**

SERIAL DIVERSE IMAGINING TASK: A NEW REMEDY FOR BEDTIME COMPLAINTS OF WORRYING AND OTHER SLEEP-DISRUPTIVE MENTAL ACTIVITY

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**Introduction**: A racing mind, worries, and uncontrollable thoughts are common bedtime complaints among poor sleepers. Beaudoin created a Serial Diverse Imagining task (SDIT) that can be used at bedtime to divert attention away from sleep interfering thoughts. An app randomly presents recordings of relatively concrete words one at a time with an 8-second interval between recordings during which the person creates and maintains a mental image of the word until the next recording prompts the next image and so on. Our study is an experimental test of SDIT compared to the standard treatment of Structured Problem-solving (SP) and to the combination of both treatments. A key feature of SP is that it must be done earlier than bedtime and requires about 15 minutes to do it. SDIT, which is done at bedtime, does not have those constraints.

**Methods**: 154 university students (137 female) who complained of excessive cognitive pre-sleep arousal were randomly assigned to receive SDIT, SP, or both. At baseline, they completed Pre-Sleep Arousal Scale (Somatic and Cognitive), Sleep Quality Scale, Glasgow Sleep Effort Scale and Sleep Hygiene Index. Depending on the measure, participants redid it one week and/or one month after starting the intervention. (They also completed sleep diaries and appraisals of the interventions, which are omitted due to space).

**Results**: Repeated measures ANOVAs indicated that cognitive and somatic pre-sleep arousal, sleep effort, and sleep quality improved significantly relative to baseline (p < .001; Partial $\eta^2 = .43$ to .71) even though sleep hygiene worsened (p < .001; Partial $\eta^2 = .23$). The latter finding is not unexpected because the baseline was done at the start of the academic term before the onset of academic pressures. The fact that we found sleep and arousal improvements in this context are notable.

**Conclusion**: Beaudoin’s Serial Diverse Imagining task (SDIT) was as effective as Structured Problem-Solving (SP) in reducing pre-sleep arousal, sleep effort, and poor sleep quality. One advantage of SDIT is that it can be done at bedtime, unlike SP.

**0586**

PRESCRIPTION SLEEP MEDICATION SATISFACTION AND SLEEP OUTCOMES: FINDINGS FROM REAL-WORLD PATIENT DATA

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**Introduction**: While sleep disorders are commonly reported, there are little real-world data on patients’ satisfaction with prescription sleep medications (Rx) and their associated sleep outcomes.

**Methods**: US patients reporting insomnia or insomnia symptoms were identified from an online patient community, PatientsLikeMe. Those currently taking Rx or those who had taken one in the past year were invited to complete a cross-sectional survey fielded in November 2014.

Patients were asked to describe their most recent Rx regimen and the types of sleep issues they experienced. Descriptive and bivariable statistics were used to characterize the sample.

**Results**: A total of 1258 patients responded to the survey. Respondents were 78% female, on average 53 years old, and had a range of comorbid conditions. Nearly half (47%) reported sleep problems for > 10 years, and 58% reported sleep problems on a daily basis. Half of patients reported taking one Rx (56%) and 68% were at least moderately satisfied with their medication. While more than half of participants experienced waking up unrefreshed (52%) or waking during the night (51%) nearly every night, the majority agreed their Rx regimen was most helpful for falling asleep (76%). Those taking 2 or more (2+) Rx with OTCs were significantly less likely to report being satisfied (p < .02), as were those experiencing daily sleep problems (p < .001). A greater proportion of those taking 2+ Rx also had sleep problems for > 10 years (p = .048).

**Conclusion**: While most patients were satisfied with their insomnia Rx, they also indicated varying sleep outcomes. Rx satisfaction was associated with a lower frequency of sleep problems and the use of fewer medications. The disconnect between patient-reported Rx satisfaction and sleep outcomes, and the use of multiple Rx for persistent sleep problems should be addressed in the care setting to ensure optimal treatment of insomnia.

**0587**

SLEEP FACILITATION BY SULFUR SPRING BATHING; EEG, CORE, PROXIMAL, AND DISTAL TEMPERATURE EVALUATIONS

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**Introduction**: Bathing, especially with hot spring with various mineral compositions, is known to facilitate/improve sleep by warming the body. Previously our study examined that sodium-hydrogen carbonated spring and artificial carbonated baths more specifically affected body temperature and sleep. The improvement of sleep was due to the dissipation of body temperature. The sulfur spring is known to keep the body warm too. In this study, we evaluated the effects of usual and sulfur spring on sleep using clinical thermometers and EEG.

**Methods**: Eight healthy men (average age 21.6 years) were included in the study. The subjects were divided into 2 groups and each group received the sulfur spring (hydrogen sulfide type) bathing, and plain hot water bathing a week interval. The temperature of the bathwater was set to be 40°C degrees. Subjects soaked in the bath deep enough so their chests touched the water at 22:00 for 15 min. From the time they finished bathing to the next morning, we measured their core body temperature (CT: rectum), distal skin temperature (DT: top side of the foot), proximal skin temperature (PT: lower part of the clavicle) and EEG using two channels portable device (Noha-sensa ZA, Proassist co.). Subjects were told to sleep from 24:00-7:00. The protocol was approved by Akita University ethics committee.

**Results**: The total time of NREM sleep significantly increased in the sulfur spring bath group (243.8 +/- 31.3 min) than the plain hot bathing group (227.3 +/- 34.5 min) (p < .05, ANOVA). The total SWS time
tended to increase in the sulfur bath group (112.6 +/- 38.6min) than plain hot bathing group (86.6 +/- 30.7min). The mean CT of hot spring group had greater zenith after bathing without significant difference (37.7 +/- 0.2C, 37.6 +/- 0.3C), while the mean CT of nadir had no differences (36.2 +/- 0.1C, 36.1 +/- 0.2C).

Conclusion: The sulfur spring bath increased total time of NREM sleep significantly and tended to increase the total SWS time. As commonly accepted, we observed that bathing before sleep facilitates and improves the sleep. These sleep changes are associated with large decline in the elevated CT, increased heat dissipation. Sulfur bathing had larger effects on these parameters without fatigue.

0588
INTERNET-DELIVERED COGNITIVE BEHAVIORAL THERAPY TO TREAT INSOMNIA: A SYSTEMATIC REVIEW AND META-ANALYSIS
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Introduction: Insomnia is of major public health importance. While cognitive behavioral therapy is beneficial, in-person treatment is often unavailable. We assessed the effectiveness of internet-delivered cognitive behavioral therapy for insomnia (iCBTI). The objective was to determine whether online treatment could improve sleep efficiency and reduce the severity of insomnia.

Methods: We searched the medical literature for randomized trials on iCBTI and found 15 trials, all utilizing a pretest-posttest randomized control group design. Mean differences in improvement in sleep measures were calculated using the Hartung-Knapp-Sidik-Jonkman method for random effects meta-analysis.

Results: Sleep efficiency was 72% at baseline and improved by 7.2% (95% CI: 5.1%, 9.3%; p < 0.001) with iCBTI versus control. Total sleep time averaged 5.7 hours at baseline and increased by 20 minutes with iCBTI versus control (95% CI: 9, 31; p = 0.004). Internet-delivered CBTI resulted in a decrease in the insomnia severity index by 4.3 points (95% CI: -7.1, -1.5; p = 0.017) compared to control. The severity of depression decreased by 2.3 points (95% CI: -2.9, -1.7; p = 0.013) in individuals who received iCBTI compared to control. Improvements in sleep efficiency, the insomnia severity index and depression scores with iCBTI were maintained from 4 to 48 weeks after post-treatment assessment. There were no statistically significant differences between sleep efficiency, total sleep time, and insomnia severity index for iCBTI versus inperson CBTI with a therapist.

Conclusion: Internet-delivered CBTI is effective in improving sleep in adults with insomnia. Efforts should be made to educate the public and expand access to this therapy.

Support (If Any): Dr. Seyffert received support from the RWJ-VA Clinical Scholar Program.

0589
META-ANALYSIS ON THE NEXT-MORNING EFFECTS OF HYPNOTIC DRUGS ON PSYCHOMOTOR SPEED AND MOTOR CONTROL IN HEALTHY SUBJECTS
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Introduction: Mixed results have been reported on the effects of hypnotic drugs taken at bedtime on next-morning psychomotor functioning. The purpose of the current meta-analyses was to examine the effect of hypnotic drugs on next-day psychomotor speed and motor control.

Methods: N = 33.969 potentially relevant articles were identified by searching Pubmed, Embase, PsycInfo, Scopus, Web of Science, and Cochrane. Studies were included if they assessed next-morning effects on psychomotor speed or motor control after bedtime administration of recommended dosages of hypnotic drugs. Studies had to be double-blind, placebo-controlled, conducted in healthy subjects, and provide sufficient data. Separate analyses were conducted for adults (18-65 years old) and elderly (≥ 65 years old).

Results: In adults, fifteen studies assessing next-morning psychomotor speed and five studies assessing next-morning motor control were included in the meta-analyses. The analyses revealed that next-morning psychomotor speed was significantly impaired (ES = 0.227, p = 0.005; 95%CI: 0.068 to 0.387), whereas next-morning motor control was not significantly impaired (ES = -0.053, p = 0.781; 95%CI: -0.426 to 0.320). In elderly, six studies assessing next-morning psychomotor speed, and three studies assessing next-morning motor control were included in the meta-analyses. The analyses revealed that in elderly both next-morning psychomotor speed (ES = -0.082, p = 0.546; 95%CI: -0.347 to 0.184) and motor control (ES = -0.161, p = 0.356; 95%CI: -0.501 to 0.180) were not significantly impaired.

Conclusion: The analyses revealed that next-morning psychomotor speed was significantly impaired in healthy adults, but not in elderly. Motor control was not significantly impaired in both adults and elderly. Additional analyses should examine potential age effects, and to what extent these findings translate to more complex behavioral tasks such as divided attention tests and driving.

0590
META-ANALYSIS ON THE NEXT-MORNING EFFECTS OF HYPNOTIC DRUGS ON SHORT- AND LONG-TERM MEMORY FUNCTIONING IN HEALTHY ADULTS AND ELDERLY
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Introduction: Sleep medication taken at bedtime may negatively affect next-morning cognitive performance. The aim of these meta-analyses was to determine the effect of hypnotic drugs on next-day short- and long-term memory functioning.

Methods: A literature search (Pubmed, Embase, PsycInfo, Scopus, Web of Science, and Cochrane) yielded N = 33.969 potentially relevant articles. Studies were included if they assessed next-morning short- or long-term memory after bedtime administration of recommended dosages of hypnotic drugs, were double-blind, placebo-controlled,
conducted in healthy volunteers, and sufficient data was reported, they were included in the meta-analyses. Separate analyses were performed for adults (18-65 years old) and elderly healthy volunteers (≥ 65 years old).

**Results:** In adults, eight studies assessing next-morning short-term memory (after bedtime administration of nitrazepam, triazolam, temazepam, flurazepam, melatonin, zaleplon, lorazepam, zolpidem), and five studies assessing long-term memory (after bedtime administration of triazolam, nitrazepam, zopiclone, flurazepam, zolpidem) were included in the meta-analyses. The analyses revealed that both next-morning short-term memory (ES = 0.427, p = 0.0001; 95%CI: 0.212 to 0.641) and long-term memory (ES = 0.536, p = 0.0001; 95%CI: 0.247 to 0.824) were significantly impaired. In elderly, three studies assessing next-morning short-term memory (after bedtime administration of flurazepam, zolpidem, temazepam), and three studies assessing long-term memory (after bedtime administration of flurazepam, zolpidem, temazepam) were included in the meta-analyses. The analyses revealed that in elderly next-morning short-term memory (ES = 0.412, p = 0.019; 95%CI: 0.068 to 0.757) was significantly impaired. No significant impairment was found for long-term memory (ES = 0.038, p = 0.825; 95%CI: -0.380 to 0.303).

**Conclusion:** The meta-analysis results suggest that sleep medication, when administered in recommended dosages at bedtime, significantly impair next-morning short- and long term memory.

**0591**

**THE IMPACT OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA ON FATIGUE SYMPTOMS: A SYSTEMATIC EXAMINATION OF RANDOMIZED CONTROLLED TRIALS**

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**Introduction:** Epidemiological data demonstrates that within daytime symptoms of insomnia, fatigue is the most common complaint. Although systematic reviews and meta-analyses have demonstrated the effectiveness of cognitive behavioral therapy for insomnia in improving sleep in patients with insomnia, its impact on daytime symptoms is still not fully understood. The aim of the present study was to examine the literature regarding the effectiveness of cognitive behavioral therapy for insomnia in the treatment of fatigue symptoms.

**Methods:** PubMed, Scopus and Web of Science were searched from 1986 to May 2015 applying the keywords “cognitive therapy” or “cognitive behavior*ral therapy” and “insomnia” or “sleep initiation and maintenance disorders”. To eligible for inclusion, studies had: to be randomized controlled trials, published in English, to incorporate sleep restriction therapy within the treatment, to include an adult insomnia sample and to have a standardized measure of fatigue.

**Results:** Database searching yielded to 1297 studies, of which 125 full texts were screened and 22 met full inclusion criteria. Treatment included both cognitive and behavioral techniques in 19 trials, while 3 studies included only sleep restriction as intervention. Eighteen studies included patients with insomnia comorbid to mental, somatic or sleep disorder. Therapy was administered in individual sessions in 8 trials, in group therapy in 7 trials and through self-help in 7 trials. Standardized quality assessment indicate 11 studies as strong, 10 as moderate and 1 as weak.

**Conclusion:** Although fatigue is a major daytime symptom of insomnia, few trials reported fatigue as outcome measure, and these were limited to comorbid insomnia populations. Meta-analysis should determine the effectiveness of cognitive behavioral therapy for insomnia on fatigue and the potential moderator role of several variables (e.g. comorbidity, circadian and homeostatic factors, inflammatory processes as well as specific strategies included in the treatment).

**0592**

**COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA AMONG ACTIVE DUTY MILITARY PERSONNEL**

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**Introduction:** Insomnia is the most prevalent sleep disorder among military personnel. This study investigated whether cognitive behavioral therapy for insomnia (CBT-I) improved sleep and reduced insomnia symptoms.

**Methods:** Retrospective review of military personnel meeting DSM-IV criteria for insomnia with or without comorbid obstructive sleep apnea who received CBT-I, delivered by clinical psychologists, in a military sleep disorders clinic between 2013 and 2015. Data was extracted from electronic medical records including baseline and follow-up Insomnia Severity Index (ISI) scores and sleep diary parameters including sleep onset latency (SOL), wake after sleep onset (WASO), total sleep time (TST), and sleep efficiency (SE).

**Results:** Eighty-five patients (mean age = 33.9, SD = 8.1; 77% male) were included in the analyses. Forty-eight percent had a comorbid diagnosis of OSA (mean AHI = 12.08, SD = 12.95). Baseline mean TST was 6.04 hours (SD = 1.36), SOL was 78 hours (SD = 67), WASO was 91 hours (SD = 73), SE was 77% (SD = 15.20), and ISI was 16.84 (SD = 4.43). After CBT-I, mean TST was 5.86 hours (SD = 1.09), SOL was .46 hours (SD = .46), WASO was .54 hours (SD = .72), SE was 86% (SD = 9.56), and ISI was 14.19 (SD = 5.68). A linear repeated measures model was used to examine change in sleep parameters after treatment, controlling for sleep medication use and OSA diagnosis (F7,75 = 11.10, P < .001), SOL (F1,81 = 22.25, P < .001), WASO (F1,81 = 13.86, P < .001), and SE (F1,81 = 30.26, P < .001) significantly improved. Scores on the ISI (F1,81 = 23.25, P < .001) significantly reduced. There were no over-all effects of OSA diagnosis or sleep medication.

**Conclusion:** CBT-I improves sleep quality and insomnia symptoms in military personnel experiencing insomnia with or without comorbid OSA.

**0593**

**TREATMENT PREFERENCES AMONG WOMEN VETERANS WITH INSOMNIA**

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**Introduction:** Women represent a growing segment of the patients served by the Veterans Administration and sleep issues in women
veterans occur at a rate substantially higher than in non-veteran women. Despite the growing need to deliver effective interventions to women veterans with insomnia, little is known regarding their treatment preferences.

**Methods:** Treatment preferences were assessed as part of a postal survey which was distributed to a national random sample of women veterans (n = 4,000). Nonresponders were mailed a second survey, followed by an opportunity to complete the survey by telephone. The survey included questions to assess ICSD-2 diagnostic criteria for Insomnia Disorder, demographics, health-related factors, psychiatric comorbidities, psychosocial factors, and insomnia treatment preferences.

**Results:** 1,559 surveys were either returned by mail or completed by telephone (response rate = 39%; mean age 52 [15 SD] years; 41.3% married; 41.0% employed for wages; and 40.6% indicated a race/ethnicity other than white). Using ICSD-2 insomnia criteria, 65.1% of respondents met criteria for insomnia. Acceptability of insomnia treatments varied: 46.4% of respondents reported behavioral therapy and pharmacotherapy were equally acceptable, 35.2% reported only behavioral therapy was acceptable, 9.5% reported only pharmacotherapy was acceptable, and 8.8% reported neither was acceptable. Overall, more respondents rated behavioral therapy than pharmacotherapy as acceptable (81.6% vs. 55.2%, p < .01). When asked to select all of the settings in which they would prefer to receive treatment for insomnia, over half of respondents selected primary care (55.6%) or women’s clinic (54.4%), while 27.1% selected mental health.

**Conclusion:** These findings highlight the importance of offering behavioral as well as medication interventions to women veterans with insomnia and providing these treatments in settings outside of mental health. Doing so would better align with the preferences of women veterans which would likely increase completion of effective treatment for insomnia.

**Support (If Any):** VA QUERI RRP-12-189 (PI: Martin)

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**0594**

**A COMPARISON OF THE DISCREPANCY BETWEEN SELF-REPORTED AND OBJECTIVELY MEASURED SLEEP AT HOME AND IN THE LABORATORY**

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**Introduction:** The discrepancy between self-reported and objectively measured sleep is a phenomenon that is common amongst patients diagnosed with insomnia and has been observed in home and laboratory settings. However, it is unclear if the magnitude of the discrepancy between self-reported and objectively measured sleep differs depending on sleep location or levels of pre-sleep arousal (PSA). The purpose of this study was to determine whether the difference between self-reported and actigraphy measured sleep varied depending on sleep location or levels of pre-sleep arousal (PSA). The purpose of this study was to determine whether the difference between self-reported and actigraphy measured sleep varied depending on sleep location or levels of pre-sleep arousal (PSA).

**Methods:** Data were gathered from 54 participants (Mage = 42.9 years-old, SD = 12.2). A majority were female (74%) and White/Caucasian (67%). Participants self-reported PSA, completed sleep diaries (i.e., subjective sleep), and wore actiwatches (i.e., objective sleep) for one night of sleep at home and in the laboratory. Misperceptions of total sleep time (TST) and sleep onset latency (SOL) were calculated by subtracting sleep diary self-reports from actigraphy calculated sleep estimates for each location.

**Results:** Multiple Wilcoxon Signed-Rank tests were conducted to examine the discrepancy between self-reported and actigraphy measured sleep at home and in the laboratory. Self-reported SOLs were greater than actigraphy measured SOLs at home (z = -4.07, p < 0.01) and in the laboratory (z = -5.22, p < 0.01). Self-reported TSTs were less than actigraphy measured TSTs in the laboratory (z = -2.77, p = 0.01). The discrepancy between self-reported and actigraphy measured SOL (z = -2.46, p = 0.01) and TST (z = -3.01, p < 0.01) was smaller at home than in the laboratory. Linear regression equations revealed that differences between home and laboratory PSA did not significantly predict differences in home and laboratory SOL and TST discrepancy.

**Conclusion:** These data indicate that discrepancies between self-reported and actigraphy measured sleep are present in both home and laboratory settings, and that estimates of objective and subjective sleep discrepancies based on one night of laboratory data may over-estimate the severity of the problem. Therefore, researchers and clinicians should consider how the method and location of sleep assessment they use in their studies and clinical practice impacts sleep and the results of research and clinical assessments.

**Support (If Any):** K23 AT003678

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**0595**

**DIPHENHYDRAMINE HCI IMPROVES BOTH OBJECTIVE AND SUBJECTIVE SLEEP PARAMETERS IN AN OCCASIONAL SLEEPLESSNESS POPULATION**

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**Introduction:** Diphenhydramine HCI (DPH) is an antihistamine of the ethanolamine class with well documented sedating properties. Little is known about its sleep inducing properties in otherwise healthy populations experiencing episodes of “sleeplessness”.

**Methods:** This was a 4-week, randomized, crossover, double-blind, placebo-controlled, 9-day treatment period, in-home study to assess the efficacy of diphenhydramine hydrochloride (30 mL, ZzzQuil, 50 mg) in 33 subjects with occasional sleeplessness. Sleep parameters were assessed using the ZEO Sleep Manager (ZSM), Actiwatch 2, and subject sleep questionnaires. Occasional sleeplessness was verified with a 7 day baseline period sleep diary. Subjects self-administered medication, as needed, for the first 7 nights of treatment followed by 2 mandatory nights. A washout period (no treatment) of at least 5 days occurred between treatments.

**Results:** Twenty-two subjects completed the study and were evaluable. DPH improved several sleep parameters assessed by the ZSM device relative to placebo (change from baseline) including latency to persistent sleep (p = 0.0312; primary efficacy variable), sleep efficiency (p = 0.0488) and minutes in “light sleep” (p = 0.0219). Importantly, DPH also positively impacted subject assessments of sleep including total sleep time (p = 0.0023), sleep onset latency (p = 0.0209), sleep efficiency (p = 0.0037), sleep quality (p = 0.0017), time awake after sleep onset (p = 0.0148), ease of falling asleep (p = 0.0162) and depth of sleep (p = 0.0014). Adverse events (AEs) were similar between treatments.

**Conclusion:** Diphenhydramine (50 mg) administered in an in-home setting provides rapid onset of sleep and improves several sleep parameters in subjects experiencing occasional sleeplessness on both objective and subjective measurements.

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**0596**

**PILOT STUDY OF AT-HOME SLEEP MONITOR BASED FEEDBACK FOR INSOMNIA**

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**Introduction:** Chronic insomnia may be exacerbated and/or perpetuated by a variety of factors, including anxiety about sleep and misper-
III. Insomnia

This research was supported by a three linked

Adherence to specific SC (e.g., going to bed only when sleepy) and
At the exit interview, 90% reported the device feedback was useful,
Therapists also rated patients’ understanding and acceptance of the
Manber R
Lebus R
were averaged across sessions. Overall adherence to SC and SRT were
was significantly improved (from 30 minutes to 15 minutes; p < 0.01).

B. Clinical Sleep Science

1
2

Device-based feedback is a simple, feasible intervention
that may benefit patients with insomnia. Confirmation will be
important in larger groups, and comparing different devices used for feedback.

Support (If Any): Department of Neurology, Massachusetts General Hospital

0597

CORRELATIONS BETWEEN ADHERENCE TO CBT-I RECOMMENDATIONS AND INSOMNIA SEVERITY: A REPORT FROM THE TRIAD STUDY
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Introduction: Patient reported adherence with sleep restriction therapy (SRT) has been associated with improvement following Cognitive Behavioral Therapy for Insomnia (CBT-I). The aim of this study was to examine how therapist-ratings of patient adherence to SRT as well as stimulus control (SC) are related to the Insomnia Severity Index (ISI) at the end of treatment among patients with comorbid insomnia and depression.

Methods: Adherence ratings were available for 54 of 75 adults with insomnia and depression randomized to individual CBT-I (7-sessions) as part of the Treatment of Insomnia in Depression (TRIAD) study. Adherence to specific SC (e.g., going to bed only when sleepy) and SRT (e.g., adhering to anchored bed and wake time) guidelines were rated by therapists at relevant sessions. Ratings of a given guideline were averaged across sessions. Overall adherence to SC and SRT were the average adherence to SC and SRT-specific guidelines, respectively. Therapists also rated patients’ understanding and acceptance of the rationale for SC and SRT. The last available ISI scores were used as outcome.

Results: Lower insomnia severity at the end of treatment was correlated with better adherence to going to bed only when sleepy ($r = -.294$, $p = .031$), getting out of bed when unable to sleep ($r = -.29$, $p = .038$), and overall adherence to SC ($r = -.28$, $p = .042$). Adherence to SRT guidelines was not correlated with insomnia severity (p-values > .1). Participants’ degree of acceptance and understanding of the rationales for SC and SRT were not correlated with adherence rating or insomnia severity.

Conclusion: Among patients with comorbid depression and insomnia, patients’ adherence to going to bed only when sleepy and getting out of bed when unable to sleep, but not to anchoring rise time and restricting time in bed, were associated with lower insomnia severity at end of treatment.

Support (If Any): This research was supported by a three linked grants from the National Institute of Mental Health, Grant numbers MH078924, MH078961, and MH079256.

0598

THE EFFECTS OF A SELF-ADMINISTERED, TWO-SESSION COGNITIVE-BEHAVIORAL INTERVENTION FOR INSOMNIA: A PILOT STUDY
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Introduction: The purpose of the present study was to explore the feasibility and effectiveness of a brief self-administered intervention for insomnia.

Methods: A within subject, pre-post design was used to assess the two session intervention. All subjects received a booklet, 4 CDs, specialized earplugs, and a set of summary cards. These materials allowed for a review of stimulus control and sleep hygiene and instruction regarding techniques that are unique to the Sleep Easily regimen. The target sample for the study was individuals with high stress occupations. Data were collected on-line. Forty-nine of 73 subjects completed the study. The primary outcomes were ISI values (total score, and two factor scores).

Results: The baseline ISI was $13.8\pm4.1$ (range = 0-28). The factor scores were $5.2\pm1.8$ (sleep continuity [SC]) and $8.5\pm3.1$ (daytime effects [DE]). The post treatment ISI was $9.8\pm4.7$ and the factor scores were $3.7\pm2.1$ (SC), and 6.1\pm3.0 (DE). The observed changes were significant (p < .0001) and had corresponding large effect sizes (total ISI = 0.89, SC = 0.76, and daytime effects = 0.81). 71.4% of the completers reported that their sleep began to improve within the first five nights. 65.3% reported the method was easy to use. After using the Sleep Easily method, 55.1% of participants reported feeling better during the day and 36.7% reported reduced anxiety and/or stress during the day. 64% of the subjects using sleep medications reported reduced use (dose or frequency) of such substances on the post treatment assessment.

Conclusion: The intervention produced significant change (and large effects) within a short time frame and did so in the context of a brief self-administered intervention.

0599

A RETROSPECTIVE ANALYSIS OF RECRUITING DATA FOR AN EFFICACY AND FEASIBILITY STUDY OF ONLINE COGNITIVE-BEHAVIORAL TREATMENT FOR INSOMNIA IN THE PRIMARY CARE SETTING
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Introduction: 50-70 million Americans suffer from chronic disorders of sleep and wakefulness with a significant burden of disease among both active duty and veteran service members and women. Tools such as online cognitive-behavioral treatment for insomnia (OCBTI) may help treat insomnia.
Methods: This is a retrospective analysis of recruiting data collected as part of an ongoing parallel group, randomized control trial comparing OCBTI directed by the primary care provider (PCM), OCBTI directed by an internal behavioral health consultant (IBHC), and treatment as usual (TAU). Patients were approached in primary care clinic waiting areas at Fort Bragg and Fort Belvoir using a three or four question sleep screening tool. Patients without a scheduled move within six months, dissatisfied with their sleep or feeling that their sleep quality was affecting their daytime functioning, and sleeping for less than 7 hours a night, had an additional comprehensive screen. Tricare beneficiaries between age 21-65 without significant co-morbid medical or psychiatric conditions without untreated pain, significant anxiety, depression, PTSD, substance abuse, or a prior diagnosis of or high risk for obstructive sleep apnea (OSA) were consented and randomized into the study.

Results: A total of 2884 individuals were screened with 92 (3%) consented and randomized to the study. 2195 (76%) of these individuals did not qualify for the second comprehensive screen based on their initial questionnaire. 1385 (63%) of those who did not pass the initial screen reported less than 7 hours of sleep a night but denied daytime symptoms. 462 (16%) of patients participated in the second screen with 296 (64%) of those who participated in the second screen excluded for meeting at least one of the exclusion criteria. Current compliance rates with OCBTI-I are poor with only 27% of those randomized still agreeing to participate in the study. Of these individuals, none have completed the OCBTI-I course despite months of access.

Conclusion: Our data confirm previous assessments of a high incidence of sleep-related disorders among the military population which may be underreported given the high number of individuals with inadequate sleep but denying daytime symptoms. Of those with identified insomnia, there is significant medical and psychiatric co-morbidity. The low observed rate of compliance with OCBTI-I, a method proven to treat insomnia, may indicate an inappropriate setting and/or population for our study.

A Pilot Study of Cognitive Behavioral Therapy for Insomnia Delivered in Pregnancy

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Introduction: We sought to investigate the impact of cognitive behavioral therapy for insomnia (CBT-I) delivered through group prenatal care sessions on maternal sleep and mental health across pregnancy and postpartum among overweight and obese women reporting short sleep duration.

Methods: We performed a randomized controlled trial of CBT-I delivered through group prenatal care versus routine group prenatal care. Women in the second trimester of pregnancy experiencing a self-reported sleep duration of < 6.5hrs per night with a pre-pregnancy BMI of ≥ 24.9kg/m2 were included. Exclusion criteria included pre-pregnancy diabetes mellitus, non-English speakers, and severe mental or physical condition limiting ability to complete the study intervention. In the second trimester (T1), late third trimester (T2) and 6-8 weeks postpartum (T3) patients completed mental health and sleep questionnaires, and portable polysomnography. Data was analyzed using Mann Whitney U. P < 0.05 was considered significant.

Results: The cohort consisted of 53 women with an average age of 29 ± 6 years and pre-pregnancy BMI of 35.4kg/m2. Mean sleep duration in hours among the entire cohort was 7.2 ± 2.3, 7.2 ± 2.4, and 7.1 ± 1.8 and AHI was 3.0 ± 3.4, 2.7 ± 4.1, and 3.0 ± 3.5 at T1, T2 and T3 respectively. No difference between study control and intervention groups was noted for sleep duration in hours at T1 (6.6 vs 7.7 p = .13), T2 (7.6 vs 7.0 p = .45), or T3 (7.0 vs 7.25 p = .66) as well as mean AHI at T1 (3.4 vs 2.6 p = .23) T2 (2.3 vs 3.2 p = .33) and T3(2.8 vs 3.0 p = .50). Finally changes in survey scores between the T1 and T3 visits were evaluated. No difference in change between groups was noted for either the Edinburgh Depression Scale (-5.1 vs -2.8 p =.21) or the Perceived Stress Scale (-1.2 vs -5.0 p = .75).

Conclusion: We noted no statistically significant difference in outcomes among women exposed to CBT-I during pregnancy. Improvements in perceived stress may be clinically significant. Larger studies are needed to confirm these findings.

0601

Insomnia: A New Approach to Treatment with Transcranial Magnetic Stimulation

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Introduction: Transcranial magnetic stimulation (TMS) is a non-invasive brain stimulation technique that has been approved as a treatment of depression. We hypothesize that low frequency TMS exerts inhibitory effect on hyper excitiable cortical state in insomnia patients and therefore is therapeutic. We compare the change in insomnia scores between baseline and end of treatment in this open label trial with bilateral low frequency TMS. We aim to study 20 patients with primary insomnia using daily stimulation for 3 weeks (15 week days).

Methods: Patients between the ages of 21-65 years who meet DSM-IV criteria for Primary Insomnia are being studied. This is a prospective, open label pilot study to compare sequential bilateral low frequency TMS in patients with chronic insomnia. Subjects receive sequential low frequency (1Hz) bifrontal cortical TMS stimulation. Inclusion criteria: patients meet DSM IV criteria for primary insomnia, age range is 21-65 years. Exclusion criteria: patients with co-morbid depression, substance abuse in last two weeks, no psychotropic medication changes in last 2 weeks, patients with an unstable medical or psychiatric disorder that may be causing or contributing to insomnia: bipolar disorder, psychosis, anxiety disorders, dementia, seizure disorder and chronic pain, patients with ferromagnetic material in their head or within 30 cm of the coil. Procedure: subjects receive sequential bilateral bifrontal low frequency TMS stimulation daily on weekdays for three weeks. Stimulation parameters are: 1Hz, 80-120% motor threshold, inter-train interval: 0, 40 minutes of treatment on each left and right prefrontal cortex. Motor threshold is calculated on left side and coil is moved forward by 5 cm to stimulate frontal cortices. Right side is stimulated at the same position as the left side. Instruments: subjects are rated weekly on PSQI, insomnia severity index, CGI and MADRS. They will be requested to keep daily sleep diaries and wear actigraphy devices throughout the three week period of study.

Results: Screened 20 patients. 5 enrolled and 4 completed study so far. Mean age: 44 years. M:F ratio: 1:1. Mean increase in sleep period by one hour on PSQI. Mean change in ISI scores by 50%. Mean increase in actigraphy documents sleep periods by 45 minutes.

Conclusion: 1. Ongoing open label study. 2. All subjects have reported beneficial effects. 3. Objective improvement in sleep periods. 4. Further studies needed.

Support (If Any): Seed grant Department of Psychiatry, University of Florida. Partial device support by Neuronetics inc.
0602
THE CONTRIBUTION OF STRESS, ANXIETY, AND BELEIFS ABOUT SLEEP TO MINDFULNESS-BASED INSOMNIA TREATMENT RESPONSE

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Introduction: While several studies have now shown that mindfulness meditation is a viable treatment for insomnia, it is unclear what type of patient will respond to this treatment approach. This study examined baseline psychological predictors of treatment response to mindfulness-based meditation interventions as a treatment for insomnia.

Methods: Thirty-eight participants (57% female; age range 24-65 years, M = 41.84, SD = 11.78) who met ICSD-2 criteria for psychophysiological insomnia with no comorbid sleep, medical or psychological disorders completed baseline questionnaires and were randomly assigned to eight weeks of mindfulness-based stress reduction (MBSR) or mindfulness-based therapy for insomnia (MBTI). Questionnaires included the Perceived Stress Scale, the Beck Depression Inventory, the Dysfunctional Beliefs about Sleep Scale, the State-Trait Anxiety Inventory, and the Insomnia Severity Index, which was also completed post-treatment as a measure of treatment response.

Results: Controlling for age, sex, race, ethnicity, and years of education, a hierarchical logistic regression analysis indicated that baseline psychological characteristics significantly predicted treatment response, defined by a reduction in insomnia severity index score of seven points or more, (χ2 (9) = 23.117, p = .006) with the model explaining 62.3% of the variance. Specifically, individuals with higher levels of perceived stress (OR = 1.71, p = .008), higher scores on the dysfunctional beliefs about sleep scale (OR = 1.042, p = .037), and lower scores on the state trait anxiety inventory (OR = .601, p = .011) were significantly more likely to respond to treatment. No other variables were significant in the model.

Conclusion: Individuals presenting with higher levels of perceived stress, greater dysfunctional beliefs about sleep, and/or lower anxiety (in the absence of comorbidities) may have an increased likelihood of responding to mindfulness-based interventions as a treatment for insomnia. These findings indicate that patients with this profile might be particularly suitable candidates for this treatment approach.

0603
EXPLORING THE UTILITY OF ADDING A MINDFULNESS AND CONCENTRATIVE MEDITATION COMPONENT TO THE CLASSIC COGNITIVE BEHAVIOURAL TREATMENT IN COMORBID INSOMNIA

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Introduction: The objective of this preliminary study was to explore the benefit of adding a mindfulness and concentrative meditation component to CBT-I in a severe comorbid insomnia population.

Methods: Ten insomniacs (27-64 years old) having a psychiatric comorbidity (mood disorder = 9; anxiety = 3) received CBT-I to which was appended a mindfulness and a concentrative meditation component. Duration of sleep onset latency (SOL), duration of wake after sleep onset (WASO), total sleep time (TST) and sleep efficiency in % (%SE) were derived from one-week sleep diaries filled at baseline, after treatment, 3 and 6 months post therapy. Kentucky Inventory of Mindfulness Skills (KIMS), Symptoms Checklist-90-revised (SCL-90-R) as well as Beck Depression and Beck Anxiety inventories (BDI, BAI) were also administered at those moments. Repeated measures ANOVAs were performed on all variables.

Results: Only one mindfulness skills (i.e. accept without judgment) out of 4 was significantly improved after therapy (F(3,27) = 18.20; p < .001). However, we found significant reductions in SOL (F(1.67,15.07) = 7.86; p = .006) and WASO (F(3,27) = 4.21; p = .014), and an increase in %SE (F(3,27) = 16.94; p < .001). No change was found in TST (F(2,18,03) = 2.77; p = .089). Results also show significant improvements at SCL-90-R global score (F(1,82,16.39) = 12.69; p < .001), BDI (F(3,27) = 17; p < .001) and BAI (F(3,27) = 4.25; p = .014). Helmer contrasts revealed that all improvements in sleep and psychological well-being occurred after treatment and were maintained at 3 and 6 months after therapy.

Conclusion: These results suggest that insomniacs with severe psychiatric comorbidities may benefit from CBT-I and this may also have a positive impact on their psychological state. Despite the fact that minimal mindfulness skills were mastered at the end of treatment, the extent of the sleep and psychological improvements that were observed suggest a relative implication of this new skill. However, it is difficult to determine, at this point, the clinical benefit of adding a meditation procedure to CBT-I in a comorbid insomnia population. Further studies are needed.

0604
MAYBE YOUR MAMA WAS RIGHT ABOUT KEEPING THAT BEDROOM TIDY: DE-CLUTTERING AS A POTENTIAL COMPONENT OF SLEEP HYGIENE TO IMPROVE SLEEP QUALITY

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Introduction: Clinicians often suggest “sleep hygiene” interventions for sleep disorders, such as developing a bedtime routine, sleeping in one’s own bed, and keeping regular bed/wake times, all of which indirectly improve sleep. Contextual cues such as clutter in the home and sleeping areas may also interfere with sleep by contributing to worry and perfectionism. Our study examined whether de-cluttering might help improve sleep quality.

Methods: Participants were 1052 (95% female, mean age 50.5) subscribers to a website offering help with housekeeping routines, particularly de-cluttering and discarding. Subscribers were given access to an on-line study link for five days in December. Measures included demographics; Housekeeping Habits Survey (HHHS); Pittsburgh Sleep Quality Index (PSQI); Daytime/Nighttime Sleep Problems (DNSP). The HHHS asked about 4 recommended habits subscribers had adopted on an at-least weekly basis, clustering around four themes: 1) regular, brief (15 min) episodes of de-cluttering; 2) planning for upcoming activities; 3) self-care, such as eating regular meals; 4) keeping thoughts positive and avoiding perfectionism.

Results: Hierarchical regression revealed that De-cluttering and Self-Care habits significantly predicted increased sleep quality (PSQI; beta = -.13 and -.13, respectively) and fewer sleep-related problems (DNSP; beta = -.08 and -.17); earlier bedtime habit accounting for the largest amount of variability (beta = -.18 and -.23). Length of website subscription (≤ 2 weeks to ≥ 3 years) also predicted better sleep quality/fewer problems. Global PSQI was highest (M: 13.2) for new subscribers; positive outcomes were achieved (p < .05) after as little as 4 weeks of regular engagement with recommended habits, although PSQI scores remained elevated (global score: 11.4) even for those who spent 3+ years on the website.

Conclusion: De-cluttering in the house frequently and regularly may be a useful habit for some people as a way to improve sleep quality.
0605

GROUP-BASED COGNITIVE-BEHAVIORAL THERAPY FOR INSOMNIA IN A VA HEALTHCARE SETTING: TREATMENT PROTOCOL DEVELOPMENT AND EVALUATION
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Introduction: Insomnia is a widespread problem among veterans, yet access to Behavioral Sleep Medicine services are limited. Demand for Cognitive Behavioral Therapy for Insomnia (CBTI) at the Durham VA Medical Center dictated development of a group-based CBTI treatment protocol.

Methods: Veterans were referred to our Behavioral Sleep Medicine clinic for an insomnia complaint. Intervention content is consistent with the VA CBTI National Dissemination effort and was provided by CBSM psychologists in 15 group-based treatment cohorts between September 2012 and October 2015. Three treatment formats were evaluated: 6 sessions @ 1½ hours each (4 cohorts: N = 18); 9 sessions @ 1 hour each (5 cohorts: N = 44); and 8 sessions @ 1 hour each (6 cohorts: N = 45). Outcomes included change in Insomnia Severity Index (ISI) across treatment, and percent of sessions attended. Outcomes were evaluated as a function of veteran characteristics (age, sex, race, sleep medication use, and presence/absence of posttraumatic stress disorder, depression and sleep apnea). During the final session of each cohort, Veterans provided feedback regarding treatment approach.

Results: Veterans (N = 107, M age = 55 years, 73.8% male, 59.8% African American, 50.5% PTSD, 66.4% depression, 56.1% sleep medications, > 50% sleep apnea) reported significant ISI reductions across each of the 3 treatment formats (Format 1, F = 9.7, p = .01; Format 2, F = 26.06, p < .01; Format 3, F = 26.0, p < .01), and improvement did not differ by treatment format (F = .27, p = .76). Veterans with depression attended a lower percentage of sessions (F = 5.57, p = .02) and benefitted less than those without depression (F = 55.0, p = .02), whereas Veterans with sleep apnea attended a higher percentage of sessions (F = 4.56, p = .04). Veterans preferred 1 hour sessions to 1½ hour sessions, and preferred an 8 session to 9 session protocol.

Conclusion: An 8-session group-based CBTI treatment protocol is effective at reducing insomnia severity and is amenable to a heterogeneous Veteran population. Veterans with depression may need increased attention.

Support (If Any): VA HSR&D 121HX001473

0606

RESULTS OF A PILOT RCT COMPARING BRIEF CBT-I TO TREATMENT AS USUAL IN PRIMARY CARE PATIENTS ENDORSING SUICIDAL IDEATION
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Introduction: Insomnia often co-occurs with major depression (MDD) and posttraumatic stress disorder (PTSD). Insomnia, MDD and PTSD are each highly prevalent among primary care (PC) patients and are each independent risk factors for suicidal ideation (SI) and suicide attempts. CBT for insomnia (CBT-I) delivered to patients with MDD and/or PTSD has resulted in decreased symptom severity of each disorder. It is possible, then, that improved sleep may have both direct and indirect effects on suicide outcomes in patients reporting SI who have both insomnia and one or more co-occurring conditions.

Methods: N = 36 participants with insomnia, recent SI and either MDD and/or PTSD were randomized to treatment-as-usual (TAU) for MDD and/or PTSD or to CBT-I plus TAU. All participants were Veterans receiving VA primary care services. CBT-I was delivered in a PC-friendly fashion: four individual sessions lasting 20-40 minutes. A blinded rater completed assessments prior to randomization and at post-treatment including the Insomnia Severity Index (ISI), the Physicians Health Questionnaire for depression (PHQ-9), and the Columbia Suicide Severity Rating Scale’s SI intensity subscale (range of 1-25). With an intent-to-treat design, general linear models were used to test time x group interactions for ISI, PHQ-9 (with sleep item removed) and SI intensity.

Results: The analysis includes N = 45 subjects (22% female; 24% minorities; mean age = 55.3) with complete data (2 lost to follow-up, 9 still active). Mean (SD) baseline scores did not differ by group and were: ISI = 18.2 (4.6); PHQ-9 = 16.1 (5.3) and SI intensity = 13.2 (3.0). CBT-I, compared to TAU, was associated with significant reductions in ISI (p < .001) and PHQ-9 (p < .01). Although SI intensity decreased by 6.6 points in the CBT-I condition and 4.3 points in the TAU condition, the time x group interaction was not significant. Effect sizes (Cohen’s d) were large for insomnia (d = 1.71) and depression (d = 1.17) and modest for SI Intensity (d = .35).

Conclusion: Findings support the efficacy of brief CBT-I formatted for delivery in PC settings in reducing both insomnia and depressive symptoms in patients presenting with SI. The fact that SI intensity was reduced in the CBT-I condition, but not significantly more than in the TAU condition suggests (among other possibilities) that SI may be influenced by other factors and/or may be less amenable to modification than symptom severity. Whether large reductions in insomnia and depression severity combined with modest reductions in SI intensity represent a meaningful reduction in suicide risk remains to be demonstrated.

Support (If Any): VA HSR&D 121HX001473

0607

A RANDOMIZED PLACEBO CONTROLLED TRIAL OF CBT-I +/- ARMODAFINIL IN PATIENTS WITH INSOMNIA COMORBID WITH SLEEP APNEA
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Introduction: This study examined whether CBT-I, armodafinil, or both, results in greater symptom reduction and response and remittance rates than a placebo among patients with insomnia comorbid with obstructive sleep apnea (OSA), when CBT-I is initiated concurrently with CPAP.

Methods: 39 patients recently diagnosed with OSA and scheduled to begin CPAP were recruited between June 2014 and July 2015. Participants were randomly assigned to one of four conditions: 1) CBT-I and placebo
(CBT-I+P); 2) CBT-I and armodafinil (CBT-I+A); 2) armodafinil alone (ARM); or 4) placebo alone (PLA). CBT-I was delivered in 8 weekly 45-60 min individual therapy sessions. A flexible dosing paradigm for armodafinil was used with a range of 50-250 mg, qam or bid. Insomnia severity was assessed using the Insomnia Severity Index (ISI). Treatment response was defined as > 50% reduction on the ISI. Remission was defined as a post treatment score of < 7 on the ISI. Analysis of variance was used to examine the differences on the ISI across groups. A Bonferroni correction was used for pairwise comparisons.

**Results:** Compared to the PLA group, the CBT-I+P (p < .001) and CBT-I+A (p = .04) groups reported a significant reduction in insomnia severity. The within subjects pre-post effect sizes were 3.44 and 3.56, respectively. Treatment response rate was 100% in the CBT-I+P and CBT-I+A groups compared to 38% in the ARM and 36% in the PLA groups. Group remission rates were 86% for CBT-I+P, 83% for CBT-I+A, 33% for ARM, and 22% for PLA.

**Conclusion:** CPAP alone appears to produce significant improvement in insomnia in up to 36% of subjects. This effect appears to be substantially augmented with CBT-I (up to 100% of subjects exhibited treatment responses). At present, the addition of armodafinil does not seem to contribute to these outcomes. Additional analyses regarding compliance are ongoing.

**Support (If Any):** This work was supported by a PI initiated grant from Teva Pharmaceutical Industries CNS-2012-10 and VA grant IK2CX000855 (SC). Study medication was provided by Teva Pharmaceuticals.

**0608 OBJECTIVE, BUT NOT SUBJECTIVE, SHORT SLEEP DURATION ASSOCIATED WITH INCREASED RISK FOR HYPTERTENSION IN INDIVIDUALS WITH INSOMNIA**

**Introduction:** Objective short sleep duration has been associated with increased risk for current or incident hypertension in studies using the Penn State Cohort. This study aims to replicate these findings in a different sample and test if subjective total sleep time (TST) can be used to detect associated hypertension risk.

**Methods:** Participants were 255 adult volunteers (165 female; Age = 42.2 ± 13.7) from a study conducted at Duke and Rush University Medical Centers examining the reliability and validity of insomnia diagnoses. Participants completed two nights of polysomnography, two weeks of sleep diaries, and questionnaires focused on sleep and health history, including presence/absence of hypertension. Logistic regressions assessed the odds ratios of hypertension among persons with insomnia and short sleep duration < 6 h and persons with insomnia and sleep duration > = 6 h, measured both objectively and subjectively. ROC curve analysis determined if a 6h cutoff was appropriate for subjective TST measures.

**Results:** Insomnia with objective short sleep < 6 h was associated with a 3.59 increased risk of reporting hypertension as a current medical problem compared to individuals with insomnia with sleep duration > = 6 h. Increased risk for hypertension was independent of major confounding factors frequently associated with insomnia or hypertension. No significant difference in associated hypertension risk was found between these groups when subjective TST groups were used. ROC curve analysis found that the best balance of sensitivity and specificity using subjective TST was at a 6h cutoff; but the area under the ROC curve showed low accuracy and did not have good discriminant value.

**Conclusion:** Objectively measured short sleep duration increased the odds of reporting hypertension more than 3-fold after adjusting for potential confounders; this relationship was not significant for subjectively measured sleep duration. This research supports emerging evidence that insomnia with objective short sleep duration < 6 h is associated with an increased risk of comorbid hypertension.

**Support (If Any):** This research was supported by the National Institute of Mental Health Grant # R01 MH67057.

**0609 INSOMNIA ASSOCIATED WITH INCREASED RISK FOR PREGNANCIES THAT DO NOT RESULT IN LIVE BIRTHS IN REPRODUCTIVE AGED WOMEN**

**Introduction:** Insomnia remains largely unexplored in its relationship to pregnancy outcomes, though previous research implicates other sleep disorders such as sleep apnea. The present study sought to examine whether insomnia partially accounts for the risk of pregnancies that do not result in live births among reproductive-aged women.

**Methods:** Data from the combined 2005-2008 National Health and Nutrition Examination Survey (NHANES) were used. Information on reproductive health was gathered from women age 18-45 (N = 5,554). Of these, N = 4,622 (83%) had been pregnant at least once and 1,870 (40%) of these had pregnancies that did not result in a live birth. Insomnia was assessed as self-reported difficulty initiating sleep, difficulty maintaining sleep, difficulty with early morning wake, and non-restorative sleep. Responses were coded as “Never,” “1/month,” “2-4/month,” “5-15/month,” or “> 15/month.” Population-weighted logistic regression analyses, adjusted for age, race/ethnicity, education, and sleep apnea symptoms (snoring and snorting/gasping frequency) assessed associations between insomnia symptoms and number of pregnancies that did not result in a live birth.

**Results:** Insomnia symptoms combined with covariates predicted the likelihood of at least one pregnancy that did not result in a live birth (overall R2 = 0.02,p15/month (OR = 2.25;95%CI[1.44-3.51];p < 0.0005).

**Conclusion:** Women of reproductive age (18–45 years) experiencing difficulty maintaining sleep are more likely to have a pregnancy that does not result in a live birth (85% increased risk). Further studies are needed to explore the risk of insomnia specifically on spontaneous abortions/miscarriages and infertility.

**Support (If Any):** K23NR0114008 (PI: Nowakowski); R01AG041783 (PI: Perlis); K23HL110216 (PI: Grandner)

**0610 PSYCHOSOCIAL AND HEALTH DETERMINANTS OF INSUFFICIENT SLEEP AMONG CARIBBEAN YOUNG ADULTS**

**Introduction:** Short-term and long-term consequences of insufficient sleep among young adults are well documented in the United States. Insufficient sleep is associated with physical and mental health problems, substance use, injury, loss of productivity and early mortality. However, unlike the U.S., very little has been done to assess effects of insufficient sleep on these outcomes among Caribbean volunteers. This study explored the prevalence and determinants of insufficient sleep in three Caribbean countries.
Methods: A total of 1,578 university participants (ages 18-30 years; female = 63.1%) from Jamaica, Barbados, and Grenada provided valid data for the current analysis. In addition to sociodemographic characteristics, participants completed self-reported health-related measures (BMI, health knowledge and physical activity). They also provided psychosocial (PTSD, substance use, social support, LOC and depression) and sleep data. Descriptive, bivariate and multivariate regression analyses were conducted using SAS 9.4.

Results: Insufficient sleep (<7hrs) was reported by 49.10% across the three countries. Barbados reported the highest rate (51.43%), compared with Jamaica (48.78%) and Grenada (45.58%). Analyses showed that males reported a higher rate of insufficient sleep (52.78% vs 47.02%, p < 0.05); 2) t-test revealed a difference in age; the average age of participants who reported insufficient sleep was 21.32 (mean diff = .28, p < .05). Regression for health habits showed exercise was significant; compared to people who report moderate levels of exercise, people with low levels of exercise were less likely to report insufficient sleep (OR = 0.77 95%CI: 0.57-1.04, p < 0.05). Regression for psychosocial factors revealed that PTSD was significant; people with PTSD symptoms are more likely to report < 7 (OR = 1.57, 95%CI: 1.20-2.06, p < .001)

Conclusion: A higher rate of insufficient sleep was found in this Caribbean sample than that observed among US samples. This elevated rate has important public health implications with regard to sleep-associated adverse health outcomes and socioeconomic burden.

0611
INSOMNIA ASSOCIATED WITH AGE AT HYSTERECTOMY AND PARTIALLY MEDIATES RELATIONSHIP WITH DEPRESSION
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Introduction: Hysterectomies occur frequently among reproductive-aged women. Depressed mood is one of the most prevalent and pervasive consequences, especially among young women. Although it is well-established that insomnia is a known risk factor for depression, few studies have examined the prevalence and role of insomnia among women who have undergone a hysterectomy. The present tested the hypothesis that insomnia would partially account for the risk of depression among these women, particularly those who underwent a hysterectomy at a younger age.

Methods: Data from the combined 2005-2008 National Health and Nutrition Examination Surveys (NHANES) were used. Reproductive health was assessed among women age ≥ 20 (N = 5820). Of these, N = 1,294 (22%) had hysterectomies. Insomnia was assessed as self-reported difficulty initiating sleep, difficulty maintaining sleep, and/ or difficulty with early morning awakenings; individuals were coded as having insomnia if they reported any of these symptoms rated at “Almost Always” (≥ 15 days/month).” Depression was assessed as “feeling down, depressed, or hopeless” at least several days in the past month. Population-weighted logistic regression analyses, adjusted for age, race/ethnicity, education, body mass index, number of pregnancies and number of live births, assessed associations between age at hysterectomy and depression and insomnia. Mediation analyses and Sobel tests examined whether the relationship with depression was accounted for by insomnia.

Results: Among those with a hysterectomy, both insomnia (19.6%) and depression (28.4%) were prevalent. Age at hysterectomy predicted depression (OR = 0.97, 95%CI [0.95-0.99], p = 0.006), as well as insomnia (OR = 0.96, 95%CI [0.94-0.98], p < 0.0001), even after adjusting for depression (OR = 0.96, 95%CI [0.94-0.98], P = 0.001). Significant partial mediation (p = 0.004) was found, such that insomnia explained 27% of the relationship.

Conclusion: Women who underwent hysterectomies at younger ages are more likely to be depressed (3% increased risk per year earlier) and have insomnia (4% increased risk per year earlier). Further, 27% of the depression relationship is explained by insomnia. This may be due to medical, psychological, and/or social factors.

Support (If Any): NIH K23NR014008 (PI: Nowakowski); NIH R01AG041783 (PI: Perlis); NIH K23HL10216 (PI: Grandner)

0612
TOWARDS A MODEL OF SLEEP DISTURBANCES IN CAREGIVERS OF PERSONS WITH DEMENTIA: CHARACTERIZING INTRAINDIVIDUAL VARIABILITY IN CAREGIVERS’ SLEEP COMPARED TO NON-CAREGIVERS
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Introduction: Disturbed sleep is a common complaint amongst caregivers of persons with dementia (CGs). Their sleep patterns are often variable, demonstrating both good and poor nights of sleep - a hallmark of chronic insomnia. This study utilized sleep diaries and actigraphy to understand night-to-night intraindividual variability in CGs reporting sleep difficulties.

Methods: Variability in 14-day sleep diaries and concurrent actigraphy of CGs (n = 38) were compared to two non-CG samples: with (n = 29) and without (n = 28) sleep disturbance. Daily sleep measures were de-trended for time using mixed effects models. Residuals from models were aggregated as intraindividual standard deviations (ISDs). ANOVAs were conducted for sleep diary (SOL, WASO, SQR, sleep efficiency, TST) and actigraphy outcomes (SOL, WASO, TWT, TST). CGs were asked to report WASO related to caregiving separately. Post-hoc pairwise comparisons compared group differences. Omnibus-ANOVA results are reported below.

Results: Actigraphy shows that CGs experience greater variability in SOL (F = 15.89; p < .001; ηp2 = .26) and TWT (F = 9.86; p < .001; ηp2 = .18) than both non-CGs and greater WASO (F = 5.84; p = .004; ηp2 = .12) and TST (F = 5.83; p = .004; ηp2 = .12) variability than non-CGs without sleep complaints. For sleep diaries, CGs were not significantly different from non-CGs with sleep complaints, but both groups had greater variability in WASO (F = 5.58; p = .005; ηp2 = .11), SQR (F = 137.56; p < .001; ηp2 = .75), TWT (F = 8.12; p = .001; ηp2 = .15), and TST (F = 8.47; p < .001; ηp2 = .16) than non-CGs without sleep complaint. For CGs, WASO related to caregiving duties was more variable than other WASO (t = 6.45; p < .001).

Conclusion: Findings illustrate distinctive characteristics of CG sleep. Although variability in self-reported sleep did not differ between CGs and non-CGs with sleep complaints, CGs exhibited greater variability in actigraphy SOL than non-CGs. Interestingly, CGs reported greater variability in care-related-WASO than other-WASO. Research investigating care-related versus other WASO is needed and has important implications as existing insomnia treatments may not be ideal for caregivers (i.e., hypnotics-because CGs need to respond to care recipients’ nighttime needs; CBTi-because care-related WASO is unlikely to respond). Novel or modified treatment may be warranted.

Support (If Any): National Institute on Aging [R01AG039495-01]; PI: Meredith Rowe, Ph.D.
III. Insomnia

This study was funded by Veteran’s Affairs Advanced Fellowship Program in Mental Health Illness Research and Veterans focused on the examination of sex differences following ex-We investigated Internet-delivered CBT-I with more complex clinical experiences of Returning Veterans (SERV), a national survey of combat Veterans focused on the examination of sex differences following exposure to trauma. Veterans (N = 770) separated from active duty and deployed at least once in support of the operations in Iraq or Afghanistan were eligible. Questionnaires covered multiple domains including: SI, insomnia, alcohol, depression, and PTSD.

Results: Psychopathology was common in this sample with veterans commonly suffering from insomnia (57.3%; n = 441) depression (35.8%; n = 276) and/or PTSD (72.5%; n = 558). A substantial number of Veterans reported current SI (17.1%; n = 132) with 14.6% (n = 111) of the overall sample having reported a history of suicide attempt. Of those who reported SI, many also met criteria for insomnia (81.8%; n = 108). In unadjusted logistic regressions insomnia was associated with: current depressive episode (OR = 8.32), PTSD (OR = 8.16), and presence of SI (OR = 4.12). In a final model adjusting for gender, age, heavy alcohol use, PTSD, and insomnia, only PTSD remained significantly associated with the presence of SI (OR = 1.07).

Conclusion: Significant associations were observed among insomnia, SI, PTSD, alcohol consumption and depression in this examination of returning Veterans. The data reported are preliminary and largely descriptive, but provide additional insight regarding the challenges facing returning Veterans. Findings lend support to the supposition that insomnia is not simply a comorbid symptom, but rather, plays a larger role in the expression and development of psychopathology.

Support (If Any): This study was funded by Veteran’s Affairs CSR&D grant ZDA1. This work was also supported, in part, by the VA Advanced Fellowship Program in Mental Health Illness Research and Treatment, VISN 2 Center of Excellence for Suicide Prevention at the Canandaigua VAMC.

0614

CHANGES IN SLEEP AND COMORBID DEPRESSION FOLLOWING USE OF INTERNET-DELIVERED CBT FOR INSOMNIA

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Introduction: The behavioral insomnia field has begun to investigate more complex questions about the benefits of CBT-I in patients with insomnia co-occurring with psychiatric symptoms. In contrast, many eHealth investigators have a belief that only patients with mild depression can benefit from interventions that are fully self-guided. We investigated Internet-delivered CBT-I with more complex clinical presentations. In this talk, sleep and depression outcomes will be presented from a large US-based RCT with adults with insomnia where comorbid medical or psychiatric disorders were included.

Methods: Participants were instructed to complete 10 days of online sleep diaries and an online self-report battery at four time points: baseline, 9 week, 6 month, and 12 month follow-up. The online measures included the Insomnia Severity Index (ISI) and Center for Epidemiologic Studies Depression Scale (CES-D). 303 adults were randomized to either a fully automated CBT-I program (SHUTi: Sleep Healthy Using the Internet) or a patient education website with static information about insomnia and CBT strategies.

Results: In all cases, mixed models group X time interaction effects were significant for ISI, sleep diary variables (SOL, WASO), and CES-D, favoring the Internet CBT-I group. Adults using the Internet program (n = 151) achieved large effect size improvements from pre-to-post in the sleep parameters (e.g., ISI d = 1.90), and small effect size improvements in depression (d = .33). In contrast, the magnitude of the improvement was smaller for the users of the online education website (n = 152): large effect size change from pre-to-post in ISI (d = .77) and minimal to no change in CES-D (d = .01).

Conclusion: Patients with comorbid depression, such as insomnia and depression, can benefit from self-guided Internet interventions. This has important implications for the reach of these programs as the majority of people with insomnia also suffer from comorbid symptoms.

Support (If Any): NIMH: 1R01MH086758-01A1

0615

INCREASE IN BETA AND ALPHA POWER IN INSOMNIA PATIENTS WITH COMORBID OSA


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Introduction: It has been reported a coexistence of insomnia and obstructive sleep apnea (OSA) in 30% to 50% of OSA patients, however little is known about the underlying pathophysiology of this coexistence and the patient’s clinical features. Primary insomnia has been considered as a state of physiological, cognitive, and cortical hyperarousal, which can interfere with the sleep initiation and maintenance. Cortical hyperarousal has been defined, as an increase in the power of the alpha, beta and gamma frequencies, during wakefulness previous to sleep onset, as well as during N1 and N2 and REM sleep. Regarding insomnia comorbid to OSA, some authors have proposed an underlying hyperarousal state. Only one study based on psychometric tests has shown psychological and behavioral activation patterns similar to insomniac patients. Considering the few information about comorbidity between insomnia and OSA, we proposed to characterize the EEG frequencies patterns in patients with this disorders coexistence during the start to sleep, with the aim to determine a possible hyperarousal cortical state.

Methods: We selected a group of insomnia comorbid to OSA patients, and a group of OSA patients without insomnia symptoms. Based on polysomnography (PSG), 30 segments lasting 2 seconds from wakefulness previous to sleep onset, and during N1 stage were selected for EEG quantitative analysis.

Results: Preliminary results are presented from of a sample of 5 subjects per group. After Mann-Whitney U statistic test, we observed that patients with insomnia comorbid to OSA showed a significant increase in the alpha and beta absolute power during wakefulness previous to sleep onset and during N1, differences were mainly found on left frontal and central EEG areas.
Conclusion: This tendency may indicate the presence of a cortical hyperarousal state during the beginning of sleep in patients with insomnia comorbid to OSA. It is necessary to increase the sample to obtain conclusive results.

Support (If Any): Consejo Nacional de Ciencia y Tecnología CONACYT México, Posgrado en Ciencias Biológicas Universidad Nacional Autónoma de México

**0616**

**WORRY AND RUMINATION IN INSOMNIA PATIENTS**

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Introduction: Insomnia is the most common sleep disorder. Repetitive thoughts such as worry and rumination are strongly correlated with anxiety and depression, contributing to its maintenance. Insomnia is thus postulated to be the result of cognitive hyperarousal. The aim of our study was to assess worry and rumination in insomnia patients, compared with healthy controls.

Methods: 31 patients with chronic primary insomnia (20 F (64.5%) and 11 M (35.5%), mean age 49.19 ± 12.59 years) were compared with 20 healthy subjects (13 F (65%) and 7 M (35%), mean age 49.35 ± 12.40 years). All participants completed a series of questionnaires: Insomnia Severity Index (ISI), Penn State Worry Questionnaire (PSWQ), Ruminationary Responses Scale (RRS), Epworth Sleepiness Scale (ESS), State Trait Anxiety Inventory (STAI-Y-1, STAI-Y-2), Beck Depression Inventory (BDI), Pittsburgh Sleep Quality Index (PSQI) and Cognitive Estimation Test (CET).

Results: The insomnia patients had higher scores (p < 0.001) on ISI, PSWQ, RRS, BDI, STAI-Y-1 and 2, PSQI and CET but not on ESS in comparison with healthy controls. Direct correlations between ISI and RSS, between PSQI and RRS and between PSWQ and RRS were observed.

Conclusion: Insomnia patients showed significantly higher scores on both PSQW and RRS compared to controls. Even though rumination and worry are considered two distinct constructs, subjects are often unable to effectively distinguish between them as indicated by the correlation between PSWQ and RRS. Further investigations will aim to differentiate these two constructs in clinical practice and to evaluate their impact on nocturnal sleep.

**0617**

**CHILDHOOD ADVERSITY AND NOCTURNAL PSYCHOLOGICAL HYPERAROUSAL IN PATIENTS WITH COMORBID INSOMNIA AND DEPRESSIVE DISORDER**

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Introduction: Childhood adversity (CA) is associated with long term HPA-axis alterations, which may predispose individuals to increased stress reactivity, psychiatric disorders, and insomnia. We therefore aimed to examine associations between CA and clinical features of patients with insomnia and depression.

Methods: We used baseline data from 148 patients (age 46.56 ± 12.6 years; 108 women) with comorbid major depressive disorder and insomnia who participated in the Treatment of Insomnia and Depression (TRIAD) study. Participants completed the Childhood Trauma Questionnaire (CTQ), containing 6 subscales: sexual abuse (SA), physical abuse, emotional abuse, physical neglect, emotional neglect, and minimization of CA; the Insomnia Severity Index (ISI); and the Ford Insomnia Response to Stress Test (FIRST). Analyses compared individuals endorsing no to low levels of each CTQ subscale to those endorsing moderate to severe levels of each subscale on the FIRST and ISI. Linear regression tested whether CTQ subscales predicted higher FIRST scores. Bivariate correlation tested the relationship between CTQ subscale scores and ISI scores.

Results: Patients with a history of moderate to severe SA had significantly higher FIRST scores (p = .037), but not significantly higher ISI scores. Minimization of CA was associated with higher ISI scores (r = -.25, p < .003).

Conclusion: Among patients with comorbid insomnia and depression, self-reported history of moderate to severe childhood sexual abuse is associated with greater perceived disposition to insomnia under stress. Although other types of elevated childhood adversity were not associated with elevation on the FIRST, minimizing experiences of childhood adversity was associated with greater insomnia severity. These results were identified in a patient sample with depression and insomnia comorbidity. Future research is needed to ascertain the relevance of early childhood experience in the population at large.

Support (If Any): This research was supported by three linked grants from the National Institute of Mental Health; MH078924, MH078961, and MH079256.

**0618**

**BRIEF CBT-I DISPROPORTIONALLY REDUCES DEPRESSION, POSTTRAUMATIC STRESS, AND INSOMNIA SEVERITY AMONG SURVIVORS OF INTIMATE PARTNER VIOLENCE WHO ARE OBJECTIVE SHORT SLEEPERS**

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Introduction: Insomnia is often observed among individuals who have experienced intimate partner violence (IPV) and developed Post-traumatic Stress Disorder (PTSD). The utility of cognitive behavioral therapy for insomnia (CBT-I) among IPV survivors has yet to be established. Further, individuals whose sleep is quantitatively different (e.g., objective short sleepers < 360 minutes of total sleep time), may have differential responses to insomnia treatments.

Methods: A randomized controlled trial of CBT-I for IPV survivors with insomnia, PTSD and depression was undertaken. Data from a planned interim analysis are presented. IPV survivors completed a baseline assessment battery, including an in-lab overnight polysomnogram. Those who met DSM-IV-TR diagnostic criteria for both PTSD and MDD and who did not meet criteria for obstructive sleep apnea, were randomized into either CBT-I (n = 27; 4 individual sessions) or attention control (n = 37; phone check-ins). Measures, which included the Insomnia Severity Index (ISI), the Hamilton Rating Scale for Depression (HRSD) and the Clinician-Administered PTSD Scale (CAPS), were administered at baseline and at post-treatment.

Results: General linear model, repeated measures analyses revealed a significant interaction between group and time, such that subjective measures of insomnia improved at a greater rate for the CBT-I group (F[1] = 35.732, p < .001). Separate GLM, repeated measures analyses also revealed significant group by time interactions of CBT-I on the
HSRD and the CAPS. When status as a objective short sleeper was added to the analyses, significant three-way interactions were observed such that short sleepers in the CBT-I group saw the greatest reductions in depression (F(1) = 4.377, p < .05) and PTSD severity (F(1) = 4.136, p < .05) as compared to both controls and non-short sleepers in the treatment group.

Conclusion: CBT-I appears to have utility in the treatment of insomnia in the context of PTSD and IPV. Reductions in psychopathology are not only limited to a positive effect on insomnia, but extend to depression and PTSD. Those characterized as objective short sleepers saw the greatest benefit from CBT-I. Further exploration of the role that sleep phenotypes play in treatment response may be warranted.

Support (If Any): This work was supported, in part, by NIH R01NR013909 and the VA Advanced Fellowship Program in Mental Health Illness Research and Treatment, VISN 2 Center of Excellence for Suicide Prevention at the Canandaigua VAMC.

DO SUBJECTIVE AND PHYSIOLOGICAL STRESS RESPONSES DIFFER BETWEEN INSOMNIA PATIENTS AND GOOD SLEEPERS WITH HIGH AND LOW SLEEP ReactIVITY?

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Introduction: Stress and hyperarousal contribute to insomnia. Evidence also suggests that stress-related sleep reactivity increases the risk of insomnia. However, it remains unclear whether increased stress response represents a trait-like vulnerability to insomnia or a state that appears following the onset of insomnia. The present study aimed to examine if elevated subjective and physiological stress responses observed in insomnia patients are also present in good sleepers with high vulnerability to sleep reactivity.

Methods: Participants were 30 adults (26.7 ± 5.3 years; 66.7% female) with insomnia (INS; n = 10) and without insomnia. Based on a median score of 20 on the Ford Insomnia Response to Stress Test, good sleepers were further sub-divided into those with high vulnerability (HV; n = 10) and low vulnerability (LV; n = 10) to sleep reactivity. Participants underwent the Trier Social Stress Test (TSST) prior to their habitual bedtime. Physiological indicators of stress reactivity included salivary cortisol, heart rate (HR), heart rate variability (i.e., HF, LF/ HF ratio), systolic (SBP) and diastolic blood pressure (DBP). Perceived stress, anxiety, physiological arousal, and emotional insecurity were assessed using visual analogue scales before, during, and after the TSST. Factorial (Group x Time) mixed-model ANOVAs for repeated measures were conducted.

Results: Physiological (salivary cortisol levels, HR, LF/HF ratio, SBP, and DBP) and subjective measures (stress, anxiety, and physiological arousal) were significantly elevated in response to the TSST in all groups (all p < .05). The INS group showed significantly greater cortisol peak response (p < .01) and higher cortisol concentration throughout the recovery period (p < .05) than LV and HV groups; no Group x Time interactions were found for the remaining subjective or physiological variables. While not significant, the HV group exhibited an overall greater cortisol concentration than the LV group. Post-hoc comparisons revealed that the INS group perceived significantly more stress (p < .01), anxiety (p < .05), and physiological arousal (p < .05) than the LV group.

Conclusion: Findings suggest that the TSST induced subjective and physiological stress responses. Participants with insomnia showed greater cortisol responses and subjective stress responses than LV group. Interestingly, the HV group showed a tendency toward increased cortisol responses compared to the LV group. These preliminary findings support the hyperarousal conceptualization in insomnia, and warrant further research to continue examining potential effect of a trait-like vulnerability in the development of insomnia.

Support (If Any): Research supported by the Canadian Institutes of Health Research (MOP42504 and B0512201) and the Fonds de recherche de Québec - Santé (32207).

THE MEDIATING EFFECT OF HYPERAROUSAL BETWEEN DAILY STRESS AND SLEEP IN INSOMNIA PATIENTS AND IN GOOD SLEEPERS WITH HIGH AND LOW SLEEP ReactIVITY

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Introduction: Stress and hyperarousal contribute to insomnia. Evidence also suggests that stress reactivity increases the risk of insomnia under stressful conditions. The present study aimed to examine the respective effects of pre-sleep arousal and sleep reactivity on the relation between daily stress and sleep under naturalistic condition.

Methods: Participants were 70 adults (25.2 ± 4.9 years; 67.1% female) with insomnia (INS; n = 23) or without insomnia. Based on a median score of 20 on the Ford Insomnia Response to Stress Test, good sleepers were further sub-divided into those with high vulnerability (HV; n = 23) and low vulnerability (LV; n = 24) to sleep reactivity. Over the course of 2 weeks, participants wore an actigraph and completed daily questionnaires assessing stress (i.e., frequency of stressful events and their perceived impact), pre-sleep somatic and cognitive arousal, and sleep (i.e., subjective sleep quality and sleep efficiency (SE)). Indirect effects of pre-sleep arousal were reported as the percentage of the total effect of daily stress on sleep.

Results: A significant mediating effect of pre-sleep somatic (5.5%-29.0%) and cognitive arousal (42.6%-50.1%) in the association between daily stress and subjective SE was observed in all groups. Somatic and cognitive arousal accounted for more than 20% of the total effect of daily stress on actigraphy-based SE in INS (46.0%) and HV (23.8%) groups; in the LV group, only cognitive arousal significantly mediated this association (14.1%). Additionally, somatic (21.9%) and cognitive (26.6%) arousal independently accounted for the total effect of stress on subjective sleep quality in the LV group; only cognitive arousal significantly mediated this association in INS (30.1%) and HV groups (48.1%).

Conclusion: Results suggest that pre-sleep arousal mediated the association between daily stress and sleep. Interestingly, similar mediating mechanisms were observed in INS and HV groups, with somatic and cognitive arousal mediating the association between stress and actigraphy-based SE, and cognitive arousal mediating the association between stress and subjective sleep quality. These preliminary findings support the hypothesis that sleep reactivity might serve as a moderator of the mediating effect of hyperarousal (moderated mediation) on the relationship between stress and insomnia.

Support (If Any): Research supported by the Canadian Institutes of Health Research (MOP42504 and B0512201) and the Fonds de recherche de Québec - Santé (32207).
0621
POOR SLEEP IS ASSOCIATED WITH ELEVATED CORTISOL IN PHYSICALLY ACTIVE MEN AND WOMEN
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Introduction: Sleep quality is an important aspect of general health and wellness. The purpose of this ongoing study is to evaluate the impact of enhancing sleep on fitness outcomes and markers of health. The current analysis focuses on the relationship between reported sleep quality and cortisol levels measured at baseline.

Methods: Within an ongoing clinical trial to evaluate the effects of a program to improve sleep quality while engaging in a fitness enhancement program [Sleep Coaching on Optimizing Resistance and Endurance training (SCORE study)], 13 individuals (8 men) completed baseline sleep questionnaires, including the Pittsburgh Sleep Quality Index (PSQI) and Athens Insomnia Scale (AIS), and provided one fasting blood sample from which cortisol levels (μg/dl) were measured. Regression methods were used to predict cortisol levels from sleep questionnaires.

Results: Average age of participants was 32.4 (4.0) years, with body mass index (BMI) 23.9 (SD 2.9) kg/m2. The mean PSQI was 5.0 (SD 2.6); and the mean AIS was 5.2 (SD 4.0). Standard linear regression showed worse PSQI was associated with higher cortisol levels (B = 0.80, P = 0.039, n = 13); however, using robust regression (which resulted in exclusion of one subject’s data), this association was no longer significant (B = 1.5, P = 0.084, n = 12).

Conclusion: In apparently healthy, younger to middle-aged adults, a range of sleep quality was captured. Poor sleep quality may be a predictor of higher cortisol levels; however, additional data are needed to clarify these preliminary results. Although these findings do not establish a causal relationship, they imply that improving sleep quality may reduce stress hormone levels in these otherwise healthy individuals.

Support (If Any): Equinox Fitness

0622
REM PROMOTION BY DUAL AND OREXIN 2 RECEPTOR ANTAGONISTS RELATIVE TO STANDARD OF CARE ACROSS MAMMALS
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Introduction: Antagonism of orexin receptors (OX1R, OX2R) induces sleep and provides an effective alternative to GABA-A receptor modulators. Clear differentiation between dual orexin receptor antagonists (DORAs) and OX2R-single antagonists (2-SORAs) as well as the specific roles of the receptor subtypes in arousal and vigilance state, however, remains unclear.

Methods: Sleep data were collected via radio-telemetry implants (Data Sciences International) in rats, mice, dog, and NHP across 3-5 days of drug administration. Sleep stages were quantified with Somnologica (Medcare) automated software modules evaluating ECoG, EMG, EOG (dog, NHP) data. Receptor occupancy was determined in hOx2R transgenic rats at Cmax and correlated with sleep state changes over 2 hours. Polysomnographic responses to single MK-1064 doses were evaluated in twenty healthy male subjects in a double-blind, randomized, 4-period crossover Phase I study.

Results: DORAs qualitatively induce REM sleep time that is no different from inactive phase sleep in rats. Standard of care GABA modulators alter REM differentially from ORAs, reducing REM sleep in rodents and even promoting paradoxical wakefulness in dogs. Using mouse genetic models, OX2R predominantly mediates orexin-induced arousal and OX2R-selective antagonism is sufficient for sleep promotion, while OX1R appears involved in vigilance state gating. In rats, DORAs required lower receptor occupancy relative to 2-SORAs to induce sleep promoting efficacy. MK-1064, a selective 2-SORA (3000x OX2R/OX1R selective binding) induces REM sleep across mammalian species.

Conclusion: In rats, DORAs promote sleep that is similar to normal resting phase sleep, unlike GABA-A receptor modulators, and appear to promote sleep by attenuating arousal and reducing the threshold for sleep stage transitions. Similar to DORAs, 2-SORAs promote REM sleep across mammals, including humans, and do not offer any apparent sleep advantage over a DORA.

Support (If Any): All work was funded by Merck & Co., Inc.

0623
FACIAL CUES OF TIREDNESS: SELF-SPECIFIC INTERPRETIVE BIAS AMONGST INDIVIDUALS WITH INSOMNIA
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Introduction: Individuals with insomnia often display interpretive-biases to sleep-related cues. We previously demonstrated that individuals with insomnia display an interpretive-bias, perceiving attributes of their own face as more tired than they physically were. This follow-up study examined whether this interpretive bias extends to the perception of other peoples faces, or is self-specific in nature.

Methods: Nineteen participants with DSM-V Insomnia Disorder (22.37 ± 6.03 years) and 19 normal-sleepers (23.95 ± 5.48 years) observed a slideshow consisting of four neutral facial photographs of other people (5000ms each). These photographs were subsequently manipulated to create face-morphs varying in degrees of tiredness-alertness. Participants completed a visual task whereby they observed the face-morphs and indicated the position corresponding to the image of the person previously shown in the slideshow. A computer algorithm scored responses between -100 (indicating an extremely-tired perception) to +100 (indicating an extremely-alert perception) based upon the discrepancy between the neutral photographs and selected positions. Mean perception scores were compared between-groups, and with results from an earlier study (using the same sample) where the same task examined an interpretive bias towards images of their own face.

Results: No group difference concerning perception of other people was observed (F[1,36] = -.14, P = .26). However, a mixed ANOVA demonstrated a significant group x face (self vs. other) interaction (F[1,34] = 7.60, P = .01); individuals with insomnia perceived images of themselves as more tired (M = -33.32, SD = 79.16) compared to those of others (M = -3.50, SD = 79.16), whereas normal-sleepers displayed the opposite.

Conclusion: Individuals with insomnia perceived their own, but not others, facial attributes of tiredness in a disorder-consistent manner, interpreting their own face as more tired than they physically were. Therefore, insomnia appears to be characterized by a self-specific, rather than general, interpretive bias of the face. These findings suggest that mechanisms perpetuating insomnia negatively influence self-perceptions of tiredness, and contribute to understanding the specificity of these mechanisms.
III. Insomnia

0624
SELECTIVE DISSOCIATION OF VISUAL PROCESSING IN PATIENTS WITH INSOMNIA DISORDER
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Introduction: Several studies show that insomnia disorder (ID) is strongly associated with daytime impairments. Although cognitive deficits are frequently reported, little is known about the effects of this pathology on perceptual processes. In this study we aim at evaluating the consequences of insomnia on visual processing by employing a visual search paradigm.

Methods: After a PSG recording night subjects performed a visual search task in which they had to respond to the presence/absence of a target (letter T) embedded into a set of distractors (letters Os, Xs, or Ls). Both target's salience and distractors' numerosity were manipulated. Accuracy and reaction times (RT) were recorded as dependent variables. The results of 23 ID patients were compared with the performance obtained by 20 age- and sex-matched control subjects.

Results: Results mainly confirmed the typical effects of a visual search task. While no difference in accuracy was found between the two groups, an overall delay in performing the task was observed for the ID patients. However, distinguishing the RT for trials containing the target from the RT for trials in which the target was absent, the clinical group differed from controls solely in the condition of target absent. The performance (RT) of the subjects correlated with the age in the control group, whereas no correlation between RT and age, disease duration and quality of sleep was found in ID patients.

Conclusion: The dissociation observed in visual search experimentally demonstrates the presence of a selective impairment in visual processing occurring in ID patients. Our results are discussed in the light of the hyperarousal concept of insomnia.

0625
TOTAL SLEEP TIME AS MODERATOR FOR SERUM GLUCOSE LEVELS IN COLLEGE STUDENTS WITH AND WITHOUT INSOMNIA
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Introduction: Previous literature that has examined metabolic activity in sleep debt conditions has shown increased glucose response. However, the relationship between metabolic activity and lower total sleep time (TST) in people with insomnia hasn't as thoroughly examined. The present study examines TST as a predictor of serum glucose levels in college students with and without insomnia. We hypothesized that lower TST would predict higher serum glucose levels in college-aged students with insomnia similar to participants in sleep debt conditions without insomnia.

Methods: Participants were 149 healthy college students; three participants were excluded for missing sleep diary data for a final N = 146 (Insomnia = 68, No Insomnia = 78). Insomnia status was determined via questionnaires and a semi-structured clinical interview for sleep disorders. TST was determined by one week of sleep diaries. Serum glucose was determined by comprehensive metabolic panel blood analysis. An independent samples t-test was performed to compare serum glucose levels between individuals with and without insomnia. Then, we conducted one linear regression within each group to examine the relationship between average TST and serum glucose levels. A repeated measures analyses examining 7-day variability of TST will be presented at the conference.

Results: There was a small difference in serum glucose levels between groups, t(147) = 1.48, p = .14, d = .25. Shorter TST was related to increased serum glucose levels among normal sleepers, F(1, 71) = 5.36, p = .02, but not among individuals with insomnia, F(1, 61) = .01, p = .93.

Conclusion: Contrary to our hypotheses, shorter TST was related to higher serum glucose levels among normal sleepers but not among individuals with insomnia. This might indicate distinct differences between late night eating behavior of college-aged students with insomnia versus those who do not have insomnia. Future research should examine eating behaviors of people with insomnia.

Support (If Any): NIH grant AI085558 NIAID (DJT, KK)

0626
ASSOCIATION BETWEEN CHRONOTYPE AND NONRESTORATIVE SLEEP
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Introduction: Nonrestorative sleep has received little attention in the literature, even though it can occur and cause impairment apart from other sleep complaints associated with insomnia. Evening chronotype, an inherent circadian preference for nighttime activity, may predispose individuals to less refreshing sleep, given societally imposed work schedules. The present study sought to assess whether greater self-reported eveningness orientation is associated with lower restorative sleep after controlling for nuisance variables.

Methods: Psychology undergraduates (N = 164, 128 women) completed a demographic survey and the morningness-eveningness questionnaire (MEQ) online. Then, each day for two weeks, students completed a sleep diary for the previous night's sleep and a restorative sleep questionnaire (daily version; RSQ). Participants' average sleep diary parameters and restorative sleep scores were computed across their entire sampling period. Hierarchical multiple regression analysis predicted restorative sleep from five consecutively entered sets of variables: demographics (gender, age, race, BMI), health problems (counts of psychiatric and medical diagnoses), sleep parameters (SOL, WASO, TWAK, TST, SE, NAP), self-reported status as an insomniac, and chronotype.

Results: Analysis revealed that MEQ explained significant incremental variance in RSQ after accounting for all previously entered covariates, ΔR-sqd = .06, p < .01. In the final hierarchical model, R-sqd = .26, F(17, 146) = 3.05, p < .001, only MEQ (β = .26, p < .01) and gender (β = -.20, p < .05) significantly predicted RSQ. Greater eveningness and female gender were associated with less restorative sleep. Notably, diary-assessed sleep pattern was unrelated to RSQ in the final model.

Conclusion: Evening chronotype was found to be uniquely associated with less restorative sleep, which builds upon previous research linking eveningness to a variety of physical and psychological health deficits. This finding also continues the work of elucidating interconnections between sleep disturbance and the circadian system.

0627
THE RELATIONSHIP BETWEEN SLEEP QUALITY AND PERCEIVED JOB PERFORMANCE IN NURSES SEEKING GRADUATE DEGREES
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Introduction: The dire consequences of sleep deprivation coupled with a nursing career can lead to critical occupational hazards and put patients, as well as nurses at risk. Registered nurses who are concur-
B. Clinical Sleep Science

0628
COMPARISON OF DIFFERENT SOCIAL PREDICTORS LEADING TO INSOMNIA IN BLACKS
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Introduction: Insomnia is a highly prevalent sleep disorder in the U.S., and it is associated with employment status, gender, income, and education. While low socioeconomic status is linked to complaints of insufficient sleep, little is known, however, about the predictive effect of certain social determinants of insomnia among blacks. Our study examined the relationship between different socioeconomic variables and presence of insomnia among blacks.

Methods: The study utilized data from the Metabolic Syndrome Outcome (METSO) study. This is an NIH-funded cohort study, enrolling a sample of 1,035 participants (mean age = 59 ± 13 years), who provided complete data for the analysis. Of the sample, 69.20% were male and 30.80% were female; 42.54% had annual family income < $10K, 64.69% reported High School Education level, and 37.71% indicated a U.S. birthplace. The Logistic regression analysis was used to assess the relationship between self-reported insomnia (a composite of difficulty falling asleep, difficulty staying asleep, and/or early morning awakening) and socioeconomic factors.

Results: Analysis showed that income was the only factor showing significant associations with insomnia after controlling for education level, birthplace, age, and gender. Based on the logistic regression analysis, blacks with annual family income < $10,000 had increased odds of reporting insomnia (OR = 1.685; 95 CL 1.07-2.65, p $10,000. These results remained significant even after controlling for covariates.

Conclusion: Consistent with previous studies, blacks reporting lower family income were more likely to report insomnia symptoms. Thus, income may play an important role in understanding higher rates of sleep complaints among blacks.

Support (If Any): This work was supported by funding from the NIH (RO1MD0041).

0629
EFFECT OF LED LIGHT TWO HOURS BEFORE BEDTIME ON DROWSINESS AND SLEEP
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Introduction: Light is the strongest zeitgeber for the circadian system. However, use of artificial lights makes a polar-day in our environment and may disturb our rhythm and health. Optimizing indoor lighting that simulate the natural environment may be an approach to improve wellbeing. The purpose of this study is to examine the effects of simulating lighting (adjustable light-emitting diodes (LED) lights E2:5000k - > 3000k, 160 lux - > 30 lux; E3:3000k 160 lux; and E4: 5000k 160 lux vs ordinary lightening E1: 5000k 160 lux fluorescent lamp) 2 hours before bedtime and during sleeping time on the drowsiness before bedtime and sleep in community dwelling adults.

Methods: A balanced cross-over experimental design was used. Under different lighting, activities performed before bedtime such as watching television/movies, using computer, pad or smart phone etc were allowed for one night and avoided for another night. Lighting kept dark during sleeping time. Twenty-four healthy volunteers (12 males and 12 females aged 20-34 years) slept 8 nights in sleep laboratory based on their habitual bedtime schedules. Drowsiness (Stanford Sleepiness Scale) was evaluated every 60 minutes two hours before bedtime and polysomnography was measured overnight.

Results: Results showed no significant difference in drowsiness level and PSG sleep among 3000–5000k LED and FL lightings. However, participants felt drowsier when using 3C were not allowed two hours before bedtime (F = 3.605–8.946, p = .064–.004). Sleep latency was shorter when using 3C was not allowed than allowed under E2 condition (F = 7.509, p = .009).

Conclusion: Participants feel drowsier and fall in sleep faster under the lighting of 3000–5000k color temperature 30-160 lux when using 3C instruments is restricted. Not only lights on the ceiling, but also lights from 3C instruments such as TV, smart phone, computer, iPad etc. may affect our readiness for sleep. Results from this study provide information for suitable lighting in our environment.

Support (If Any): This study was funded by the Industrial Technology Research Institute in Taiwan.

0630
TELEVISION AND COMPUTER HOURS AND SLEEP DISTURBANCES: IN THE 2005-2006 NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY
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Introduction: There is strong evidence on the link between sitting behavior, morbidity and premature death. Television viewing and screen based entertainment including computer use appears to be the most important indicator of non-occupational sitting behavior. However there is very little data on the relationship between screen based entertainment and sleep symptoms. We examined whether Television and computer hours were associated with sleep symptoms.

Methods: Data from the 2005-2006 US National Health and Nutrition Examination Survey were analyzed. Television hours, computer hours and sleep symptoms during the past 30 days were assessed at home interview. A total of 4,342 participants (including 2181 non-Hispanic whites, 1018 non-Hispanic blacks and 842 Mexicans Americans) age 20 years and over had data on screen hours and sleep symptoms.

Results: The median hours of sleep among the population was 7 hours; the median TV time was 2 hours; the median computer time was 1 hour.
Participants who reported 3 or more TV hours were more likely to report sleep more than 8 hours (p < 0.001), snoring/stop breathing (p = 0.016), snore > 1-2x/week (p = 0.025), sleepiness during the day (p = 0.015), waking up at night (p < 0.001), waking up too early (p = 0.003) and sleep latency > 30 minutes (p < 0.001). After adjusting for multiple variables including race, ethnicity, age, BMI, marital status and educational level, the significance for sleep disturbance remained. However, computer usage was not associated with any of sleep disturbance.

Conclusion: Television viewing was associated with significant sleep disturbances. However, computer use was not significantly associated with sleep disturbances.

0631
INSOMNIA WITH AND WITHOUT SHORT SLEEP DURATION - DIFFERENCES AND COMMON FEATURES
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Introduction: Two subtypes of insomnia have been suggested. Insomnia with polysomnographically (PSG) determined short sleep duration (total sleep time, TST < 6h) has been reported to be associated with hypertension, type 2 diabetes and longer insomnia duration in comparison with insomnia with normal sleep duration (TST > 6h).

Methods: In a retrospective study, 328 insomnia patients (203 women, 125 men; 44.3 ± 12.2 years) were investigated. All participants underwent two consecutive nights of PSG sleep monitoring. Blood pressure was routinely measured digitally or manually by trained nurses in the morning after awakening following a resting period. Hypertension was defined as a systolic blood pressure of ≥ 140 mm Hg, a diastolic blood pressure of ≥ 90 mm Hg, or use of antihypertensive medication. Fasting routine laboratory samples were taken in the morning after the first sleep laboratory night. A fasting glucose level of ≥ 126 mg/dl, or use of antidiabetic medication was defined as diabetes. Insomnia duration was assessed retrospectively.

Results: Insomnia with short sleep duration did not show any significant association with hypertension (first night: OR 0.80, CI 0.41-1.55; second night: OR 1.82, CI 0.82-4.02) or diabetes (first night: OR 1.39, CI 0.34-5.67; second night: OR 2.30, CI 0.48-10.96). Insomnia with short sleep duration was significantly associated with insomnia duration (first night: F = 6.02; p = 0.015) when the classification was based on the first but not on the second night.

Conclusion: Insomnia with short sleep duration was not replicated to be significantly associated with hypertension and type 2 diabetes, but with longer insomnia duration. Future work should seek to further elucidate the association between subtypes of insomnia and cardiometabolic diseases as well as insomnia duration.

0632
SLEEP DISTURBANCES, PERSONALITY, AND EMOTIONAL INTELLIGENCE
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Introduction: Insomnia defines difficulty falling or staying asleep, or waking earlier than desired with inability to return to sleep. Complaints of nonrestorative sleep (NRS) often associate with insomnia but can occur independently. Fragmented sleep and NRS affect mood, emotions, cognitions, and behaviors. The associations between sleep disturbance, personality traits, and trait emotional intelligence (TEI) were studied.

Methods: 219 participants (50 males, M age = 18.6 years; SD = 1.5), completed questionnaires about sleep difficulties related to insomnia (Insomnia Severity Index), restorative sleep (Restorative Sleep Questionnaire), personality traits (Big Five Inventory), and TEI (TEIQue-SF). Participants were compared on five personality scores and TEI.

Results: Personality traits and TEI were tested as predictors of insomnia severity and restorative sleep quality using blockwise multiple regression models controlling for gender, race, and sleep medication. The overall model regressing insomnia severity on personality traits and TEI was significant, R² = .19, F(5, 213) = 10.13, p < .001. Additionally, the overall model regressing restorative sleep quality on personality traits and TEI was significant, R² = .32, F(6, 212) = 16.22, p < .001. Insomnia severity related to the use of sleep medication (β = .15, p < .05), lower conscientiousness (β = -.22, p < .01), and lower TEI (β = -.24, p < .01). Restorative sleep quality related to lower neuroticism (β = -.33, p < .001), higher conscientiousness (β = .30, p < .001), and higher extraversion (β = .13, p < .05).

Conclusion: Individual characteristics, like personality traits and the perception of one’s emotional abilities, are associated with insomnia severity and restorative sleep quality. Restorative sleep related to lower neuroticism and higher extraversion, TEI was negatively associated with the severity of insomnia symptoms, and higher conscientiousness related to less disrupted sleep overall. Personality and emotional intelligence traits may play a role in development and maintenance of sleep disorders and daytime impairment of NRS, with positive personality traits and higher TEI possibly demonstrating a protective role to experiencing negative effects of poor sleep.

0633
SLEEP FRAGMENTATION DOES NOT EXPLAIN Misperception OF LATENCY OR Total SLEEP TIME
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Introduction: Misperception is not uncommon among patients with insomnia, although the mechanisms remain elusive. Quantifying the misperception phenotype involves two operational challenges: defining objective sleep latency and treating sleep latency and total sleep time as independent factors. We evaluated a novel approach to address these challenges and test the hypothesis that fragmentation explains misperception.

Methods: We performed a retrospective analysis on patients with or without obstructive sleep apnea during overnight diagnostic polysomnography in our laboratory (n = 391; n = 252). We compared subjective and objective sleep-wake durations to characterize misperception. We introduce a new metric, sleep during subjective latency (SDSL), which captures latency misperception without defining objective sleep latency and allows correction for latency misperception when assessing total sleep time (TST) misperception.

Results: The stage content of SDSL is related to latency misperception, but in the opposite manner as predicted: those with > 20 minutes of misperception had less N1%, more N3%, and lower transition frequency. After adjusting for misperceived sleep during subjective sleep latency, TST misperception was not associated with stage percentage but was greater in those with longer bouts of REM and N2 stages (OSA patients) as well as N3 (non-OSA patients).

Conclusion: Despite the advantages of SDSL as a phenotyping tool to overcome operational issues with quantifying misperception, our results suggest that misperception is not associated with sleep fragmentation. Further investigation of sleep physiology utilizing alternative methods than that captured by conventional stages may yield additional mechanistic insights into misperception.

Support (If Any): Department of Neurology, Massachusetts General Hospital
**0634**

**INFLUENCE OF ALTITUDE ON PERIODIC LEG MOVEMENTS DURING SLEEP IN INDIVIDUALS WITH RESTLESS LEGS SYNDROME AND HEALTHY CONTROLS: A PILOT STUDY**

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**Introduction:** Peripheral tissue hypoxia has been associated with restless legs syndrome (RLS) symptoms and is correlated with RLS severity. These observations support a pathophysiological role of peripheral hypoxia in RLS. A higher RLS prevalence was reported in high altitude mountain compared to coastal regions. Aim of this study was to investigate the influence of altitude on periodic leg movements during sleep (PLMS) in RLS patients and healthy subjects.

**Methods:** Five untreated RLS individuals and five healthy controls underwent two nights polysomnography according to AASM criteria with additional pCO2 measurements: one night in a simulated high altitude environment with normobaric hypoxia corresponding to 3000 m above sea level, and a control night with the same environment at Innsbruck local altitude (574 m), in randomized order. Sleep was scored according to AASM criteria. PLM scoring was performed twice: according to AASM criteria, and a further analysis included also respiratory-related leg movements (RRLM).

**Results:** 5 patients (4 f, 1 m) and 5 controls (3 f, 2 m) were included in this pilot study, mean age 39.7 ± 13.2 years. Age and sex distributions were no different between the two groups (p = 0.433 and p = 0.545, respectively). Sleep variables did not differ between the two nights, except oxygen saturation and apnea-hypopnea index (AHI). One control and one RLS subject with excessive AHI at 3000 m (86.6/h and 67.8/h, respectively) were excluded because of the influence of high AHI on PLM count. PLMS index including RRLM differed significantly between the two conditions (8.9 ± 12.1/h at 574 m, 15.2 ± 12.4/h at 3000 m; p = 0.042).

**Conclusion:** This pilot study investigated the acute effect of high altitude on PLMS in individuals with and without RLS. We found that high altitude is associated with higher PLMS indices in both RLS patients and healthy subjects. These results further support the pathophysiological role of peripheral hypoxia in RLS. Further studies with larger sample size are needed.

**0635**

**PRIOR TRAUMA AND ADVERSITY PREDICT IDIOPATHIC NIGHTMARES EVEN IN HEALTHY CONTROLS**

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**Introduction:** Frequent nightmares (NM) and nightmare-related distress have been linked to psychopathology, but the mechanisms underlying nightmare production remain largely unknown. Some neural correlates of nightmares have been proposed (Nielsen & Levin, 2007), mainly based on PTSD research, but the model has not yet been tested empirically. This model proposes that nightmares are a failure in an emotion regulation function of dreaming, resulting from a dysfunction of the Affect Network, which includes medial prefrontal cortex, anterior cingulate cortex, hippocampus, and amygdala. In this study, we use functional imaging during wakefulness to investigate possible neural correlates of NM production in a sample of frequent NM sufferers.

**Methods:** 62 subjects (42F; M = 24.3 ± 4.2yrs) recalling 2+ NM/wk and 61 CTls (41F; M = 24.0 ± 4.6yrs) recalling less than 1 NM/mo were recruited by advertisement. Retrospective measures: all subjects completed the TAQ, the NM Distress Questionnaire (NDQ) and items estimating last-month frequencies of recalling dreams, bad dreams (BD), NMs, and distress occurring during (DistressRD) or after (DistressRA) disturbing dreams. Prospective measures: 2-week home logs evaluated intensities (1-9 scales) of Negative and Positive emotions, Fear, Distress during (DistressPD) and after (DistressPA) each dream and if the dream woke them up (WU: yes/no). Measures were BDRecall (%dreams with Negative/Fear greater than 4 and all Negative ratings greater than Positive ratings and no WU), NMRecall (same as BDRecall but with WU), average 2-wk Negative, Fear, DistressPD and DistressPA ratings, and %dreams with WU. TAQ measures were Adversity (sum of 35 adversity items x 4 age strata) and Trauma (sum of 17 trauma items x 4 age strata).

**Results:** Unpaired t-tests showed NM greater than CTl on all measures (p < .001). Significant Spearman correlations were found between Adversity and all 12 measures (p < .002) and between Trauma and 9 of 12 measures (p < .02). However, within the NM group, Adversity and Trauma correlated only with retrospective distress (all p < .01); within the CTl group, they correlated with retrospective distress (DistressRD: r = .300, p = .020; NDQ: r = .426, p = .001), NMRecall (r = .322, p = .011) and prospective measures (Adversity only): i.e., with Fear (r = .272, p = .042), DistressPD (r = .289, p = .031), DistressPA (r = .379, p = .004), and WU (r = .309, p = .020).

**Conclusion:** Association of past adversity with NM-associated distress among non-clinical NM sufferers and, especially, among healthy controls supports diathesis-stress explanations of NM pathogenesis. Common NMs may signal accumulating, adversity-induced risk for developing future PTSD.

**Support (If Any):** Canadian Institutes of Health Research Natural Sciences and Engineering Research Council of Canada

**0636**

**DECREASED ACTIVITY IN MEDIAL PREFRONTAL CORTEX AND ANTERIOR CINGULATE CORTEX IN IDIOPATHIC NIGHTMARE SUFFERERS DURING WAKEFULNESS**

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**Introduction:** Frequent nightmares (NM) and nightmare-related distress have been linked to psychopathology, but the mechanisms underlying nightmare production remain largely unknown. Some neural correlates of nightmares have been proposed (Nielsen & Levin, 2007), mainly based on PTSD research, but the model has not yet been tested empirically. This model proposes that nightmares are a failure in an emotion regulation function of dreaming, resulting from a dysfunction of the Affect Network, which includes medial prefrontal cortex, anterior cingulate cortex, hippocampus, and amygdala. In this study, we use functional imaging during wakefulness to investigate possible neural correlates of NM production in a sample of frequent NM sufferers.

**Methods:** We used high resolution 99mTc-ECD SPECT imaging to assess regional cerebral blood flow (rCBF) in 14 frequent NM sufferers and 14 control subjects (NM: 25.1 ± 4.8 yrs (10 W), CTL: 24.8 ± 5.6 yrs (10 W); t26 = .145, p = .89) during the viewing of negative pictures from the International Affective Picture System. To evaluate group differences in rCBF, we used multiple t-tests for independent samples with a significance threshold of p < .001 (uncorrected).
ASSOCIATION BETWEEN RESTLESS LEG SYNDROME, CARDIOVASCULAR DISEASE, AND MORTALITY: A SYSTEMATIC REVIEW AND META-ANALYSIS
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Introduction: Previous research suggests a possible link between restless leg syndrome (RLS) and cardiovascular disease or mortality. However, there was controversy about findings from those studies. Association from those studies could also be due to confounders. We performed a systematic review and meta-analysis to assess risk of cardiovascular events and mortality from restless leg syndrome.

Methods: Eligible observational studies assessing the association between restless leg syndrome and cardiovascular disease or mortality were comprehensively searched in MEDLINE and EMBASE from their inception to December 2015. Search terms used were restless leg syndrome, restless leg syndrome in older people, frequent leg movements in sleep, sleep disturbance, sleep-related events, sleep-related disorders, sleep-related events, sleep-related disorders, and mortality in restless leg syndrome. Two authors independently assessed article quality and extracted the data. Primary outcome was composite endpoint of mortality, ischemic heart disease, stroke, and major adverse cardiac events (MACE). Secondary outcome was mortality as an independent outcome. A meta-analysis using a random-effects model comparing between participants with restless leg syndrome and control was performed. We calculated pooled hazard ratio (HR) of outcome using reported HR in the multivariate model adjusting for confounders.

Results: From 46 full-text articles, nine prospective observational studies met our inclusion criteria and were included in the meta-analysis. There was a significant increase risk of all composite endpoint with a pooled HR of 1.34 (95% CI: 1.21-1.61, p-value < 0.001), and mortality a pooled HR of 1.40 (95% CI: 1.08-1.83, p-value = 0.01) in participants with RLS.

Conclusion: Restless leg syndrome increases risk of mortality, ischemic heart disease, stroke, or major adverse cardiac events compared to controls. Future studies should assess the impact of restless leg syndrome treatment and risk reduction of these outcomes.

THE ASSOCIATION BETWEEN PERIODIC LIMB MOVEMENTS AND CHANGE IN COGNITIVE FUNCTION IN OLDER MEN
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Introduction: Periodic limb movements in sleep (PLMS) are common among elderly men, with impaired dopaminergic transmission proposed as a mechanism. Studies have reported an association between PLMS and Parkinson’s disease (PD) as well as worse executive function in the setting of PD. However, no study has prospectively examined the link between PLMS and change in cognition in community-dwelling older adults.

Methods: We studied 2636 older men (mean age 76 years) without significant cognitive impairment who underwent in-home polysomnography at baseline with measurement of the periodic limb movement index (PLMI) coded as the total number of periodic leg movements per hour of sleep. Random-effects models were used to examine the association between categories of PLMI (roughly by tertile: <5, 5 to <30, ≥30) and change in cognitive function from baseline over 3-4 years with 2 follow-up visits, as assessed by a test of global cognition, Modified Mini-Mental State Examination (3MS), and a test of executive function, Trails B.

Results: After adjustment for age, clinic, race, education, physical activity, diabetes, hypertension and coronary heart disease, the increase in Trails B test completion time over 3 years were 3.45, 6.27 and 8.1 seconds for PLMI category of ≤5, 5-30 and ≥ 30, respectively (p for trend = 0.02); adjusted decline in 3MS score for PLMI categories were 1.26, 0.87, and 0.96 points over 3 years, respectively, but this association was not significant (p for trend = 0.23). Further adjustment for polysomnography-measured sleep efficiency or dopaminergic use did not appreciably alter the results. Sensitivity analysis among the subset of participants after excluding men with a history of PD (N = 29) showed similar findings.

Conclusion: Among non-demented older men, increasing PLMS frequency was associated with declining cognitive function, particularly in executive function. Identification of PLMS in the elderly might help to predict future cognitive decline.

Support (If Any): The Osteoporotic Fractures in Men (MrOS) Study is supported by National Institutes of Health funding. The National Heart, Lung, and Blood Institute (NHLBI) provides funding for the MrOS Sleep ancillary study “Outcomes of Sleep Disorders in Older Men” under the following grant numbers: R01 HL071194, R01 HL070848, R01 HL070847, R01 HL070842, R01 HL070841, R01 HL070837, R01 HL070838, and R01 HL070839.

CLINICAL EFFICACY OF FERRIC CARBOXYMALTOSE TREATMENT IN PATIENTS WITH RESTLESS LEGS SYNDROME
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Introduction: There have been a few randomized, placebo-controlled, double-blind studies of IV iron in RLS. The purpose of this study was to replicate and extend the findings from the prior study, Allen et al.
Conclusion: Significant CSVA deficits exist in individuals with RBD, and these deficits worsen with time. Intriguingly, the degree of CSVA deficits is similar among patients with and without PD. To date, no patient in the non-PD-RBD subgroup has developed extrapyramidal signs, however further follow-up is warranted.

Support (If Any): This study was supported by the FSU College of Medicine and TMH Healthcare Foundation.

0640

GENETIC CHARACTERIZATION OF THE PAINFUL RESTLESS LEGS PHENOTYPE

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Introduction: Genome-wide association studies have identified six genomic loci (BTBD9, MEIS1, PTPRD, MAP2K5/SKOR1, TOX3/BC034767) conferring susceptibility for restless legs syndrome (RLS) based on common single nucleotide polymorphisms (SNPs). Ekbom’s original description and subsequent cohorts have consistently recognized a painful subgroup of about 1/3 of RLS patients, however the biological basis for this phenotypic variant remains unknown. We explored whether any individual SNPs associating with RLS as a whole were more strongly associated with complaints of painful versus non-painful RLS.

Methods: RLS patients (N = 224; Age = 53.3 ± 16.4; 89% Caucasians; 60% females) diagnosed clinically were genotyped for known variants associating with RLS susceptibility. Affectation status of painful RLS required that subjects selected “painful” from a multiple-choice list of (N = 14) adjectives proffered to describe their sensory experience(s) as well as answering in the affirmative to an explicit question asked later in the questionnaire as to whether they perceived their RLS symptoms as pain. We thus identified two patient subgroups, a painful (n = 8) versus non-painful RLS (n = 176). Demographic data were analyzed using Chi-square or Fisher’s exact tests. Genotypes were tested for Hardy-Weinberg-Equilibrium (HWE) by applying Fisher’s exact test prior to data analysis using PLINK (v1.09). Genotype association tests employed logistic regression analyses with assumption of an additive genetic model. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. Permutation tests based on 1,000,000 replications were performed to correct for multiple comparisons.

Results: Painful versus non-painful RLS did not differ in age (p = 0.474), gender (p = 0.079) or ethnicity (p = 0.396). Among the six tested loci, only TOX3/BC034767 was more significantly associated with painful RLS. The at-risk allele T of SNP rs3104767 increased the risk of RLS being perceived as painful by 1.74-fold (95% CI = 1.07-2.825) in the overall RLS patients sample (p = 0.025).

Conclusion: These data suggest a possible biological substrate for painful RLS that requires replication in larger and more diverse RLS populations.

Support (If Any): We thank the RLS Foundation and individual patients for monetary support and donating biological samples, and DECODE Genetics for genotyping patient samples.
Iron Deficiency and Anemia in the Mu Opiate Receptor Knockout Mouse Model of Restless Legs Syndrome

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Introduction: Previous studies have separately implicated endogenous opiate and iron deficiency in the pathogenesis of Restless Legs Syndrome (RLS). However, few studies have explored the relationship between these two systems and hypotheses.

Methods: Mu opiate receptor knockout mice were imported from Jackson Labs and bred in house. Motor activity was examined by wheel running over the entire circadian cycle. Brain striatum was examined for changes in iron, dopamine and serotonin. Blood samples were drawn to look for evidence of iron deficiency and to look for the cellular pathology typical of iron deficiency anemia. Iron deficient (wild type) mice, pharmacologic blockade of the mu opiate receptor was done and the serum examined for the presence of iron deficiency.

Results: Wheel running showed statistically significant increases in motor activity during the animal’s normal sleep period parallel to human RLS (P < .05). Serum iron was significantly decreased both in the mu opiate receptor knockout mice (P < .05) and in the wild type mice who underwent pharmacologic blockade of the mu opiate receptor (P < .05). The knock out mice were also anemic as red cell count, hemoglobin and hematocrit were all statistically significantly reduced compared to the wild type. Red cell morphology typical of iron deficiency anemia (microcytosis and hypochromia) was seen in 5 of 11 knock out mice and none of 4 wild type mice. There were no significant changes in striatal brain iron, dopamine or serotonin concentrations, perhaps related to sample size.

Conclusion: This small in-vivo RLS animal model study supports our previous in-vitro RLS animal model study showing that endogenous opiate deficiency may lead to iron deficiency, a known trigger of RLS. An intact endogenous opioid system may be an important factor in preventing the iron deficiency that precipitates RLS. Larger studies are needed.

What About Other Body Metals in RLS?: Preliminary Evidence for an Increase in Zinc in Restless Legs Syndrome

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Introduction: Iron (Fe) deficiency is a well known cause of Restless Legs Syndrome (RLS). However limited information is available on other body metals in RLS except for calcium (Ca) and magnesium (Mg) for which results are contradictory.

Methods: Serum body metals were analyzed in a pilot study of 10 RLS patients (6 female, 4 male avg age 53.1 yrs, range 39-65 yrs) and 9 matched controls (6 female, 3 male avg age 48.8 yrs, range 30-65 yrs).

Results: Serum levels of Zinc (Zn) were significantly increased in RLS patients compared to controls (1100.2 mcg/L versus 914.8 mcg/L) (P = .008). There were no significant differences in Fe, Ca, Mg or Selenium (Se), Manganese (Mn), Cobalt (Co) or Copper (Cu).

Conclusion: In this small preliminary study of serum body metals in RLS, only Zn showed statistically significant differences between patients versus controls. We doubt that treatment was the cause of the changes observed since the patients were under different treatments for RLS. Larger sample sizes are probably needed to show differences in iron. We are currently extending our observations to RLS patients who are off treatment for RLS and we are also examining Zn levels in cultured lymphoblasts. Zn biologically and separately interacts with iron, the dopamine system, the endogenous opioid system and vitamin D, all of which have been implicated in the pathogenesis of RLS. Further studies of these interactions are needed. Zn and Fe also act upon the same biological systems so studies of Zn in RLS Fe related systems would also be in order.

Support (If Any): This project has been supported in part by NIH R01 ES010563 (ABB, MA). We would like to thank our research assistant Wendi Welch for her help in carrying out this project.

Familial Aggregation of REM Sleep Behavior Disorder: Preliminary Findings from a Case-Control Family Study

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Introduction: Previous study from the international RBD study group has found that patients with RBD reported a higher rate of family history of RBD symptoms than controls did. However, self-reported family history may lead to significant bias. Therefore, further study with confirmation of diagnosis for relatives of patients is warranted to ascertain the familial aggregation of RBD. We aimed to investigate the familial aggregation of RBD symptoms.

Methods: First degree relatives (FDR) of RBD probands and FDR of controls whose age and sex were matched with RBD probands were recruited. The RBDQ-HK and face-face clinical interview were employed to document RBD symptoms. Participants with RBD symptoms were further confirmed by video-polysomnogram. Unified Parkinson’s disease rating scale (UPDRS) was used to measure motor problems.

Results: Up to December 2015, a total of 182 FDR were recruited including 141 of RBD probands (age: 53.34 ± 8.60 years, male: 43.0%) and 41 controls (age: 57.54 ± 10.52 years, male: 31.7%). There was a trend of statistical significance in RBDQ-HK total score (9.22 ± 8.50 for FDR of RBD patients vs. 6.98 ± 10.12 for FDR of controls, p = 0.156) and probable RBD diagnosis by clinical interview (17.2% vs. 7.3%, p = 0.121). FDR of RBD patients had a significant higher percentage of RBDQ factor 2 with a cut-off of 7/8 than FDR of controls (25.4% vs. 10.2%, p = 0.013). There was also a trend of statistical significance in RBD diagnosis confirmed by v-PSG between FDR of RBD patients and FDR of controls (7.1% vs. 0%, Fisher Exact test p = 0.120).

Conclusion: In the preliminary analyses of this on-going study, we found a familial aggregation in RBD symptoms and diagnosis. We are recruiting more participants to increase the sample size.

Support (If Any): This project is supported by Health and Medical Research Fund (Reference number:12131501), Hong Kong SAR, China. The funding body has no role in conception, design, conduction, interpretation and analysis of the study or in the approval of the publication.
0645
THE RELATIONSHIP OF MUSCARINIC ANTAGONISTS WITH SLEEP RELATED MOVEMENT DISORDERS: REM ATONIA AND PERIODIC LIMB MOVEMENTS
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Introduction: Numerous pathways have been postulated to explain the mechanisms responsible for the development of REM sleep without atonia (RWA). This includes medication effects on glycinergic and GABA-ergic pathways. The muscarinic receptors on glutaminergic synaptic potentials may also play a key role in this process. The objective of this study was to determine the effect of muscarinic antagonists on sleep related movements disorders.

Methods: A retrospective chart review of attended polysomnograms (PSGs) completed between 2013 and 2015 was performed on patients taking muscarinic antagonists. Exclusion criteria included (i) absence of REM sleep (ii) presence of alpha synucleinopathy and (iii) the use of antidepressants known to cause RWA. RWA was defined as an increase in EMG tone > 10% of REM sleep. Periodic limb movements in sleep (PLMS) was defined as a periodic limb index (PLMI) of > 15 limb movements/hour.

Results: 30 subjects (10 male, 20 female) with a mean age of 56.2 ± 9 (range 36-70 years) and a mean BMI 41.42 ± 11.2 kg/m2 were included. The most common muscarinic antagonists used were oxybutynin (27%) and hydroxyzine (47%). 2 patients (1 male, 1 female, aged 38 and 60 years) had significant RWA (15% and 37% of REM sleep respectively). 9 patients (30%) had PLMS with a mean PLMI of 51.11 ± 25.4 (range 15-104) with the same gender distribution. These patients did not have a statistically different severity of obstructive sleep apnea compared to the remainder of the group and their PLMI’s did not improve with CPAP.

Conclusion: Patients taking muscarinic antagonists may have a higher incidence of RWA and PLMS. These findings suggest these medications may contribute to ‘pharmacologically’ induced RWA and PLMS and explain the mechanism by which these phenomenon occur. Further investigations are needed to better define this relationship and its consequences.

0646
NEW INSIGHTS INTO DISORDERS OF AROUSAL BY HIGH-DENSITY EEG VIDEO-POLYSOMNOGRAPHY
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Introduction: Disorders of arousal (DOA) are NREM sleep parasomnias characterised by recurrent episodes of disassociated wake-sleep behaviours abruptly emerging from slow wave sleep. The underlying mechanisms of DOA are still unknown. They might depend on abnormal activation of excitatory brain areas or on aberrant deactivation of inhibitory areas, which eventually result in the release of motor or behavioural programs named “central pattern generators”. The aim of the study is to identify which brain areas are involved during DOA episodes and their pattern of activity.

Methods: In a non-medicated otherwise healthy 22-year old male patient with a history of DOA we recorded 14 DOA episodes during 2 V-PSG recordings (one by a 10-channel EEG montage, the other by a 256-channel HD-EEG montage). All the events were accompanied by a high-voltage hyper-synchronous delta (3-5 Hz) activity at scalp EEG. The pre-arousal period of each event was analysed: A) by a time-frequency analysis (Morlet’s wavelets), on the average of the 10 EEG channels in common to both V-PSG recordings; B) by a cortical source analysis of EEG activity on the 256-channel EEG V-PSG at different spectral bands; C) by a connectivity analysis (estimation of Granger’s causality) based on this latter.

Results: In the 30 seconds preceding the events: A) time-frequency analysis showed an increase of delta (0.5-2 Hz) band power; B) source analysis demonstrated an increase followed by a decrease in delta band at right prefrontal cortex, followed in turn by an increase of the same frequency band in right and left prefrontal and left temporal cortices compared to the baseline (p < 0.001); C) connectivity analysis suggested bidirectional interactions among these three regions (p < 0.05).

Conclusion: We hypothesize DOA to be triggered by a failure of inhibition of delta activity starting at right prefrontal cortex, eventually resulting in the release of central pattern generators.

0647
RESTLESS LIMBS SYNDROME (RLS): NATURAL HISTORY VS. AUGMENTATION
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Introduction: The natural history of RLS is not well-defined. Dopamine Agonists (DA) have side effects including augmentation which can cause symptoms to worsen, occur earlier in the day, and spread to other parts of the body. The precise incidence of augmentation is unknown.

Methods: 983 patients with IRLSSG criteria for RLS completed a survey addressing location and diurnal variability of symptoms at onset (mean age 38 years) and presentation (mean age 53 years). 772 received DA’s (M group) and 102 did not (NM group). The groups were compared for progression.

Results: M and NM groups were matched at onset for age, gender, onset of symptoms in the legs (58.8% vs. 57.8%) and nocturnal onset (46.3% vs 52.7%). At presentation (mean time progression = 15 years) symptoms involved the arms in 56.2% M and 49.5% NM (p = 0.68). Of patients with only nocturnal symptoms at onset, symptoms became diurnal in 74% M and 73.4% NM (p = 0.50). 120 of 772 M patients (15.5%) experienced worsening of symptoms or side effects. 36 of these had complaints suggesting augmentation including: worsening of pain/symptoms (22), earlier onset (5) or shorter effects of medication (9).

Conclusion: These data support that the natural history of RLS includes spread of symptoms over space and time. Progression in these realms was not significantly different between medicated and non-medicated groups.

0648
PREVALENCE OF RESTLESS LEGS SYNDROME/ WILLIS-EBKOM DISEASE AND ITS ASSOCIATION WITH IRON DEFICIENCY. RESULTS FROM THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (HICH/SOL)
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Introduction: In the United States and Western Europe the estimated Restless Legs Syndrome (RLS)/Willis-Ekbom Disease (WED) preva-
lence ranges from 7.5% to 19%. There is limited data regarding the prevalence of RLS in the Hispanic/Latino population residing in the US.

**Methods:** The Hispanic Community Health Study (HCHS)/Study of Latinos (SOL) is a community based prospective cohort study of 16,415 self-identified Hispanic/Latino persons from 4 US field centers. Presence of RLS/WED was established by formulary using the diagnostic criteria from the International Restless Legs Study Group. A total of 10,845 subjects were included in the analysis. Prevalence weighted to adjust for sampling probability and non-response of RLS/WED was calculated using a linear regression model and then adjusted for age, gender, BMI, education level, acculturation, diabetes, CKD, OSA and shift work. We used logistic regression models to assess the association between RLS and log transformed ferritin levels and RLS/WED and iron deficiency anemia.

**Results:** Unadjusted prevalence of RLS/WED was 26.3% (Mexican 20.6%, Cuban 25.7%, Puerto Rican 40.6%, Dominican 33.4%, Central American 22.4%, South American 22.4%). Age-adjusted prevalence was 21.3% in men and 30.8% in women (20.1% and 29.6% after adjusting for covariates). RLS/WED was overall associated with log transformed ferritin levels OR = 0.94 (0.88-0.995), p = 0.03 but this association was not observed after adjusting for covariates OR = 0.99 (0.91-1.07), p = 0.72. RLS/WED was weakly associated with iron deficiency anemia and non-iron deficiency anemia but not after adjusting for covariates. No association was observed between RLS/WED and iron deficiency anemia. This study did not exclude potential RLS mimics which could contribute to the high prevalence of RLS/WED noted in Hispanic/Latinos.

**Conclusion:** The prevalence of RLS/WED in Hispanic/Latinos higher than expected compared to the general US population. RLS/WED was associated with ferritin levels and iron deficiency without anemia but this was not observed after adjusting for covariates.

**Support (If Any):** The Hispanic Community Health Study/Study of Latinos was carried out as a collaborative study supported by contracts from the National Heart, Lung, and Blood Institute (NHLBI) to the University of North Carolina (N01-HC65233), University of Miami (N01-HC65234), Albert Einstein College of Medicine (N01-HC65235), Northwestern University (N01-HC65236), and San Diego State University (N01-HC65237).

**0649 ASSOCIATION BETWEEN PERIODIC LIMB MOVEMENT DISORDER AND CARDIOVASCULAR OUTCOME: A SYSTEMATIC REVIEW AND META-ANALYSIS**

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**Introduction:** Periodic limb movement disorder (PLMD) is associated with hypertension and other cardiovascular risk factors. However, its association with cardiovascular outcome such as coronary artery disease (CAD), congestive heart failure (CHF), and stroke is still controversial. We performed a systematic review and meta-analysis to assess association between PLMD and cardiovascular outcome.

**Methods:** Eligible observational studies assessing the association between PLMD and cardiovascular outcome were comprehensively searched in MEDLINE and EMBASE from their inception to December 2015. Search terms used were periodic limb movement, nocturnal myoclonus syndrome, PLMD, sleep-disturbance, coronary disease, cardiovascular disease, cerebrovascular event, and stroke. Two authors independently assessed article quality and extracted the data. Primary outcome was composite endpoint of ischemic heart disease, stroke, congestive heart failure, and cardiovascular disease. A meta-analysis using a random-effects model comparing between participants with PLMD and control was performed. We calculated pooled odds ratio (OR) of outcome using reported number of participants and OR in the multivariate model adjusting for confounders.

**Results:** From 18 full-text articles, five observational studies met our inclusion criteria and were included in the meta-analysis. PLMD was diagnosed with polysomnography. There was a significant increase odds of all composite endpoint with a pooled OR of 1.83 (95% CI: 1.26-2.66, p-value < 0.001). In a subgroup analysis of CVD as an independent outcome, the pooled OR was 1.87 (95% CI: 0.88-3.97, p-value = 0.10).

**Conclusion:** Periodic limb movement disorder has higher odds of cardiovascular outcome including CAD, CHF, CVD and stroke compared to controls. Future studies should assess the impact of PLMD treatment on improvement of these outcomes.

**0650 NOCTURNAL LEG CRAMPS: PREVALENCE AND ASSOCIATIONS WITH DEMOGRAPHICS, SLEEP DISTURBANCE, MEDICAL COMORBIDITY, AND CARDIOMETABOLIC RISK FACTORS**

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**Introduction:** Nocturnal leg cramps (NLC) are common and poorly understood. Their primary morbidity is sleep disturbance and its next day consequences.

**Methods:** Data from the National Health and Nutrition Examination Survey was used from the 2005-2006 and 2007-2008 waves. NLC were assessed with: “In the past month, how often did you have leg cramps while trying to sleep?” Responses were categorized as None (“Never”), Mild (“1/month” or “2-4/month”), or Moderate-Severe (“5-15/month” or “> 15/month”). Variables representing demographics, medical history, sleep disturbances, and cardiometabolic risk factors were selected from the 2005-2006 dataset. Those that demonstrated significant relationships to NLC after adjusting for age, sex, education, and BMI were assessed in the 2007-2008 dataset. Variables that were still significant were entered into a forward stepwise regression model combining both waves, to determine which variables contributed the most unique variance to NLC.

**Results:** Prevalence was similar among both waves, with 24-25% reporting mild and 6% reporting moderate-severe NLC. NLC increased with age, lower education, unemployment, shorter sleep duration, all assessed sleep symptoms (nocturnal “leg jerks”), snoring, snorting/gasping, difficulty falling asleep, difficulty maintaining sleep, early morning awakenings, non-restorative sleep, sleepiness, sleep insufficiency, use of sleep medications), higher BMI, medical history (hypertension, heart failure, angina, stroke, arthritis, respiratory disease, and cancer), depression symptoms, and biomarkers (CRP, HbA1c, calcium, mercury, red blood cells). Stepwise analysis showed that the factors that contributed unique variance to severe leg cramps were (in decreasing order with direction): “leg jerks(+)”, overall health(-), arthritis(+), difficulty falling asleep(+), age(+) nonrestorative sleep(+), red blood cell count(+), education(+), angina(-), hypertension(-), BMI(+), early morning awakenings(+), HbA1c(+), heart attack(+), asthma(+), and marital separation(+).

**Conclusion:** Based on this first large, representative national prevalence study, NLC occur > 5x per month in 6% of the adult US population. Multiple sleep disturbance symptoms and health-related comorbidities are associated with higher frequency of NLC.
**IV. RLS, Movement Disorders and Parasomnias**

0651

**IRON STATUS AND NOCTURNAL LEG SYMPTOMS IN WOMEN OF REPRODUCTIVE AGE**

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**Introduction**: The purpose of the present study was to examine the relationship between measures of iron status and nocturnal leg symptoms in a large, nationally-representative female sample. As a secondary aim we examined this relationship among pregnant women.

**Methods**: Data were obtained from the National Health and Nutrition Examination Survey (NHANES) for secondary analysis. Measures of iron status included ferritin, transferrin saturation, erythrocyte protoporphyrin, serum transferrin receptor (sTfR), and total body iron. Nocturnal leg symptoms were defined by sleep-related leg jerks ≥ 5 times a month. Univariate and multivariate associations were tested.

**Results**: In the full sample, the prevalence of leg symptoms was not significantly different across quintiles of any iron measure tested. However, there was a significant race interaction, with low transferrin saturation associated with leg symptoms among white women (p = 0.006) but not women of other races (p = 0.19). Among pregnant women, low sTfR was associated with leg symptoms, even after adjusting for covariates (p = 0.03). CRP level did not alter these results.

**Conclusion**: These data support an association between low transferrin saturation and leg symptoms, but only among white women. In addition, among pregnant women, we found a relationship between low sTfR and the presence of leg symptoms; we speculate that this finding represents a shunting of available iron from maternal to fetal tissues predisposing to leg symptoms.

0652

**A STUDY ON THE MORTALITY OF PATIENTS WITH PERIODIC LIMB MOVEMENTS IN SLEEP**

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**Introduction**: Sleep disorders have negative effects on physical and mental health. Periodic limb movement disorder (PLMD) has also significant sleep disturbance and can impair mental, physical functioning. There are prior studies that periodic limb movements in sleep (PLMS) increase mortality rate in patients with heart disease or kidney disease.

**Methods**: Nocturnal polysomnographic recordings of the 1,344 subjects from 1995 to 2008 were reviewed. Those diagnosed as RLS, OSA, CSA, RBD, narcolepsy, or under 15 years old were excluded. Subjects were divided into four groups based on PLMS and insomnia: reference (PLMS ≤ 5), insomnia (PLMS ≤ 5 and insomnia symptoms), 5 < PLMS ≤ 15 and PLMS > 15. Sleep Efficiency (SE), Wake after sleep onset time (WASO), Sleep latency (SL) and hazard ratio of mortality(HR) were compared among the four groups. We searched each subject’s Korean Identification Number and name in the death records from Statistics of Korea, the national bureau of statistics, to determine the deaths in the cohort that occurred prior to December 31, 2013.

**Results**: There was significant difference between four groups in age (mean ± SD; reference, 39.1 ± 14.4 years; insomnia, 48.0 ± 12.2 years; 5 < PLMS ≤ 15, 51.7 ± 12.6 years; PLMS > 15, 56.4 ± 13.3 years, p < 0.001), and gender (%male; 65.7%; 43.8%, 47.0%, 45.2%, p < 0.001). Adjusting for age and gender, SE in insomnia and PLMS > 15 was significantly lower than those in reference. (76.2 ± 106.6% and 75.5 ± 18.0% vs 81.6 ± 18.6%, p < 0.001). WASO in insomnia and PLMS > 15 was significantly higher than those in reference (93.3 ± 69.0min and 95.1 ± 72.0min vs 70.5 ± 79.7min, p < 0.001). Before adjusting for age and gender, HRs in 5 < PLMS ≤ 15 and PLMS > 15 were significant higher than those in reference (3.37, 95%CI 1.73 to 6.55, p < 0.001; 5.77, 95%CI 3.24 to 10.29, p < 0.001). With adjusting for age and gender, only PLMS > 15 has higher mortality ratio than reference (2.10, 95%CI 1.12 to 3.92, p = 0.020).

**Conclusion**: The current results suggest that patients with PLMS may be associated with increased mortality risk.

0653

**MORTALITY AND ITS RISK FACTORS IN PATIENTS WITH RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER**

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**Introduction**: To determine the mortality and its risk factors in patients with rapid eye movement (REM) sleep behavior disorder (RBD).

**Methods**: A total of 205 consecutive patients with video-polysomnography confirmed RBD (78.5% males, mean age = 66.4 ± 10.0 years) were recruited. Medical records and death status were systematically reviewed in the computerized records of the health care system. Standardized mortality ratio (SMR) was used to calculate the risk ratio of mortality in RBD with reference to the general population.

**Results**: Forty-three patients (21.0%) died over a mean follow-up period of 7.1 ± 4.5 years. The SMR was not increased in the overall sample (SMR (95% CI) = 1.00 (0.73-1.33)). However, SMR (95% CI) increased to 1.80 (1.21-2.58) and 1.75 (1.11-2.63) for RBD patients who eventually developed neurodegenerative diseases and dementia, respectively. In the final Cox regression model, mortality was significantly associated with chronic obstructive pulmonary disease (HR = 3.01; 95% CI, 1.33-6.84), cancer (HR = 2.60; 95% CI, 1.15-5.88), periodic limb movements during sleep (HR = 4.79; 95% CI, 2.27-10.11), and dementia (HR = 1.98; 95% CI, 1.06-3.70).

**Conclusion**: Patients with RBD have a higher mortality than the general population only if they develop neurodegenerative diseases. Several risk factors on clinical and sleep aspects are associated with mortality in RBD patients. Our findings underscore the necessity of timely neuroprotective interventions in the early phase of RBD before the development of neurodegenerative diseases.

**Support (If Any)**: This work was supported by the General Research Fund (Reference number 476610) of the Research Grants Council and the Health and Medical Research Fund (Reference number 01120326) of the Food and Health Bureau of Hong Kong SAR, China.

0654

**THE USE OF THE SUGGESTED IMMOBILISATION TEST IN CHILDREN WITH ADHD: RELATIONSHIPS WITH PERIODIC LEG MOVEMENTS DURING SLEEP AND NOCTURNAL AWAKENINGS**

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**Introduction**: The Suggested Immobilisation Test (SIT) is used to detect the restless legs syndrome (RLS) in adults. In this study, we administered the SIT in children with ADHD and explored its relationship with periodic leg movements during sleep (PLMS) and during wake (PLMW).
Methods: 54 children (6-17 years, 41 boys) were recruited in a sleep disorder clinic for children and referred to the laboratory for one night of diagnostic polysomnography on the basis of various types of sleep complaints. Before lights out, they were asked to sit in bed with legs outstretched, trying not to move them while surface EMG was recorded from bilateral anterior tibialis muscles during 30–60 minutes. The sleep of 41 additional children (5-17 years, 28 boys) was also recorded without having the SIT. Every child was diagnosed with ADHD and no one had epilepsy or intellectual deficiency. Periodic leg movements during the SIT, PLMS and PLMW were scored according to standard methods. Groups were compared with ANOVAs and the association between the SIT, PLMS and PLMW results was analyzed with Pearson correlations.

Results: 65% of the children tested with the SIT had an index above the clinical cut-off core of 40 (mean index: 137.6). The number of periodic leg movements during SIT in all children combined was positively correlated with both PLMS ($r = 0.271, p = 0.048$) and PLMW ($r = 0.372, p = 0.006$). The PLMS index was greater in the total sample of SIT-tested children than those not tested ($p = 0.001$) but the PLMW index was not different. The SIT-positive children showed these same differences but SIT-negative children did not.

Conclusion: This study confirms that the SIT can be used in ADHD children and supports that RLS prevalence is high in this population. It also suggests that the SIT could be used to predict the severity of PLMS and PLMW in children with ADHD.

Support (If Any): This work was partly supported by “Fondation Petits trésors de l’hôpital Rivière-des-Prairies” and the Bell Canada Mental Health Research Initiatives Support Program.

0655

VALIDATION OF A NEW DATA-DRIVEN ALGORITHM FOR THE COMPUTATION OF THE PLM INDEX DURING SLEEP AND WAKEFULNESS

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Introduction: The aim of this study was to evaluate an alternative index for periodic leg movements during sleep (PLMS) and wakefulness (PLMW), developed to be more closely correlated with the “genuine” periodic portion of leg movements than the standard index and expected to be similar to the standard index when leg movement activity is genuinely periodic but significantly lower when periodicity of leg movement activity is low.

Methods: One-hundred-and-seven patients with RLS were retrospectively identified and included, along with 63 normal controls. Night-to-night variability was analyzed in a subgroup of 17 RLS patients for whom two recordings were available while PLMS were evaluated in a subgroup of 66 patients with RLS. Two “alternative” PLMS/PLMW indices were calculated: one obtained by simply increasing the lower limit of the inter-movement intervals from 5 to 10 s (“Alt1”) and another by additionally considering only non-interrupted series of 4 or more leg movements, each separated by 10-90 s (“Alt2”). Both alternative indices were compared to the “standard” PLMS/PLMW indices, calculated according to current IRLSSG/WASM criteria.

Results: Despite a high correlation between the methods, only the “Alt2” algorithm provided significantly different results with PLMS/PLMW indices being consistently lower than those provided by the other two methods; the difference was more evident in controls than in patients during wakefulness, when periodicity was lower. The difference between the “Alt2” and the standard PLMS index showed a significant negative correlation with the Periodicity index. Night-to-night variability was similar for all PLMS indices and significantly higher than the variability seen in the periodicity index. Moreover, the optimal threshold for the identification of RLS patients was found to be 15-16/hour for the “standard” PLMS index, 13/hour for the “Alt2 index, and 0.5 for the periodicity index. All methods showed high values of sensitivity, specificity, and accuracy; the ROC areas were similar and the Kappa coefficient indicated a “very good” agreement between the PLMS indices.

Conclusion: This methodological study introduces an alternative to the standard PLMS/PLMW indices and successfully initiates the validation process for a new way to compute the PLMS/PLMW index, more adherent to the parameters that allow a reliable evaluation of their periodicity. However, the diagnostic accuracy of all indices for RLS vs. controls, was found to be acceptably high, with the new “Alt 2” PLMS index performing slightly higher than the other indices.

0656

SCREENING FOR PERIODIC LIMB MOVEMENTS AND APNEA VIA SMARTPHONE-CONNECTED BALLISTOCARDIOGRAPHIC FLEXIBLE BED SENSOR STRIP SUITABLE FOR LONG-TERM HOME USE

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Introduction: The accuracy of a ballistocardiographic flexible bed sensor strip for periodic limb movement disorder (PLMD) and apnea screening was investigated. The measurement method would allow convenient home screening.

Methods: A clinical study with 20 volunteers was carried out, wherein synchronized polysomnography and ballistocardiography (BCG) signals were acquired. The PLMs and apnea events detected from the BCG signal via our own algorithm were compared to PLMs and apnea events detected via PSG. The BCG signal was acquired from a flexible piezoelectric sensor that measures vibrations caused by body movements, heartbeat, and respiration.

Results: We evaluated the accuracy of PLMD detection based on the PLM index (PLMI, the number of PLMs per hour of sleeping), using 17 cases that had a clean tibialis EMG signal. A case was classified as PLMD if PLMI > 5. The specificity for PLMD was 0.91 and sensitivity 0.83 (N = 17, PLMD cases via PSG = 6). The correlation between BCG-based and PSG-based PLM counts per case was found to be 0.92. We evaluated the accuracy in a similar way, so that the apnea-hypopnea index (AHI) was used to compare the results (AHI includes hypopneas, central apneas, mixed apneas, and obstructive apneas). A case was classified as apnea if AHI > 15, which corresponds to moderate or severe apnea. The specificity for apnea detection was 0.94 and sensitivity 1.0 (N = 20, apnea cases via PSG = 3).

Conclusion: We obtained promising results for screening of PLMD and apnea with a flexible bed sensor strip, in a study of 20 overnight polysomnography cases.

Support (If Any): Research supported by Beddit Ltd.
IV. RLS, Movement Disorders and Parasomnias

0657
PILOT OPEN-LABEL TRIAL OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) BELOW THE KNEE FOR THE TREATMENT OF RESTLESS LEGS SYNDROME (RLS)

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Introduction: Case reports and small clinical studies suggest that transcutaneous electrical nerve stimulation (TENS) may be beneficial in reducing symptoms of RLS. The SENSUS Pain Management System is an FDA-cleared TENS device for the symptomatic treatment of chronic pain.

Methods: Patients with moderate to severe RLS were enrolled in this 28 day study. Sensation threshold was assessed at baseline. Timing, daily duration of use, current intensity, and unilateral vs bilateral use was determined at home by individual patients. All RLS medications (if present) were kept constant. Visits occurred in person at one and four weeks, with phone contact at two weeks. Hours of use and current intensity information were obtained at 1 and 4 weeks through device download. The CGI, IRLS, and MOS sleep scales were used to assess baseline and final RLS symptoms. AEs were assessed at each visit.

Results: At baseline, patients (N = 9; mean age = 62.0 ± 7.0, 55.6% male) had moderate to severe RLS rated on the CGI-S and the IRLS (mean = 19.6 ± 5.9). All patients completed the study. Six of nine patients were responders to SENSUS treatment, based on responses of “very much” or “much” improved on the CGI-I. Considering all participants, there was a significant decrease in IRLS scores from baseline to final visit (−6.2 ± 5.9, p = 0.013). For responders, a significant improvement in MOS sleep disturbance was also observed (−11.9 ± 14.9, p = 0.043). There was no statistically significant change in sleep adequacy or quantity. Responders used the device longer (6.43 vs 4.03 hrs/day) and at higher current intensity than non-responders. Subjects reported minimal adverse events.

Conclusion: This pilot study suggests that mild to moderate RLS symptoms can be successfully treated with the TENS SENSUS device with minimal adverse events. A sham-controlled device trial is indicated to further assess the efficacy of this non-pharmacologic approach to RLS treatment.

Support (If Any): Investigator-initiated research grant from NeuroMetrix.

0658
SYMPTOM PERSISTENCE AFTER IRON NORMALIZATION IN RESTLESS LEGS SYNDROME WITH LOW SERUM FERRITIN

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Introduction: In restless legs syndrome (RLS) with iron deficiency defined as low serum ferritin (< 50μg/L), persistence of RLS symptoms and clinical courses after correcting iron deficiency remain unknown. The aim of our study was to investigate the clinical course of RLS and potential risk factors associated with the symptom persistence after iron normalization in RLS with low serum ferritin.

Methods: A total 41 RLS patients (38 female, 53.8 ± 13.1 years) with iron deficiency were confirmed to have iron normalization (serum ferritin ≥ 50μg/L or iron saturation > 20%) after oral iron replacement therapy. RLS characteristics and clinical data were obtained retrospectively and severity of RLS was evaluated by the international RLS study group scale (mild-moderate = 0-20, severe-very severe = 21-40). The remission or persistence of RLS symptom were estimated by face to face or telephone interview. An incidence of remission was defined as having no RLS symptoms for at least 6 months.

Results: Over the observation period of 47.3 ± 29.2 months, 14 patients reported no RLS symptom and 27 patients still complained of RLS symptoms. The remission rate was 34.1%. Between the remission and the persistence group, differences were observed in duration of symptom (4.27 ± 3.45 vs. 13.08 ± 12.19 years, p = 0.002) and substantial increased if RLS symptoms have been lasting more than 10 years (OR = 10.4, 95% CI = 1.19-91.18). Also, the relative risk of symptom persistence was increased in severe to very severe RLS patients (OR = 5.75, 95% CI = 1.29-25.56) compared with mild to moderate patients.

Conclusion: Two third patients of RLS with iron deficiency showed persistence of RLS symptoms after iron normalization. Considering longer duration of symptoms and severe RLS severity as risk factors for symptom persistence, early intervention of iron deficiency in RLS needs to be warranted.

0659
ONE- AND TWELVE-MONTH EFFICACY AND SAFETY OF AN ALGORITHM TO SWITCH FROM ORAL DOPAMINE AGONISTS TO ROTIGOTINE IN PATIENTS WITH RESTLESS LEGS SYNDROME

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Introduction: We examined the short- and long-term efficacy and tolerability of a cross-titration algorithm from oral dopamine agonists to rotigotine in patients dissatisfied with their RLS treatment.

Methods: Patients with RLS (n = 20, 65% female) taking an oral dopaminergic agent were recruited at a single site. The cross-titration consisted of decreasing oral dopaminergic agents (ropinirole by 1 mg or pramipexole by 0.25 mg) and increasing rotigotine by 1 mg every two days. Efficacy (IRLS rating scale and RLS-6) and AEs were assessed at 1, 3, 6 and 12 months after the switch.

Results: Patients (n = 20) had moderate-severe RLS symptoms at baseline (mean IRLS score 19.4 ± 5.5), duration of dopaminergic treatment of 7.6 ± 5.2 years; 85% had augmentation and 45% reported afternoon RLS symptoms. Baseline mean pramipexole equivalent dose was 0.6 ± 0.3 mg. At 1 month, 85% (17/20) had successfully switched from their oral dopamine agonist to rotigotine (mean dose 2.5 ± 0.6 mg; change in IRLS score: -6.7 ± 8.4, p = 0.002); 14 patients were CGI-I responders (much or very much improved); 6 were non-responders. Three patients withdrew by 1 month due to lack of efficacy. At 12 months after cross-titration, 10 patients continued on rotigotine, of whom 4 required either higher doses of rotigotine or supplemental RLS medication compared to their optimal 1 month dose. In those 10 patients, at 12 months, IRLS score was 12.8 ± 11.0 (compared to 21.2 ± 5.6 at baseline and 9.1 ± 4.0 at 1 month). Between months 1-12 five patients withdrew due to AEs and 2 due to lack of efficacy. 70% (14/20) reported at least one adverse event during the study. No SAEs were observed.

Conclusion: A cross-titration to rotigotine was efficacious at 1 month in 70% of patients dissatisfied with RLS treatment, but this decreased to 50% at 1 year, even with addition of a higher rotigotine dose or use of additional RLS medication during long-term follow-up.

Support (If Any): Supported by an investigator-initiated grant from UCB.

0661
RESPONSES TO DOPAMINERGIC TREATMENT OF PRIMARY RESTLESS LEGS SYNDROME: AUDIT OF 192 INDIAN PATIENTS
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Introduction: Restless legs syndrome or Willis-Ekbom disease (RLS/WED) is often misdiagnosed and undertreated. Due to socio-cultural differences in manifestation, this is a bigger problem in the Indian subcontinent. We conducted this study to evaluate the effectiveness of, and problems associated with pharmaceutical treatment in patients with primary RLS/WED.

Methods: A retrospective chart review analysis was carried out for treatment details of adult patients diagnosed as RLS/WED by a single experienced Sleep physician, over an 8 year period. Only patients fulfilling IRLSSG diagnostic criteria for RLS and those with bilaterally symmetrical symptoms were included. Patients with significant co-morbidities like chronic kidney disease, malignancies or any major medical illness, as well as pregnant ladies were excluded. Patients for whom at least one year follow up data was unavailable, were also excluded. All data was entered and descriptive statistical analysis was carried out.

Results: A total of 192 (mean age 42.9+/−14.6 years) out of 407 patients evaluated, fulfilled all inclusion criteria. Mean IRLS scale scores changed from 21.4+/−7.4, to 6.2+/−6.3 on treatment. Nearly 62% patients reported > 80% relief in symptoms, at a one-year follow up of treatment with pramipexole (N = 132), ropinirole (N = 128), or both (N = 38) or with pregabalin (N = 12). Eighteen patients reported less than 20% response to any of these. Median serum Ferritin was 35 (range 1.5-208) and oral iron was co-prescribed to 68 (35.4%) patients. Augmentation was observed in 14(7.3%) patients, at median 3.4 years of dopaminergic therapy, with median augmentation scale scores of 5.4 (range 2-10). Mild Impulse control disorders were observed in only 2 patients.

Conclusion: Dopaminergic agonists are effective symptomatic treatment agents for majority of Indian patients with primary RLS/WED, with ‘augmentation’ not being encountered frequently. A third of these patients benefit with oral iron supplementation.

0662
UNDERSTANDING OF DOsing OF RESTLESS LEGS SYNDROME (RLS) APPROVED TREATMENTS BY SLEEP SPECIALISTS, NEUROLOGISTS, AND OTHER HEALTH CARE PROVIDERS (HCPS): RESULTS FROM AN ELECTRONIC SURVEY
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Introduction: RLS treatment guidelines are available from the International RLS Study Group. We queried clinicians regarding their understanding of pharmacologic treatment strategies and RLS guidelines.

Methods: Participants anonymously completed a 5-question electronic survey on RLS symptoms and treatments. Two questions addressed augmentation: Question 4 queried respondents’ knowledge of symptoms indicative of augmentation, and Question 2 assessed treatment strategies in response to a patient with increasing RLS symptoms while on the maximum dose of a dopamine agonist (DA).

Results: 117 clinicians participated in the survey (15 sleep specialists [SSs], 24 neurologists with an interest in movement disorders, 29 primary care physicians [PCPs], 24 nurse practitioners [NPs], 25 physician assistants [PAs]). 67%-73% of SSs considered the following guideline-defined symptoms as always/frequently indicative of augmentation: increased symptoms after increasing DA dose, earlier symptom onset, shorter symptom latency, spread of symptoms to other body parts, and increased symptom intensity. These symptoms were considered always/frequently indicative of augmentation by 46%-67% of neurologists and by 41%-66% of PCPs. Fewer NPs (38%-59%) and PAs (36%-52%) reported these symptoms as always/frequently indicative of RLS augmentation. The most common strategy SSs reported using to address augmentation was changing to an alpha-2-delta-ligand (38%), followed by dose splitting (28%), changing to another DA (21%), and adding an alpha-2-delta ligand to the DA (13%). Among neurologists, the most common strategy was increasing the DA dose (46%), followed by dose splitting (38%), adding an alpha-2-delta ligand (33%), changing to another DA (21%), and changing to an alpha-2-delta ligand (17%). Dose splitting was the most common strategy among PCPs (27%), NPs (50%), and PAs (45%).

Conclusion: These survey results show a wide range of opinions and practices related to RLS augmentation, suggesting a need for greater education on the identification and management of augmentation in RLS.

Support (If Any): This survey was funded by XenoPort, Inc., Santa Clara, CA, and conducted in collaboration with the Medical Insights Group, Knoxville, TN. Medical writing support was provided by CondonMedical, an Ashfield Company, part of UDG Healthcare plc, and was funded by XenoPort, Inc.
mg/day), the ranges were 2-6 mg/day (SSs), 2-25 mg/day (neurologists), 3-4 mg/day (PCPs), 3 mg/day (NPs), 2-3 mg/day (PAs).

**Conclusion:** Results show variation in dosing knowledge and treatment practices, which may not reflect the most current literature or prescribing information. Use of higher than approved doses reported in this survey could result in the possibility of dose-related side effects for both drug classes. Furthermore, some prescribing behaviers reported here could favor the development of augmentation.

**Support (If Any):** This survey was funded by XenoPort, Inc., Santa Clara, CA, and was conducted in collaboration with the Medical Insights Group, Knoxville, TN. Medical writing support was provided by CodonMedical, an Ashfield Company, part of UDG Healthcare plc, and was funded by XenoPort, Inc.

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**0663**

**TARGETED PRESSURE ON THE FLEXOR HALLUCIS BREVIS AND ABDUCTOR HALLUCIS FOOT MUSCLES CAUSED A SIGNIFICANT REDUCTION IN MODERATE TO SEVERE RESTLESS LEGS SYNDROME SYMPTOMS**

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**Introduction:** Restless legs syndrome (RLS) treatments include drugs with many side effects. A device with no drug side effects would have extensive applications. This study assessed efficacy and safety of a device (Restiffic®, medi Corp) which produced targeted pressure on the abductor hallucis and the flexor hallucis brevis muscles.

**Methods:** This study was conducted between 4/17/2009 and 8/12/2012 in two office settings in Erie, Pennsylvania. This was an 8-week single arm, open label, dual center clinical trial with a repeat measures design. Subjects included 30 otherwise healthy adults, 8 men and 22 women, with a mean age 51.5 years, (range 30 to 75 years), with moderate to severe primary RLS. Average follow-up was 1.3 ± 0.5 years. RLS devices (one on each foot) were administered intermittently through the course of the study. Primary end point was mean change in the International Restless Legs Study (IRLSS) Rating Scale from baseline to week 8; the secondary measure, the CGI Scale. Meta-analysis was used to compare the RLS Device to three historic reports of ropinirole and placebo pill. Demographics, disease severity, inclusion/exclusion criteria, assessment tools were similar among studies.

**Results:** Change in mean IRLSS score was significantly greater for the RLS Device, 17.2 ± 6.2 (95% confidence interval 14.92 through 19.52, p ≤ .0001) compared with historic reports for ropinirole, 12, and its placebo, 8.9 (p < .05). Sleep loss significantly decreased from 119.5 ± 61.6 min to 22.1 ± 31.1 min per night (p ≤ .0001). Global Improvement Scale-Responders were significantly greater for RLS Device, 90% (27/30), compared with ropinirole, 63% (293/464) (p < .05). Only mild, transient AEs (e.g., pain sensation, paraesthesia) were reported that were relieved by loosening straps.

**Conclusion:** The RLS device significantly reduced symptoms of moderate to severe restless legs syndrome, without side effects of drug therapy.

**Support (If Any):** Financial support to develop the RLS Device was provided by Mary M. Sorg, the inventor of device.
THE EFFECT OF GABAPENTIN ENACARBIL (GEN) ON SLEEP ADEQUACY IN ADULTS WITH MODERATE-TO-SEVERE PRIMARY RESTLESS LEGS SYNDROME (RLS): A POOLED RESPONDER ANALYSIS FROM TWO 12-WEEK TRIALS

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Introduction: Up to 81% of patients with RLS experience insomnia. RLS symptom severity is correlated with sleep impairment. We explored whether GEN improved sleep adequacy in adults with moderate-to-severe primary RLS.

Methods: Responder analyses of Medical Outcomes Study (MOS) sleep adequacy, Post-Sleep Questionnaire-3 (PSQ-3; number of nights with RLS symptoms) and International Restless Legs Scale-4 (IRLS-4; sleep disturbance) were conducted. Inclusion criteria included MOS sleep adequacy ≤ 80; PSQ-3 ≥ 1 night or worsening from 0 at baseline; IRLS-4 ≥ 1 or worsening from 0 at baseline. From baseline to week 12, sleep adequacy responders improved ≥ 20 points; PSQ-3 and IRLS-4 responders improved ≥ 1 category/point. Combined responders met criteria for sleep adequacy and one other parameter. Spearman’s rank correlation coefficients and Pearson Chi-square P values were calculated.

Results: 541 patients were randomized (placebo, n = 204; GEN 600 mg, n = 114; GEN 1200 mg, n = 223). Most patients were combined sleep adequacy and PSQ-3 responders (placebo, 34%; GEN 600 mg, 61%; GEN 1200 mg, 56%). Some had no response (placebo, 29%; GEN 600 mg, 15%; GEN 1200 mg, 14%) or response only for PSQ-3 (placebo, 30%; GEN 600 mg, 17%; GEN 1200 mg, 21%). Few were sleep adequacy responders only (placebo, 8%; GEN 600 mg, 6%; GEN 1200 mg, 9%). Differences across response categories were significant between both GEN doses vs placebo (all P < .001). Results were similar for sleep adequacy and IRLS-4. Sleep adequacy and PSQ-3 or IRLS-4 (week 12) correlations were moderate for all groups (−0.36 to −0.53, all P < .05). In the clinical trials, the most common treatment-emergent adverse events with GEN were somnolence and dizziness.

Conclusion: Most GEN-treated adults with moderate-to-severe primary RLS had improved sleep adequacy from baseline plus improvement in number of nights with RLS symptoms or sleep disturbance. More patients in the placebo group had no response vs the GEN treatment groups.

Support (If Any): These studies and this analysis were conducted by XenoPort, Inc., Santa Clara, CA. Medical writing support was provided by CodonMedical, an Ashfield Company, part of UDG Healthcare plc, and was funded by XenoPort, Inc.

OUTCOMES FOR HYPSNOsis THERAPY FOR PARASOMNIAS: A RETROSPECTIVE ANALYSIS

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Introduction: Parasomnias are undesirable and potentially injurious abnormal behaviors that occur during sleep, or transition to or from sleep, and may arise during non-rapid eye movement (NREM), rapid eye movement (REM) sleep, or both stages. Parasomnias are most often treated by medications, which are variably effective and have side effects. Hypnosis may be an effective alternative therapy for parasomnias, but data regarding treatment outcomes remain limited.

Methods: We retrospectively analyzed consecutive patients with parasomnia treated with hypnosis. We excluded patients lacking reported treatment outcomes from further analysis. We calculated descriptive statistics, and compared subgroups of patients with contingency tables and Chi Square analyses.

Results: Thirty-two patients received hypnosis therapy with mean duration of follow-up of 7.6 (range 0-48) months. Nine (39%) REM and 14 (61%) NREM parasomnia patients received hypnosis therapy. 19 (63%) patients had at least slight improvement of parasomnia. Of those treated with hypnosis, 4 (13%) had a complete response without further parasomnia events; 9 (30%) had significant, sustained benefit; 6 (20%) had slight temporary benefit; 11 (37%) had no benefit. Therapeutic response to hypnosis was significantly associated with a history of anxiety (p = 0.03), but not with a history of depression or other mental health disorders, and was unassociated with age, gender, NREM or REM parasomnia type, sleep co-morbidities (insomnia, sleepiness, RLS, OSA), or importantly, the previous number of failed medication treatments (all p > 0.05).

Conclusion: Hypnosis therapy appears to be a promisingly effective and underutilized therapy for parasomnias, and may be effective even when prior medications have failed, especially in those with a history of anxiety disorders. A comprehensive treatment outcomes survey to
better assess patient reported outcomes, and a prospective randomized controlled trial of hypnosis therapy is needed to determine its efficacy and safety in the treatment of parasomnias.

Support (If Any): This project was supported by the National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant Number 1 UL1 RR024120-01. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

**0668**

RESTLESS LEGS SYNDROME DURING OPIOID DETOXIFICATION

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**Introduction:** Opioid use disorder is an important public health problem associated with substantial morbidity and mortality. Relapse after detoxification is unfortunately common. A strategy that attenuates physical symptoms of withdrawal may mitigate this risk. Small case series suggest that symptoms of Restless Legs Syndrome (RLS) are present during opioid withdrawal. However, the prevalence is unknown.

**Methods:** We conducted an observational study aimed at determining the prevalence of RLS among patients receiving buprenorphine detoxification from opioids. Participants were recruited from an inpatient detoxification unit and assessed using a validated questionnaire. Only those meeting all essential IRLSSG criteria for RLS, including a circadian fluctuation in symptoms, were considered to have likely RLS.

To assess the specificity of RLS to opioid withdrawal, we also administered the questionnaire to patients experiencing alcohol withdrawal.

**Results:** The sample consisted of 124 adults with primary opioid use disorder and 180 with primary alcohol use disorder. In the total sample, 33.6% met a likely RLS diagnosis: 50.8% of those with an opioid use disorder and 21.7% of those with an alcohol use disorder. This difference was statistically significant ($\chi^2 = 27.96[1,304] p < .001$). In the logistic regression analysis controlling for socio-demographic and clinical variables related to RLS diagnosis (age and employment status), diagnosis of opioid use disorder was associated with more than twice the likelihood of RLS diagnosis ($OR = 2.05, 95\% CI 1.09-3.88$) relative to diagnosis of alcohol use disorder.

**Conclusion:** Approximately half of patients undergoing inpatient opioid withdrawal exhibited the symptoms characteristic of RLS, including a circadian component. We believe that these data support the existence of a secondary form of RLS attributable to opioid withdrawal. Future studies should explore whether treatment strategies aimed at mitigating these symptoms during opioid detoxification may reduce the risk of relapse to opioid use.

**0669**

VALIDATION OF PERIODIC LEG MOVEMENTS COUNTS IN A COMMERCIAL AVAILABLE CUSTOM POLYSOMNOGRAPHY SYSTEM AGAINST MANUAL SCORING

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**Introduction:** Periodic leg movements (PLM) during sleep (PLMS) are considered strongly related to restless legs syndrome (RLS), and are associated with polymorphism in RLS risk genes. Various software for automatic analysis of PLMS are available, but only few of them have been validated. The aim of this study was to validate a PLM analysis algorithm integrated in a commercially available polysomnography (PSG) system against manual scoring.

**Methods:** Twenty patients with RLS and a PLMS index $> 20/h$ and 20 controls with a PLMS index $< 5/h$ were included. Manual and computerized scoring of PLM was performed according to standard AASM criteria. PLM indices during sleep and wakefulness, the rate of PLMS associated with respiratory events and intermovement interval (IMI) were manually and automatically scored.

**Results:** The correlation between manual and computerized scoring was very high for all investigated parameters (Spearman correlation coefficients between 0.751 and 0.996, $p < 0.001$; intraclass correlation coefficients between 0.775 and 0.999, $p < 0.001$). Bland-Altman plots showed high agreement between manual and automatic analysis.

**Conclusion:** This study validated an integrated software algorithm for the detection and analysis of PLM against the gold standard manual scoring according to AASM criteria. The data demonstrate that the software used in the study has an outstanding performance for computerized PLM scoring and PLM indices generated with this software can be reliably integrated in the routine PSG report.

**0670**

PERIODIC LEG MOVEMENTS DURING SLEEP IN PARKINSON DISEASE PATIENTS WITH OR WITHOUT RESTLESS LEGS

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**Introduction:** Although epidemiological studies have shown that RLS may herald later development of PD, both neuroimaging and genetic studies suggest RLS and PD are distinct conditions. We hypothesized that, since PLMS are a marker for RLS and have been shown to occur in greater frequency in PD than the general population, an association between RLS and PLMS should be discernible in PD patients.

**Methods:** Idiopathic PD patients (n = 75) (X [SD] age = 62.5 [9.6]; UPDRS score = 17.4 [8.2]; 50 M; 25 F) underwent 2 consecutive nights of in-lab NPSG (6 patients had a single night) with conventional scoring of PLM. Prior to study all were administered RLS questions based on the epidemiological studies of Lavigne et al (Sleep 1994; 17: 739-43) and Phillips et al (Arch Int Med 2000; 160: 2137-41). Patients responding to both RLS questions with a frequency of “often” or “very often” were classified as positive for RLS (n = 7).

**Results:** PD/RLS+ patients did not differ in age (p = .76), sex distribution (p = .77) or UPDRS score (p = .42) when compared to PD/RLS- patients. PLM Index did not differ between groups based on either Night 1 (21.0 [46.4] vs 13.2 [25.7]; t = .70, p = .480) or Night 2 (6.9 [9.3] vs 14.2 [26.6]; t = .66, p = .51). There were no differences between groups in daily levodopa dose (281.6 [321.6] vs 307.1 [262.1] mg; t = .20, p = .83) or pergolide dose equivalents (1.68 [1.61] vs 1.02 [1.47] mg; t = 1.12, p = .26).

**Conclusion:** These data do not suggest an association between RLS and PLMS in idiopathic PD patients. Indirectly, these data support other studies suggesting that, although both characterized by dopamine dysfunction, RLS and PD remain distinct conditions without causal attribution.

Support (If Any): NS-050595
DREAMS OF COLLEGE—DOES DREAMING CORRELATE WITH BETTER GRADES?

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Introduction: Academic performance requires information processing and memory consolidation, functions attributed stage REM sleep. Dreams can occur in any sleep stage but are most common and vivid during REM sleep. Using dreaming frequency as an accessible clinical indicator of REM sleep, we sought to correlate grade point averages (GPA) among college students with their recalled dreaming frequency. We hypothesized that dream frequency would correlate with higher GPA.

Methods: A prospective questionnaire survey of college students gathered information on demographics, GPA and sleep habits including dream frequency. Pearson product moment correlation coefficients were calculated for dream frequency and GPA. Furthermore, the GPAs of students with the highest dream frequency were compared with infrequent dreamers and non-dreamers using t-tests.

Results: Participants (n = 85) had a mean age of 23.2 ± 7.5 years, included 46 men (56%), had a GPA of 3.3 ± 0.5, and were racially mixed (35W, 15B, 19H, 10A, 6 other). Of 85 students, 23 (27%) experienced dreaming multiple times per night, 13 (15%) recalled dreaming once per night, 8 (9%) dreamed three to four times per week, 26 (31%) dreamed once or twice per week, and 15 (18%) rarely or never experienced dreams. Dream frequency showed a weak negative correlation (pr = -0.20) with GPA. By t-test, students who dreamed most frequently showed a trend toward lower GPA (mean 3.1 ± 0.6) than infrequent dreamers (mean 3.4 ± 0.4, p = 0.09). There was no correlation between dreaming frequency and age (pr = 0.061), caffeine use (pr = 0.1034), bed times (pr = 0.0606), morning rise times (pr = 0.0998) or total sleep times (pr = 0.0902).

Conclusion: The hypothesis that dream frequency correlates with higher GPA is rejected. Higher frequency of dreaming correlates weakly with a lower GPA. This finding did not appear to be due to other factors such as age, caffeine use, bed time, rise time or total sleep time.

AN ANALYSIS OF PROGNOSTIC COUNSELING OF PATIENTS WITH IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

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Introduction: Prognostic counselling of patients with REM sleep behavior disorder (RBD) for phenocconversion to overt synucleinopathies including Parkinson disease and dementia with Lewy Bodies has not to our knowledge been previously analyzed. This topic is controversial given lack of disease-modifying interventions and uncertainty associated with prognosis. We aimed to analyze RBD patient and physician characteristics associated with the likelihood of prognostic counselling provided, as documented in the medical record.

Methods: We conducted a retrospective chart review of 138 polysomnography-confirmed RBD patients diagnosed at Mayo Clinic between 2012-2015. We reviewed physician and patient demographics, initial complaint, and information discussed concerning phenocconversion risk between physician and patient as noted in the chart transcripts.

Results: 65 (47.1%) of the 138 patient records reflected documentation concerning prognosis. Mean age of patients was 63.9 ± 13.5 years, and 100 (72.5%) were men. RBD was a secondary finding to the initial complaint in 87 (63%) of cases. Patients who reported dream enactment behavior, discussed RBD with their physician before polysomnography, and whose RBD was the primary initial complaint were significantly more likely to receive a prognosis concerning phenocversion (all p < 0.05). Patients older than 60 years were more likely to receive a prognosis than younger individuals (p = 0.03). Compared to other sleep subspecialists, there was a trend toward greater prognostic documentation for sleep neurologists (p = 0.057), of whom men were significantly more likely to document disclosure than women (p = 0.0025).

Conclusion: Several physician and patient specific factors appear to be significantly associated with the likelihood of prognostic documentation. Future surveys to assess physicians’ thinking and patients’ understanding and preferences are needed to determine whether physician behavior is appropriate and the reasons behind the identified differences in approach.

Support (If Any): This project was supported by the National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant Number 1 UL1 RR024120-01 and the Vann Fellowship of Davidson College. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH or Davidson College.

A QUANTITATIVE STUDY OF REM WITHOUT ATONIA IN HEALTHY SLEEP

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Introduction: Rapid eye movement (REM) without atonia (RWA) is essential for diagnosis of REM sleep behavior disorder (RBD). In contrast, there is no quantitative threshold for RWA in RBD and studies for RWA in healthy sleep are largely lacking. We quantitatively investigated RWA in people who has no history of dream enactment.

Methods: This was a cross-sectional analysis from the ongoing prospective cohort study, the Korean Genome and Epidemiology Study (KoGES). We included 2,868 adults (male 49.3%, range 50-80 years, 59.1 ± 7.2) who participated in the KoGES evaluation, 2012-2013 were utilized in this study. All subjects were asked to fill out the RBD Screening Questionnaire, and healthy people was defined when the score was less than 5. Fifteen thousand subjects underwent polysomnography (PSG) and 681 PSG of healthy subjects was included. Tonic, phasic, and any EMG activities of mentalis during REM sleep on PSG were quantified.

Results: The difference in mentalis EMG activity measures over the respective age groups was not significant (P > 0.05). Men and women did not differ in respect to mentalis EMG activity measures (P > 0.05). Results remained unchanged when entering both age and sex in a linear regression model (P > 0.05).

Conclusion: Idiopathic RBD has been reported to mostly affect elderly men. But, results of this study demonstrated no sex- or age dependent difference in any of the EMG activity measures. Quantification of RWA in middle aged healthy subjects is first step toward early diagnosis of RBD.
NORMATIVE RAPID EYE MOVEMENT SLEEP ATONIA IN ADULTS
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Introduction: Normative values for physiologic atonia during rapid eye movement (REM) sleep are not clearly established. Therefore, determining thresholds for abnormal amounts of REM sleep without atonia (RSWA) remains challenging. Previous research by our group suggests that older age and male gender may also be associated with greater amounts of physiologic RSWA. Here, we present quantitative RSWA analyzed in adult men and women without REM sleep behavior disorder (RBD) drawn from a comprehensive sleep medicine practice.

Methods: We analyzed phasic and tonic muscle activity in submentalis and anterior tibialis muscles during REM sleep, as well as automated submentalis REM atonia index (RAI) in neurologically normal adults who had normal polysomnography or primary snoring without RBD, narcolepsy, or other parasomnias. Statistical comparisons were made in 85 subjects subdivided into 7 age deciles: 20-29 years; 30-39 years; 40-49 years; 50-59 years; 60-69 years; 70-79 years; and 80-89 years. Gender comparisons were also performed within and across these age groups. A p value < 0.007 was considered statistically significant in order to correct for multiple comparisons.

Results: Submentalis and anterior tibialis phasic burst durations were similar across the age groups. Mean submentalis/anterior tibialis phasic burst durations (seconds) were: 20-29 years: 0.54 ± 0.26/0.40 ± 0.22; 30-39 years: 0.67 ± 0.40/0.91 ± 0.57; 40-49 years: 0.53 ± 0.31/0.45 ± 0.26; 50-59 years: 0.52 ± 0.29/0.58 ± 0.39; 60-69 years: 0.39 ± 0.28/0.82 ± 1.00; 70-79 years: 0.51 ± 0.44/0.31 ± 0.33; and 80-89 years: 0.33 ± 0.17/0.76 ± 0.80. No differences in submentalis, anterior tibialis, and combined submentalis and anterior tibialis phasic muscle activity were noted across the age groups. Mean total/submentalis/anterior tibialis activity percent ages were: 20-29 years: 2.47 ± 0.77/1.61 ± 0.73/0.92 ± 0.61; 30-39 years: 3.48 ± 1.48/1.70 ± 1.11/1.89 ± 1.53; 40-49 years: 2.13 ± 1.39/1.14 ± 0.91/1.04 ± 1.07; 50-59 years: 2.12 ± 0.89/1.09 ± 0.90/1.13 ± 0.72; 60-69 years: 2.35 ± 2.22/1.25 ± 1.67/1.13 ± 1.33; 70-79 years: 3.87 ± 2.96/1.86 ± 2.20/2.07 ± 2.05; and 80-89 years: 3.95 ± 3.20/2.17 ± 2.72/1.91 ± 1.04. No tonic muscle activity was observed in these subjects. All subjects had submentalis RAI > 0.9, indicating absence of RSWA. No gender differences in submentalis, anterior tibialis, and combined submentalis and anterior tibialis phasic muscle activity were observed in these groups.

Conclusion: These findings are useful to further inform normative values for RSWA across the lifespan. Additional study of an even larger number of healthy community adults will be necessary to determine whether age or gender influence quantitative physiologic REM atonia.
0675
JZP-110 HAS A LARGE EFFECT SIZE ON THE MAINTENANCE OF WAKEFULNESS TEST IN PATIENTS WITH NARCOLEPSY INDEPENDENT OF 20- OR 40-MINUTE CENSORSHIP OF THE DATA

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Introduction: JZP-110 is a second-generation wake-promoting agent and dopamine-norepinephrine reuptake inhibitor. In 2 clinical trials of adult patients with narcolepsy, JZP-110 significantly improved wakefulness versus placebo on the 40-minute Maintenance of Wakefulness Test (MWT). Some studies of other medications have used a 20-minute MWT. This post-hoc analysis evaluated changes from baseline in mean MWT sleep latency and the associated effect sizes for JZP-110 with the data censored to include the first 20 minutes of the 40-minute MWT.

Methods: In Study 201, patients (N = 33) were randomized to receive placebo or JZP-110 for 2 weeks in a crossover design (150-mg/day, weeks 1 and 3; increased to 300-mg/day, weeks 2 and 4). In Study 202, patients (N = 93) were randomized to receive placebo or JZP-110 for 12 weeks in a parallel-group design (150-mg/day weeks 1-4; 300-mg/day weeks 5-12). Effect sizes (Cohen's d) at end of treatment were calculated for change from baseline in mean MWT sleep latency using 20-minute censored data or 40-minute data.

Results: In Study 201, mean (SD) changes in MWT sleep latency were 12.7 (10.6) minutes with JZP-110 versus 0.9 (6.0) minutes with placebo (P = 0.0002) for 40-minute data, and 8.9 (6.3) versus 0.4 (4.6) minutes for 20-minute censored data (P < 0.0001). In Study 202, mean changes in MWT sleep latency were 12.8 (10.3) minutes with JZP-110 versus 2.1 (7.9) minutes with placebo (P < 0.0001) for 40-minute data and 8.9 (5.5) versus 1.1 (5.6) minutes for 20-minute censored data (P < 0.0001). In Studies 201 and 202, respectively, effect sizes were large and slightly greater for 20-minute censored data (1.54 and 1.41) versus 40-minute data (1.37 and 1.17).

Conclusion: In patients with narcolepsy, JZP-110 significantly improved the ability to stay awake compared to placebo with large effect sizes that were independent of whether the MWT data were censored at 20 or 40 minutes.

Support (If Any): Jazz Pharmaceuticals.

0676
FLUMazenil FOR THE TREATMENT OF REFRACTORY HYPersomnolence: CLINICAL EXPERIENCE WITH 154 PATIENTS

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Introduction: While many patients with central disorders of hypersomnolence achieve satisfactory symptom control with standard wake-promoting medications, a subgroup remains relatively refractory to conventional treatment. Based on the finding that the cerebrospinal fluid from some patients with hypersomnolence demonstrates in vitro excess potentiation of GABA-A receptors, a finding which reverses with flumazenil, we initiated prescribing compounded flumazenil to carefully selected, treatment-refractory hypersomnolent patients.

Methods: We performed a retrospective chart review of 154 consecutive patients treated with transdermal and/or sublingual flumazenil by physicians at our center between 2013 and 2015.

Results: Patients were 35.6 years old (±/- 14.3) and ninety-three (60.4%) were women. Mean Epworth Sleep Scale (ESS) scores were 15.0 (±/- 4.5), despite treatment trials with an average of 4.6 (±/- 1.9) wake promoting therapies prior to flumazenil. Symptomatic benefit from flumazenil was noted by 100 patients (64.9%), with a mean reduction of 4.7 ESS points (±/- 4.7) among responders. Of these, 63 remained on flumazenil chronically, for a mean of 7.8 months (±/- 7.0 months). Adverse events were common, but less commonly resulted in treatment discontinuation. Serious adverse events included a transient ischemic attack and a lupus vasculopathy, although whether these events occurred because of flumazenil administration is unknown.

Conclusion: This chart review demonstrates that sublingual and transdermal flumazenil was associated with sustained clinical benefit in 41% of patients with treatment-refractory hypersomnolence. Prospective, controlled studies of this GABA-A receptor antagonist for the treatment of hypersomnolence are needed.

Support (If Any): This work was supported by K23 NS083748 (LMT) and UL1 TR000424 from the National Institutes of Health.

0677
DAY TO DAY VARIABILITY OF TWO CONSECUTIVE MSLTS IN PATIENTS WITH HYPERSOMNIA IS LOW

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Introduction: Day to day variability of mean sleep latency test (MSLT) performed in a two consecutive day manner in patients with subjective hypersomnia symptom is unknown.

Methods: MSLT results of patients with complaints of persistently severe hypersomnia (but with low pre-test probability of pathological hypersomnia) who underwent two in-lab consecutive MSLT protocol coupled with overnight sleep studies (n = 29) were reviewed. Actigraphy and sleep log were obtained to control for potential effect of sleep deprivation. Patients found to have sleep apnea were treated with continuous positive airway pressure overnight. Agreement of MSL between day 1 and 2 for the evaluation of pathological hypersomnia (as defined by MSL < 8 and < 10 min) was evaluated using Kappa statistics. Analyses were repeated after excluding patients with sleep apnea (n = 9).

Results: Under the protocol, 2 out of 29 patients were diagnosed with narcolepsy. Total sleep hours of prior night sleep was similar between night 1 and 2. Mean MSL was 10.9 (SD: 6.0, Median: 11.5) and 10.9 (6.0, 11.2) min for 1st and 2nd day respectively. When 9 patients with sleep apnea were excluded, mean MSL was 11.3 (6.0, 11.6) and 11.8 (5.9, 12.7) min. Correlation coefficient (r) between day 1 and 2 was 0.86 (p < 0.001) and 0.83 (p < 0.001) for all and those excluding sleep apnea respectively. Inter-test agreement in detection of pathological hypersomnia between MSLT day 1 and 2 showed k: 0.85 for MSL < 8 min and 0.86 for MSL < 10 min for all and, k: 0.76 for MSL < 8 min and 0.78 for MSL < 10 min for those excluding sleep apnea.

Conclusion: In patients with subjective complaints of hypersomnia (but with low pretest clinical probability of pathological hypersomnia), day to day MSLT variability is low. Results of a carefully controlled single MSLT can be considered accurate.
0678
MAINTENANCE OF WAKEFULNESS TESTING IN EPILEPSY: CORRELATION WITH THE EPWORTH SLEEPINESS SCALE AND EPILEPSY-RELATED VARIABLES
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Introduction: Excessive daytime sleepiness (EDS) is a common complaint of people with epilepsy, typically attributed to antiepileptic drugs (AEDs) or seizures. Objective measurements of EDS in epilepsy are few. We report baseline Maintenance of Wakefulness Test (MWT) result from a randomized controlled trial exploring effects of the AED lacosamide (LCM) in adults with focal epilepsy.

Methods: Fifty-one subjects underwent baseline PSG and MWT and completed the Epworth Sleepiness Scale (ESS). A MWT variable was created (mean %sleep time [MST]) representing the percentage of seconds visually scored in 3-sec bins of non-wake EEG from lights out to sleep onset, averaged over 4 trials. Spearman correlation assessed the correlation between mean sleep latency (MSL), MST and ESS. Linear regression was used to assess the association between MSL and MST controlling for age, BMI, AED standardized dose and disabling seizure frequency.

Results: Sample characteristics: 69% female, age 43.5 ± 13 yr, BMI 25.1 ± 11.6 kg/m², standardized AED dose 1.9 ± 1.1, ESS 8.8 ± 5.7, median frequency of disabling seizures over 2 weeks (0.00 [0.00,3.0]). MSL was 21.7 ± 11.9 min; < 8 min in 8 (15.7 %) and < 19.2 min in 23 (45.1%) subjects. MSL and MST were negatively correlated (MST coefficient -0.85 (-0.99, -0.70), p < 0.001). ESS did not correlate with either MSL (p = 0.67) or MST (p = 0.61). MSL was significantly reduced in patients with Generalized motor seizures (GMS) vs. those without GMS (17.9 min (13.7, 22.2), 27.3 min (21.3, 33.4), p = 0.013). MST values were significantly greater in patients with GMS comparing with those without GMS (9.23 (4.87, 17.5), 3.06 (1.23, 7.62), p = 0.047).

Conclusion: Adults with focal epilepsy have significant EDS as measured by the MWT. Objective measures correlate poorly with ESS. GMS was the only significant predictor of sleepiness. MST has a potential to be utilized as a marker of sleepiness in future research.

0679
ADHD SYMPTOMS REPORTED IN ADULTS WITH NARCOLEPSY AND IDIOPATHIC HYPERSONMIA
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Introduction: Sleepiness is associated with Attention Deficit Hyperactivity Disorder (ADHD), however, the presence of attentional difficulties occurring commonly among those with hypersomnia has not been examined. The aim of this analysis was to begin to address this gap by assessing ADHD symptoms in adult patients diagnosed with a central hypersomnia disorder.

Methods: In this study, adults with Narcolepsy Type 1 (NT1), Narcolepsy Type 2 (NT2), and Idiopathic Hypersomnia (IH) completed a self-report adult ADHD-screener, the ASRS (v1.1), and the Epworth Sleepiness Scale (ESS) via an online survey. The World Health Organization (WHO) Adult ADHD Self-Report Scale (ASRS) is a 6- or 18- question screening tool (the 6-question version is reported on here). The two scales were part of a larger anonymous online survey, the Boston University Narcolepsy and Idiopathic Hypersomnia Patient Perspectives Study (BUNIHPPS), which focuses on symptoms, cognitive functioning, the diagnostic interval, and quality of life in this population. Preliminary data collected between October 10 and December 10, 2015 are presented here.

Results: 513 participants reporting a diagnosed hypersomnia condition completed the online survey (189 NT1, 137 NT2, 118 IH, and 68 mixed). Across participants, mean age ± SD was 39.4 ± 13.2 years and gender was predominantly female (434 females, 78 males). Fifty-five percent (n = 280) screened positive for the likelihood of ADHD on the ASRS, yet fewer than 13 percent self-reported having an ADHD diagnosis. Eighty-six percent (n = 439) reported ESS scores of 10 or higher (ESS mean ± SD = 14.5 ± 4.8). There were no significant differences between the type of hypersomnia diagnosis on either the ASRS or the ESS, however the mean and median scores were marginally higher on both measures for the NT1 group. A logistic regression analysis revealed a positive and significant relationship between ASRS and ESS variables (t(512) = 7.99, p < .0001, R-square = 0.1111).

Conclusion: These results indicate that self-reported attention and sleepiness are correlated among those with a central hypersomnia disorder. Clinical assessment of attentional deficiencies in those with a hypersomnia diagnosis may improve outcomes in patients with NT1, NT2, and IH. Future work will examine how additional measures of attention and impulsivity may influence sleepiness and other symptoms of NT1, NT2, and IH.

0680
CORRELATION BETWEEN THE EPWORTH SLEEPINESS SCALE AND THE MAINTENANCE OF WAKEFULNESS TEST IN PATIENTS WITH NARCOLEPSY PARTICIPATING IN TWO CLINICAL TRIALS OF SODIUM OXYBATE
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Introduction: In evaluating pathological sleepiness, the Epworth Sleepiness Scale (ESS) assesses subjective sleep propensity whereas the Maintenance of Wakefulness Test (MWT) measures ability to stay awake. Both tests are used to evaluate sleepiness and alertness, respectively, in clinical trials of narcolepsy and other conditions of excessive daytime sleepiness. This analysis evaluated the strength of the correlation between ESS and MWT with regard to absolute values in scores.

Methods: Data were analyzed separately from the intent-to-treat populations of two 8-week clinical trials of sodium oxybate for the treatment of narcolepsy, SXB-15 and SXB-22. Regardless of treatment group, the correlation between ESS and MWT was evaluated separately at baseline, week 4, and week 8 using the Pearson product-moment correlation coefficient.

Results: The cumulative correlations of all treatment groups in each study described an inverse relationship, reflecting the scoring of each measure; i.e., whereas higher ESS scores indicate greater sleepiness, higher MWT scores indicate a greater ability to remain awake. Significant correlations, although of generally low-to-moderate strength, were observed at all time points in both studies. In SXB-15, correlation coefficients were -0.272, -0.365, and 0.343 at baseline (n = 221), week 4 (n = 212), and week 8 (n = 205), respectively, with all P < 0.0001. Similarly, in SXB-22, correlation coefficients were -0.302 (n = 216), -0.418 (n = 211), and -0.432 (n = 196) at the 3 time points, respectively, also with all P < 0.0001.

Conclusion: Although all correlations showed statistical significance, they were of low-to-moderate strength. These results indicate that ESS
and MWT measure features of pathological sleepiness that may be distinct, but partially overlapping. These data corroborate those of other studies, which suggest that physiological mechanisms that regulate alertness and sleep propensity may function somewhat independently.

Support (If Any): Study supported by Jazz Pharmaceuticals.

0681
REPEATABILITY OF THE MULTIPLE SLEEP LATENCY TEST IN NARCOLEPSY TYPE 1 AND 2 WITH KNOWN HYPOCRETIN LEVELS OR HLA DQB1*06:02 STATUS
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Introduction: This retrospective study was undertaken to evaluate the repeatability of the MSLT for narcolepsy in individuals with known CSF hypocretin (hcrt) levels or HLA DQB1*06:02/cataplexy status.

Methods: We retrospectively identified patients with known CSF hypocretin levels or HLA DQB1*06:02/cataplexy status who had undergone at least two MSLTs.

Results: Narcolepsy type 1 (NT1, n = 50, mean age (SD) 33.9 ± 18.7 yrs), compared to type 2, (NT2, n = 22; mean age (SD) 29.9 ± 14.39), demonstrated significantly shorter mean sleep latencies on MSLT, more SOREMps on MSLT and PSG, higher BMI, and were more likely to be taking a sleep-related medication (i.e., stimulant, antidepresant, and/or sodium oxybate) at time of 2nd MSLT. In NT1 (with hcrt deficiency, n = 32; HLA DQB1*06:02 positive with cataplexy, n = 18) and NT2 (with normal hcrt levels, n = 9; HLA DQB1*06:02 negative with no cataplexy, n = 13), both MSLTs were positive for narcolepsy in 74 % and 22.7 % of individuals, respectively. After requiring the initial MSLT be positive for narcolepsy, the repeatability of the MSLT for narcolepsy was not significantly different (OR 3.364, p = 0.119) between NT1 (n = 48) and NT2 (n = 10). After excluding subjects on sleep-related medication(s), both MSLTs were positive for narcolepsy in 89.2 % and 55.5 % of NT1 (n = 28) and NT2 (n = 9) subjects, respectively (OR 6.67, p = 0.045). In NT1 subjects with hcrt deficiency not taking (n = 13) vs. taking (n = 19) a sleep-related medication(s), both MSLTs were positive for narcolepsy in 84.6 % and 57.9 % of the individuals, respectively (OR 4.0, p = 0.141).

Conclusion: In individuals with known CSF hcrt levels or HLA DQB1*06:02 status, the repeatability of the MSLT is better in narcolepsy type 1 vs type 2. Additional subjects are being identified to increase power.

0682
INCIDENCE OF NARCOLEPSY SYMPTOMS AMONG THE FAMILY MEMBERS OF NARCOLEPTIC PROBANDS: A LONGITUDINAL STUDY
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Introduction: Narcolepsy is a rare disabling sleep disorders characterized by excessive daytime sleepiness (EDS), sudden daytime sleep attacks, often accompanied by cataplexy and sleep paralysis, and disturbed nocturnal sleep. The disorder has its likely origins in certain gene defects that trigger an autoimmune response. The genetic etiology of the disease is also confirmed by the higher prevalence of the disease among close relatives of narcoleptics. The objective of this study is to estimate the incidence of narcoleptic symptoms in a longitudinal study of narcoleptic family members.

Methods: 4,397 individuals were interviewed by telephone with the Sleep-EVAL system. The study sample included 358 subjects diagnosed with narcolepsy and 4039 family members evaluated at 3 to 5 year-intervals.

Results: At follow-up, 192 family members were deceased and 54 couldn’t be interviewed due to debilitating or terminal disease. The incidence of narcolepsy among family members was 1.2%, two to three times higher than in the control group. Half of the family members reported moderate to severe sleepiness at follow-up, and, among these, 34.2% reported an increase in their sleepiness. Incidence of excessive sleepiness was highest among third-degree relatives. Incidence of sleep paralysis was highest among second-degree relatives. At follow-up, the frequency of sleep paralysis increased in 57% and decreased in 19% of cases. The predictors of developing narcolepsy at follow-up were presence of sleep paralysis at the first interview (AOR: 4.73) and presence of excessive sleepiness (AOR: 4.95).

Conclusion: Risks for narcolepsy are high among family members. However, incidence of different narcoleptic symptoms is not the same among first-, second- and third-degree relatives.

Support (If Any): Educational grant from Jazz Pharmaceuticals.

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CORRELATION OF CHANGES IN PATIENT-REPORTED QUALITY-OF-LIFE WITH PHYSICIAN-RATED GLOBAL IMPRESSION OF CHANGE IN PATIENTS WITH NARCOLEPSY PARTICIPATING IN A CLINICAL TRIAL OF SODIUM OXYBATE
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Introduction: Patients with narcolepsy report lower health-related quality-of-life (HRQoL) relative to the general population (Flores, JCSM 2015), measured by the Short Form-36 (SF-36), with the greatest differences for the SF-36 Vitality (VT) and Role Physical (RP) domains. This analysis evaluated whether changes in SF-36 domains correlated with physician-rated Clinical Global Impression-Change (CGI-C).

Methods: Data were evaluated from 209 of 228 patients with narcolepsy participating in an 8-week clinical trial of sodium oxybate. Regardless of treatment group, the change from baseline for SF-36v2 subscales (physical functioning [PF], RP, bodily pain [BP], general health [GH], VF, social functioning [SF], role emotional [RE], and mental health [MH]), and the physical component summary (PCS) and mental component summary scores (MCS) were evaluated for correlation with CGI-C scores (1 = very much improved, 2 = much improved, 3 = minimally improved, 4 = no change, 5 = minimally worse, 6 = much worse, 7 = very much worse). Correlations were calculated using the Pearson product-moment correlation coefficient (r).

Results: Correlations described an inverse relationship in scores, but a direct relationship in improvement, such that greater changes, lower CGI-C scores (i.e., better), were associated with improvements in SF-36 domain scores (i.e., improved HRQoL). Although moderate and significant correlations were observed for VT (r = -0.464; P < 0.0001) and RP (r = -0.310; P < 0.0001), significant but weak correlations were observed for SF (r = -0.289; P < 0.0001), MH (r = -0.182; P < 0.05), PF (r = -0.196; P < 0.05), and GH (r = -0.155; P < 0.05), as well as the summary scores PCS (r = -0.286; P < 0.0001) and MCS (r = -0.229;
Introduction: Both Idiopathic hypersomnia (IH) and Narcolepsy are characterized by increased daytime sleepiness. One of the differentiating features between these two disorders is the presence of 2 or more sleep onset REM episodes in the latter. We aim to understand the various psychiatric comorbidities associated with these two conditions.

Methods: A retrospective chart review was performed at the University of Missouri Sleep disorders center on the patients who were diagnosed with either idiopathic hypersomnia or Narcolepsy since 2009. Patients with a diagnosis of Depression, Generalized anxiety disorder, bipolar disorder, Attention deficit hyperactivity disorder (ADHD), Obsessive compulsive disorder (OCD), panic disorder, impulse control disorder, borderline or dissociative personality disorder, schizoaffective disorder and learning disability were identified among the various hypersomnia groups.

Results: 145 and 53 patients met the criteria for IH and Narcolepsy. 55.8% of patients with IH had a diagnosis of at least one of the psychiatric comorbidities while only 39.6% of patients with Narcolepsy had at least one psychiatric comorbidity. Both the groups showed a female predominance with IH group having 77.2% of women while Narcolepsy group having 64.2% of women. Mood disorders were the most common in both the groups with depression being more common than anxiety. The mean age of the onset of the disease was 38.4 years in IH group while it was 28.1 years in the Narcolepsy group. The incidence of bipolar disorder and ADHD was also increased in both the groups.

Conclusion: Our study suggests that Idiopathic hypersomnia is more often associated with psychiatric comorbidities than Narcolepsy. Multiple studies in the past showed an increased prevalence of psychiatric illnesses in Narcolepsy. Our study shows that idiopathic hypersomnia is infact more commonly associated with a psychiatric comorbidity than Narcolepsy. The relevance of this finding is unclear at this time but may be related to the pathogenic mechanisms that operate in these disease conditions. Also, understanding this strong association will help clinicians identify the coexisting psychiatric problem thereby help lowering the patient’s morbidity.
ALTERED BRAIN PERFUSION PATTERNS IN IDIOPATHIC HYPERSOMNIA
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Introduction: Idiopathic hypersomnia (IH) is a sleep disorder characterized by excessive daytime sleepiness despite normal or long nocturnal sleep time. While some of its clinical characteristics overlap with other types of central hypersomnias such as narcolepsy, IH remains a poorly understood condition with unclear pathophysiological mechanisms. The present study aims at investigating the neural correlates of IH, using single photon emission computed tomography (SPECT).

Methods: Eleven patients with IH and eleven matched healthy controls (HC) were scanned during resting wakefulness in the morning using SPECT with Tc-99m ethyl cysteinate dimer (ECD). Analysis of SPECT data allowed comparing distribution of regional cerebral blood flow (rCBF) between the two groups. In addition, correlation analyses were made between rCBF and clinical characteristics to assess the functional correlates of specific brain perfusion patterns. For all analyses, significance was set at p < 0.01 (uncorrected for multiple comparisons) for clusters of at least 50 contiguous voxels.

Results: Compared to healthy controls, IH patients showed a significant rCBF decrease in regions belonging to the default mode network (e.g., medial prefrontal, anterior cingulate and precuneus) as well as in putamen and posterior cerebellum. In addition, they showed a significant increase in the amygdala and temporo-occipital cortices. Interestingly, lower rCBF in regions of the default mode network were associated with larger levels of both subjective and objective daytime sleepiness. Larger subjective daytime sleepiness was also associated with lower rCBF in the putamen and higher rCBF in the amygdala. Finally, higher rCBF in the amygdala and lower rCBF in regions of the default mode network were associated with larger depression symptoms.

Conclusion: This report constitutes the first neuroimaging investigation of IH. Our results suggest that identified abnormalities in the default mode network and limbic system contribute to the excessive daytime sleepiness and mood disturbances in these patients.

Support (If Any): Research funded by the Sleep Research Society Foundation (J. Christian Gillin MD research grant), the Canadian Institutes of Health Research (CIHR) and the Fonds de Recherche du Québec - Santé (FRQ-S).

DIFFERENT FINDINGS OF BRAIN IMAGING AND NEUROCOGNITIVE FUNCTION IN TYPE I AND TYPE II NARCOLEPSY
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Introduction: The International Classification of Sleep Disorders-3 dissociate type 1 and type 2 “narcoleptics” There are little data on the differences between these 2 types of patients and comparison between brain imaging with simultaneous performance testing has never been presented. Our study aims at such comparison.

Methods: 90 type 1 young narcolepsy patients and 17 age and sex matched type 2 narcolepsy patients diagnosed based on ICSD-3 criteria are involved in the study. Sixteen age matched normal subjects were recruited from the general population. All patients, untreated, had (1) clinical interview based on ICSD-3 and Stanford narcolepsy questionnaire, (2) sleep-wake evaluation questionnaires, (3) study of sleep/wake with 7 days actigraphy; PSG and multiple sleep latency test (MSLT), (4) blood tests (with HLA typing). Once the diagnosis of narcolepsy and its type was established, all subjects underwent a PET study with CPT and WCST test on the same day.To compare the distribution pattern for patients with different narcolepsy diseases, a voxel-wise 2-sample t-test was used to evaluate the statistical difference between type 1 and type 2 narcolepsy. Uncorrected P value of 0.005 with 50 extent voxels was selected as the threshold of statistical significance in each test.

Results: Type 1 and type 2 narcoleptics were presenting with similar subjective sleepiness at scale results, both very abnormal compared to controls. But type 1 narcoleptics had more disturbed monitored nocturnal sleep. They also had more sleep-onset REM periods during nocturnal sleep and at MSLT and had shorter mean sleep latencies. The imaging study confirm the greater impairment of type-1 narcoleptics: Comparison between type-1 and type-2 narcoleptics shows significant difference particularly in Heschl gyrus, striatum, thalamus, basal ganglia and cerebellum (P-value < 0.01).

Conclusion: Type-1 and type 2 narcoleptics present difference in clinical presentation but also significant differences at performance tests and brain metabolic imaging.

CHARACTERISTICS OF NARCOLEPSY ACCORDING TO THE AGE OF DIAGNOSIS
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Introduction: To conduct a descriptive analysis between narcoleptic patients diagnosed before and after 18 years.

Methods: Data extracted from the National French multicentre research program on narcolepsy (PHRC AOM07-138), 23 pediatric patients from the Lyon’s center were added to this data base. Clinical and electrophysiological characteristics were compared between de novo patients diagnosed before (n = 59) and after 18 years (n = 108).

Results: Mean ages ± SD at diagnosis were respectively 11.6 ± 2.9 in pediatric (PP) vs 35.7 ± 15.6 y in adult (AP) patients. Sleepiness appeared earlier in children (10 ± 2.8 vs 25.6 ± 11.8 y, p < 0.001) with a tendency to a shorter diagnostic delay (6.7 ± 5.4 vs 13.4 ± 10.3 y, p = 0.059). PP had less sleep paralysis than AP (22% vs 52.8% (p = 0.003), more sleep talking (37% vs 26%, p < 0.001), more sleep drunkenness (66% vs 24.5%, p < 0.001)) but no statistical difference for hypnagogic hallucinations (46% vs 66%). HLA DQB1*0602 was found in 98% of the PP vs 91% in AP (NS). PP were more frequently obese (58% vs 16.9% (p < 0.001) with earlier puberty (13.2 ± 1.4 vs 14.7 ± 1.2y (p = 0.005) and night eating (22% vs 5%, p = 0.033). On PSG, PP had higher TST (p = 0.002) and tended to have more N3% (p = 0.06). Compared to AP, PP had lower AHI (p = 0.04). Four % of PP patients vs 28.3% of AP patients had AHI > 5 (p = 0.002). A correlation was found between respectively BMI z-score and age (r = 0.59, p < 0.001) and AHI (r = 0.39, p < 0.001). No differences were found between PP and AP for EPWORTH scores. On Conners RS-R (> 75), ADHD scores were higher in PP than in adults especially for impulsivity (p < 0.001). Depressive feelings were found in 33.3% of AP vs 24.3% of PP (NS). However, AP had lower quality of life (QL) than PP (43.5 ± 6.2 vs 60.9 ± 14.3,
p < 0.001). QL were affected by depressive feelings (r = -0.57, p < 0.001), fatigue (r = -0.43, p < 0.001), age (r = -0.46, p < 0.001) and obesity (BMI-z) (r = -0.31, p = 0.001).

**Conclusion:** The clinical presentation with obesity and ADHD was more pronounced in narcoleptic patients diagnosed during pediatric age, which could reflect a more severe form of this disease. Indeed, the prevalence of obesity in the PP is largely higher than in the general pediatric population in France. We recommend a prompt diagnosis and a more thorough assessment and long term management of psychological health in this population.

**Support (If Any):** CAPES Grant to Clara O. Inocente, PHRC AOM07-138-French Health Ministry Grant to Isabelle Arnulf and Interface-Hôpitaux Grant Isabelle Arnulf & Patricia Franco.

### 0689

**CHARACTERIZATION OF THE STANFORD NARCOLEPSY DATABASE**

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**Introduction:** The Stanford Narcolepsy Database contains over 5,000 case entries. We examined and described the available clinical characteristics in cases diagnosed with narcolepsy type 1 (NT1), narcolepsy type 2 (NT2), and idiopathic hypersomnia (IH).

**Methods:** We examined the Stanford Narcolepsy Database for cases of NT1, NT2, and IH. A number of clinical characteristics were then summarized including CSF hypocretin (Hcr) level, Epworth Sleepiness Scale (ESS), MSLT mean sleep latencies (MSL) and number of SO-REMs, PSG data on AHI and sleep efficiency, percentage of individuals with sleep paralysis, hallucinations, and percentage of individuals with the HLA DQB1*06:02 genotype.

**Results:** A total of 1,350 case entries of NT1 were found, of which 559 had confirmed low CSF Hcr level. In this group, mean CSF Hcr level was 19.4 ± 1.1 pg/mL (SEM), mean ESS was 17.7 ± 0.1, MSLT MSL was 2.3 ± 0.1 min. We also identified 304 cases of NT2 and 126 cases of IH with intermediate to normal CSF Hcr levels. Mean CSF Hcr level was 321.0 ± 5.5 pg/mL for NT2 and 310.5 ± 6.0 pg/mL for IH. Mean MSLT MSL was 3.8 ± 0.1 min in NT2 and 4.5 ± 0.2 min in IH cases. Sleep efficiency was highest in IH with 90.3% ± 0.9 and lowest in NT1 with 85.9% ± 0.4. In terms of the presence of sleep paralysis, 67.0% of NT1, 48.9% of NT2 and 23.7% of IH cases were found. Overall, results suggest that objective and subjective sleepiness was highest in NT2. Platinum, we use mainly tricyclic antidepressants (TCA) for the treatment of REM related symptoms. However, TCA has side effects such as anti-cholinergic function. New SNRI and SRI, which is lesser side effect than TCA, may effective for REM related symptoms and nocturnal sleep. We tried several medications using anti-depressants and hypnotics for one narcoleptic patient aimed at comparison. All procedures of this research were approved by the Ethical Committee of AkitaUniversity Hospital.

**Methods:** The subject is one patient with narcolepsy type 1 (30’s, female, orexin (hypocretin) level < 40pg/ml). She tested TCA (clomipramine), SNRI (duloxetine, milnacipran), SRR (paroxetine) and recorded effectiveness and effective dose for REM related symptoms, and disturbed nocturnal sleep. She also tested benzodiazepines (BZs, eszopiclone, brotizolam and etizolam) and orexin antagonist (suvorexant) for disturbed nocturnal sleep using 35mg of clomipramine at evening. She reported adverse effects at the same time.

**Results:** Among anti-depressants, most effective treatment for cataplexy is clomipramine (35mg) and most effective for disturbed nocturnal sleep is milnacipran (75mg). Considering with the adverse effects, most acceptable treatment for cataplexy is duloxetine (40mg) and most acceptable for disturbed nocturnal sleep is milnacipran (75mg). BZ hypnotics were equally effective for the nocturnal sleep with no significant differences. Orexin antagonist (suvorexant, 20mg) did not have main effect nor side effects.

**Conclusion:** Considering with the usable in Japan and adverse effects, most acceptable treatment for cataplexy is duloxetine (40mg) and most acceptable for disturbed nocturnal sleep is milnacipran (75mg) among examined anti-depressants. In the hypnotics, BZs (eszopiclone, brotizolam and etizolam) were equally effective for the nocturnal sleep and did not show significant differences. Suvorexant, a novel orexin antagonist, is contraindicated for narcolepsy patient in USA and careful administration in Japan. This compound did not have main effect nor adverse effects for one orexin deficient narcolepsy patient.

### 0690

**SEVERAL COMPARATIVE TREATMENTS FOR REM RELATED SYMPTOMS AND NOCTURNAL SLEEP DISTURBANCES OF NARCOLEPTIC PATIENT**

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**Introduction:** Symptoms of narcolepsy are excessive daytime sleepiness, disturbed nocturnal sleep, cataplexy and other REM-sleep symptoms, such as sleep paralysis and hypnagogic hallucination. Since gamma-hydroxybutyrate and venlafaxine were not approved in Japan, we use mainly tricyclic anti-depressant (TCA) for the treatment of REM related symptoms. However, TCA has side effect such as anti-cholinergic function. New SNRI and SRI, which is lesser side effect than TCA, may effective for REM related symptoms and nocturnal sleep. We tried several medications using anti-depressants and hypnotics for one narcoleptic patient aimed at comparison. All procedures of this research were approved by the Ethical Committee of AkitaUniversity Hospital.

**Methods:** The subject is one patient with narcolepsy type 1 (30’s, female, orexin (hypocretin) level < 40pg/ml). She tested TCA (clomipramine), SNRI (duloxetine, milnacipran), SRR (paroxetine) and recorded effectiveness and effective dose for REM related symptoms, and disturbed nocturnal sleep. She also tested benzodiazepines (BZs, eszopiclone, brotizolam and etizolam) and orexin antagonist (suvorexant) for disturbed nocturnal sleep using 35mg of clomipramine at evening. She reported adverse effects at the same time.

**Results:** Among anti-depressants, most effective treatment for cataplexy is clomipramine (35mg) and most effective for disturbed nocturnal sleep is milnacipran (75mg). Considering with the adverse effects, most acceptable treatment for cataplexy is duloxetine (40mg) and most acceptable for disturbed nocturnal sleep is milnacipran (75mg). BZ hypnotics were equally effective for the nocturnal sleep with no significant differences. Orexin antagonist (suvorexant, 20mg) did not have main effect nor side effects.

**Conclusion:** Considering with the usable in Japan and adverse effects, most acceptable treatment for cataplexy is duloxetine (40mg) and most acceptable for disturbed nocturnal sleep is milnacipran (75mg) among examined anti-depressants. In the hypnotics, BZs (eszopiclone, brotizolam and etizolam) were equally effective for the nocturnal sleep and did not show significant differences. Suvorexant, a novel orexin antagonist, is contraindicated for narcolepsy patient in USA and careful administration in Japan. This compound did not have main effect nor adverse effects for one orexin deficient narcolepsy patient.

### 0691

**LEVEL OF FATIGUE PREDICTS EPWORTH SLEEPINESS SCALE SCORE**

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**Introduction:** Epworth Sleepiness Scale (ESS) is widely used in the epidemiological and clinical settings to measure daytime sleepiness. This study reports the relationships between ESS and depression symptoms (Beck-II), Fatigue Severity Scale (KFSS), and objective measurements of sleepiness (MSLT) in a sample of obese patients.
**Methods:** One hundred and twenty-four obese patients referred to sleep laboratory for suspicion of sleep-disordered breathing at INC-MNSZ in Mexico City, gave their informed consent, and the study was approved by the local ethics committee. Patients were mean age 37.9 ± 11.4 (range 17-68) years old, Women (55.6%), BMI 47.6 ± 10.4 (SD), and underwent standard in-laboratory polysomnography, and a MSLT. Beck-II, sleep habits, and KFSS were administered prior to the PSG night, and the ESS on the MSLT day.

**Results:** Patients’ total sleep time = 385.1 ± 62.4 min, AHI = 33.6 ± 32.6, KFSS score = 3.8 ± 1.6, Beck-II = 17.6 ± 11.5, Beck-II without fatigue and sleep items (Beck-II-NFS) = 14.6 ± 10.5, MSLT = 5.6 ± 4.1 min, and ESS = 7.8 ± 4.9. Spearman inter-correlations: ESS with MSLT rho = -0.329, p = 0.0001; ESS with Beck-II rho = 0.401, p = 0.001; ESS with Beck-II-NFS rho = 0.368, p = 0.001; ESS with KFSS rho = 0.462, p = 0.001. The logistic regression model with dependent variable ESS score > 10 as sleepy, controlling for age, sex, BMI, total sleep time, AHI, Beck-II-NFS, MSLT score, showed that KFSS score was the only predictor of ESS sleepiness score (ExpB = 2.42), p = 0.02, explaining 58.2% of the variance, Ch2 = 21.9, p = 0.005.

**Conclusion:** The KFSS score can explain a substantial percentage of variance on the sleepiness score of ESS, suggesting that fatigue is a major contributor of ESS score.

**Support (If Any):** This research was supported by CONACYT 46257-H and PAPIIT IN209109, and DGAPA-PASPA UNAM projects.

**DOES THE STANFORD SLEEPINESS SCALE PREDICT PHYSIOLOGIC SLEEPINESS?**

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**Introduction:** The Stanford Sleepiness Scale (SSS) is designed to assess subjective sleepiness at a moment in time and it can be used to assess subjective sleepiness as it varies over time. However, to our knowledge, comparison of SSS versus sleep latency (SL) derived objectively by electroencephalography is limited to one study where SSS was administered prior to nocturnal polysomnography. We proposed to compare SSS and corresponding SL derived in the course of the multiple sleep latency test (MSLT).

**Methods:** The protocol for MSLT at Miami Sleep Disorders Center (MSDC) includes assessment of instantaneous subjective sleepiness by administration of the SSS prior to each nap and every MSLT is carried out to 5 naps. We reviewed all 167 MSLT conducted at MSDC between July 2004 and October 2015. MSLT were scored in accordance with published guidelines by the American Academy of Sleep Medicine. The same Diplomat of the American Board of Sleep Medicine scored all MSLT. We excluded subjects lacking either SSS or SL in any of the 5 naps. The final sample consisted of 142 subjects (77 females and 65 males). Mean ± SE age was 41.27 ± 1.27 years. 116 subjects were < 60 years old, 29 had a final diagnosis of narcolepsy, 55 had MSLT mean sleep latency < 5 min. and 107 had BMI < 30 kg/m². We analyzed the relationship between SL and corresponding SSS for the group as a whole. Patients were then stratified in two groups according to gender, age (≥ 60 yrs. vs < 60 yrs.), obesity (BMI < 30 kg/m² vs BMI ≥ 30 kg/m²), diagnosis (narcolepsy vs others) and physiologic sleepiness (mean sleep latency < 5 min. vs ≥ 5 min.). Pearson correlations were used to access associations between SL and SSS in each nap. A 2 (group) X 5 (nap) repeated measures ANOVA with Bonferroni’s alfa adjustment was used to identify differences between the groups SL and SSS.

**Results:** There was a statistically significant (p = 0.016) weak (r = -0.206) association between the SSS and SL in nap 3 only. The ANOVA revealed no significant differences in SSS and SL in the groups stratified by gender, age, obesity, physiologic sleepiness and diagnosis.

**Conclusion:** In a clinical sample of adult patients complaining of excessive sleepiness the SSS does not reliably predict SL.

0693

**SYMPTOMATIC NARCOLEPSY-CATAPLEXY WITH MA2 ASSOCIATED ENCEPHALITIS DUE TO TESTICULAR CANCER**

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**Introduction:** Idiopathic narcolepsy with cataplexy is thought to be an autoimmune disorder targeting hypothalamic orexin neurons. Symptomatic orexin deficient narcolepsy due to the paraneoplastic limbic encephalitis with anti-Ma2 antibody was very rare and only 7 cases had been reported. Since the onset of symptom in this upper middle aged male is much older than usual, we suspected of symptomatic narcolepsy and measured anti-Ma2 antibody.

**Methods:** A 52 year-old man presented with upper and lower limb cataplexy. He went to emergency room, however there is no finding at brain CT, MRI and blood test. During the several examinations, cataplexy became quite often. He also has 20kg weight loss within 4 month. Therefore he was introduced to our hospital for further examinations. We also suspected of RBD because his family told us about his abnormal behavior and sleep talking during the night. His character was remarkable changed in this short period.

**Results:** During the PSG, REM sleep without atonia (RWA) was observed with no findings of OSAS and SOREMP. Mean sleep latency of MSLT was 7 sec with 4 SOREMPs without atonia in 4 naps. The orexin level of CSF was 74pg/ml. HLA DQB1*0602 was negative. We suspected of symptomatic narcolepsy and measured AQP4 and Ma2 antibodies. As the result, Ma2 antibody was positive and a tumor at left testis was found. Left testis was delivered, thereafter, his symptoms get better and his weight was recover 10kg.

**Conclusion:** In contrast to neuromyelitis optica due to AQP4 antibody, distinct CNS lesions were not observed in anti-Ma2 encephalitis. Nevertheless, orexin deficiency was observed in this condition. This suggests that the orexin deficiency in this condition may occur at the neuron or ligand levels. Considering that the autoimmune hypothesis is the most popular theory for orexin cell death in narcolepsy, but no clear inflammation was observed in the hypothalamus, a subset of Ma2 antibody positive paraneoplastic syndrome that is associated with orexin deficiency, may be important models for studying.
**0694**

**POLYSOMNOGRAPHIC ASSESSMENT OF SLEEP COMORBIDITIES IN DRUG-NAIVE NARCOLEPSY-SPECTRUM DISORDERS—A JAPANESE CROSS-SECTIONAL STUDY**

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**Introduction:** This is a large cross-sectional study aimed to investigate comorbidity rate, degree of sleep-related breathing disorder, polysomnographically diagnosable rapid eye movement sleep behavior disorder/rapid eye movement sleep without atonia and periodic limb movements during sleep in Japanese drug-naive patients with narcolepsy-spectrum disorders.

**Methods:** A total of 158 consecutive drug naïve patients with narcolepsy with cataplexy, 295 patients with narcolepsy without cataplexy and 395 patients with idiopathic hypersomnia without long sleep time were enrolled for retrospective evaluation of nocturnal polysomnography and multiple sleep latency test.

**Results:** Higher rates of periodic limb movements during sleep (per hour) (10.2%) and polysomnographically diagnosable rapid eye movement sleep behavior disorder (1.9%) were found in patients with narcolepsy with cataplexy. They had more severe periodic limb movements during sleep especially during rapid eye movement sleep and higher percentages of rapid eye movement sleep without atonia than the other two patient groups.

**Conclusion:** In the present large sample study, Japanese drug naïve patients with narcolepsy with cataplexy showed the highest comorbidity rates of periodic limb movements during sleep, polysomnographically diagnosable rapid eye movement sleep behavior disorder and rapid eye movement sleep without atonia among those with the other narcolepsy-spectrum disorders; the rates were lower than those for Western patients.

**0695**

**DENSE ARRAY ELECTROENCEPHALOGRAPHIC (DEEG) PATTERNS AT PATIENTS WITH NARCOLEPSY**

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**Introduction:** Narcolepsy is a neurological disease characterized by sleep attacks, cataplexy, hypnagogic hallucinations, and sleep-wake cycle abnormalities. There are several published studies describing pathologic electroencephalographic patterns in narcoleptic patients. Dense array EEG (DEEG) employs up to 256 channels compared to standard EEG. The purpose of the study was to assess the prevalence of DEEG abnormalities in narcoleptic patients.

**Methods:** In this retrospective study the DEEG data of 45 patients were analyzed. The inclusion criteria were the patients assessed in the Honolulu Neuroscience Clinic during 2012-2015 who had clinical and polysomnographic criteria of narcolepsy diagnosis. Data was analyzed for pathologic DEEG patterns occurring during wake, sleep, or both. DEEG was acquired at 500 Hz for at least 60 minutes in a wake and sleep protocol using EGI, 128 channel System 300. Patients underwent strobé and hyperventilation challenges, and a mathematics task. Frequency bands reviewed were Delta (0.1-3.5 Hz), Theta (3.5-7.5 Hz), Alpha (7.5-12.5 Hz), Beta (12.5 - 20 Hz), Upper Beta (20-30 Hz), and Gamma (30-40 Hz).

**Results:** Clinical characteristics of the patients - 42% were men; mean age of 45 ± 15 years. Of the 46 DEEG reports 32 were considered abnormal (81.5%; P < 0.01). The most common abnormalities were focal/epileptiform activity (84.4%), spike wave activity (65.6%), focal or diffuse (83.3%), predominantly in parietal (76.9%) and frontal (53.8%) regions. 88.9% had abnormal EEG patterns both in wake and sleep. 34.4% had signs of slow background or cortical irritability.

**Conclusion:** We found in patients with narcolepsy DEEG patterns consistent with cortical irritability and encephalopathy. Impairments of these regions could affect higher order executive functions and aspects of working memory. In patients with narcolepsy DEEG gives valuable information that can help to understand potential associated cognitive dysfunction.

**0696**

**SLEEP STAGE TRANSITION INDEX FROM REM IS ASSOCIATED WITH SUBJECTIVE NOCTURNAL A WAKENINGS AND INCREASED IN NARCOLEPSY TYPE 1**

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**Introduction:** It is experienced that subjective sleep quality and objective polysomnography (PSG) data do not always coincide. Recently sleep stage transitions are used as biomarkers for narcolepsy type 1, so in order to obtain better objective markers for subjective number of nocturnal awakenings in patients with central hypersomnia, we performed sleep stage transition analyses using diagnostic PSG records.

**Methods:** Patients visiting sleep clinic in Neuropsychiatric Research Institute Seiwa Hospital and underwent PSG and multiple sleep latency test (MSLT) for differential diagnosis of central hypersomnia were asked to participate in this study. Of 99 patients giving written informed consent during Oct 2014 to Oct 2015, we excluded those with sleep breathing disorders and sleep movement disorders, those with medication affecting sleep and those with severe first night effects. Data from resultant 74 patients (12 narcolepsy type 1, 8 narcolepsy type 2, 33 idiopathic hypersomnia (IHS) and 21 non central hypersomnia patients (mostly suffering sleep insufficient syndrome) were used for this analysis. Male/Female ratio was 46/28, mean age was 26.9 ± 10.4 years old, mean BMI were 21.6 ± 3.1 and there were no significant differences among 4 disease groups. Non-parametric correlation coefficients were calculated to find suitable index and analysis of variance (ANOVA) was used for evaluating differences among groups.

**Results:** We found that conventional sleep variables such as sleep efficiency and wake after sleep onset (WASO) did not correlate with subjective number of nocturnal awakenings. Among other markers showing significant correlation (using sleep stage transition and arousals), REM sleep stage transition index seemed most coincident with subjective number of nocturnal awakenings/sleep fragmentation (Spearman correlation coefficient 0.331 p = .004). This index also showed narcolepsy type 1 specific increase compared with other groups (narcolepsy type 1: 6.5 ± 1.7, type 2: 5.6 ± 2.8, IHS 4.3 ± 1.4 and non-hypersomnia 4.8 ± 2.0 groups), reflecting well the number of subjective nocturnal awakenings.

**Conclusion:** REM sleep stage transition index could be applied to the evaluation of subjective nocturnal awakenings and could reflect the characteristic of nocturnal sleep in narcolepsy typel patients. Additional sample collection and validity confirmation process is on-going.

**Support (If Any):** MEXT (The Ministry of Education, Culture, Sports, Science and Technology) / JSPS (Japan Society for the Promotion of Science) KAKENHI Grant Number 25293056, 25670521 and Mitsui Life Social Welfare Foundation.
CIRCADIAN TIMING AND SLEEP COMPLAINTS IN WOMEN WITH CHRONIC MIGRAINE

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Introduction: Research has indicated a connection between chronic migraine (CM) and sleep complaints, but markers of circadian phase, such as the dim light melatonin onset (DLMO), remain understudied in this population. The present study evaluated circadian timing, sleep complaints, and migraine symptoms in women with CM compared to healthy controls (HC).

Methods: Twenty women with CM (≥15 headache days per month) and 20 age-matched HC women between the ages of 18 and 41 completed a laboratory assessment that included salivary DLMO, overnight laboratory PSG, and headache- and sleep-related measures evaluating current symptoms. Prior to the PSG participants wore an actigraph and completed daily sleep diaries for ≥7 days to determine habitual sleep/wake patterns. Phase angles were calculated as the difference between DLMO and sleep midpoint as measured by actigraphy for the average of 3 nights before PSG.

Results: Among women with CM, Spearman’s rank order correlations demonstrated a significant relationship between DLMO-sleep midpoint phase angles and headache-related disability as measured by grade on the Migraine Disability Assessment Questionnaire (ρ = 0.57, p < 0.05). Specifically, as DLMO-sleep midpoint increased (sleep at later circadian time), headache-related disability increased. In addition, trends toward significance were observed between later DLMO and increased insomnia severity as measured by the Insomnia Severity Index (ρ = 0.44, p = 0.08), as well as later DLMO and increased pre-sleep somatic arousal as measured by the Pre-Sleep Arousal Scale (ρ = 0.43, p = 0.09) for women with CM. These trends were not observed for HC women.

Conclusion: These findings provide preliminary evidence that delayed circadian timing may be associated with clinical features of chronic migraine, including headache-related disability, insomnia severity, and pre-sleep arousal. Further research specifying the mechanisms involved in the circadian-sleep-migraine relationship is warranted.

Support (If Any): This research was supported by the National Institute of Neurological Disorders and Stroke (R21 NS081088) and the National Institutes of Health.

SLEEP IN NON-DEMENTED PATIENTS WITH PARKINSON’S DISEASE: SHORTER SLEEP DURATIONS PREDICT INCREASED BURDEN IN THEIR CAREGIVERS

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Introduction: Sleep disturbances are a common non-motor feature in Parkinson’s disease (PD) and have been linked to shorter sleep durations. Burden in PD caregivers is of great clinical relevance, however evidence for how PD patients’ sleep associates with caregiver functioning has been mixed. We examined established and potential predictors of PD caregiver burden and hypothesized that shorter sleep durations would associate with increased caregiver burden.

Methods: Participants comprised 34 individuals with idiopathic PD (age = 68.1 ± 6.1) and 17 age-matched controls (age = 67.6 ± 4.4). Participants were asked how many hours they sleep on average (Sleep duration), their current dopaminergic medication dosage (to calculate Levodopa Equivalency [LE] scores), and to complete the Geriatric Depression Scale (GDS) and State-Trait Anxiety Inventory (STAI). Motor symptom severity (UPDRS Part II) was also assessed. Caregivers of participants completed the Zarit Caregiver Burden Scale (Zarit) to quantify current burden. Hierarchical linear regressions (HLR) were performed predicting Zarit scores (higher = more burden) with the following steps: Step 1: Group status; Step 2: Sleep duration; Step 3: GDS, STAI, UPDRS Part II, and LE scores.

Results: Caregiver Zarit scores significantly correlated with sleep, motor, LE, and mood variables (r range = .31-.54; all ps < .05). HLR showed that increasing caregiver burden related to Group status (Step 1; β = .336; R-squared = .113) and shorter sleep durations (Step 2; β = -.0445; R-squared = .276). In the final Step 3 model (R-squared = .486, p < .001), sleep duration was the only uniquely significant predictor of Zarit scores (β = -.387, p = .008) after adjusting for all other variables.

Conclusion: Shorter PD sleep durations moderately associate with caregiver burden above and beyond other symptoms associated with care burden in previous studies. The symptoms underlying shorter sleep durations in PD patients warrant further study, particularly as these symptoms relate to caregiver functioning and wellbeing. Modifiable aspects of sleep in PD could be targeted by interventions to improve patient and caregiver outcomes.

Support (If Any): NINDS K23NS060660 and R01NS082386 (Price).

PROGRESSION OF DEMENTIA ASSESSED BY TEMPORAL CORRELATIONS OF PHYSICAL ACTIVITY

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Introduction: Unobtrusive tools for ambulatory monitoring of dementia are still lacking and long-term monitoring of cognitive function and behavior is a challenge in dementia care. Cross-sectional studies using nonlinear dynamic methods show that activity fluctuations in healthy young adults possess robust temporal correlations that become altered with aging and in dementia. Using data from a longitudinal study we investigated whether: (i) within-subject changes of activity correlations track the clinical progression of dementia as assessed by cognitive function and depression scores; and (ii) clinical interventions aimed at stabilizing circadian rhythmicity and improving sleep in dementia, namely timed bright light therapy and melatonin supplementation, preserve such activity correlations.

Methods: We examined motor activity recordings of 165 patients (70-96 years old) with mid- to late-stage dementia from an existing database of a double-blind randomized clinical trial, in which subjects were assigned to daily treatment with bright light (n = 45), bedtime melatonin (n = 39), both (n = 44) or placebo only (n = 37). These patients were assessed at baseline and every 6 months thereafter for up to 3.5 years. Detrended fluctuation analysis was used to assess temporal correlations in activity fluctuations at multiple time scales from 0.1 up to 12 hours.

Results: Activity correlations at temporal scales < ~2 hours significantly decreased over time (p < 0.0001). The decrease strongly correlated to the degrees of worsening mood assessed by Cornell Scale for Depression in Dementia (p < 0.0001), cognitive decline assessed by Mini-Mental State Examination (p = 0.014), and worsening of with-
OBJECTIVELY MEASURED OBSTRUCTIVE SLEEP APNEA AND THE RISK OF INCIDENT ALZHEIMER’S DISEASE: A LONGITUDINAL ANALYSIS OF OLDER ADULTS WHO UNDERWENT SLEEP STUDY AT TAMPA GENERAL HOSPITAL


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Introduction: Cross-sectional studies suggest that Obstructive Sleep Apnea (OSA) is associated with cognitive-decline and Alzheimer’s disease (AD) in older adults, however longitudinal studies are needed to better understand whether sleep-disorders precede the onset of AD. We tested the hypothesis that OSA is associated with incident AD in older adults.

Methods: This is a retrospective-cohort analysis of Tampa General Hospital sleep-study data available from 2001 to 2013 of all participants aged 65 and older, linked to Medicare-diagnosis data. Participant underwent polysomnography between 2001 and 2005 and included 756 OSA diagnosed patients with no history of cognitive decline or AD matched on age, sex, race, body mass index (BMI) and zip code to 3,024 controls, who had a medical diagnosis that is not associated with sleep disorder. AD diagnosis was assessed through the thirteenth year of follow-up from Medicare data with the use of ICD-9 diagnostic codes. Cox proportional hazard models was used to test for the relationship between OSA and AD.

Results: Over a follow-up period of up to 13-years (mean 8.5 years), 513 individuals developed AD. In a Cox proportional hazards model controlling for age, sex, race, BMI and education, OSA was associated with an increased risk of AD (HR = 2.22, 95% CI 1.73-2.84, P < .0001). A dose response was seen when OSA was stratified according to severity with mild, moderate and severe OSA associated with an increased risk of AD (HR = 1.67 95% CI 1.33-2.24, HR = 1.81 95% CI 1.62-2.74, 2.63 95%CI 1.86-2.92, P < .01 for all respectively). The association of OSA with incident AD was unchanged after controlling for total sleep time, percentage of time in Rapid Eye Movement (REM) and Non-REM sleep, chronic medical conditions, and the use of sleep medications.

Conclusion: OSA in older adults is associated with incident AD. Further research is needed to investigate potential mechanisms of this association.

Support (If Any): The Byrd Alzheimer Disease Institute

PREVALENCE OF OBSTRUCTIVE SLEEP APNEA IN AN EPILEPSY MONITORING UNIT

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Introduction: Prior studies have shown an increased prevalence of obstructive sleep apnea (OSA) in adults with epilepsy (AWE) compared with the general adult population. Most of these studies were in small cohorts. Sleep deprivation is a known risk factor for breakthrough seizures, and there are potential pathophysiological commonalities between OSA and epilepsy. Therefore knowing the prevalence of OSA in this patient population and finding the appropriate screening tools that would lead to timely diagnosis is a crucial part of caring for patients with epilepsy.

Methods: We retrospectively reviewed patient charts from our epilepsy monitoring unit (EMU) admissions between July 2011 and September 2015. Clinical history of OSA symptoms was obtained in all EMU patients prior to admission. Those with high clinical suspicion underwent full polysomnography (PSG) when in the EMU. Patients with a previous diagnosis of OSA and patients without definite diagnosis of epilepsy were excluded from analysis.

Results: Of 245 AWE admitted to the EMU, 31 underwent a PSG. Fourteen patients were diagnosed with OSA based on an apnea/hypopnea index (AHI) > / = 5, representing 5.7% of our AWE population. The average AHI among the patients with OSA was 28.8. Among patients undergoing PSG, t tests did not show any significant difference between patients with OSA and without OSA in age, BMI, gender, or number of anti-epileptic drugs.

Conclusion: The prevalence of symptomatic OSA in our EMU population is similar to that of the general population (3.3%) and significantly lower than the prevalence reported in prior studies of AWE (13% for AHI ≥ 15/hour).

EXCESSIVE DAYTIME SLEEPINESS IN NEUROMUSCULAR DISEASE FOCUSING ON MYOTONIC DYSTROPHY

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Introduction: Excessive daytime sleepiness (EDS) is a common complaint among patients with neuromuscular disorders. There is limited data comparing measures of the severity of EDS within the subsets of neuromuscular diseases to understand differences in their clinical presentation. The aim of this study is to better understand the myotonic dystrophy (DM) patient’s complaints of EDS compared to affected peers in other neuromuscular diseases using their subjective levels of sleepiness.

Methods: A clinic-based cohort of 40 confirmed neuromuscular disease patients was conducted by cross-referencing the patient history obtained in the University hospital based sleep disorders center against that of the hospital electronic medical record to verify neuromuscular diagnosis. Subjects were classified into 1 of 3 broad categories, myotonic dystrophy (DM), myasthenia gravis (MG), or muscular dystrophy (MD). Once the diagnosis was established, each subject’s age, gender, body mass index, and pre-sleep study Epworth sleepiness scale (ESS) value, were tabulated. In addition, repeat ESS values were obtained for the subjects when seen in follow-up while on therapy for sleep-related breathing disorders (SRBD).

Results: Fifteen subjects were categorized with DM, thirteen patients with MG, and twelve with MD. After adjusting for age, gender and BMI, the average ESS scores were 11.6, 7.3, and 6.2 for subjects...
with DM, MG, and MD, respectively. After comparing the mean ESS scores between groups, there is a statistically significant elevation of sleepiness scores when comparing DM subjects to both MG subjects (p = 0.03) and MD subjects (p = 0.01), with no significant difference noted between the MG and MD cohorts. In the subset of 11 patients that have been seen in follow-up, the average change in ESS during SRBD therapy, adjusted for age, gender, and BMI, was 4.6, 5.0, and 3.6 for DM, MG, and MD, respectively. There is no significant difference in change in ESS noted with treatment of SRBD between the groups.

Conclusion: There is a statistically significant elevation of the subjective complaint of daytime sleepiness in myotonic dystrophy as compared to their peers with other neuromuscular diseases. Limited results of SRBD treatment effect show no significant change in sleepiness in the DM cohort. These findings support early evaluation of myotonic dystrophy patients for SRBD, as well as further investigation into the CNS underpinnings of their hypersomnolence which differs from their affected neuromuscular peers.

0704
BRAIN GLUCOSE METABOLISM IN DEMENTIA WITH LEWY BODIES WITH AND WITHOUT REM SLEEP BEHAVIOR DISORDER

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Introduction: Dementia with Lewy Bodies (DLB) is the second most common neurodegenerative dementia with an incidence of 3.5/100,000 persons each year [Savica et al., 2013]. RBD can occur in the absence of any other obvious associated neurologic disorder or in association with a neurodegenerative disease. RBD is frequently associated with Parkinson’s disease (PD) [Comella et al., 1998; Adler et al., 2011; Boeve, 2013] DLB [Boeve et al., 1998] and multiple system atrophy (MSA) [Plazzi et al., 1997; Tachibana et al., 1997]. Aim of this study was to compare the brain glucose metabolism in Alzheimer’s Disease (AD) patients and in DLB patients with or without RBD.

Methods: In this retrospective study, the presence of probable RBD was ascertained by a self-administered RBD Single-Question Screen (RBD1Q), followed by a sleep structured interview by experts in sleep disorders blinded to clinical information. We evaluated 31 clinically diagnosed DLB patients and 12 AD patients. All subjects underwent an 18F-FDG-PET imaging scan.

Results: RBD1Q questionnaire identified N = 20/27 DLB RBD+ and N = 7/27 DLB RBD-. None of AD patients was positive to RBD1Q test. FDG PET hypometabolism at the single- and group-level tested by means of an optimized SPM approach confirmed the typical DLB metabolic pattern. Each DLB patient showed a predominant occipital hypometabolic pattern, extending in to parietal, temporal and frontal regions, which supported the clinical diagnosis. DLB RBD+ and DLB RBD- voxel-based comparisons revealed between-group metabolic differences, namely a more severe metabolic decrease in DLB RBD+ than in the DLB RBD- patients in left inferior temporal, superior parietal and dorsolateral prefrontal areas.

Conclusion: We found a high prevalence of RBD in DLB, as identified by RBD1Q questionnaire. In DLB patients, RBD was associated to significant more severe metabolic decreases in DLB-signature brain regions that could reflect a more severe neurodegeneration.

0705
SLEEP PATTERN AND SPECTRAL ANALYSIS OF CAREGIVER-MOTHERS OF Sons WITH DUCHENNE MUSCULAR DYSTROPHY, AND AN EXAMINATION OF DIFFERENCES BETWEEN CARRIER AND NON-CARRIERS


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Introduction: To compare sleep patterns of caregiver-mothers (CM group) of sons with Duchenne Muscular Dystrophy (DMD) with those of non-caregivers (CTRL) and also to examine the differences between non-carriers and carriers of the gene related to DMD

Methods: Observational case-control study. CM and CTRL groups were matched for age, body mass index and social class. Polysomnog-
A slowing ratio was calculated based on the relative power of (delta + 4R-TAUOPATHY DISEASE values compared to non-carriers. Spectral analysis showed that car Neylan TC SLEEP, Volume 39, Abstract Supplement, 2016 B. Clinical Sleep Science

Conclusion: There was an impairment of sleep pattern in the CM group compared to CTRL mothers, possibly associated with difficulty in initiating sleep. Being a DMD gene carrying caregiver further compromised some aspects of sleep microstructure during REM sleep. Our data demonstrate the importance of sleep evaluation in caregiver-mothers, and the relationship between sleep and being a carrier of the gene associated with DMD, which we demonstrate can impact sleep quality

Support (If Any): This work was supported by grants from Associação Fundo de Incentivo a Pesquisa (AFIP), CAPES, CNPq (M.L.A) and S.T. are recipients of the CNPq fellowship and São Paulo Research Foundation (FAPESP) (grant #2014/08067-0 to KTN).

0706 HYPERAROUSAL AND INCREASED EEG ACTIVITY DURING SLEEP IN A NEURODEGENERATIVE 4R-TAUOPATHY DISEASE

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Introduction: We previously described insomnia in Progressive Supranuclear Palsy (PSP), a primary 4 repeat (4R) taurpohathy disease. Specifically, there was increased latency to sleep onset, shorter sleep durations and increased wake after sleep onset as compared to healthy controls. Further, on a multiple sleep latency test (MSLT), PSP took longer to fall asleep. The insomnia and lack of sleep recovery the subsequent day could suggest a state of hyperarousal in PSP. We hypothesized that PSP have faster EEG than controls during sleep periods, suggesting increased arousal.

Methods: PSP (n = 16, 12 men; mean age: 70.1 ± 5.7 years) and clinically healthy older adults (n = 13; 5 men; mean age: 72.5 ± 3.8 years) were studied in the UCSF clinical research center with overnight polysomnography and either a MSLT or maintenance of wakefulness test (MWT) the next day. Spectral power analyses of artifact free NREM and REM sleep EEG from channels F3, F4, C3 and C4 were performed. A slowing ratio was calculated based on the relative power of (delta + theta)/(beta1 + beta2).

Results: We found that the slowing ratio was smaller in PSP for total relative power on both C (p < 0.05) and F (p < 0.05) channels. Significantly smaller slowing ratios on the central channels were also seen for PSP in NREM sleep (p < 0.05), while REM was unaffected.

Conclusion: Overall faster EEG (elevated beta) is present during sleep in PSP, suggesting a hyperaroused state in PSP, which likely contributes to the sleep disruption we have previously observed.

Support (If Any): This research was funded by the Rainwater Foundation (Neylan), Hillblom Foundation Network Grant (Kramer & Miller), National Institute on Aging (NIA) under the following grant numbers: P01 AG019724 (Miller), RO1 AG038791 & U54NS092089 (Boxer) and RO1 AG032289 (Kramer).

0707 SLEEP DISORDERS AND ALZHEIMER’S DEMENTIA: A CROSS-SECTIONAL ANALYSIS OF OLDER ADULTS DISCHARGED FROM TAMPA GENERAL HOSPITAL

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Introduction: Recent studies in humans and animals suggest links between sleep disorders and Alzheimer’s disease. Our objective was to determine the association between ICD-9 diagnoses of Obstructive Sleep Apnea, Insomnia, and Restless Leg Syndrome and Alzheimer’s disease in older adults discharged from Tampa General Hospital.

Methods: This is a cross-sectional analysis of Tampa General Hospital Discharged patients aged 65 and older with ICD-9 diagnosis codes of Obstructive Sleep Apnea (OSA), Insomnia, and Restless Leg Syndrome (RLS) as exposure variables and Alzheimer’s dementia as the outcome, between 10/1/2011 through 11/1/2015. Participants included 2150 OSA patients matched on age, sex, race, BMI, and zip code to 8,600 unexposed controls, 480 RLS patients matched on age, sex, race, BMI, and zip code to 1,920 unexposed controls, 1560 Insomnia patients matched on age, sex, race, BMI, and zip code to 6,240 unexposed controls. Crude and adjusted odds ratios (AOR) with 95% confidence intervals were calculated using conditional logistic regression to examine the association of each sleep disorder and Alzheimer’s disease.

Results: Participants were aged (mean ± standard deviation) 82.2 ± 7.5 years at Alzheimer’s disease diagnosis, and 76.4 ± 8.0 (range 65 - 114), 68.4 ± 8.6 (range 65-93), and 70.4 ± 6.0 (range 65 - 92) at Obstructive Sleep Apnea, Insomnia, and Restless Leg Syndrome diagnoses. Compared with unexposed controls, individuals who were diagnosed with OSA were significantly more likely to also have a diagnosis of Alzheimer’s disease (Adjusted Odds Ratio (AOR): 2.20; 95% Confidence Interval (CI): 1.70-2.70). Compared with unexposed controls, individuals who were diagnosed with insomnia were significantly more likely to also have a diagnosis of Alzheimer’s disease (Adjusted Odds Ratio (AOR): 1.48; 95% Confidence Interval (CI): 1.20-1.80). There was no significant association between RLS and Alzheimer’s disease (AOR: 1.04; 95% CI: 0.60-1.64).

Conclusion: Among discharged older adults at Tampa General Hospital, Obstructive Sleep Apnea, and Insomnia are associated with Alzheimer’s dementia. Longer-term longitudinal studies are required to better understand whether sleep disorders precede the onset of Alzheimer’s disease.

Support (If Any): College of Public Health Student Research Scholarship and Byrd Alzheimer’s Disease Institute

0708 SLEEP DISORDERS IN AMYOTROPHIC LATERAL SCLEROSIS: A QUESTIONNAIRE-BASED STUDY

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Introduction: Sleep disorders in Amyotrophic Lateral Sclerosis (ALS) have received scant attention with few studies suggesting presence of sleep related complaints. This study aims to assess the spectrum of sleep disorders and determinants in patients with ALS.

Methods: This study was conducted prospectively at Sir Ganga Ram hospital, New Delhi, India from May 2014 to December 2015 after institutional ethics committee approval. Patients diagnosed to have ALS based on El Escorial criteria, were included after obtaining informed
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Thales, University of Crete: A multi-disciplinary...was associated with poorer sleep quality (70.6%), AD (82.4%) and 54.3% poor sleep quality. 68.6% had insomnia, 14.3% obstructive sleep apnea (OSA) and 5% restless legs syndrome. Insomnia had female predominance. Most of poor sleepers had insomnia (94.7%). Majority of insomniaics (83.3%) had secondary causes. Additional causes for sleep fragmentation in ALS were muscle cramps (45.8%), difficulty turning sides in bed (50%) and body pains (12.5%). 60% had AD; 5 moderate and 13 severe, being higher in age < 50 years, males and insomniaics (45.7%). ALS duration > 12 months was associated with poor sleep, insomnia (75%) and moderate-severe AD. ALS-FRS score < 30 was associated with poorer sleep quality (70.6%), AD (82.4%) and sleep disorders (82.4%).

Conclusion: Three quarters of ALS patients suffered from sleep disorders, notably insomnia and OSA. Some novel causes of sleep fragmentation were observed in ALS. Insomnia and poor sleep quality was strongly associated with gender, duration and severity of ALS.

0709 SLEEP DISTURBANCES IN PATIENTS WITH CLINICALLY DIAGNOSED TAUOPATHY

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Introduction: Corticobasal degeneration/syndrome (CBD-S), progressive supranuclear palsy (PSP) and frontotemporal dementia (FTD) are neurodegenerative diseases with pathological aggregation of Tau protein in the brain. REM sleep behavior disorder (RBD) has been reported to occur in PSP, but is most strongly associated with synucleinopathy neurodegeneration. The frequency of sleep disorders in these diseases is uncertain, as previous studies were based on questionnaires or short case series.

Methods: Retrospective study of 50 adult men and women with a clinical diagnosis of CBD-S (10 patients), FTD (22 patients) and PSP (18 patients) referred to the sleep center with polysomnography (PSG) evaluation between January 1, 2000 and October 1, 2015. We reviewed demographic, clinical, and PSG data.

Results: Across all CBD-S, FTD, and PSP groups, the median age of patients was 68.5 years (range of 48-84 years) with 32 men and 18 women, median body mass index of 29.4 (range of 22-45) and median Epworth sleepiness scale score of 11 (range of 0-21). Insomnia and restless legs syndrome were present in 16% and 10% of patients, respectively. Median sleep efficiency was 64%, with median arousal index of 42.6 events/hour. Obstructive sleep apnea (OSA) was present in 78% of patients with a median apnea-hypopnea index of 9 (range of 0-101). RBD with diagnostic features of both a history of dream enactment behavior (DEB) and confirmatory REM sleep without atonia (RWSA) was present in only 3 patients (6%; one each with PSP, CBD-S, and FTD). Three others (6%; 2 PSP, 1 FTD) had probable RBD (DEB without RWSA), while 3 (6%) FTD patients had isolated RWSA without DEB.

Conclusion: Sleep disturbances were frequent in this relatively large cohort of clinically diagnosed tauopathy patients, especially daytime sleepiness, OSA, sleep fragmentation, and poor sleep efficiency. In contrast to some prior reported series of PSP patients, RBD was seen in only 6% of our patients, a relatively comparable frequency to an older general population, implying that overlap with concurrent synucleinopathy could instead explain RBD in PSP patients. Future clinicopathologic studies including age-gender matched controls and synucleinopathy patients are necessary to confirm the frequency and specificity of RBD and other sleep disturbances in tauopathy in comparison to other neurodegenerative diseases.

0710 LONG SLEEP DURATION IS ASSOCIATED WITH COGNITIVE DECLINE IN PATIENTS WITH MILD COGNITIVE IMPAIRMENT (MCI)

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Introduction: Mild Cognitive Impairment’s (MCI) prevalence increases among elderly and is associated with high risk for dementia. Studies that examine factors predicting the progress of MCI to dementia are limited. In this study we examined the role of objective sleep in predicting the course of MCI.

Methods: A subsample of 294 participants with a diagnosis of probable Alzheimer’s Disease (AD; N = 70) or mild cognitive impairment (MCI; N = 132), and 92 cognitively intact persons were recruited from a large population-based cohort in the island of Crete, Greece of 3222 older adults (> 60yrs). The goal of this study was the assessment of the prevalence and risk factors associated with cognitive impairment. All participants underwent medical history/physical examination, extensive neuropsychiatric and neuropsychological evaluation and 3-day 24-h actigraphy. We examined the association of key actigraphy variables, and neuropsychological testing among the 3 groups using ANOVA controlling for age, gender, and BMI. Hierarchical multiple regression analyses were used to model neuropsychological indices as a function of actigraphy measures controlling for psychotropic medications, BMI, and demographics.

Results: Patients with AD showed a significantly longer night Total Sleep Time (TST; 448.7 ± 100.7 min), and Total Minutes in Bed (TIB; 560.1 ± 94.3min), compared to patients with MCI (397.9 ± 76.2min, and 501.4 ± 89.9min, respectively) and cognitively intact controls (420.5 ± 85.5min, and 515.2 ± 95.3min, respectively). Furthermore, within the MCI group long sleep duration (TST ≥ 7.8h) was associated with decline of short-term verbal memory, episodic and semantic memory.

Conclusion: Our study shows that elderly patients with dementia sleep longer and spend more time in bed compared to both MCI patients and normal controls. Also, long sleep duration among patients with MCI is associated with decline in episodic and semantic memory. It appears that long sleep duration in patients with MCI is an early biologic marker of rapid decline of cognition within this group.

0711
SLEEP DEPENDENT MEMORY CONSOLIDATION IN CHILDREN WITH AUTISM SPECTRUM DISORDERS
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Introduction: Overwhelming evidence shows that sleep is important for the consolidation of newly acquired memories. While sleep disturbances among children with ASDs are a major clinical concern, it is unclear how these sleep disturbances affect their memory consolidation. In this study, we determine if sleep disturbances in children with ASD result in failure of overnight sleep dependent memory consolidation.

Methods: 22 children with ASDs (mean age 11.4 years (+/-2.1) and 20 control subjects (mean age 12.3 years (+/-2.2) participated. Subjects were trained and tested on a 2D object location task. Retesting occurred 10 hours later over a period of wake and sleep with condition counterbalanced. Memory consolidation was determined by the relative difference in performance at retesting testing minus the performance at the last trial at learning. Overnight sleep architecture data were collected using home polysomnography. Analyses were adjusted for age, gender and NIQV.

Results: Children with ASDs had poorer sleep efficiency (p = < 0.001) but there was no significant difference in sleep architecture between groups. ASD subjects demonstrated poorer overall memory consolidation compared to controls (p = 0.02). Interestingly, both groups demonstrated better memory consolidation across the sleep interval compared to the wake interval (p < 0.05). No group x condition interaction was detected.

Conclusion: Despite their more disturbed sleep quality, children with ASD still demonstrate more stable memory consolidation across sleep than in wake conditions. Our results suggest that improving sleep quality in children with ASD could have direct benefits to improving their overall cognitive functioning.

Support (If Any): Autism Speak, Inc., American Brain Foundation

0713
WITHDRAWN

0714
DISRUPTED SLEEP IS ASSOCIATED WITH INCREASED CORTISOL AND MEMORY DECLINE IN MILD COGNITIVE IMPAIRMENT (MCI) AND DEMENTIA
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Introduction: Subjective sleep problems are very prevalent among elderly with cognitive decline, whereas, several studies report elevated cortisol levels in this group. However, studies on the role of objectively assessed 24-h sleep/wake patterns, in the association of cortisol levels and cognition are very limited. Our goal was to assess the associations between objective sleep, plasma cortisol levels and cognition in elderly with dementia and Mild Cognitive Impairment (MCI).

Methods: A subsample of 179 participants with probable Alzheimer’s Disease (AD; N = 48), MCI (N = 64) and cognitively intact controls (N = 67) were recruited from a large population-based study in the island of Crete, Greece of 3222 older adults (> 60yrs). All participants were assessed with medical history/physical examination, extensive neuropsychiatric and neuropsychological evaluation, 3-day 24-h actigraphy and a single morning plasma cortisol level. Group differences in plasma cortisol and average 3-days actigraphy measures were assessed using ANOVA controlling for age, gender, and BMI. Furthermore, we examined direct and indirect (mediated) effects of sleep variables on cognitive indices as a function of elevated cortisol levels.

Results: Patients with AD showed significantly higher age-adjusted cortisol levels compared to patients with MCI (133.1 ± 112.8ng/ml vs. 83.0 ± 96.8ng/ml, p < 0.035) and normal controls (72.4 ± 93.4ng/ml, p < 0.004). Univariate analysis revealed significant associations between mean duration of night awakenings and cortisol (r = 0.196, p = 0.008) as well as cortisol and immediate and delayed verbal episodic memory (-0.330 < r < -0.231, p < 0.002). Mediated regression models suggested that the negative impact of poor (fragmented) night sleep on episodic memory can be largely explained by increased cortisol (Bindirect = -0.311, 95%CI = -0.0733 to -0.0033).

Conclusion: Fragmented sleep with long night awakenings is associated with elevated cortisol levels and episodic memory decline. Improving sleep quality in older adults with mild cognitive difficulties may be a modifiable factor preventing/delaying further memory decline.

0715
ASSESSING EFFECTS OF SLEEP AND REPEATED, LOW-LEVEL BLAST EXPOSURE ON CONCUSSION-LIKE SYMPTOMS IN MILITARY PERSONNEL
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Introduction: Insufficient sleep is common in the military. In select military occupational specialties, personnel are also subject to repeated, low-level blast exposure. A growing body of evidence links these exposures to concussion-like symptoms. The role that sleep plays in the relationship between repeated blast overpressure exposures and symptomology has not been well studied. Extended wakefulness may account for variance in symptomology associated with blast exposure; therefore it is important to differentiate effects of blast from effects of sleep loss. Sleep, blast overpressure, and symptoms were compared among three military training sites.

Methods: This study was conducted at three distinct, military sites where individuals were exposed to low-level blasts as part of their standard occupational training. Sleep, measured using wrist-worn actigraphy; blast exposure, captured via helmet-mounted pressure sensors; and daily symptom reporting were collected from 100 male, participants over two weeks.

Results: Sites significantly differed on daily averages for total sleep time (TST; F[2, 993] = 68.06, p < .001); daily-total blast impulse energy (F[2, 655] = 35.94, p < .001); and intensity of concussion-like symptoms (F[2, 957] = 11.81, p < .001). The site with the greatest TST (7.11 hours) had the lowest average blast exposure (2.63 psi/ms) and lowest symptom intensity reported; whereas the site with the least TST (5.45 hours) had the greatest average blast exposure (13.31 psi/ms) and greatest symptom intensity reported.

Conclusion: This analysis suggests a connection between TST, blast exposure, and self-reported concussion-like symptomology for military personnel exposed to low-level blast in training. Differences in occupational specialties and training environments across the three sites may also contribute to altered daily TST and consequential symptom endorsement. Utilizing actigraphy to objectively measure sleep informs the relationship between blast exposure and symptom reporting.

Support (If Any): Navy Bureau of Medicine, Army Medical Research and Materiel Command

0716
DETERMINANTS OF PHYSIOLOGICAL AND PATHOLOGICAL CONSTRUCTS OF FATIGUE IN CHRONIC MILD TRAUMATIC BRAIN INJURY/CONCUSSION
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Introduction: Concussion is the most common type of mild traumatic brain injury (mTBI). Various efforts have focused on the characterization of mTBI/concussion given that it is often not benign but involves disabling symptoms that persist in at least 20% of persons. One such adverse outcome is fatigue, yet challenges in the systematic quantification of its onset following concussion have resulted in hesitation by clinicians to consider it an injury-related. Nonetheless, in current classification systems fatigue is regarded as a component of postconcussive syndrome. To resolve this controversy, the aim of our study was to, for the first time, model intrinsic and extrinsic explanatory factors of fatigue among a concussed population exhibiting protracted recovery.

Methods: We performed a cross-sectional study in 88 persons with an established diagnosis of mTBI/concussion at the chronic stage post injury. The main outcome of interest was total fatigue, measured using the Fatigue Severity Scale (FSS). We applied multivariable quantile regression (QR) to estimate independent variable effects within physiological, psychological, neurological, and non-neurological constructs of fatigue. Where linear regression assumptions were satisfied, we compared ordinary least squares linear regression effect estimates to those from quantile regression of the median. All models were adjusted for age and sex.

Results: Eight participants were excluded due to missing data resulting in our adult study sample (n = 80) with mean age of 45.4 (SD: 10.1) years, 59% of whom were male. Scoring higher on insomnia, depression and anxiety scales; self-administration of study questionnaire during the morning and taking tricyclic antidepressants were positively associated with higher levels of fatigue. Our results revealed covariate effects to vary across the distribution of the FSS outcome.

Conclusion: Our results confirm the multifactorial nature of fatigue in chronic mTBI/concussion, and highlight insomnia as key covariate. Compared with conventional regression modeling, QR provides better interpretation and richer inference about covariates of fatigue.

Support (If Any): Our study had no external funding source. The first author was supported by 2015/2016 Rehabilitation Science Institute and the Toronto Rehab University Health Network Postdoctoral Fellowship.

0717
SLEEP DISTURBANCE IS ASSOCIATED WITH CONCUSSION SEVERITY IN CHILDREN AND ADOLESCENTS
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Introduction: There is increasing evidence that children who sustain concussions can experience difficulty with sleep. However, an association between sleep disturbance the severity of concussion in children is yet to be established. This study sought to determine whether sleep quality is associated with concussion severity in children and adolescents.

Methods: Forty children and adolescents (ages 9-19) with a recent history of concussion were evaluated retrospectively through IMPACT testing and completed questionnaires. The data obtained included presence or absence of concussion-related symptoms including headaches; headache treatment; and sleep quality measures including fatigue, daytime sleepiness, difficulty falling asleep, sleeping more or less than usual, and recent sleep duration. Composite scores of sleep quality and concussion-related symptoms were analyzed using Pearson’s correlations and univariate analysis.

Results: Participants who reported poor sleep quality experienced more severe concussion symptoms overall including headaches (r = 0.542, p = 0.01, n = 39). In addition, participants with poor sleep quality were more likely to experience severe headaches requiring medication, while participants with normal sleep quality were more likely to experience no/mild headaches not requiring medication treatment (F(1,35) = 4.472, p = 0.046).

Conclusion: Sleep quality is associated with concussion severity in children and adolescents who have sustained a concussion, with poor sleep quality increasing the likelihood of medication treatment of
headache. These results suggest that sleep quality may be an important predictor of outcome in patients with concussion. Further investigation with a larger sample size and a prospective approach is necessary better understand this change in sleep quality in children and adolescents with concussion.

Support (If Any): This research is supported by Georgetown University funds.

0719
SUBJECTIVE SLEEPINESS IN SLEEP DISORDERED BREATHING AND CEREBROVASCULAR DISEASE
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Introduction: The association between cerebrovascular disease (CVD) and sleep disordered breathing (SDB) is well known, yet often overlooked when addressing risk factors in patients with CVD. In a population of patients followed in stroke clinic, we assessed the value of common screening measures employed for detection of SDB.

Methods: This is a retrospective chart review of 35 patients with ischemic or hemorrhagic stroke or transient ischemic attack referred from our stroke clinic from June 2014 to May 2015 who endorsed SDB symptoms and underwent nocturnal polysomnography according to AASM guidelines at the TIRR-Memorial Hermann Hospital Sleep Center. The Epworth Sleepiness Scale was used to assess excessive daytime sleepiness (EDS), with score ≥ 10 indicative of EDS. Those with SDB diagnosed within 3-24 months of stroke or TIA were included.

Results: Of the 35 patients, 19 (54.2%) were male and 16 female (45.7%). Mean body mass index was 31.75 ± 6.55, 85% of those with EDS and 76% of those without EDS were diagnosed with SDB, almost all obstructive sleep apnea (OSA). One patient had central sleep apnea along with OSA. Overall, 80% of those studied were diagnosed with SDB. Mean Apnea-Hypopnea Index was 29.5 (± 22.6). Of subjective symptoms reported, snoring (88%) was the most common. Others were witnessed apneas (38%), fatigue (31%), dry mouth in the morning (26%) and morning headache (15%). 85% of those who reported snoring were diagnosed with OSA.

Conclusion: In this population of stroke patients, sleep-disordered breathing was detected in a large proportion (76%) of patients who did not report hypersomnia as assessed by ESS. Deficient reporting, differential presentation of OSA in patients with CVD, altered neuroanatomy and neurochemistry as a result of CVA may be contributing factors. Correlating with other subjective symptoms, particularly snoring may improve screening efficiency for OSA.
VI. Neurological Disorders and Sleep

0722

IMPACT OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) THERAPY ON SLEEP EFFICIENCY IN SUBJECTS WITH CHRONIC PAIN

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Introduction: Chronic pain is a common cause of poor sleep. It is usually treated pharmacologically, however many patients also respond to TENS therapy. We evaluated a wearable TENS device (Quell®, NeuroMetrix, Waltham, MA) designed for day and night use with actigraphy to track sleep.

Methods: De-identified data from device users consenting to have their data uploaded to a cloud server was analyzed. The dataset included daily therapy (hours/day) and sleep duration (SD) and efficiency (SE) for nights the device was used. SD and SE were determined from a tri-axial accelerometer. Users were stratified into low (< 5 hours of therapy/day), medium (5-9 hours), and high (> 9 hours) dose groups. Change in sleep metrics was determined by comparing average values in the first and last ten available nights.

Results: Data from 1396 users was collected over 4.3 months, including 223,609 hours of therapy and 18,645 nights of sleep. Sleep nights with SD between 6 and 12 hours had a higher SE (93.9% ± 5.0%) than those with a shorter SD (89.6% ± 13.1%, p < 0.001). 138 users had 30 or more nights with SD between 4 and 12 hours. Of these users, 22 were in the low, 66 in the medium, and 45 in the high dose groups. The high dose group showed a statistically significant improvement in SE from 93.8% ± 3.3% to 94.9% ± 2.4% (p = 0.003). SD had no change. No differences in sleep metrics were found for the other groups.

Conclusion: Preliminary analysis of sleep metrics collected by a wearable TENS device suggests that high dose TENS therapy may improve SE in subjects with chronic pain. Clinical significance is unclear due to the limited dynamic range of SE. Subsequent studies should evaluate metrics such as total sleep time, sleep onset, and periodic leg movements that may show larger changes.

0723

UNDERESTIMATION OF TOTAL SLEEP TIME IN WOMEN WITH CHRONIC MIGRAINE

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Introduction: Sleep disturbance commonly occurs during the course of chronic migraine (CM), with up to 85% reporting insomnia symptoms. However, the existing literature is limited to primarily subjective measures of sleep. To examine the accuracy of subjective complaints, we assessed differences between women with CM and healthy controls (HC) on self-report measures and polysomnography (PSG).

Methods: Twenty-two women with CM (mean age = 33 years) and 20 HC women (mean age = 32 years) completed an overnight laboratory PSG with a fixed 8-hour time in bed, and several headache and sleep-related measures including sleep diaries. Difference scores were calculated for sleep parameters by subtracting PSG data from same-night sleep diary data. CM and HC were compared using t-tests on PSG, sleep diaries, and difference scores.

Results: A significant difference (p < .05) was found between individuals with CM and HC on total sleep time (TST) and sleep efficiency (SE%) difference scores (diaries-PSG). CM underestimated TST (M = -34.0 minutes) and SE% (M = -9.5%), and HC overestimated TST (M = +10.4 minutes) and only slightly underestimated SE% (M = -0.58%). No significant differences were found across groups on

a score > 10. The median time from stroke until sleep testing was 67 days (IQR 9-137). The median apnea-hypopnea index (AHI) was 13 (IQR = 6-26), with 85% (n = 22) of sleep studies diagnostic of OSA (AHI ≥ 5), and 50% (n = 13) with AHI ≥ 15. Predominant central sleep apnea was diagnosed in 2 patients, 8%. The ESS score was not associated with AHI. Only 6 of the 40 patients (15%) referred for sleep evaluation upon discharge from inpatient rehabilitation were eventually started on CPAP.

Conclusion: Obstructive sleep apnea is highly prevalent among stroke patients undergoing rehabilitation, most without remarkable sleepiness. The early diagnosis of OSA prior to rehabilitation discharge may enhance initiation and adherence with CPAP and reap the benefits of treating OSA, including potentially improved stroke recovery in the short-term and secondary stroke prevention in the long-term.

Support (If Any): University of Washington Institute of Translational Health Sciences Pilot Grant (UL1TR000423); NIH National Center for Advancing Translational Sciences

0721

ALTERED SLEEP AND CEREBRAL HEMISPHERE PREDICT POST STROKE FATIGUE

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Introduction: Introduction: Post stroke fatigue (PSF) is a common complication of stroke. There is controversy as to predictors of PSF, including altered sleep, diabetes (DM), and stroke location. The presence of poor sleep after stroke, DM, and stroke location will predict PSF in a predominantly minority, Caribbean-black cohort.

Methods: Methods: Cross-sectional, 3 site, IRB-approved study between Jun 2014 - Jul 2015. Eligible patients with ischemic stroke within 3 years and without depression, aphasia, prior hemorrhagic stroke, or dementia in the outpatient stroke clinic or acute rehab were consented. The previously validated 10-item Fatigue Assessment Scale (FAS) ranging from no fatigue (10) to maximal fatigue (50) was used to measure levels of PSF. We dichotomized FAS (≥ 22 = PSF) based on several validation studies of polysomnographic fatigue. To measure post-stroke sleep changes, we dichotomized question 16 of the Beck Depression Inventory into no sleep change post stroke and sleep change post stroke. Stroke location was dichotomized into right/left sided. Chi-square tested for associations between categorical variables. Stepwise multivariable logistic regression was used to determine predictors associated with PSF.

Results: Results: Of the 60 subjects (Caribbean-black 95%, Caucasian 3%, Asian 2%, 52% female) the mean cohort age was 66.3 years (SD 3 years and without depression, aphasia, prior hemorrhagic stroke, or dementia in the outpatient stroke clinic or acute rehab were consented. The presence of poor sleep after stroke, DM, and stroke location will predict PSF in a predominantly minority, Caribbean-black cohort.

Conclusion: Conclusions: Altered sleep and right-sided strokes, but not DM independently predict PSF in an urban, minority cohort.
PSG measures of sleep parameters. However, a trend toward significance ($p = .06$) was observed for CM versus HC subjective reports of TST and SE%. Compared to HC, women with CM reported less total sleep time (405 minutes versus 443 minutes) and lower SE% (83% versus 90%).

**Conclusion:** Results indicate a relative difference between women with CM and HC on the accuracy of sleep-diary estimated TST and SE% compared to PSG-derived TST and SE%, despite no significant difference in objective measures of sleep. This subjective/objective discrepancy suggests that women with CM perceive their sleep to be more disturbed than what is corroborated by objective measures, a finding which may have implications for assessment and intervention using self-report measures in this population.

**Support (If Any):** This research is supported by a grant (R21 NS081088) from the National Institute of Neurological Disorders and Stroke (NINDS) and the National Institutes of Health.

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**0724**

**LONGITUDINAL CO-OCCURRENCE OF HEADACHES AND TROUBLE SLEEPING: DATA FROM THE KANSAS STATE EMPLOYEE WELLNESS PROGRAM**

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**Introduction:** Sleep disturbance and headaches are common and can influence one another. This study examined this relationship in a nonclinical sample, as well as associations beyond just pain, and longitudinal relationships.

**Methods:** Data from the Kansas State Employee Wellness Program from 2008 (N = 11,698) and 2009 (N = 5,597) were used. Being “Bothered by,” “Trouble Sleeping,” and “Headache” were reported as “Never,” “Seldom,” “Sometimes,” “Often,” or “Always.” Overall pain was assessed as “No pain,” “Very mild pain,” “Mild pain,” “Moderate pain,” or “Severe pain.” Multinomial logistic regression examined whether trouble sleeping frequency predicted frequency of headache, adjusted for age, sex, education, race/ethnicity, and overall pain. 1-year change for trouble sleeping and headache was categorized as “same,” “better,” or “worse.” Change in sleep was also examined as a predictor of change in headache, adjusted for covariates and baseline sleep and headache.

**Results:** Prevalence of headache at baseline was Never (55.7%), Seldom (23.2%), Sometimes (14.6%), Often (5.4%), and Always (1.0%); over 1 year, 37% got worse and 13% improved. At baseline, headache frequency was associated with sleep. For example, trouble sleeping “Often” was associated with headaches “Seldom” (OR = 2.81, $p < 0.0005$), “Sometimes” (OR = 4.86, $p < 0.0005$), “Often” (OR = 9.59, $p < 0.0005$), and “Always” (OR = 8.12, $p < 0.0005$). Similarly, trouble sleeping “Always” was associated with headaches “Seldom” (OR = 2.64, $p < 0.0005$), “Sometimes” (OR = 2.64, $p < 0.0005$), “Often” (OR = 12.19, $p < 0.0005$), and “Always” (OR = 23.00, $p < 0.0005$). If sleep worsened, headaches were more likely to worsen (OR = 2.09, $p < 0.0005$) and less likely to improve (OR = 0.66, $p = 0.0001$). If sleep improved, headaches were more likely to improve (OR = 2.48, $p < 0.0005$) and less likely to worsen (OR = 0.63, $p < 0.0005$).

**Conclusion:** Baseline data showed a positive relationship between headaches and trouble sleeping. Longitudinal data showed that changes in headaches mirrored changes in sleep. This supports the hypothesis that there is a bidirectional relationship between sleep and headaches, beyond the relationship of sleep and pain, over time.

**Support (If Any):** Dr. Grandner is supported by the National Heart, Lung and Blood Institute (K23HL100216) and the National Institute of Environmental Health Sciences (R21ES022931). We also thank Drs. Ellerbeck, Shireman at University of Kansas Medical Center, and Ms. Cheryl Miller (the former Program Administrator of KS employee wellness Program) for facilitating the data acquisition for this study. The authors report no conflicts of interest.

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**0725**

**INVERSE ASSOCIATION BETWEEN DAYTIME INDOOR TEMPERATURE AND OBJECTIVELY MEASURED SLEEP QUANTITY INDEPENDENT OF DAY LENGTH: THE HEIJO-KYO STUDY**

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**Introduction:** Although some previous studies reported seasonal change of the sleep parameters, influence of cold exposure independent of day length on sleep remains unclear. To investigate the association between indoor cold exposure and objectively measured sleep among elderly, we conducted the present study.

**Methods:** We simultaneously measured indoor temperature at 10 min intervals and actigraphic sleep for 48 hours in winter among 1083 elderly (71.9 years ± 7.1 (SD: standard deviation)). As an index of indoor cold exposure, we calculated mean indoor temperature during at home.

**Results:** Mean indoor temperature in daytime was 16.1 ± 3.68°C. A decrease in daytime indoor temperature by 1 SD was significantly associated with longer total sleep time by 6.8 min (P = 0.002), longer duration in bed by 7.6 min (P = 0.002), and earlier bedtime by 6.2 min (P = 0.006), respectively. In contrast, daytime indoor temperature did not significantly associate with sleep quality such as sleep efficiency (P = 0.488), and wake after sleep onset (P = 0.550). After adjusting for age (per 5 years), gender, current smoking, ethanol intake (≥ 30 g/day), obesity (BMI ≥ 25), depression (GDS: geriatric depression scale ≥ 6), sleep medication, education (≥ 13 years), house hold income (≥ 400 million JPY/year), day length, and outdoor temperature in daytime, time spent out of home (≥ median: 166 min), a 1 SD decrease in daytime indoor temperature was significantly associated with longer total sleep time by 8.4 min (95% confidence interval: 3.5 to 13.2 min, P = 0.001), longer duration in bed by 10.0 min (4.7 to 15.3 min, P < 0.001), and earlier bedtime by 9.0 min (4.1 to 14.0 min, P < 0.001).

**Conclusion:** Indoor cold exposure in daytime was associated with early bedtime and longer sleep time in winter.
0726  
PRE-DIAGNOSIS SLEEP DURATION, NAPPING AND MORTALITY AMONG PATIENTS WITH COLORECTAL CANCER IN A LARGE US COHORT  
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Introduction: Sleep deficiency has been linked to metabolic disorders, immune impairment, and hormonal dysfunction, and previous studies have suggested that extremely long and short sleep durations may be associated with higher risk of developing colorectal cancer (CRC). Moreover, both short and long sleep, as well as excessive daytime napping have also been associated with higher mortality in the general population. However no study has examined sleep duration or napping in relation to survival among CRC patients.

Methods: We studied sleep duration and napping reported prior to diagnosis in relation to mortality among 4369 CRC patients in the NIH-AARP Diet and Health Study. Sleep duration and napping were self-reported and vital status was ascertained by linkage to the Social Security Administration Death Master File and the National Death Index. We imputed values for missing variables. Hazard ratios and 95% confidence intervals were estimated using Cox regression adjusting for confounders (demographics, cancer stage, grade and treatment, smoking) as well as possible mediators (body-mass index, physical activity and sedentary behavior) in separate models.

Results: Compared to the participants whose sleep duration met the recommendation of National Sleep Foundation (7-8 hr), those slept 5 hr or less had ~30% higher all-cause mortality and > 50% higher CVD mortality. Less than 5 hours of sleep was also associated with ~30% increase in CRC specific mortality with borderline statistical significance. Long sleep (>9 hr) was not associated with mortality. Compared to those reporting no napping, patients who reported napping for 1 hr or more had significantly higher total and CVD mortality, but there was no association between napping and CRC mortality.

Conclusion: Short sleep and long napping were associated with higher total and CVD mortality among CRC patients. There was also a suggestion of short sleep and higher CRC mortality.

Support (If Any): The work was supported by the Intramural Research Program of the National Institutes of Health, National Cancer Institute, National Institutes of Health, Department of Health and Human Services.

0727  
OBJECTIVE SHORT SLEEP DURATION IS ASSOCIATED WITH DECREASED LEVELS OF SERUM VITAMIN D: RESULTS FROM A CROSS-SECTIONAL STUDY  
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Introduction: Recent evidence suggests a link between disturbed sleep and vitamin D deficit. Studies have shown increased prevalence of sleep disorders and decreased sleep duration in general population, in parallel to vitamin D deficiency. Men with obstructive sleep apnea (OSA) seem to present low levels of vitamin D compared to controls in an OSA severity-dependent manner. However, whether short sleep duration modulates vitamin D levels independently of OSA is unknown. Thus, we investigated the effects of objective short sleep duration on vitamin D levels.

Methods: A cross-sectional study included 328 participants aged 30-60 years from Sao Paulo, Brazil. Exclusion criteria were uncontrolled or severe medical diseases and body mass index (BMI) > 40 kg/m2. All participants signed the informed consent form. After a nocturnal polysonography, blood samples were collected for serum 25-hydroxyvitamin D (25(OH)D) quantification. Objective short sleep duration was defined as total sleep time below or equal to 5 hours (TST < 5h). Linear regression models adjusted for potential confounders quantified the associations, assuming 0.05 as significance level.

Results: Of the 328 subjects, 148(45.1%) were male (median age = 49.0, median BMI = 28.0, and median apnea-hypopnea index (AHI) = 9.0, and 67(20.4%) presented TST < 5h. 112(34.1%) had no OSA, 90 (27.4%) mild OSA, 59(18.0%) moderate OSA, and 67(20.4%) severe OSA. TST < 5h was associated with decreasing serum levels of 25(OH)D after adjustment for age, BMI and AHI (p = 0.047). Age was also associated with serum 25(OH)D (p = 0.046). Other factors, including AHI, were not significantly associated with 25(OH)D. Stratification by gender did not modify the association.

Conclusion: TST < 5h was associated with reduced serum vitamin D levels independently from gender, obesity and OSA. Considering that important enzymes related to vitamin D regulation are present in the hypothalamus, a sleep-regulatory area, this study contributes with one of the first evidences regarding a link between sleep duration and vitamin D regulation.

Support (If Any): This study was supported by Associaçao Fundo Incentivo a Pesquisa (AFIP).

0728  
INSOMNIA SYMPTOMS ARE ASSOCIATED WITH INCIDENT CARDIO- AND CEREBROVASCULAR DISEASE EVENTS IN YOUNG TO MIDDLE-AGED MEN  
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Introduction: Poor sleep is related to incident cardio- and cerebrovascular disease events (CVD), but previous studies mostly assessed these associations among middle-aged and older adults. We investigated the association of insomnia symptoms among young to middle-aged adults on CVD events by sex and race.

Methods: In 2000-01, non-Hispanic black and white adults (32-51 years) from the Coronary Artery Risk Development in Young Adults study with no history of CVD reported on insomnia symptoms including difficulty initiating sleep, maintaining sleep, and waking too early. CVD events from 2001 to 2013 were self-reported and adjudicated with medical records. Cox proportional hazard regression modeled the association of each insomnia symptom and cumulative symptoms on incident CVD events, adjusting for demographics, socioeconomic status, health behaviors, body mass index, depressive symptoms, systolic blood pressure, antihypertensive and lipid-lowering medication use, cholesterol levels, diabetes, thyroid and kidney problems, and self-rated health. Interaction terms for sex and race were added.

Results: The prevalence of difficulty initiating sleep, maintaining sleep, and waking too early was 16.3%, 9.3%, and 20.6%, respectively among men (n = 1,328), and 20.7%, 14.5%, and 20.1%, respectively among women (n = 1,622). CVD events occurred among 4.1% (n = 54) of men and 2.3% (n = 37) of women, over mean follow-up of 11.5 ± 1.4 years. There was a significant interaction between difficulty initiating sleep and sex (p = 0.02) such that men with this symptom had increased risk for CVD events (HR: 2.71, 95%CI: 1.52-4.81), but not women. Reporting more than one insomnia symptom also conferred increased risk for CVD events among men with each additional symptom (HR: 1.41, 95%CI: 1.09-1.84). There was no evidence associations varied by race.
Conclusion: Younger to middle-aged men with insomnia symptoms, particularly difficulty initiating sleep, were at greater risk for incident CVD events. These results are based on few incident cases and need to be confirmed in larger studies.

Support (If Any): The Coronary Artery Risk Development in Young Adults Study (CARDIA) is supported by contracts HH-SN268201300025C, HH-SN268201300026C, HHSN268201300027C, HHSN268201300028C, HHSN268201300029C, and HHSN26820090041C from the National Heart, Lung, and Blood Institute (NHLBI), the Intramural Research Program of the National Institute on Aging (NIA), and an intra-agency agreement between NIA and NHLBI (AG0005).

0729
KIDNEY FUNCTION TRAJECTORY PRIOR TO SLEEP APNEA DIAGNOSIS AND PAP THERAPY
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Introduction: Sleep apnea is associated with pathophysiologic risks to the kidneys that may predate the diagnosis of sleep apnea. We therefore compared the rate of loss of kidney function prior to sleep apnea diagnosis and PAP therapy to a group never diagnosed with sleep apnea.

Methods: Retrospective cohort study in Kaiser Permanente Southern California between 2002-2013. Chart review showed 90% positive predictive value (PPV) for case-identification and 99% PPV for non-case identification. Two or more serum creatinines (SCr) were required prior to sleep apnea diagnosis in cases and prior to a randomly chosen time-point in non-cases. Estimated glomerular filtration rate (eGFR) was calculated from SCr using the CKD-EPI equation. The rate of change of eGFR was determined using linear regression with adjustment for age, sex and race. Mean rate of change was compared by regression and the distribution was compared by the Kolmogorov-Smirnov statistic.

Results: There were 41,725 cases and 1,231,361 non-cases for analysis. Mean age: 51.7 years cases, 50.2 non-cases; gender: 64.0% male cases, 42.2% male non-cases; first eGFR: 90.5 mL/min/1.73m2 cases, 94.2 non-cases. The mean (95%CI) slope was -1.96 (-2.06,-1.85) in cases and -1.74 (-1.80,-1.68) in non-cases. The distribution of eGFR change/year was different (K-S p < 0.0001). Extreme rates of decline (< -10 mL/min/year) were not more common among sleep apnea patients.

Conclusion: Patients who are diagnosed with sleep apnea and treated with PAP have a more rapid rate of decline in renal function than non-cases. However, the difference is very small (0.2 mL/min/year) and appears insufficient to produce significant end-stage kidney disease.

Support (If Any): NIH/NIDDK 1R21DK103104

0730
SHORT SLEEP DURATION MODIFIES THE RELATIONSHIP BETWEEN CARDIOVASCULAR / CEREBROVASCULAR DISEASE AND ALL-CAUSE MORTALITY
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Introduction: Short sleep duration has been associated with increased risk of cardiovascular (CVD) and cerebrovascular (CBV) disease and mortality. However, the role of sleep duration in predicting mortality in the context of CVD/CBV is still not well-understood. We hypothesized that short sleep duration is a key effect modifier of the relationship between CVD/CBV and all-cause mortality.

Methods: We addressed this question in the Penn State Adult Cohort, a random, general population sample of 1,741 adults (20-88y) who were studied in the sleep lab and followed-up for 15y. An in-lab, 8-hour polysomnography (PSG) was performed to ascertain sleep duration. CVD/CBV was defined by the presence of hypertension, diabetes, heart disease and/or stroke. We tested the interaction between CVD/CBV and PSG sleep duration on all-cause mortality with multivariable logistic regression while adjusting for age, race, sex, BMI, cholesterol, smoking, sleep apnea, sleep complaints, and depression.

Results: The odds of mortality associated with CVD/CBV were 2.62 (95% CI: 1.88-3.64). The interaction between CVD/CBV and PSG sleep duration was significant (p = .04), indicating that the odds of mortality increased significantly as a function of shorter sleep duration in individuals with CVD/CBV; specifically, the multivariable-adjusted ORs associating CVD/CBV and all-cause mortality were 1.87 (1.15-3.06), 2.91 (1.53-5.55), and 4.18 (2.26-7.71) for individuals with ≥ 6, 5-6, and ≤ 5 hours of sleep, respectively.

Conclusion: We found that objective sleep duration modifies the relationship between CVD/CBV and all-cause mortality in a dose-response manner. Short sleep duration in individuals with cardiovascular risk or who survive a stroke may serve as a biomarker of the severity of central autonomic dysfunction. Future studies should examine whether improving sleep reduces the odds of mortality in individuals with CVD and/or stroke.

Support (If Any): AHA’s 14SDG19830018 and NIH’s R01 HL51931, R01 HL40916, and R01 HL64415

0731
THE IMPACT OF SLEEP AND BODY MASS INDEX ON STROKE DISPARITIES BETWEEN BLACKS AND WHITES: A COMPARATIVE ANALYSIS OF STRUCTURAL EQUATION MODELING AND BAYESIAN BELIEF NETWORK MACHINE LEARNING ANALYSIS
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Introduction: Previous research has shown that Blacks/African-Americans (vs Non-Hispanic Whites) are more likely to be obese, suffer from stroke, and experience short sleep (SS8hrs/day) durations. Also, sleep duration itself is related to obesity and stroke risk, and the relationship between sleep duration and obesity is stronger in Blacks/African-Americans. This study explored the mediating role of obesity on relationships of SS and LS with stroke, while also contrasting traditional and newer multivariate machine modeling approaches.

Methods: Data from the National Health Interview Survey from 2004-2013 (N = 288,888) was used. Structural equation modeling (SEM) and Bayesian Belief Network (BBN) analysis assessed the mediating effects of BMI on the relationship between SS, LS, and stroke, while also contrasting traditional and newer multivariate machine modeling approaches.

Results: Based on SEM results, BMI positively mediated relationships between SS and stroke (Path Coefficient Estimates < 0.027,p < 0.001), and between LS and stroke (Path Coefficient Estimates = 0.024;p < .001), adjusting for covariates. In SEM, race/ethnicity did not significantly moderate relationships between SS or LS and obesity. In contrast, BBN analysis showed that these relationships differed between blacks and whites. Blacks who were SS and obese had a 5.14% stroke probability, while white counterparts had a 3.73% stroke probability, with a significant difference of 37.8% (p < 0.001). Blacks who were LS and obese had an 11.71% stroke probability compared to whites with an 8.66% stroke probability and a significant difference of 35.21% (p < 0.001).
**Conclusion:** No racial/ethnic influences on the mediating effect of BMI on the sleep-CVD relationship were detected using SEM. However, BBN analysis (but not SEM) showed racial/ethnic influences on the mediating effect of BMI on the sleep-stroke relationship, suggesting that obese blacks who reported short or long sleep were at greater risk for stroke. Findings also highlight the power of BBN analysis to elucidate disparities in complex chronic diseases.

**Support (If Any):** NIH (R01MD007716, U54NS081765 and R01HL095799).

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**0732**

**POLYSOMNOGRAPHIC MEASUREMENT OF SLEEP DURATION AND BODILY PAIN PERCEPTION IN THE SLEEP HEART HEALTH STUDY**

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**Introduction:** Sleep and pain measures are related; however, the specific sleep stage and the type of pain measured has varied greatly in the literature. The objectives of this study are to determine whether total sleep time and specific sleep stage duration are associated with bodily pain perception and whether gender modifies this relationship.

**Methods:** Total sleep time (TST), rapid-eye movement (REM) sleep time, and slow wave sleep (SWS) time were measured by unattended, in-home nocturnal polysomnography. Bodily pain perception was measured via the SF-36 questionnaire bodily pain component. We used logistic regression to examine associations between total and individual sleep stage durations and bodily pain perception controlling for age, gender, race, body-mass index, apnea-hypopnea index, antidepressant use, and important cardiovascular conditions (smoking [pack-years], history of diabetes, and history of percutaneous coronary intervention and/or coronary artery bypass graft).

**Results:** In the fully adjusted model, REM sleep time and SWS time were not associated with moderate to severe bodily pain perception, while TST was: Each 1-hour decrement in TST was associated with a 7% increased odds of moderate to severe bodily pain perception (OR 1.07, 95% CI 1.002, 1.14). Due to modification of the association between SWS time and moderate to severe bodily pain perception by gender (p for interaction = 0.01), we performed analyses stratified by gender: Each 1-hour decrement in SWS time was associated with a 20% higher odds of moderate to severe bodily pain perception among men (OR 1.20, 95% CI 1.03-1.42) while an association was not observed among women.

**Conclusion:** Shorter TST among all subjects and shorter SWS time in men was associated with moderate to severe bodily pain perception. REM sleep duration was not associated with bodily pain perception in this cohort.

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**0734**

**COMPARISON OF SELF-REPORTED SLEEP QUALITY BY SLEEP APNEA STATUS IN INDIVIDUALS WITH HEART FAILURE**

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**Introduction:** Sleep apnea (SA) is highly prevalent in patients with heart failure (HF). Untreated SA has been associated with increased morbidity and mortality. Literature suggests HF patients have poor sleep quality due to HF symptoms, comorbidities, and medications. SA is an important predictor of sleep quality in the general population. However, there is little known about whether or not SA status is associated with self-reported sleep quality in HF patients. Thus, we aimed to compare different self-reported sleep measures by SA status among HF patients.

**Methods:** A total of 27 community-dwelling individuals’ data from a larger study were examined after excluding participants who were undergoing SA treatment. SA assessments were performed using a portable multi-channel SA monitoring device. An apnea hypopnea index ≥ 10 was used to define SA. We compared 15 people with untreated SA and 12 people without SA. Three sleep related measures were examined: Pittsburgh sleep quality index, insomnia severity index, and Epworth sleepiness scale. Independent t test and chi-square test were used for this analysis.

**Results:** The mean (SD) age was 68 (6) years; 63% were male. There were no significant differences in age, gender, comorbidities, and New York Heart Association classes between individuals with and without SA. Between patients with and without untreated SA, there were no investigated in young adults with T1DM. The objective of this investigation was to characterize the time-varying coupling between glucose and physical activity over multiple days in young adults with T1DM; hypothesizing that coupling would differ during sleep versus wakefulness and would exhibit circadian variations.

**Methods:** Twenty-three young adults (age 18-30 years) with T1DM participated in the study. Glucose variations were monitored with a continuous glucose monitoring system and activity was assessed using an actigraph worn on the non-dominant wrist. Simultaneous glucose and physical activity data for a continuous 60-hour period were used for analysis. Wavelet coherence analysis was employed to quantify time- and frequency-dependent coupling between physical activity and glucose. Cosinor analysis was used to assess whether glucose/activity coherence exhibited significant circadian variations.

**Results:** Coherence analysis demonstrated substantial coupling between physical activity and glucose variations during both wakefulness (0.362 ± 0.046) and sleep (0.357 ± 0.049). For rapid (10- to 30-minute) fluctuations, mean coherence was higher during sleep than wakefulness (F = 10.86, p = 0.003). In addition, rapid glucose variations consistently led changes in physical activity (p = 0.001) consistent with arousal/awakening from sleep. Cosinor analysis revealed significant circadian modulation of glucose/activity coupling, especially for fluctuations with periods between 2 and 4 hours (F = 6.69, p ≤ 0.0001).

**Conclusion:** Activity and glucose variations demonstrate strong time- and frequency-dependent coupling over a 60-hour period in young adults with T1DM. Specifically, glucose variations may be a source of sleep disruption. Further, circadian modulation is evident in the sleep/wake relationship between activity and glucose. Understanding sleep/wake and circadian modulation of glucose/activity relationships may help to improve diabetes management.

**Support (If Any):** American Academy of Diabetes Educators Foundation/Sigma Theta Tau International and a NIH TL-1 Institutional Fellowship, STLTR000049-05.
significant differences in sleep quality (4.6 and 7.3), insomnia symptoms (5.1 and 8.6), and excessive daytime sleepiness (6.0 and 7.3).

**Conclusion:** Preliminary analyses suggest that there are no differences in sleep and daytime symptoms between HF patients with and without SA. Given high rate of undiagnosed SA, researchers and clinicians may not distinguish patients with SA using self-reported sleep quality measures. Further exploration, using larger and more diverse samples is needed to confirm these findings.

**Support (If Any):** Research reported in this abstract was supported by the National Institute of Nursing Research of the National Institutes of Health under Award Number R00NR012773 (Brain Alterations and Cognitive Impairment in Older Adults with Heart Failure, Lisa Bratze, PI).

### 0736

**LEFT ATRIAL ECHOCARDIOGRAPHIC PARAMETERS IN SLEEP DISORDERED BREATHING AND PAROXYSMAL ATRIAL FIBRILLATION**

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**Introduction:** Left atrial morphologic alterations, a recognized atrial fibrillation (AF) risk have been described in sleep disordered breathing (SDB). We postulate that left atrial volume alterations in SDB will be observed in those with paroxysmal AF (PAF) compared to those without.

**Methods:** The Sleep Apnea and Atrial Fibrillation Biomarkers and Electrophysiologic Atrial Triggers (SAFEBEAT) study was designed in part to examine echocardiographic parameters in SDB and PAF. Cases included those > 18 years of age with PAF 1:1 matched to controls without AF by age (± 5 years), sex, race and body mass index (BMI ± 5kg/m\(^2\)). Participants underwent polysomnography with 2-dimensional echocardiography the subsequent morning. SDB was dichotomized by median apnea hypopnea index (AHI = 9.3) and median percentage sleep time < 90% oxygen saturation (TST90 = 0.4%). Echocardiographic measures were left atrial volume (LAV, ml) and LAVI indexed for body surface area (LAVI, ml/m\(^2\)). Two-sample t test and linear regression for interaction of AF and SDB on LA measures was performed.

**Results:** The analytic sample consisted of 158 participants (n = 78 cases and n = 80 controls): age 60.8 ± 13.3 years, 66.5% male, 85.4% Caucasian and BMI of 31.3 ± 6.3/kg/m\(^2\). In those with PAF, LAV was higher with greater vs lesser SDB severity: 74.0 ± 17.5 vs 61.7 ± 20.9, p = 0.011 and greater vs lesser hypoxia (TST90 > 0.4%): 73.6 ± 19.9 vs 60.0 ± 19.1, p = 0.004. Similarly, in controls without AF, LAV was higher with greater vs lesser SDB severity: 64.0 ± 18.0 vs 61.5 ± 22.5, p = 0.60 and greater vs lesser hypoxia: 65.8 ± 18.6 vs 60.0 ± 20.6, p = 0.20. Similar findings were observed with LAVI, although not statistically significant. The interaction of hypoxia and LAVI in relation to PAF was not statistically significant.

**Conclusion:** Left atrial volume was increased with greater SDB severity and hypoxia in PAF and less so in those without, suggesting SDB-related pathophysiologic influences plays a role in left atrial remodeling even in the early AF spectrum of onset.

**Support (If Any):** NHLBI R01 1 R01 HL 109493, Clinical and Translational Science Collaborative of Cleveland, UL1TR000439 from the National Center for Advancing Translational Sciences (NCATS) component of the National Institutes of Health and NIH roadmap for Medical Research.

### 0737

**POLYSOMNOGRAPH-BASED SLEEP PARAMETERS AND PAROXYSMAL ATRIAL FIBRILLATION**

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**Introduction:** There is preponderance of data characterizing the association of sleep disordered breathing (SDB) and atrial fibrillation (AF). Although understudied, epidemiologic data identify non-SDB sleep abnormalities associated with increased continuous AF prevalence. We
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17.7% (13.1-20.6), p = 0.86.

50% early, 21% normal, and 29% late types. Overall, 45% reported

versus 19.6 (13.4-26.5) versus 19.6(13.4-27.6), p = 0.59, periodic limb movement index [2.8 (0.00-21.8) versus 2.8 (0.00-25.7), p = 0.43], N3 [17.9% (11.2-24.8) versus 17.9%(11.1-24.7), p = 0.92] and REM sleep[17.2%(13.6-20.6) versus

Conclusion: Unlike published data pertaining to continuous AF, no significant associations were observed of non-SDB sleep parameters and paroxysmal AF suggesting that sleep abnormalities may not contribute to atrial arrhythmogenesis in early AF.

Support (If Any): NHLBI RO1 R01 HL 109493, Clinical and Translational Science Collaborative of Cleveland, UL1TR000439 from the National Center for Advancing Translational Sciences (NCATS) component of the National Institutes of Health and NIH roadmap for Medical Research

0738
CHRONOTYPE, SLEEP CHARACTERISTICS, AND MUSCULOSKELETAL DISORDERS AMONG HOSPITAL NURSES

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Introduction: Musculoskeletal disorders (MSDs) are the leading cause of occupational injuries and illnesses, and pain and disability among healthcare workers. There is a known relationship between pain and sleep quality. However, the relationship among chronotype, sleep characteristics, and MSDs has not been studied.

Methods: Questionnaires were given to registered nurses and licensed practical nurses at a community hospital in Massachusetts. Chronotype was assessed with the modified final question from the Morningness-Eveningness Questionnaire about self-described early/normal/late type. Sleep characteristics included sleep disturbances, usual sleep duration, sleep episodes/day, usual sleep latency, and use of sleep-promoting substance. Sleep disturbances were measured with the PRO-MIS Sleep Disturbance Short Form. MSDs were assessed for six body regions: low back, shoulder, neck, wrist/forearm, knee, and ankle/feet; and were defined as “yes” for participants reporting moderate, severe, or extreme pain in any region.

Results: Among 397 nurses (95% female; age 43 ± 12 y), there were 50% early, 21% normal, and 29% late types. Overall, 45% reported sleep latency ≥ 30 minutes and 30% reported taking sleep-promoting substance. Nearly half (47%) reported MSDs. Multivariate robust Poisson regressions indicated that late chronotype (PR = 1.32, p < 0.05), sleep latency ≥ 30 minutes (PR = 1.37, p < 0.05), and taking sleep-promoting substance (PR = 1.35, p < 0.01) were associated with increased risk of MSDs, after adjustment for age, gender, race, BMI, regular exercise, shift work, and other sleep characteristics. Sleep disturbances (33%), short (≤ 6h/day) sleep duration (49%), and ≥ 2 sleep episodes/day (19%) were not associated with MSDs after adjustment for covariates.

Conclusion: Late chronotype, long sleep latency, and regular use of sleep-promoting substance were associated with MSDs among hospital nurses. Longitudinal studies are needed to explore the causal relationships among these factors. Well-designed evidence-based non-pharmacological interventions to reduce sleep latency and the need for sleep-promoting substance may reduce MSDs.

Support (If Any): This study was supported by a University of Massachusetts Lowell Faculty Start-up Award to YZ. JFD is supported by the National Institute of Health, R01 AG044416.

0739
SLEEP DISTURBANCES EXPERIENCED BY MILITARY BURN SURVIVORS

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Introduction: Military men and women may suffer from burn injuries because of their military duties. Due to advances in burn care, many survive their injuries. Following discharge, military burn survivors continue to experience sleep disturbances; however there is a lack of understanding of sleep disturbances in this population after discharge from the military burn center. The purpose of this study was to examine subjective reports of sleep disturbance as experienced by military burn survivors over time.

Methods: In this descriptive longitudinal study data were gathered at 5 time points: burn center discharge; 3, 6, 12, and 18 months post-discharge from 78 participants. Sleep specific items were collected from The Burn Specific Health Scale-A (BSHS-A), the Post-Traumatic Distress Check List-Military (PCL-M), and the Center for Epidemiologic Studies Depression Scale (CESD); participants also completed demographic and clinical history forms. Data were analyzed using measures of central tendency, correlations, and ANOVA.

Results: The participants were primarily Army (74%), enlisted service members (96%) with an average of 62 months service. Most were Caucasian (69%), males (n = 97%) with a mean age of 25 years, at least a high school education or GED (56%) with an annual income of $40,000 or less (78%), and 45% were married. They presented with thermal burns and polytrauma resulting from combat injuries and accidents with a mean total body surface area burned = 24%; average length of stay in the burn unit was 44 days (median = 17 days). Patients reported persistent sleep disturbances that included: nightmares (50%), insomnia (71%), hypersomnia (31%) and excessive daytime sleepiness (63%). Data analysis is ongoing.

Conclusion: These patients were relatively young and in good physical health prior to sustaining a burn injury. Participants’ sleep disturbances remained relatively consistent over this 18 month study post-discharge. Understanding burn patients’ sleep disturbances assists with interpretation of burn rehabilitation progress and psychosocial needs.

Support (If Any): This study was funded by the TriService Nursing Research Program.
0740
THE INTERACTION BETWEEN ERECTILE DYSFUNCTION COMPLAINTS AND DEPRESSION IN MEN: A CROSS-SECTIONAL STUDY OF SLEEP, HORMONES AND QUALITY OF LIFE
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Introduction: Depression is one of the main disabling diseases and is considered a contributor factor for erectile dysfunction (ED). Both of these conditions alone can affect sleep pattern. We aimed to evaluate the interaction between ED complaints and depression symptoms on objective and subjective sleep parameters, hormone levels, and quality of life in men from an epidemiological sample.

Methods: This was a cross-sectional study of 468 men aged 20-80 years-old from the Epidemiological Sleep Study (EPISONO). The participants were classified according to the presence of ED and/or depression (D) according to sexual questionnaire and Beck Depression Inventory, respectively. Thus, there were 4 groups of men: no D without ED (ND+NED), no D with ED (ND+ED), D without ED (D+NED) and D with ED (D+ED). All participants also completed questionnaires about sleep, comorbidities, medications, and quality of life and underwent a full-night polysomnography. On the following morning, they had blood samples collected for testosterone and progesterone quantification.

Results: In the subjective assessment, ND+ED participants showed higher frequency of insomnia symptoms (65.5%) whereas of the group D+NED was associated with difficulty falling asleep (60%) and early morning awakening (72.5%). In the polysomnography, all groups showed similar parameters. Heart attack and cardiac diseases were more frequent in patients with D+ED. This group also presented lower testosterone levels and a worse score in the psychological domain quality of life compared to the other groups.

Conclusion: ED or depression, as independent factors, negatively impacted subjective sleep parameters. The interaction between these factors led to a lower quality of life and was related to a higher frequency of cardiac comorbidities.

Support (If Any): Our studies have been supported by Associação Fundo de Incentivo à Pesquisa (AFIP), São Paulo Research Foundation (FAPESP, #2014/152159-2 to CH and #2015/02036-8 to JHSP) and The National Council for Scientific and Technological Development (CNPq).

0741
TRANSLATIONAL SCIENCE: PROCESS EVALUATION OF A BRIEF BEHAVIORAL INTERVENTION FOR INSOMNIA IN LUNG CANCER SURVIVORS
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Introduction: Individuals with lung cancer often underestimate their insomnia and/or fail to recognize the role of sleep in quality of life. Understanding the facilitators and barriers to translate Brief Behavioral Therapy for Insomnia (BBT-I) into practice is crucial for implementation in a clinical setting. The purpose of this study was to perform a formative evaluation of BBT-I implementation.

Methods: Two separate focus groups were led by a qualitative methodologist during off hours at the work sites lasting about 60-minutes each. Focus group discussion questions included recruitment barriers, implementation of BBT-I including teaching and follow-up phone calls and suggestions for improvement. Data were audio-recorded, transcribed verbatim and analyzed by the constant comparative method. Initial coding of data was accomplished by reviewing each transcript several times to identify and label data with substantive codes that describe participants’ perceptions and experiences.

Results: Two focus groups (N = 3 and N = 11) included 9 nurses, 2 physicians, and 3 clerks. Recruitment barriers included lack of focus on sleep issues. Recruitment issues included logistic and adverse climate barriers. Patients and providers tended not to recognize or underestimate sleep problems. Patients were much more likely to participate in the study if they were referred by a health care provider. BBT delivery by nurses was promoted by structured training. BBT in group format promoted patient engagement and participation while encouraging conversation between patients. This engagement promotes understanding of class content and increases the likelihood that the patient followed the program. Follow-up phone calls allowed research staff to evaluate patients understanding and application of class content and give patients a report on their sleep efficiency.

Conclusion: BBT-I is effective when implemented by trained nurses. Improvement in recruitment is possible by support from clinical staff and providing training in the importance of sleep to patient outcomes.

Support (If Any): 1R15NR01377901A1
as compared to G/G genotype. Using a multivariate logistic regression model, subjects with CC genotype showed higher risk of OSA and NAFLD (OR, 6.54, 95% CI: 3.09-11.5, p = 0.0001).

Conclusion: Asian Indian subjects carrying -174G/C SNP of IL-6 gene is predisposed to develop OSA and NAFLD.

0743 CARDIAC VARIABLE TRENDS IN PATIENTS WITH MULTIPLE RESPIRATORY CONDITIONS
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Introduction: Recent research has found that coexistence of OSA and low pulmonary function leads to worse prognosis for patients. Both OSA and decreased pulmonary function have been recognized as independent risk factors for cardiovascular disease mainly from the impacts of increased arterial stiffness, systemic inflammation and vascular dysfunction. The purpose of this pilot study was to analyze the impact of the concomitant respiratory conditions on cardiac variables.

Methods: Subjects were recruited from consecutive patients referred for suspected sleep disordered symptoms at a local sleep medicine clinic. Patients were screened with standard polysomnography and diagnosed using AASM guidelines. Resting cardiac function was assessed using non-invasive thoracic bioimpedance technology. From the chart review of 101 tested subjects, a group of 10 patients had spirometry data consistent with low pulmonary function. We used FEV1/FVC < 80%, FVC predicted < 90 and AHI > 5 to categorize patients as having multiple respiratory conditions (MRC).

Results: Patients with MRC trended toward higher systolic (138.4 ± 19.7 mmHg, p = 0.09) and diastolic blood pressures (82.0 ± 16.7 mmHg, p = 0.6) than patients with OSA only (SBP = 126.6 ± 15.7 mmHg; DBP = 75.5 ± 14.8 mmHg), or no OSA (SBP = 122.2 ± 12.7 mmHg; DBP = 75.6 ± 13.0 mmHg). In addition, stroke volume (SV) appeared to be decreased in MRC patients (68.5 ± 39.9 ml, p = 0.04) compared to OSA patients without reduced pulmonary function (93.6 ± 15.6 ml) or no sleep apnea (86.6 ± 21.4 ml).

Conclusion: Based on preliminary data, there is some evidence that individuals with MRC may have an elevated cardiovascular risk over those with OSA only, due to increases in BP, lower overall SV, and CO. Larger scale replications of this study may confirm the deleterious effects of MCS on cardiac function.

0744 DELIRIUM IN THE ICU: DOES SLEEP PLAY A ROLE?
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Introduction: Sleep disturbances in the ICU may be associated with increased risk for delirium. Actigraphy as a measure of sleep has been used in patients with disorders of consciousness.

Methods: To study the effectiveness of a reorientation intervention program for the prevention of delirium in the ICU and its relationship with sleep, thirty adult patients were randomized to three subgroups. Ten patients received a scripted reorientation message from a familial voice (Group 2), ten patients received a similar message from a non-familial voice (Group 3) and ten patients did not receive a reorientation message (Group 1). Wrist actigraphy was recorded for a maximum of five consecutive days starting from the time of admission to the ICU. Delirium was evaluated by the Confusion Assessment Method (CAM)-modified ICU version. To explore the possible mediation effect of sleep in a longitudinal study setting, it was fitted two linear mixed models: (1) the CAM score against the group assignment and (2) the CAM scores against the percent of sleep and Sobel’s test was applied.

Results: Actigraphy was successfully obtained in 76% (n = 23) of the sample. The data from two patients could not be downloadable. Seven patients had a very low activity count and sleep variables could not be estimated. Following the reorientation intervention, the mean sleep efficiency in Group 2 increased from 56% to 66%; also, sleep efficiency increased from 45% to 52% in Group 3 as compared with Group 1 (sleep efficiency decreased from 54% to 52%). The Sobel’s test within linear mixed models yielded an effect of 4.84x10^-5 (P value of 0.99).

Conclusion: While it was not statistic significant, there was a trend towards improvement of the sleep efficiency as measured by actigraphy in the two intervention groups. Whether sleep prevents ICU delirium will require further study in a larger patient population.

0745 GASTRO-ESOPHAGEAL REFUX DISEASE (GERD) AND SLEEP DISORDERS: RESULTS FROM A NATIONALLY REPRESENTATIVE US SAMPLE
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Introduction: Gastroesophageal reflux (GER) symptoms affect 20% of US adults weekly, and among these 79% report GER symptoms during sleep (ICSD3). Sleep-related GER symptoms have been reported in up to 62% of obstructive sleep apnea (OSA) patients. There are no studies of sleep disorders in gastroesophageal reflux disorder (GERD), defined as more troublesome symptoms of GER, in patients from a nationally representative US sample.

Methods: We studied patients age > 18 years from 1995-2010, in the National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey with physician-diagnosed GERD (ICD9-CM code 530.81). Each patient visit is assigned up to 3 ICD9-CM diagnoses, and up to 3 ‘Reasons for Visit’ (RFV).

Results: There were 10,019 physician-diagnosed GERD visits (representing an estimated 201,215,560 (+/- SE) ± 11,911,420 patients) (59.3% ± 0.9% female; 83.4% ± 1.0% ‘white’; mean ± SE age: 56.43 ± 0.33 years). All sleep disorders accounted for 2.2% ± 0.3% of GERD visits (unweighted count = 245). GERD was significantly associated with ‘Insomnia’ (ICD9-CM 780.52, RFV 1135.1) (OR = 1.375, 95%CI 1.000-1.980) and ‘OSA’ (ICD9-CM 780.57, 327.23, RFV 1135.5) (OR = 1.661, 95%CI 1.140-2.421), which accounted for 52.8% ± 3.5% and 32.6% ± 3.9% of sleep disorders visits, respectively in GERD. Proton pump inhibitors (PPIs) represented 52.5% ± 4.1% of medications in GERD and were significantly more commonly used in GERD versus all other patients (OR = 29.61, 95% CI 27.18-32.24). Logistic regression analysis revealed that the relationships between GERD and OSA (OR = 0.898, 95% CI 0.601-1.341), and GERD and Insomnia (OR = 1.044, 95% CI 0.747-1.457) were no longer significant after the effect of PPIs was controlled for.

Conclusion: GERD was significantly associated with both OSA and Insomnia when compared to all other patient visits in a nationally representative US sample, a finding that is consistent with previous reports. Our finding (which is counter-intuitive as PPIs are expected to improve GERD symptoms and thereby improve sleep) further suggest that the relationship between GERD and both Insomnia and OSA are no longer significant after the effect of PPIs is controlled for.
ARE CHANGES IN CIRCADIAN ACTIVITY RHYTHMS RELATED TO CHANGES IN BODY MASS INDEX IN THE FIRST YEAR AFTER ADJUVANT BREAST CANCER CHEMOTHERAPY?

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Introduction: Lower circadian activity rhythms (CAR) have been associated with higher body mass index (BMI) in breast cancer survivors. Significantly lower 24-hr. amplitude and autocorrelation coefficient activity rhythms in obese women may be associated with increased morbidity and mortality. In women at baseline (day of first adjuvant chemotherapy treatment) and 1 year later, our purpose was to examine 1) changes in CAR and BMI over time; 2) relationships between changes in CAR and BMI in the total sample (n = 147) and in two groups [non-obese: BMI 30 (n = 70)].

Methods: A secondary analysis used data from a Randomized Controlled Trial. Mean age was 51.6 (29-73 yrs.), 97% white, 70% partnered, stage I-IIIA breast cancer, 50% pre/50% post-menopausal, Midwestern US setting. Participants all received 4-8 chemotherapy treatments; 50% received radiation therapy after chemotherapy. A wrist actigraph was worn for 7 days at each time to determine CAR mesor, amplitude, acrophase, 24-hr. circadian quotient, and 24-hr. autocorrelation coefficient. BMI was calculated from scale height and weight. Analyses included correlations and t-tests

Results: For the total sample, mean changes were significant in BMI and all CAR variables except acrophase. Change in BMI was not correlated with change in any of the CAR variables. CAR variables significantly improved for both non-obese and obese groups. However, BMI change was non-significant for the non-obese but significantly increased for the obese group. Among the total sample, 47 women experienced no change or a decrease in BMI and 100 women had increased BMI over time.

Conclusion: The total sample and both groups experienced positive changes in CARs at 1 year compared to baseline. However, 2/3 of the women had increased BMI, particularly those who were obese at baseline. Promoting stronger CARSs through day activity and quality sleep may assist in weight management.

Support (If Any): R01NR007762

0747
NEGATIVE INFLUENCE OF SYMPATHETIC DYSFUNCTION ON SLEEP QUALITY IN CHRONIC SUBJECTIVE TINNITUS

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Introduction: Sleep difficulties are among the frequent complaints associated with chronic tinnitus. Most studies reporting on this problem are questionnaire-based. The perceived distress in tinnitus patients seems to be sympathetically mediated was also proposed recently. We aimed to investigate the significant predictors of chronic subjective tinnitus, and to assess the interaction of autonomic nerve system (ANS) function and sleep quality on the tinnitus severity.

Methods: Adult patients with subjective tinnitus who visited the department of otolaryngology in National Cheng-Kung University Hospital and Tainan Hospital were recruited since 2013. The duration of tinnitus complaint was required to be at least 6 months. According to previous medical records, subjects with the average hearing threshold above 25 dB HL were excluded. Objective assessments included pure-tone audiometry, over-night hospital polysomnography (PSG) and ANS function test. Subjective questionnaire assessments were Pittsburgh Sleep Quality Index and Tinnitus Handicap Inventory. Participants (with and without tinnitus) were matched for health and relevant socioeconomic factors.

Results: There were 40 tinnitus patients and 40 control subjects without tinnitus completed the whole protocol. Tinnitus patients were older than non-tinnitus subjects (p < 0.05). Characteristics of hearing status among tinnitus patients included worse 4k-Hz hearing threshold and worse 4k-Hz uncomfortable loudness level. Longer sleep latency and lower sleep efficiency were found among tinnitus patients (p < 0.05). 4k-Hz uncomfortable loudness level, sleep latency and ANS function hyperactivity were significant predictors of the severity of Tinnitus handicap inventory (THI). Furthermore, combination with longer sleep latency and ANS function hyperactivity led to higher score level of THI.

Conclusion: Our study showed that longer sleep latency and ANS function hyperactivity aggravated the tinnitus severity. According to these findings, further clinical interventions to improve the ANS function hyperactivity and sleep difficulties among chronic subjective tinnitus patients should be considered.

0748
SLEEP EFFICIENCY MEDIATES THE EFFECTS OF ETHNICITY ON CLINICAL PAIN SEVERITY IN TEMPOROMANDIBULAR JOINT DISORDER

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Introduction: Ethnic differences in sleep have been well documented, generally indicating that African Americans (AA) experience greater disturbed sleep compared to non-Hispanic Whites (NHW). Extensive evidence shows that African Americans have a higher prevalence of and more pain. This study examined the potentially important role of sleep in explaining the relationship between ethnicity and clinical pain severity in a sample of adults with Temporomandibular Joint Disorder (TMJD).

Methods: 83 women with TMJD (n = 16 AA, and n = 67 NHW) recruited from a large clinical trial completed baseline testing, including self-reported measures of pain [Brief Pain Index (BPI)] and pain catastrophizing [Pain Catastrophizing Scale (PCS)]. The covariate of catastrophizing is a negative cognitive-affective response to pain involving rumination, helplessness, and magnification that is associated with negative pain outcomes. Sleep variables were collected using 2 weeks of wrist actigraphy, and one night of ambulatory polysomnography (PSG). Data was analyzed using a statistical bootstrapping technique for indirect effects tests.

Results: AA participants reported significantly greater pain severity (mean = 5.73, SD = 1.77) compared to NHW participants (mean = 4.12, SD = 1.43; p < 0.001). AA displayed lower sleep efficiency (actigraphy/PSG mean = 81.98%/65.28%, SD = 9.23/22.32) compared to NHW (actigraphy/PSG mean = 88.08%/86.79, SD = 4.11/10.40; p’s < 0.001). Results suggested that ethnicity was associated with sleep efficiency, and a significant portion of variance in clinical pain severity attributable to ethnicity was mediated by sleep efficiency (actigraphy/PSG t = -1.54/-1.16, p’s < 0.05).

Conclusion: These findings indicate that the effects of ethnicity on pain are exerted indirectly through sleep efficiency (measured by actigraphy & PSG). Thus, the greater clinical pain severity observed in African Americans with TMJD may be partially explained by reduced
sleep efficiency. Consequently, sleep disturbance in this population is an important clinical factor to consider and address in chronic pain treatment.

Support (If Any): The present work was supported by NIH grant R01DE019731 (Haythornwaite, JA and Smith, MT).

0749
PAIN MODERATES THE ASSOCIATION BETWEEN SELF-RATED HEALTH AND SLEEP
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Introduction: The association between poor health and disrupted sleep is well documented. Less is known, however, about factors moderating this association, or the association between health and sleep assessed at the daily level. The current study uses daily diary data to explore the relation between self-rated health and sleep outcomes as moderated by pain.

Methods: The sample of 38 community-dwelling older adults (M age = 73.40, SD = 7.19) was derived from a daily diary study of factors predicting cognition. Self-rated health was measured with a single item, and sleep and pain outcomes were calculated from daily diaries.

Results: Using multilevel modeling analyses, and controlling for select covariates, mean pain was a significant moderator of the association of self-rated health and the following sleep outcomes: NWAK (B = -0.08, p < 0.01), SQR (B = 0.04, p = 0.02), TST (B = -4.63, p = 0.05), TWT (B = 5.32, p < 0.01), and SEI (B = -1.33, p < 0.01). For individuals with higher levels of pain on average, better health ratings were associated with a lower number of nighttime awakenings, less total wake time, greater total sleep time, greater sleep efficiency, and higher subjective sleep quality ratings. Pain did not moderate the association between health and these sleep outcomes in those with less pain, with the exception of TST, which was higher with higher health ratings. However, the effect was smaller than in the high pain group.

Conclusion: Results indicate that pain moderates the association between self-rated health and sleep outcomes, such that individuals with higher overall levels of pain exhibit a positive association between higher self-rated health and better sleep outcomes. Results highlight the importance of examining moderating factors of well-established relations between health and sleep to further our understanding of the additional processes influencing these associations.

0750
LACK OF ASSOCIATION BETWEEN EPWORTH SLEEPINESS SCALE AND FLOPPY EYELID SYNDROME
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Introduction: Previous studies have supported an association between Floppy Eyelid Syndrome (FES) and Obstructive Sleep Apnea (OSA), but the validity of this association was uncertain. A prospective observational clinical study was done to better evaluate the role of OSA in eyelid laxity spectrum disorders, and there was no association found between OSA and eyelid laxity. Using this dataset, it was further examined whether subjective sleepiness as reported by the patient was associated with eyelid laxity spectrum disorders.

Methods: 201 adult patients that visited the Mount Sinai Sleep Center for overnight polysomnography from 3/1/15-8/31/15 were enrolled in the initial study. ESS scores were available for 189 of these patients within the electronic medical record. Subjects underwent bedside evaluation at the sleep center, including an ocular history, visual acuity assessment, and an eyelid and ocular surface exam. Three surrogate measurements were designed to assess patient’s FES status: eyelid laxity score (0-24), ocular surface score (0-16), and eye symptom score (0-3). Correlation between ESS score and eyelid surface and eyelid score was obtained through multivariate linear regression analysis; association with positive history of OES ocular symptoms was obtained through multivariate ordered logistic regression. Analysis was adjusted for OSA severity, gender, age, BMI, and systemic disease.

Results: No statistically significant association was observed between ESS score and eyelid laxity score (regression coefficient 0.006, 95% CI -0.093 to +0.105), ocular surface score (regression coefficient 0.024, 95% CI -0.036 to + 0.085), or an odds ratio of positive history of FES symptoms (OR 0.98, 95% CI 0.92 to 1.03).

Conclusion: There is no significant association between subjective sleepiness as represented by the ESS score and eyelid laxity.

0751
CHARACTERISTICS OF SLEEP IN CHRONIC KIDNEY DISEASE
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Introduction: Sleep disorders are very common in chronic kidney disease (CKD). However, sleep has not been well characterized in CKD using polysomnography (PSG).

Methods: We conducted a cross-sectional analysis of 248 veterans aged 18-91 with estimated glomerular filtration rate (eGFR) of 15-44 ml/min/1.73m2 enrolled in the SNORE Study. Participants underwent 25 channel unattended PSG and completed Epworth Sleepiness Scale (ESS). Serum creatinine (to calculate MDRD eGFR) and urinary albumin excretion (UACR) were measured the morning after PSG. Albuminuria was defined as UACR ≥ 30 mg/g Cr. We compared sleep parameters categories of kidney function as follows: 1) (best function) eGFR ≥ 30, no albuminuria, 2) eGFR < 30, no albuminuria, 3) eGFR ≥ 30, albuminuria, and 4) (worst function) eGFR < 30, albuminuria using ANOVA for normally distributed variables and Kruskal-Wallis Test for skewed variables.

Results: Mean age was 73.2 ± 9.6 years, 95.2% male and 78.2% white. Mean BMI 30.3 ± 4.8 kg/m2, 95.6% diabetic, 96.0% hypertensive. Mean eGFR 34.9 ± 8.7 ml/min/1.73m2 , 25.4% had eGFR < 30, 52.4% had albuminuria. Mean ESS score was 8.9 ± 4.9. Overall sleep data: total sleep time (TST) was 349.1 ±101.3 min, sleep efficiency was 69.1 ± 14.6%, %TST NREM 86.0 % [IQR 80.7-90.3], %TST REM 14.1% [IQR 9.8-19.4], REM latency was 115.5 min [IQR 68.0-229.5], sleep latency 10.5 min [IQR 3.5-21.5], arousal index (AI) 17.8 [12.2-35.6], %TST < 90% 3.0 [IQR 0.4-16.1], AH1 was 16.6 [IQR 3.9-23.1]. The proportion with AH1 ≥ 5, 15, and 30 was 71%, 39%, and 19%, respectively. Across categories of renal function, only A1 and AI varied across level of renal function. Median AHI was 8.5 [IQR 3.1-21.9] for those with the best kidney function and 10.4 [5.0-22.5] for those with the worst kidney function (p = 0.017). Median AI was 15.8 [IQR 11.0-35.2] for those with best function and 21.3 [IQR 13.1-29.2] for those with worst function (p = 0.042).

Conclusion: Compared to reported population norms in older individuals, sleep apnea is more common among veterans with CKD. In addition, sleep latency, sleep efficiency, and % TST REM were lower and REM latency was higher than population norms of similar age.
Finally, AHI and AI are higher with worse renal function defined by eGFR and albuminuria.

Support (If Any): This material is the result of work supported by a VA CSR&D Career Development Award (CX000533-01A1) and by support from the Division of Nephrology at the University of Florida.

0752
SLEEP DURATION AND CANCER RISK: AN UPDATED META-ANALYSIS OF PROSPECTIVE STUDIES

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Introduction: It is believed that melatonin, which usually has lower serum concentration in habitual short-sleepers, has the potential to reduce cancer risk through antiinflammatory, apoptotic, immune, and antiangiogenic mechanisms. However, in general, evidence on the association of sleep duration and cancer risk has been inconsistent. In this study, therefore, we performed a meta-analysis to clarify the association between sleep duration and cancer risk.

Methods: A comprehensive search using PubMed, SCOPUS, from inception through November 2015 was performed. A random-effects dose-response meta-analysis was used to study the relationship between sleep duration and cancer risk.

Results: Data from 14 prospective cohort studies reporting a total of 7856 incident cases of cancer in 232549 short-sleepers and 3945 incident cases of cancer in 128163 long-sleepers, for a follow up period ranging from 7 to 22 years, was analyzed. The pooled hazards ratio for incidence of cancer in those with short sleep duration (<7 hours) is 0.99 (95% CIs 0.93 -1.06; p = 0.88). The pooled hazards ratio for incidence of cancer in those with long sleep duration (≥8 hours) is 1.03 (95% CIs 0.88 -1.21; p = 0.64). Further meta-analysis on dose-response relationships with different durations of sleep (≤5, 5-6, 6-7, ≥7, ≥8, and ≥9) does not show an elevated risk for cancer. Analysis of the data based on the specific types of cancer studied (breast, colorectal, endometrial, lung, ovarian and prostate cancer) shows significant risk for colorectal cancer with long sleep duration (pooled hazards ratio 1.41; 95% CIs 1.17 - 1.71; p ≤ 0.001). No publication bias was detected in any of the main analyses.

Conclusion: Our meta-analysis only shows an elevated risk for colorectal cancer with long sleep duration and not with other hormone-sensitive cancers. Possible explanations for this observation with colorectal cancer include either reverse-causality or residual confounding.

0753
THE EFFECT OF SSSIS ON NOCTURNAL URINARY FREQUENCY- A RETROSPECTIVE STUDY

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Introduction: This study evaluates the impact of selective serotonin reuptake inhibitors (SSRIs) on nocturnal urinary frequency in subject undergoing nocturnal polysomnography. Existing data suggest a correlation between urinary frequency and the use of SSRIs. SSRIs are thought to increase the urinary frequency, especially in patients with overactive bladder. An increase in nocturnal urinary frequency can have a significant negative impact on the quality of sleep.

Methods: A retrospective chart review was conducted to compare nocturnal urinary frequency in subjects on SSRl therapy versus no therapy. The study population included all patients 18 years and older undergoing polysomnography in the period 9/2012-8/2013 with the exception of patients with documented chronic kidney disease or diuretic administration after 12pm. The subjects were divided into 2 groups- subjects on SSRIs and subjects not taking SSRIs. The average number of bathroom visits per night was calculated for both groups and the means were compared using a non-paired student t-test.

Results: Total of 314 subjects were reviewed. There was no significant demographic differences between the subjects treated with an SSRI (n = 89) and the ones not on an SSRI (n = 225). No statistically significant difference was found in nocturnal urinary frequency between the subjects on SSRI therapy and those not receiving SSRIs (p = 0.40). The degree of urinary frequency in sertraline users was more than three times higher than in duloxetine users but the difference did not reach statistical significance (p = 0.06).

Conclusion: SSRI’s do not appear to have a significant impact on nocturnal urinary frequency as a class effect. The reason for that may be 1. SSRIs are not associated with nocturnal frequency; 2. SSRIs are associated with worsening nocturia only in a specific population (e.g. patients with hyperactive bladder); 3. The power of our study was not sufficient to detect a real association between frequency and SSRI’s type 2 error.

0754
SLEEP PRACTICES, BELIEFS AND ATTITUDES ASSOCIATED WITH OVERALL HEALTH


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Introduction: As sleep plays an important role in overall health, beliefs, practices, and attitudes about sleep may differentially predict an individual’s overall health status.

Methods: Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used. SHADES is a community-based study of adults age 22-60 (N = 1007). Sleep beliefs and attitudes were assessed with the previously-validated Sleep Practices and Attitudes Questionnaire. Responses were categorized as whether or not participants agreed with statements about sleep practices, beliefs and attitudes. Overall health was assessed as Excellent (N = 125, reference), Very Good (N = 344), Good (N = 365), or Fair/Poor (N = 173). Logistic regression results were adjusted for age, sex, and education.

Results: Compared to those in excellent health, those in fair/poor health were more likely to get up and read/watch TV (OR = 2.38, p = 0.021), eat/drink (OR = 2.05, p = 0.028), drink alcohol (OR = 1.76, p = 0.022), or smoke (OR = 2.23, p = 0.005) if they have trouble sleeping. When experiencing longer-term sleep problems, they are more likely to report using sleep medications (OR = 1.93, p = 0.028). Overall, they are more likely to exhibit poor stimulus control, including watching TV (OR = 1.90, p = 0.041), worrying (OR = 6.77, p = 0.002), and arguing (OR = 2.34, p = 0.002) in bed. They are more likely to believe that medical conditions (OR = 6.17, p < 0.0005), mood (OR = 4.19, p < 0.0005), and stress (OR = 3.18, p < 0.0005) affect their sleep. They are less likely to believe that they have control over their sleep (OR = 0.20, p < 0.0005), that they make sure they have enough time to sleep (OR = 0.38, p = 0.002), or that they can tell when they are sleepy (OR = 0.36, p = 0.034). They are more likely to believe that poor sleep can lead to weight gain (OR = 1.81, p = 0.018), low energy (OR = 3.20, p = 0.024), and missed work days (OR = 2.32, p = 0.001).

Conclusion: Several sleep-related practices and attitudes were related to overall health. Relative to those in excellent health, a person in fair or poor health is more likely to engage in dysfunctional sleep practices.
and feel that they do not have control over their sleep due to a number of external influences.

Support (If Any): The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216.

0755
TOTAL SLEEP TIME STRONGLY CORRELATES WITH SELF-REPORTED HOSPITAL ADMISSIONS; AN INPATIENT COPD COHORT SURVEY

Introduction: 36% of American adults suffer from sleep loss. An estimated 15 million Americans have been told they have COPD by a medical professional. Direct costs of COPD care are an estimated $29.5 billion annually. Sleeping less than 7 hours per night on a regular basis is associated with adverse health outcomes. Therefore, we conducted a self-report survey, on an inpatient cohort, to evaluate total sleep time (TST) and Pittsburgh Sleep Quality Index (PSQI) scores in patients with COPD exacerbation.

Methods: Using a real time, inpatient, screening process, we identified COPD patients in the hospital setting and surveyed 55 patients from July 2015 to December 2015 at a University Hospital. Inclusion criteria were ≥ 18 years old, screened for COPD as cause for hospitalization, and could understand English. Patients were only excluded if they could not understand English, or if they refused for any reason. 5 patients declined to take the survey. A seven question survey was developed after focus group sessions, with physicians in the fields of pulmonary, critical care, and sleep medicine contributing. Permission was obtained, and a Pittsburgh Sleep Quality Index (PSQI) form was also attached. No identifying patient information was collected and therefore an implied consent waiver was added to the survey form. A total of 50 surveys were collected for a pilot study. Not all surveys were filled out as instructed, however this data was still included. Skewness and kurtosis statistics yielded normal distribution. Pearson r correlations were run between responses to survey items to test for potential associations. In order to adjust for testing multiple hypotheses concurrently, a Bonferroni correction was employed for alpha value (.05/3 tests = Bonferroni corrected alpha value of 0.17)

Results: A significant negative correlation between Average Hours of Sleep reported and Total Hospital Admissions reported was found (r = -0.34, p = .01). A probable Type II error was found between Average Hours of Sleep reported and Last 12 months Hospital Admissions (r = -0.3, p = .04). PSQI did not correlate significantly with hospitalizations.

Conclusion: Total sleep time correlated significantly with reported hospitalizations. Patients with COPD that get < 6 hours of sleep on average, reported more hospitalizations.

0756
ELECTRONIC CIGARETTES, DIABETES AND SLEEP DISTURBANCE
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Introduction: There is growing use of electronic cigarettes (e-cigarettes) as an alternative to cigarette smoking. However, little is known about the cardiometabolic consequences of e-cigarette use. The current study therefore evaluated the associations between e-cigarette use, and diabetes as well as the interactions between e-cigarette use, and difficulty falling asleep.

Methods: We used data from the 2014 National Health Interview Survey (NHIS) supplement. The NHIS is an in-person household survey that provides estimates on health indicators, health care utilization and access, and health-related behaviors of the civilian, non-institutionalized US population. The main independent variable for the study was use of electronic cigarettes. Description of demographics was performed for the studied population using survey frequency procedures. The moderating role of sleep on electronic cigarette and diabetes was also assessed using interaction effects.

Results: From the 36,521 survey participants included in the study, mean age = 49.3 years ± 0.10 (± SEM), mean BMI kg/m(2) = 27.9 ± 0.03. Of the entire sample, 52% were female; White 66.9%; 11.9% Black; 5.6% Asian; and Hispanics 15.6%. The rate of electronic cigarette use was 12.8%. Two percent of these individuals used electronic cigarettes alone, 10.8% were combined e-cigarette users and cigarette smokers, 28% strict non-electronic cigarette smokers, and 59.4% non-e-cigarette use/non-smoker. After multivariate logistic regression analysis, strict electronic cigarette users had lower odds of having diabetes than non-electronic-cigarette users/non-smokers, OR [95% CI] = 0.33 [0.16-0.69]; p = 0.01. There was a significant interaction effect for strict users of electronic cigarettes and difficulty falling asleep on diabetes (β estimate = 0.7428, p < 0.01). There were no significant interactions for strict non-electronic-cigarette smokers and difficulty falling asleep on diabetes (β estimate = 0.2558, p < 0.10).

Conclusion: The use of e-cigs lowered the risk of the disease, compared to non-electronic-cigarette users / non-smokers. However, among those strict e-cig users who have difficulty falling asleep, there was increased association with diabetes. Further studies are needed to confirm these findings and to examine the underlying mechanisms of these associations. Given the overall serious and well established health hazards, we do not endorse any form of smoking.

Support (If Any): NIH (R01MD007716, U54NS081765 and R01HL095799).

0757
SELF-REPORTED SLEEP CHARACTERISTICS AND CARDIOVASCULAR DISEASES: DATA FROM THE STUDY ESSE-RF (RUSSIA)
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Introduction: Study was completed to evaluate the association of duration and quality of sleep with cardiovascular diseases in different regions of the Russian Federation.

Methods: participants of the cohort study Epidemiology of cardiovascular disease in various regions of the Russian Federation - ESSE-RF (Russian) population aged 25-65 years from 13 regions of the Russian Federation were interviewed about average duration of sleep, difficulty falling asleep, and maintaining sleep.

Results: Results were obtained for 20,359 participants, mean age 49 (25; 65) years. The prevalence of hypertension was 37.7%, coronary artery disease 2%, myocardial infarction 10.5%, stroke 2%. For short-sleepers prevalence of hypertension was 1.2 (95% CI: 1.2; 1.4) χ2 = 25, p < 0.001, coronary heart disease 1.3 (95% CI 1.1; 1.7) χ2 = 8.6, p < 0.01; myocardial infarction 1.5 (95% CI 1.3; 1.6) χ2 = 63, p 0.05. Subjects with frequent difficulties falling asleep had 1.3 (95% CI 1.2; 1.4) χ2 = 40, p < 0.001 prevalence for hypertension; 1.7 (95% CI 1.4; 2.1)
VII. Medical Disorders and Sleep

SPONTANEOUS AROUSALS RELATED BLOOD PRESSURE VARIABILITY: AN INDEPENDENT PREDICTOR OF INCREASED CARDIOVASCULAR RISK AND TARGET ORGAN DAMAGE

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Introduction: A LIFE sub-study published recently in Journal of Hypertension (September 16, 2015) confirmed blood pressure variability as an independent predictor of cardiovascular events and target organ damage. Spontaneous arousals are commonly observed during polysonmography. Severe spontaneous arousals occur with several sleep disorders. Autonomic hyperactivity is known to occur with spontaneous arousals. This study was carried out to show direct correlation between severity of spontaneous arousals and increased variability/elevations in systolic blood pressure. We wanted to demonstrate a likely increase in risk of cardiovascular events and target organ damage caused by increased variability in blood pressure secondary to spontaneous arousals.

Methods: Polysomnographic recording of spontaneous arousals and continuous blood pressure measurement (with pulse transit time, PTT) was performed in 26 consecutive subjects irrespective of prior history of hypertension or anti-hypertensive medications. PTT was standardized using cuff-based blood pressure measurement at the beginning and at the end of the sleep study. Studies have shown PTT to be a reliable non-invasive method compared to cuff-based measurement of blood pressure. Polysomnogram was cross-scored by two experienced RPSGT technicians and reviewed by a sleep physician. Only systolic blood pressure variability/elevations immediately following spontaneous arousals were used for this study.

Results: Severity of spontaneous arousals as measured by increased spontaneous arousal Index (Mean 30.11, SD 20.87) showed strong correlation with frequency of systolic blood pressure variability/elevations (Mean 34.46, SD 34). Variability/elevations in systolic blood pressure occurred immediately after spontaneous arousals and suggests a cause and effect phenomenon.

Conclusion: Spontaneous arousals, when pathological (greater than 10/hour of sleep), cause measurable (by polysomnography) variability/elevations of blood pressure. Pathological spontaneous arousals may independently increase cardiovascular risk and target organ damage. Long-term multi-centric outcome studies may establish the risk of cardiovascular events and target organ damage caused by blood pressure variability associated with pathological spontaneous arousals.

ECG-DERIVED SPECTROGRAM MEASURES OF SLEEP QUALITY, SLEEP-DISORDERED BREATHING, INSOMNIA AND FUNCTIONAL OUTCOMES AMONG PATIENTS WITH HEART FAILURE

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Introduction: Objective measures of sleep quality in chronic heart failure (HF) patients require overnight polysomnography (PSG). We evaluated: (1) the relationship between PSG and electrocardiogram (ECG)-derived sleep spectrogram (a simpler, more cost-effective alternative) measures of sleep quality; and (2) determined whether PSG or spectrogram markers are associated with functional outcomes among those with HF.

Methods: Cross-sectional study. 116 (65% male) patients with stable HF (44% New York Heart Association class III/IV) and ejection frac-
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AF undergo polysomnography (PSG). A sleep evaluation prior to PSG was started on PAP therapy at the same time. Differences between the two groups determined through Student’s t-test, Chi-square test, and Mann-Whitney U test. Results: Over half of HF patients reported insomnia symptoms and 36% had sleep apnea (AHI > 15 events/hour) with central AHI 3.6. In bivariate analyses, percent of spectral windows with high frequency coupling (HFC, marker of stable NREM sleep) and very low frequency coupling (VLFC, maker of stable REM sleep) were not correlated with any of the PSG sleep architecture measures. Elevated low frequency coupling (e-LFC, marker of fragmented NREM sleep) was inversely correlated with percent REM sleep (p < 0.02). Correlations between AHI and HFC, e-LFC were -0.2 (p-value 0.04) and 0.3 (p-value 0.005) respectively. DIMS and e-LFC exhibited inverse correlation (r = -0.2, p < 0.02), which was no longer significant when adjusted for covariates. Similarly, in adjusted models, the spectrogram biomarkers were not associated with 6MWT distance, SF-36 physical or mental health measures or depression.

Conclusion: In this cohort of heart failure patients (unlike in healthy adults, or those with insomnia or fibromyalgia), ECG-derived sleep spectrogram biomarkers were not associated with PSG sleep quality measures. There was also no association with insomnia or functional outcomes.

Support (If Any): This project was funded by NIH R01NR08022 (Redeker, PI), NIH R21 HL079248 (Thomas, PI).

0761 TREATMENT ADHERENCE IN ATRIAL FIBRILLATION PATIENTS DIAGNOSED WITH OBSTRUCTIVE SLEEP APNEA AFTER DIRECT REFERRAL FOR POLYSOMNOGRAPHY

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Introduction: The association between obstructive sleep apnea (OSA) and atrial fibrillation (AF) is well established. The risk factors for AF and OSA are similar. Yet, the prevalence of OSA is significantly higher in those with AF compared to age-matched control groups. Treatment failure (rhythm control, cardioversion, and ablation) and increased risk of embolic events is more likely to occur in AF complicated with untreated OSA. For these reasons, it is recommended that patients with AF undergo polysomnography (PSG). A sleep evaluation prior to PSG may inappropriately increase healthcare costs and result in unnecessary delays. However, limiting contact with a sleep medicine specialist may have a detrimental effect on positive airway pressure (PAP) adherence.

Methods: We conducted a performance improvement initiative to determine if direct referrals for PSG in patients with AF impacts PAP compliance compared to a traditional approach. We assessed the prevalence of OSA in forty consecutive AF patients directly referred for PSG after evaluation by a cardiologist. Those found to have OSA were subsequently initiated on PAP therapy. We compared these individuals to an age-matched cohort of OSA patients without AF who were started on PAP therapy at the same time. Differences between the two groups determined through Student’s t-test, Chi-square test, and Mann-Whitney U test.

Results: In the AF cohort (aged 57.8 ± 12.8, 31 males), 78.4% of patients were diagnosed with OSA. The majority had moderate to severe disease with a mean AHI of 29.04 ± 20.69. Compared to the control group, those with AF and OSA had less daytime somnolence (ESS of 7.64 ± 5.3 versus 12.0 ± 5.8, p = .003). In the AF cohort (diagnosed with OSA after direct referral), 34.2% did not initiate PAP therapy in the first month, and were much less adherent with PAP after beginning treatment (37.5% versus 62.5%, p = .002).

Conclusion: The high incidence of AF with OSA in our study, in spite of a lack of traditional symptoms, warrants that all patients with AF undergo a PSG. A customary approach of undergoing a formal sleep medicine evaluation prior to PSG may lead to increased costs, delays in diagnosis, or dismiss the need to obtain PSG. However, circumventing a sleep medicine evaluation may significantly impede the acceptance and adherence of PAP therapy.

0762 MODERATING EFFECTS OF SLEEP DURATION ON DIABETES RISK AMONG INDIVIDUALS WITH CANCER DIAGNOSIS

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Introduction: Although the association between sleep disturbance and cancer is well documented, there is little evidence regarding how sleep duration among cancer survivors may be associated with other chronic diseases. Growing evidence suggests that cancer and diabetes may share common risk factors such as age, gender, race, being overweight, physical inactivity, smoking and alcohol. However, it is yet unclear how unhealthy sleep duration (a known cardiometabolic risk factor) may affect the relationship between cancer and diabetes. The aim of this study was to investigate whether sleep duration moderated the relationship between physician-diagnosed cancer and diabetes.

Methods: Data was extracted from the NHIS dataset (2004-2013), providing demographics, chronic diseases and sleep duration. For the present analysis, we used a subset of individuals providing complete data for the following variables: physician-diagnosed cancer and diabetes and self-reported habitual hours of sleep. Data were analyzed to assess the moderating effect of sleep duration on cancer and diabetes risk.

Results: Of the total sample of 283,086 participants, 15.8% were black and 77.2% were white; 55.7% were female and the mean age was 47.7 (18.0) years. In the first adjusted regression model, short sleep duration [< 7 hours] (Beta = 0.15, p < .001) and cancer (Beta = 0.91, p < .001) were independently associated with diabetes. However, moderation analysis indicated that only long sleep significantly moderated relationships between cancer and diabetes [Beta = -0.218, S.E. = 0.055, p < .0001, 95% CI = -0.326-0.110]. Short sleep did not significantly moderate those relationships.

Conclusion: Our findings demonstrate significant associations of short and long sleep with cancer and diabetes. We should note that among people with long sleep, having a cancer diagnosis did not increase diabetes risk. However, among people with a cancer diagnosis, short sleep seemed to have increased diabetes risk.

Support (If Any): NIH (R01MD007716, R01HL78566, U54NS081765, and R01HL095799).
0763
FINANCIAL DIFFICULTY, SLEEP QUALITY, AND FUNCTIONAL OUTCOMES IN ADULTS WITH DIABETES
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Introduction: Recent research suggests a relationship between financial difficulty and poor sleep quality. The purpose of this study was to examine the relationship between financial difficulty, sleep quality, and functional outcomes sensitive to sleepiness in a racially diverse sample of people with diabetes.

Methods: A secondary analysis was done with merged baseline data from two studies on sleep apnea in persons with type 2 diabetes (R21 HL 089522, R01DK096028). Instruments included the Pittsburgh Sleep Quality Index (PSQI) and the Functional Outcomes of Sleep Questionnaire (FOSQ Total Score). Clinical evaluation included height and weight to calculate BMI kg/m2 and A1C level. Demographic information included age, gender, race, and the question “How difficult is it for you to meet your basic needs.” Responses were dichotomized as “not at all difficult” and “somewhat difficult to extremely difficult.” Data was analyzed with IBM SPSS 22; significance was set as p < .05.

Results: The sample (N = 247) was middle-aged (Mean ± SD = 54 ± 9.7 years, range = 26-88 years), had suboptimal glucose control (Mean A1C = 7.7 ± 1.8), was obese (BMI kg/m2 = 35 ± 6.6), well distributed by gender and race (females 56%, non-Caucasian 55%), and had poor sleep quality (mean PSQI = 10.4 ± 4.2; 84% ≥ 5). The majority (n = 149, 62%) responded they had a somewhat or extremely difficult time paying for their basic needs. Persons with financial difficulty had significantly decreased functional outcomes and sleep quality (p < .05), there was no difference in A1C or BMI. Black women were the most likely to have financial difficulty (p < .01). A regression model found lower age, financial difficulty, and impaired sleep quality significant (all p-values < .05; R2 = 31) in predicting lower functional outcomes when controlling for gender and race.

Conclusion: Functional outcomes were negatively affected by poor sleep quality and by financial difficulty in persons with diabetes.

Support (If Any): This research was supported by a grant from the National Institutes of Health, National Heart Lung and Blood Institute HL 089522 (E. Chasens), R21 HL 089522, R01DK096028 and through grants, UL1 RR024153 and UL1 TR000005.

0764
CHANGES IN POLYSOMNOGRAPHY-BASED SLEEP DURATION AND SLEEP EFFICIENCY AND THE RISK OF DEVELOPING HYPERTENSION, DIABETES, DYSLIPIDEMIA AND OBESITY: A FOLLOW-UP STUDY
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Introduction: Sleep is vital for cardiometabolic health, but research on the changes in sleep duration and efficiency and their associated risk of developing hypertension, diabetes, dyslipidemia, and obesity are sparse. Our objective was to estimate the risk of developing hypertension, diabetes, dyslipidemia and obesity following changes in home-polysomography (PSG) measured sleep duration and efficiency.

Methods: To examine this, the Sleep Heart Health Study data cycles 1995-1998 and 2001-2003 were used (≥ 39 y; N = 2,097). Sleep duration and efficiency were assessed with home-PSG at baseline and approximately 4y later. The changes from baseline to follow-up were categorized as a decrease (≥ 5%), increase (≥ 5%), or no change (change < 5%, referent). The usage of medications for hypertension, diabetes, and dyslipidemia, and body mass index (BMI) for obesity were used to define the outcomes. Age, sex, education, alcohol, smoking, marital status and BMI were considered as confounders; BMI was excluded as a confounder in the obesity analysis.

Results: The number of participants (%) who developed hypertension, diabetes, dyslipidemia, and obesity during the follow-up are 373 (17.79%), 99 (4.72%), 175 (8.35%), and 119 (5.67%), respectively. Those who developed hypertension, diabetes, and dyslipidemia had decreased sleep efficiency. However, an increase in sleep duration increased the relative risk (RR) of developing hypertension (RR 95% CI: 1.29 (1.02-1.64)). Decrease in sleep efficiency increased the RR of developing diabetes and dyslipidemia (1.57 (0.87-2.83), and 1.65 (1.03-2.64), respectively). Neither change in sleep duration nor sleep efficiency increased the risk of developing obesity.

Conclusion: Sleep efficiency, but not sleep duration, decreases over time, and is related to a higher risk of developing diabetes and dyslipidemia. Sleep duration increase is associated with higher risk of developing hypertension. Further research with longer and multiple follow-up periods will help extend our understanding of the relationship between sleep and cardiometabolic health.

0765
PREVALENCE AND RISK FACTORS FOR LONG-TERM SLEEP DIFFICULTIES IN A NATIONWIDE COHORT OF PREMENOPAUSAL DANISH WOMEN 7-9 YEARS FOLLOWING PRIMARY SURGERY FOR BREAST CANCER
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Introduction: Breast cancer (BC) patients have been found to be at a heightened risk of sleep difficulties at the time of diagnosis and treatment. Yet little is known about the long-term prevalence and risk factors of long-term sleep difficulties in BC survivors. Our aim was to investigate the prevalence of and prospective risk factors for clinically significant sleep difficulties in a nationwide cohort of premenopausal Danish women treated for BC 7-9 years previously.

Methods: A total of 783 pre-menopausal women completed questionnaires at two time points: 3 months after primary surgery for BC and again at a 7-9 years follow-up. The questionnaires included the Pittsburgh Sleep Quality Index (PSQI) and validated scales assessing depressive symptoms, cancer-related post-traumatic stress, trait anxiety, physical functioning, and health behaviours. Clinical data were obtained from the Danish Breast Cancer Cooperative Group and surgical departments. Sociodemographic information was obtained from Danish national longitudinal registries.

Results: PSQI data at 7-9 years post-surgery were available for 783 women. The long-term prevalence of sleep difficulty (PSQI > 5) was 51.7%. A logistic regression revealed eight prospective (baseline) risk factors for long-term sleep difficulties. In order of strength, these were: higher initial PSQI score (OR = 1.20, 95%CI [1.14-1.27], p < 0.001), more than 7-9 years of education (ORs = 1.57-3.5, p = 0.006), higher occupational status (OR = 1.91, 95%CI [1.23-2.99], p = 0.004), higher levels of cancer-related post-traumatic stress symptoms (OR = 1.02, 95%CI [1.01-1.04], p = 0.004), poorer physical functioning (OR = 1.02, 95%CI [1.00-1.03], p = 0.010), lower personal income (OR = 1.14, 95%CI [1.03-1.27], p = 0.012), no comorbidity (OR = 2.08, 95%CI [1.03-4.35], p = 0.042), and lumpectomy (OR = 1.50, 95%CI [1.02-2.21], p = 0.042).

Conclusion: Our results suggest that the long-term prevalence of clinically significant sleep difficulties after BC treatment is high. The combination of psychological, sociodemographic, clinical, and health-related risk factors present at the time of primary treatment suggest that
early interventions targeting a broad range of factors may be relevant for preventing or reducing long-term sleep difficulty in these women.

**Support (If Any):** This research was supported by The Danish Cancer Society (9915008, PP00014,PP03034), The Health Insurance Foundation (Helsefonden) (2005B075), IMK Almene Fond, and The Aase and Ejner Danielsen Foundation (Åse og Ejner Danielsens Fond).

**0766**

**PREVALENCE AND PREDICTORS OF SLEEP DISTURBANCE IN AFRICAN AMERICAN BREAST CANCER SURVIVORS**


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**Introduction:** Although African Americans (AAs) are at elevated risk of sleep disturbance, little research has examined the prevalence or predictors of sleep disturbance in AA breast cancer survivors (BCS). This study aimed to examine demographic, clinical, physical activity, and psychosocial predictors of sleep disturbance in AA BCS.

**Methods:** We assessed sleep disturbance in an ongoing cohort of AA BCS, the Women’s Circle of Health Study, among participants recruited from January, 2013 to October, 2015 (N = 277, age M = 54, SD = 11). Participants were assessed after completing treatment (M = 9 months after diagnosis, SD = 3) and again approximately 20 months after diagnosis (SD = 3) during in-person home interviews. Interviews collected data on sleep disturbance (PSQI), demographics, lymphedema, physical activity (LSI), perceived stress (PSS), and spiritual well-being (Facit-SP-12); height and weight were also measured. Logistic regression analyses examined predictors and correlates of clinically significant sleep disturbance (PSQI ≥ 5).

**Results:** Sleep disturbance was reported by 61% of AA BCS approximately 20 months after diagnosis. At diagnosis, education, and income were not associated with sleep disturbance (ps ≥ .46). Obesity, failing to meet recommended physical activity guidelines, and persistent lymphedema were significantly associated with greater risk of sleep disturbance (ORs = 1.65-3.10; ps < .05). Greater perceived stress and less spiritual well-being were associated with greater risk of sleep disturbance (ORs = 1.13-1.15 ps < .05). Perceived stress and spiritual well-being remained significant predictors in a multivariate analysis with significant univariate predictors of sleep disturbance.

**Conclusion:** This study, among the first to use a validated measure of sleep disturbance in any AA cancer population, found that a majority of AA BCS report clinically significant sleep disturbance. Obesity, physical inactivity, and lymphedema were associated with risk of sleep disturbance. Perceived stress and spiritual well-being were independently associated with sleep disturbance in expected directions. These results suggest potentially modifiable risk factors that can be targeted by interventions to address sleep disturbance in AA BCS.

**Support (If Any):** NCI grants R01CA185623-S1; R01CA185623; P01 CA151135

**0767**

**THE EFFECTS OF SYSTEMATIC LIGHT EXPOSURE ON SLEEP QUALITY IN CANCER SURVIVORS**


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**Introduction:** Sleep disturbances are reported by cancer patients at a significantly higher rate than in the general population and are associated with fatigue and poor quality of life. The purpose of this secondary analysis was to examine the effectiveness of systematic light exposure (sLE) to improve sleep quality among cancer survivors.

**Methods:** Fifty-four breast, gynecologic, and hematologic cancer survivors who were participating in a study investigating the effects of sLE on cancer-related fatigue, were examined. Participants had to be ≥ 18 years of age and report clinically significant fatigue. Eligible participants were randomized to a bright white light (BWL) or comparison dim red light (DRL) group and instructed to self-administer their respective light box for 30 minutes/morning for 4 weeks. Participants completed the Pittsburgh Sleep Quality Index (PSQI) one week prior to sLE (T1), during the second week of sLE (T2), at the end of the fourth week of sLE (T3), and three weeks post-sLE (T4). A higher PSQI score indicated lower sleep quality.

**Results:** Linear mixed model was employed using baseline (T1) PSQI scores as a covariate to account for T1 differences. There were no significant differences between the two treatment groups at T2 (BWL: Mean PSQI = 8.20; DRL: Mean PSQI = 9.27). At T3, after 4 weeks of sLE, the BWL group improved from T2 more than the DRL group (BWL: Mean PSQI = 7.74; DRL: Mean PSQI = 9.11; Tukey-adjusted t(53) = -3.14; p = 0.0315). However, at three weeks post-sLE, the two groups were essentially equal in sleep quality.

**Conclusion:** Results provide preliminary evidence for four weeks of systematic bright white light treatment improving sleep quality in cancer survivors. As expected, the benefits to sleep quality diminished upon sLE discontinuation. Longer, larger studies are needed to replicate these findings.

**Support (If Any):** National Cancer Institute R21CA158954 and 7K07CA184145-02

**0768**

**SLEEP DISTURBANCE AT TIME OF NEWLY DIAGNOSIS: A COMPARATIVE STUDY OF HIV, CANCER PATIENTS, AND GENERAL POPULATION CONTROLS**

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**Introduction:** Sleep disturbance (SD) is a prevalent and troubling symptom in patients with highly stressful illnesses such as HIV and cancer. However, SD associated with major illnesses has been under diagnosed. This study aimed to compare the incidence, prevalence of
SD among people newly diagnosed with HIV, patients with cancer, and the general population controls in Taiwan.

**Methods:** We used a matched cohort study design to compare the risk of SD among the three groups from reimbursement claims recorded in Taiwan’s National Health Insurance Research Database. 14,531 HIV-infected persons were compared with 1,493 cancer patients, and 1,373 general population controls matched by age, sex and index-year. Cox proportional hazard regression models were used to test the differences of relative risk of SD among three groups.

**Results:** The mean time between the index date and newly diagnosis of SD among HIV, cancer, general population controls were 1.7, 2.3, 1.8 years separately. Compared with the cancer patients and general population controls, except depression, HIV-infected persons were most likely to have history of SD, substance use, alcohol abuse, and anxiety. As well as the HIV-infected persons exhibited a higher risk of newly SD after controlling for history of SD, substance use, alcohol abuse, anxiety, and depression (adjusted hazard ratio [AHR], 1.20, P < 0.001 and AHR, 3.74, P < 0.001, respectively).

**Conclusion:** The HIV-infected persons exhibited a higher risk of developing SD than the cancer patients and general population controls. Further studies are needed to explore the impacts of SD on HIV treatment and diseases related outcomes.

**Support (If Any):** Our study was supported by grants from the National Science Council, The Executive Yuan of Taiwan (MOST 104-3011-E-006-003-).
 mines and heart failure Collaboration (CKD-EPI) estimated glomerular filtration rate (eGFR) change, adjusting for key covariates. Logistic regression was used to calculate odds of a rapid decline in eGFR (> 3 ml/min/1.73m²/ year) by presence or absence of SA.

**Results:** Mean age was 50 ± 8 years, mean BMI was 30.5 ± 6.5 kg/m², 97% were white, 55% were male, 3.5% were diabetic, 24% were hypertensive, mean baseline eGFR was 78.7 ± 13.9 ml/min/1.73m², 11% had SA at baseline. Mean eGFR change for the entire cohort was 0.05 ± 1.25 ml/min/1.73m²/year. 2% had rapid decline in eGFR. eGFR change over time was 0.03 ml/min/1.73m²/year (95% CI -0.06-0.11) for those without SA and 0.23 ml/min/1.73m²/year (95%CI -10.0.55) for those with SA (p = 0.09). Those with SA were less likely to experience a rapid decline in eGFR even after adjustment for PAP use, age, gender, race, BMI, baseline eGFR, diabetes and hypertension, however, confidence intervals were wide and not statistically significant (OR 0.54, 95% CI 0.05-5.52, p = 0.60).

**Conclusion:** In a cohort of healthy middle-aged men and women not selected for sleep disorders or kidney disease, linear analysis of eGFR change found that eGFR tended to increase slightly over time among those with SA. SA was not associated with a more rapid decline in eGFR when compared to those without SA.

**Support (If Any):** This work was supported by 1R21DK103104-01, the National Heart, Lung, and Blood Institute (R01HL62252) and the National Center for Research Resources (UL1RR025011) at the National Institutes of Health. Additional support for Dr. Canales came from a VA CSR&D Career Development Award CX000533-01A1.

**0772**

**EFFECTS OF ANGIOTENSIN-CONVERTING ENZYME INHIBITORS AND ANGIOTENSIN RECEPTOR BLOCKERS ON SLEEP ARCHITECTURE**

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**Introduction:** Angiotensin converting enzyme inhibitors (ACEI) and Angiotensin Receptor Blockers (ARBs) target the Renin-Angiotensin-Aldosterone system (RAAS). The RAAS components relate to osmoregulation, reproduction, memory processes and immune system regulation. In addition, angiotensin occurs in the brain and may affect sleep.

**Methods:** In a retrospective IRB approved study of consecutive patients presenting to a sleep disorders center, we examined in-laboratory polysomnographically measured sleep in three groups. 1) Use of neither ACEI nor ARBs but not necessarily unmedicated (Control), n = 431; 2) ACEI, n = 185; 3) ARBs, n = 121. We used a multivariate analysis of variance to examine total sleep time, deep sleep percentage, and REM sleep percentage in these groups with follow-up paired comparisons.

**Results:** The ACEI and ARB groups had significantly less total sleep time (Control 372 ± 62.2 minutes, ACEI 353 ± 69.4 minutes (p = .001), ARBs 357 ± 66.1 minutes (p = .031)) and percent of sleep time in slow wave sleep (Control 9% ± 10.9%, ACEI 6% ± 8.1% (p = .001), ARBs 6% ± 8.1% (p = .003)). However, there was sparing of changes in percent of sleep time in rapid eye movement sleep (Percent REM) (Control 15% ± 7.4%, ACEI 15% ± 9.0%, ARBs 15% ± 8.0%) in both drug groups compared to the absence of ACE or ARBs. Similar results occurred when AHI and PLMI were covariates.

**Conclusion:** Those using an ACEI or an ARB had less total sleep time and less percentage deep sleep. The percent of REM sleep was not associated with and ACEI or ARB use. We are currently increasing the number of patients reviewed in order to explore possible confounding factors e.g. other medications and associated illnesses such as sleep apnea and periodic limb movements. Less sleep in these groups particularly less deep sleep suggests that their daytime alertness could be associated with the use of these medications.

**0773**

**PREVALENCE, EVOLUTION AND ASSOCIATION OF GASTROESOPHAGEAL REFLUX DISEASE (GERD) WITH SLEEP, MEDICAL AND PSYCHIATRIC CONDITIONS IN THE US GENERAL POPULATION**

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**Introduction:** GERD is a digestive disease originating from the spilling of gastric acid from the stomach into the esophagus. The objective of this study is to assess the prevalence of GERD in the US general population and analyze its evolution and association with sleep, medical and psychiatric conditions.

**Methods:** The study sample was representative of the US general adult population. 12,218 subjects were interviewed at wave 1 (W1) and 10,830 subjects were interviewed at wave 2 (W2). Three years elapsed between the two interviews. All the interviews were conducted with the SleepEVAL system.

**Results:** At W1, 10.6% of the sample reported having seen a physician for GERD and/or were taking a medication for GERD while this prevalence increased to 12.4% at W2. GERD was chronic for 3.9% of the sample interviewed. The prevalence of GERD increased with age but plateaued at 55 y.o. GERD chronicity increased with age, with individuals between 45 and 64 being at greater risk. Subjects affected by GERD reported significantly higher nocturnal awakenings and were significantly more often diagnosed with obstructive sleep apnea and restless leg syndrome, while insomnia disorders were significantly higher only among subjects with chronic GERD. Subjects affected by GERD were more likely to report other medical conditions, such as hypercholesterolemia, diseases of the musculoskeletal system and connective tissue and hypertension, than people that never experienced GERD. Individuals with chronic GERD were also significantly more likely to be affected by a major depressive disorder.

**Conclusion:** GERD prevalence as well as chronicity increase with age. GERD is also characterized by comorbidity with several medical disorders and tends to be associated with major depressive disorders. Sleep disorder symptoms such as nocturnal awakening are highly prevalent among GERD patients and can often lead into a sleep disorder diagnosis when they are not treated.

**Support (If Any):** Educational grant from Takeda Pharmaceuticals.

**0774**

**ALPHA DELTA SLEEP IN POLYSOMNOGRAM AND ITS ASSOCIATION WITH FIBROMYALGIA, DEPRESSION AND OTHER CHRONIC PAIN CONDITIONS**


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**Introduction:** Alpha delta sleep is the abnormal intrusion of alpha activity within the delta waves in the Polysomnogram (PSG). It is known to be associated with non-restorative sleep. Conditions like fibromyalgia, depression, chronic fatigue, chronic pain have known association with alpha delta sleep. There have been few studies in this regard and no statistically significant association have been found so far. However, there have been evidence that alpha delta sleep is common in these conditions. We studied the prevalence of fibromyalgia, other chronic pain conditions and depression in 17 patients with alpha delta sleep in PSG.
**Methods:** We identified 17 consecutive patients with alpha delta sleep in PSG between 22 August, 2015 and 22 November 2015 and analyzed the clinical data of these patients. We did not have any exclusion criteria. We retrospectively looked at their medical history for the presence of depression, fibromyalgia, other chronic pain conditions (which included arthritis, back pain, migraine) and also combination of these conditions.

**Results:** Of the 17 patients with alpha delta sleep, 8/17 (47 %) had depression, 8/17 (47 %) had fibromyalgia, 10/17 (58 %) had other chronic pain conditions and 7/17 (41 %) had more than one of these conditions.

**Conclusion:** Our study shows that all the patients with alpha delta sleep had the presence of at least one of the chronic conditions like depression, fibromyalgia or other chronic pain conditions. We conclude that Alpha delta sleep is a prevalent finding in PSG and we suggest that sleep physicians should pay attention to this finding. This finding could even be a useful objective marker for these conditions.
0775

EVENINGNESS DURING LATE ADOLESCENCE PREDICTS VENTRAL STRIATAL REACTIVITY TO REWARD TWO YEARS LATER
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Introduction: Eveningness, a preference for later sleep-wake timing, is linked to affective disorders and substance abuse. Eveningness has also been linked to variations in reward function, including increased impulsivity, novelty-seeking, and recently, altered neural response to monetary reward. Notably, the extant literature is nearly entirely based on cross-sectional data, yet both eveningness and reward function show developmental changes. In the present analyses, we examined whether morningness-eveningness (ME) during late adolescence predicted the neural response to reward two years later.

Methods: Participants were 90 males, assessed at ages 20 and 22, from the Pittsburgh Mother and Child Project. Morningness-eveningness was assessed via the Composite Scale of Morningness. All participants completed a monetary reward fMRI paradigm. Using an anatomical mask of the bilateral ventral striatum (VS), BOLD activation during win outcomes (relative to baseline) was extracted via the MarsBar toolbox. Cross-lagged panel analyses were conducted in AMOS to examine the longitudinal paths from ME to the VS response to win. We also explored correlations between ME, VS response to win, and scores on the Beck Depression Inventory, Sensation Seeking Scale, and Alcohol Dependence Scale.

Results: We identified significant paths from age 20 ME to age 22 ME, as well as to the age 22 VS response to win (greater eveningness was associated with a larger win response). Age 22 ME was not associated with VS response at either age. Eveningness at both age 20 and 22 was associated with greater depression and alcohol dependence severity at age 22. Neither ME score was associated with sensation seeking. Finally, age 22 VS response to win was positively associated with age 22 alcohol dependence severity.

Conclusion: Our findings provide novel evidence that morningness-eveningness predicts the neural reward to reward over time, suggesting that eveningness may be a risk factor for reward-related problems such as mood and substance use disorders.

Support (If Any): This work was supported by grants from the National Institutes of Health, including DA026222 (Forbes, Shaw) and K01DA032557 (Hasler).

0776

THE CIRCADIAN PATTERN OF SUICIDES IN INTOXICATED INDIVIDUALS WITH ALCOHOL DEPENDENCE
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Introduction: Alcohol use and alcohol dependence (AD) are established risk factors for suicide. Prior research has demonstrated a circadian pattern of suicides in individuals with AD with and without intoxication.

Methods: Archival data of suicides from the 2003-2010 National Violent Death Reporting System were evaluated in individuals with AD for whom data on blood alcohol levels were available (N = 3,722). The time of injury was categorized into 1-hour bins and the hourly distribution was used to compute the incidence of suicides over the circadian period. To compute the highest risk part of the day, data were also binned across for 4 time intervals: nighttime (00:00-05:59), morning (06:00-11:59), afternoon (12:00-17:59), and evening (18:00-23:59).

Results: Alcohol was consumed in 73.4% of individuals prior to committing suicide, as reflected by a mean blood alcohol concentration of 179 ± 101 mg/dL. In the total sample, the peak incidence of suicide was at 1 PM (4%) and the nadir was at 6 AM (2.6%). Across each hour of the day, the incidence rates were higher in the BAL+ subjects than in BAL- subjects (p < 0.001). BAL+ subjects had an acute spike at 1 PM (3.5%) and then a gradual increase across the day to a peak incidence at 9 PM (6.4%), which then decreased to a nadir at 7 AM (2.6%). In contrast, BAL- subjects demonstrated a peak incidence at 1 PM (6.2%) and a nadir at 5 AM (2.7%). Examining the 6-hour blocks, the observed frequency in the evening time was higher than expected by chance (p < 0.001).

Conclusion: In alcohol dependent individuals, alcohol consumption, which on average reflected intoxication, was associated with a greater number of suicides and a peak incidence of suicide that occurred later in the evening, as compared to those who were abstinent.

Support (If Any): This study was supported by the following grants: VA grant IK-2-CX000855 (SC); NIH K24 AA013736 (HRK); NIH K23 HL110216 & NIH R21 ES022931 (MAG); and NIH R01AG041783 (MLP).

0777

ALCOHOL USE, IMPULSIVITY, AND ACUTE RESPONSE TO ALCOHOL VARY ACCORDING TO CHRONOTYPE AND DAILY REPORTS OF SLEEP TIMING IN ONE'S OWN ENVIRONMENT
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Introduction: Evening chronotypes experience more alcohol-related problems and have altered reward responsiveness, and higher impulsivity, which may explain the tendencies for problematic alcohol use. In the present study, we extended this literature by examining the association between chronotype, daily reported sleep timing, alcohol use, self-reported and behavioral measures of impulsivity, and acute subjective response to alcohol.

Methods: One hundred and twenty one moderate to heavy social drinkers (50% with childhood ADHD, aged 21-35, 11 females) were recruited to complete two counterbalanced beverage administration sessions in the laboratory: alcohol and non-alcohol (control). During the alcohol administration, participants received a moderate dose of alcohol based on weight and gender to achieve a target BAC of 0.08 (0.72g/kg alcohol). Participants subsequently completed a 10-day ecological momentary assessment (EMA) protocol. Chronotype was assessed via the Composite Scale of Morningness, and sleep timing was assessed daily throughout the 10-day protocol. Impulsivity was assessed via the UPPS-P and the Cued Go/No-Go task (behavioral disinhibition; administered at 3 timepoints: sober, 45, and 90 minutes post-alcohol consumption). The Biphasic Alcohol Effect Scale assessed stimulation and sedation throughout the alcohol and control sessions.

Results: Eveningness was associated with past-year binge drinking and alcohol problems. Both eveningness and later EMA-assessed sleep timing were associated with greater impulsivity on 4 of 5 UPPS-P subscales (not sensation seeking). Later and more variable sleep timing was associated with greater behavioral disinhibition while sober and post-alcohol consumption. Eveningness, later sleep timing, and more variable sleep timing were all associated with greater self-reported stimulation following alcohol relative to non-alcohol beverage consumption.
Conclusion: Our novel findings point to one potential pathway for evenness relating to alcohol problems. These individuals may have higher levels of impulsivity (sober and intoxicated) and experience increased sensitivity to the rewarding effects of alcohol, which may increase heavy drinking and engaging in riskier behaviors while intoxicated.

Support (If Any): This work was supported by grants from the National Institutes of Health, including K01DA032557 (Hasler) and K01AA021135 (Pedersen), as well as a Foundation Grant from ABM-RF/The Foundation for Alcohol Research (Pedersen).

0778
CIRCADIAN CHANGE IN OLDER PEOPLE WITH DEPRESSION: CLINICAL FEATURES AND DIFFERENCES DEPENDING ON AGE OF ONSET
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Introduction: Late-life depression (LLD) is common, with clinically significant depressive syndromes affecting 9-18% of the general elderly population. Importantly, sleep wake dysfunction is evident in patients with LLD, affecting up to 90% of individuals. The phenotype of LLD can vary, and importantly it is recognised to include those who develop depression early in life and whom have grown older, with recurrence of illness as an older adult (early-onset depression; EoD), as well as those whom develop depression for the first time in later-life (late-onset depression, LoD). Importantly, it is posited that different neuropathology underpins the EoD and LoD phenotypes. Classically, EoD has been associated with a diathesis/stress model whereas LoD often presents in the context of medical and neurological disorders. This study aimed to examine whether sleep and circadian differences were evident in patients with the EoD and LoD phenotypes in comparison to control subjects.

Methods: In total, seventy participants with current or euthymic LLD were recruited from the Healthy Brain Ageing Research Clinic; 31 with EoD (mean age = 63.5 years) and 34 with LoD (mean age = 66.06 years). In addition, 70 control subjects with no history of major depression (mean age = 64.5 years) were recruited through community advertisement. All study participants underwent psychiatric, medical and neuropsychological assessment followed by two weeks of actigraphy monitoring.

Results: Both the EoD and LoD groups reported significantly higher depressive symptoms (F = 26.4, p < 0.000). After correction for multiple comparisons, EoD did not differ significantly from control subjects in terms of mean sleep onset/offset times, total sleep time, wake after sleep onset, wake bouts or circadian rhythmicity. By contrast, participants with LoD has significantly greater wake bouts (F = 3.1, p = 0.048) and poorer circadian rhythmicity (F = 4.0, p = 0.020) in comparison to control subjects.

Conclusion: This study demonstrates significant sleep and circadian differences between EoD and LoD phenotypes in older adults with LLD. Further research investigating the relationship between the neuropathology underlying sleep wake dysfunction, cognition and clinical outcomes is now warranted.

0779
DEPRESSION SCORE CHANGES IN RESPONSE TO SLEEP DISORDERED BREATHING TREATMENT WITH CONTINUOUS POSITIVE AIRWAY PRESSURE IN A LARGE CLINIC-BASED COHORT
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Introduction: Real-world effectiveness data on impact of Continuous Positive Airway Pressure (CPAP) therapy on depressive symptoms in Sleep Disordered Breathing (SDB) is limited. We hypothesize that CPAP improves depression scores in a large clinic based population.

Methods: Questionnaire-based Patient Health Questionnaire-9 (PHQ9) scores of 2,211 patients with SDB who initiated CPAP (1/1/2010 - 12/31/2014) were retrospectively analyzed. Paired and two sample t tests were used to evaluate PHQ9 score changes following CPAP initiation and stratification based on PAP adherence (usage > 4 hours nightly > 70% of the time). Post-CPAP PHQ9 scores were estimated using multivariable regression models, adjusting for the pre-CPAP score and including age, gender, race, smoking status, median income, co-morbidities (cancer, chronic renal failure, diabetes, depression, coronary artery disease, hypertension, stroke and atrial fibrillation) as covariates. Interaction between age, median income and pre-CPAP score was also examined.

Results: Mean age was 56.4 ± 13.3 yrs, 75.8% Caucasian and 54.1% were males. 48.8% had history of HTN and 23.9%, a history of diabetes. Significantly greater wake bouts (F = 3.1, p = 0.048) and poorer circadian rhythmicity (F = 4.0, p = 0.020) in comparison to control subjects.

Conclusion: CPAP therapy and better adherence were associated with depressive symptom improvement in this clinic-based cohort. Lower PHQ9 score reductions in younger and lower-income patients suggest additional barriers to treatment effectiveness in these groups, aside from CPAP adherence.

Support (If Any): Research was made possible by the Cleveland Clinic Neurological Institute Research Project Pilot Funding. We acknowledge the Knowledge Program Data Registry of Cleveland Clinic, Cleveland, OH for providing the data used in these analyses. We acknowledge the Neurological Institute Center for Outcomes Research and Evaluation (NICORE) Cleveland Clinic, Cleveland, OH for providing biostatistical resources and NICORE Scholars Award.

0780
THE CONTRIBUTION OF EXTERNAL DESYNCHRONY TO DEPRESSION SYMPTOMS
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Introduction: External desynchrony (e.g., misalignment of internal rhythms and the external light/dark cycle) has been hypothesized as
an etiological mechanism linking abnormal circadian rhythms and the development of depression. However, a paucity of research has examined whether the interval between internal rhythms and external light/dark is altered in the context of depression. Therefore, the current study aimed to investigate whether the intervals between mid-sleep and dawn/dusk times are associated with depressive symptomatology.

**Methods:** Participants were healthy midlife adults (N = 451; 53% female; 42.74 ± 7.39 yrs old) from the University of Pittsburgh Adult Health and Behavior II project. Workday and non-workday midsleep times were calculated via actigraphy. Dawn and dusk times were extracted from http://www.esrl.noaa.gov and averaged across workdays and non-workdays. External desynchrony was operationalized as the respective intervals between dawn or dusk and midsleep times, and calculated separately for workdays and non-workdays. Depression symptoms, as measured by the Beck Depression Inventory (BDI), were collected on average 53.70 (SD = 22.51) days from first actigraphy monitoring day. Regression models were built using workday and non-workday dusk-midsleep and midsleep-dawn intervals to predict BDI scores while controlling for age, sex, and other sleep/circadian variables (i.e., morningness-eveningness, midsleep time, and social jetlag).

**Results:** Longer dusk-midsleep intervals were significantly associated with higher BDI scores on workdays (R² = 0.053, β = 0.22, p = 0.003) and non-workdays (R² = 0.053, β = 0.25, p = 0.003). Shorter midsleep-dawn intervals were associated with higher BDI scores on both workdays (R² = 0.054, β = -0.23, p = 0.002) and non-workdays (R² = 0.053, β = -0.25, p = 0.002). When the time period between actigraphy and BDI collection was restricted to 30 days (n = 67), the effect of midsleep-dawn intervals on BDI scores was stronger (workdays R² = 0.20, β = -0.42, p = 0.04; non-workdays R² = 0.22, β = -0.51, p = 0.05).

**Conclusion:** Measures of external desynchrony predicted depressive symptoms above and beyond sleep/circadian measures previously linked to depression severity. Results provide preliminary support for a novel, easily collected, and calculated risk marker for the development of depression.

**Support (If Any):** Supported by NIH POI HL040962 (SBM) and DGE 124 7842 (MAM)

0782

**THE ROLE OF SLEEP IN INTERPLAY WITH RISK FACTORS AND PSYCHOTIC-LIKE EXPERIENCES**

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**Introduction:** Sleep is known to be health-protective when optimal, but when problematic worsens well-being and mental health. Sleep disturbance is one indicator among six other features in a prediction of psychosis model in aid of a prognostic index in early-detection research. Since predictive rates are not yet satisfactory, further improvement of risk assessment and individualised risk estimation is ongoing. The aim of the present investigation is to improve the sleep criterion in terms of specificity by profiling sleep, psychosis symptomatology and prominent risk factors.

**Methods:** In a systematic literature search we identified the most salient risk factors for developing psychosis. Based on 74 articles, an online survey was created with about 100 questions covering 29 risk factor components, measures of psychotic-like experiences (including Prodromal Questionnaire-16) and factors of sleep quantity, quality and timing (including Pittsburgh Sleep Quality Index, Munich Chronotype, Sleep Condition Indicator). The survey targets the general population and participants are being followed-up yearly.

**Results:** From this ongoing survey a baseline sample of 1400 individuals has been explored. For each risk factor component, a binary score was calculated and summed to provide a total risk score. An accumulating number of risk factors is associated with increased psychotic-like experiences (r = 0.53 p < 0.001). Anxiety, stress symptoms and cannabis use are currently presenting the strongest influence (Odds ratio: 1.70, Confidence Interval: 1.40-2.10). Accumulation of risk factors as well as increased psychotic-like experiences are both associated with significantly longer sleep onset latency and lower sleep quality (z = 16.21, p < 0.001), but not with sleep duration or sleep efficiency.

**Conclusion:** Our exploratory analysis suggests that sleep phenotypes vary with sub-clinical psychotic symptoms. Individuals of highest risk from this survey (top 15%) are phenotyped further using neurocognitive, neurobiological, and quantitative sleep and circadian measurements to explore whether the accuracy of the variables can be increased.

**Support (If Any):** The study is supported by a Wellcome Trust Strategic Award (098461/Z/12/Z) to the Oxford Sleep and Circadian Neuroscience Institute (SCNi) and by the National Institute for Health Research (NIHR) Oxford Biomedical Research Centre based at Oxford University Hospitals NHS Trust, Oxford University (KW, RGF, A90305 and A92181). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.
**0783**

**STRESS AND SLEEP: ARE ALL STRESSORS EQUAL?**

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**Introduction**: Research demonstrates that higher stress predicts worse sleep. However, different types of stress and stressors have not been systematically evaluated leaving open the question, are all stressors equal?

**Methods**: Participants came from the Midlife in the United States (MIDUS) study including MIDUS I (1995-1996) and MIDUS II (2004-2006). Participants are 441 adults (Mage = 54.1, 60.3% women) with complete sleep actigraphy data from the MIDUS II biomarker project. Objectively assessed sleep onset latency (SOL), wake after sleep onset (WASO), sleep efficiency (SE), and total sleep time (TST) were obtained from actigraphy over seven days. A comprehensive array of self-report stress measures were assessed in MIDUS I including: discrimination (daily and lifetime), inequality (work, home, and family), neighbourhood quality, and strain (partner, family, friend). Multilevel models were used to test the relations between stress measures and SOL, WASO, SE, and TST, controlling for day (one to seven), sex, and age (at MIDUS II).

**Results**: Daily discrimination was the strongest predictor of all the stress measures for each of the four sleep outcomes, and was the only statistically significant predictor of TST. Controlling for day, sex, and age, daily discrimination predicted longer SOL (beta = .11, p < .001), higher WASO (beta = .11, p = .003), lower SE (beta = -.18, p < .001), and lower TST (beta = -.11, p = .002). Daily discrimination also uniquely predicted SOL and SE, over and above all other stress measures. Family strain and lifetime discrimination were the next most potent predictors of sleep, with few significant effects for other stress measures.

**Conclusion**: Although stress is important for sleep, not all types of stress have equally deleterious effects on sleep quality (SOL, WASO, SE) or sleep quantity. Despite each event not being severe, daily discrimination may be particularly detrimental to sleep due to its repeated and ongoing nature.

**0784**

**ADVERSE CHILDHOOD EXPOSURES ASSOCIATED WITH ADULT INSOMNIA SYMPTOMS**

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**Introduction**: Acute psychosocial stressors in childhood may precipitate insomnia as well as future comorbid medical and psychiatric conditions. In this study, we evaluated this relationship between current insomnia status with specific childhood stressors.

**Methods**: Data were assessed as part of the Sleep and Healthy Activity Diet Environment and Socialization (SHADES) study, a community-based study of N = 1,007 adults aged 22-60 in the Philadelphia area. Insomnia was assessed with the Insomnia Severity Index and categorized as “none” (0-7), “mild” (8-14), or “moderate-severe” (≥ 15). Participants self-reported psychosocial stressors including child abuse, parental divorce, death of a parent, or having a parent suffering from depression or an anxiety disorder. Multinomial logistic regressions examined whether these experiences were individually associated with insomnia symptoms, adjusted for age, sex, race/ethnicity, education, and depressed mood. A final model examined all adverse exposures simultaneously, to determine whether any exert unique effects separate from the others.

**Results**: Childhood abuse was associated with mild (OR = 2.40, p < 0.005) and moderate-severe (OR = 2.73, p < 0.0005) insomnia. Parental divorce was associated with mild (OR = 1.57, p = 0.008) and moderate-severe (OR = 1.64, p = 0.014) insomnia. Parental death was associated with moderate-severe insomnia (OR = 2.00, p = 0.009). Parental depression was associated with both mild (OR = 1.60, p = 0.010) as well as moderate-severe (OR = 1.66, p = 0.018) insomnia. Parental anxiety was also associated with mild (OR = 1.69, p = 0.018) and moderate-severe (OR = 2.02, p = 0.006) insomnia. In a model that included all covariates and experiences, mild insomnia was uniquely predicted by childhood abuse (OR = 2.24, p = 0.0001) and divorce (OR = 1.47, p = 0.029), and moderate-severe insomnia was uniquely predicted by childhood abuse (OR = 2.44, p < 0.0005) and parent death (OR = 1.86, p = 0.022).

**Conclusion**: Childhood adversities, which are known to play an important role in mental and physical health, are also associated with poor sleep, especially child abuse, and parental divorce or death, even after adjusting for depressed mood. Future research should explore this vulnerability to insomnia, the role of physiologic stress systems, and whether adverse health outcomes are partially explained by worse sleep.

**Support (If Any)**: The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216.

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**0785**

**CHANGES IN SLEEP, SLEEP-RELATED FUNCTIONING, AND PSYCHOLOGICAL DISTRESS IN MOTHERS ATTENDING A FIVE-DAY RESIDENTIAL PROGRAM FOR UNSETTLED INFANTS**

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**Introduction**: Parents whose infants have sleeping and settling difficulties may experience significant sleep disturbance, sleepiness, fatigue, and psychological distress. Currently, few interventions are available for parents with these difficulties. This study examined changes in sleep, sleep-related functioning, and psychological distress in mothers attending a five-day residential program for unsettled infant behaviors in Australia.

**Methods**: Participants were 75 mothers (age M ± SD = 34.47 ± 4.02, infants age 8.77 ± 4.89 months) attending the program. Sleep was assessed via self-reported total sleep time (TST), wake after sleep onset (WASO), and number of awakenings (NA). Sleep-related functioning was assessed subjectively via the Epworth Sleepiness Scale (ESS), Fatigue Severity Scale (FSS), and objectively via mean reaction time (RT) and number of lapses (RTs > 500ms) on the 10-minute Psychomotor Vigilance Task (PVT) on a subset of 45 participants. Psychological distress was assessed via the Depression Anxiety Stress Scale (DASS-21). All measures were repeated on the first and last day of the program.

**Results**: From baseline to post-intervention, mothers reported a mean (SD) reduction in nightly NA from 3.98 (1.87) to 1.98 (1.20) times (p < .001, d = 1.22), a reduction in WASO from 39.07 (34.57) to 13.61 (14.98) minutes (p < .001, d = 1.20), and an increasing trend in TST of 18.15(81.32) minutes (p = .08, d = 0.25). There were significant reductions in depression, anxiety, stress, fatigue and sleepiness scores (all p < 0.001, d ranges 0.61-1.43). There was decreasing trend in mean RT by 9.60 (36.86) ms (p = .08, d = 0.24), but changes in mean lapses were not significant (p = .47).
B. Clinical Sleep Science

Conclusion: Addressing unsettled infant behaviors via a brief residential program was associated with rapid improvement in maternal subjective sleep and psychological wellbeing. Further research is needed to better understand how these changes are associated with objectively assessed alertness and daytime functioning, and how these changes are sustained over time.

Support (If Any): Monash School of Psychological Sciences.

0786
TRAUMA AND GENETIC INFLUENCES ON SLEEP DISTURBANCE IN A LARGE HAN CHINESE SAMPLE
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Introduction: Both genetic and environmental influences contribute to the etiology of disturbed sleep. A significant environmental risk factor is exposure to traumatic events. Childhood events, as opposed to adult onset events, and those interpersonal in nature (e.g., sexual assault) compared to non-assaultive traumas (e.g., natural disasters) tend to be more “potent” risk factors for psychopathology. Few studies have parsed out the effects of trauma type and timing on sleep. Additionally, although insomnia has been shown to be heritable, no studies to date have examined the SNP-based heritability.

Methods: Genetic and phenotypic data on 12,000 Han Chinese females (6,000 with recurrent depression) was used. Trauma type (interpersonal and non-assaultive) and trauma timing (childhood and adult) sum scores were created. Both a general sleep disturbance item (GS) and a sum score of sleep items within depression (SDS; depressed cases only) were used as sleep outcomes. Hierarchical regressions were used to examine the incremental contributions of trauma type, beginning with demographics and adding each trauma type sequentially. Similar models were run for trauma timing. Additionally, genome-wide complex trait analysis (GCTA) will be conducted for each sleep variable to determine SNP-based heritability.

Results: Both interpersonal and non-assaultive traumatic events contributed significantly to GS: The best-fit (lowest AIC) model for trauma type included both non-assaultive (odds ratio[OR] = 1.43, p = 2.0e-5) and interpersonal (OR = 1.31, p = 3.8e-12) traumas. Similarly, the best-fit timing model included childhood (OR = 1.30, p = 4.9e-5) and adult (OR = 1.38, p = 1.1e-10) events. However, for SDS, only non-assaultive trauma (OR = 1.19, p = 0.01) (type) and adult trauma (OR = 1.24, p = 0.001) (timing) were significant.

Conclusion: Both interpersonal and non-assaultive traumas contributed uniquely to the development of disturbed sleep. Similarly, both childhood and adult events had significant effects when included together. However, these relationships may differ for sleep within depression. Genetic analyses (GCTAs) are also in progress and results will be discussed.

0787
INTERACTION OF INSOMNIA AND PTSD ON NEUROCOGNITIVE OUTCOMES IN MILITARY SOLDIERS
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Introduction: Chronic insomnia is a prominent feature of posttraumatic stress disorder (PTSD), and has been linked to neuropsychological deficits. The present study examined the contribution of insomnia in the relationship between PTSD and neuropsychological functioning in military soldiers.

Methods: Data from the All-Army Study (AAS) of the Army Study to Assess Risk and Resilience in Servicemembers (STARRS) were used for the present study. The Army STARRS is a multicomponent study designed to examine suicidal behaviors and correlates of psychopathology. Soldiers (N = 21,499, 87.6% male, mean age 28.7, SD = 7.4) completed the AAS questionnaire between 2011 and 2013, which included Composite International Diagnostic Interview screening scales for PTSD, insomnia, and cognitive domains. Five items from the attention and concentration scale were reduced to a single dimension (i.e., cognitive problems) using factor analysis. Memory problems and concentration problems were used from the health status scale. Multiple regressions were utilized to determine the independent and interactive effects of PTSD and insomnia on neurocognitive functioning.

Results: Multivariate analyses showed that PTSD and insomnia were significant independent predictors of cognitive problems (R² = .25, p < .001), memory problems (R² = .22, p < .001), and concentration problems (R² = .29, p < .001). The interaction between PTSD and insomnia on neurocognitive outcomes were significant for cognitive problems (b = -.12, t = -3.32, p = .001) and memory problems (b = -.09, t = -2.41, p = .016), but not concentration problems (b = -.05, t = -1.23, p = .219).

Conclusion: Findings suggest that insomnia may have important clinical implications for functional outcomes in soldiers with PTSD. Therefore, a sleep specific assessment should be included with initial screenings for PTSD.

0788
PREVALENCE AND ASSOCIATED RISK FACTORS OF INSOMNIA AMONG FEMALE VETERANS
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Introduction: Symptoms of insomnia - the most frequent complaint among veterans - are associated with a range of psychosocial and psychological sequelae. As the proportion of female veterans grow, it is important to understand the prevalence of insomnia in this population. This study sought to fill this gap by: (1) examining the prevalence of insomnia symptoms among female veterans, and (2) identifying homogenous subgroups of women with insomnia symptoms to inform targeted detection and treatment.

Methods: This study was a cross-sectional analysis of insomnia and associated characteristics among a stratified random sample of female veterans using VA primary care facilities between 2010 and 2011 (N = 6247). The primary outcome was presence of insomnia symptoms. Other variables included psychological disorders, mental health visits, chronic conditions, chronic pain, and demographic variables obtained from telephone surveys and medical records. Receiver Operating Characteristic (ROC) analyses were conducted to identify patient-level predictors of a positive screen for insomnia symptoms.

Results: Overall, 47.5% of female veterans screened positively for insomnia symptoms despite limited diagnosis of sleep disorders (0.27%). ROC analysis indicated the primary factor that differentiated those with versus without insomnia was the presence of an outpatient mental health visit (66.3%, 34.5%). Individuals were further differentiated based on presence of pain and several other factors. This resulted in 8 homogeneous groups of women with sleep problems. Those groups with the highest rate of insomnia symptoms were women with general mental health symptoms, those with chronic pain, and women with PTSD.

Conclusion: These results shed light on the prevalence of insomnia symptoms among female veterans. In addition, eight homogeneous
groups of women were identified to be associated with clinically significant insomnia symptoms. Results can inform targeted detection and customized treatment among female veterans, particularly those with mental health symptoms, chronic pain, and PTSD.

Support (If Any): This study was funded by the VA HSR&D SDR 12-196. Additional funding support was provided by a VA Clinical Science Research and Development Career Development Award (IK2 CX001023; Babson).

0789
INSOMNIA AND DEPRESSION PREDICT COGNITIVE FUNCTIONING IN US ARMY SOLDIERS
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Introduction: Insomnia is common among recently deployed U.S. military Veterans and can significantly impact cognitive performance. Literature is lacking on the additive or interactive contribution of mental health comorbidities such as depression to the cognitive impact of insomnia. The purpose of this analysis was to: (1) describe the number of U.S. Army soldiers with insomnia and/or depression using data from a representative sample; and (2) test for independent and interactive associations of depression and insomnia on cognitive functioning.

Methods: The All-Army Study (AAS), of the Army Study to Assess Risk and Resilience in Service members (STARRS) was the data source. Participants were a representative sample of 21,499 U.S. Army soldiers who completed the AAS self-administered questionnaire from 2011-2013, which included Composite International Diagnostic Interview screening scales for depression, insomnia, and cognitive domains. Attention and concentration were assessed with five items, which were reduced to a single dimension (i.e., cognitive problems) using factor analysis. Memory and concentration problems were used from the Health Status scale. Multiple regression was used to determine independent and interactive effects of depression and insomnia on cognitive functioning.

Results: Participants were 87.6% male; mean age = 28.7 (SD = 7.4). Respective rates of probable current insomnia and depression were 23.7% and 6.8%. Multivariate analyses showed that insomnia and depression were significant independent predictors of cognitive (R2 = .30, p < .001), memory (R2 = .23, p < .001), and concentration problems (R2 = .31, p < .001). The interaction between insomnia and depression on cognitive functioning was significant for memory β = .17, t = 4.16, p < .001 and concentration β = .12, t = 2.74, p < .05, but not cognitive problems β = .06, t = 1.35, p = .18.

Conclusion: Results reveal the importance of screening for insomnia in tandem with depression symptoms, as both have a unique, negative association with cognitive functioning. Because cognitive deficits associated with depression may persist after depression recovery, directly addressing insomnia may yield longer-lasting functional improvement.

Support (If Any): This is the result of work supported with resources and the use of facilities at the VA Capitol Health Care Network (VISN 5) MIRECC.

0790
BEHAVIORAL INHIBITION SYSTEM SENSITIVITY, HABITUAL SLEEP QUALITY, AND EMOTION REGULATION DIFFICULTIES PREDICT EMOTIONAL REACTIVITY
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Introduction: Emotional reactivity (ER) reflects the magnitude of an individual’s emotional response to stimuli and has been implicated in the development of psychopathology, where higher levels lead to heightened vulnerability. Behavioral inhibition system (BIS) sensitivity and poor sleep quality have been shown to be predictive of emotional reactivity. Emotion regulation, which is one’s ability to regulate their emotional experience, has not been examined in relation to emotional reactivity as a result of heightened BIS sensitivity and poor sleep quality. The current study connects these lines of research by examining the influence of emotion regulation difficulties.

Methods: Participants were 123 undergraduate students from a large, Midwestern university. After consent, subjects completed a battery of questionnaires; including self-report measures of BIS sensitivity, emotion regulation difficulties, and habitual sleep quality, and then completed an emotion reactivity laboratory task.

Results: Results indicated a three-way interaction between BIS sensitivity, emotion regulation difficulties, and habitual sleep quality (F = 3.084, p < .007). The simple slopes test for high emotion regulation difficulties and poor sleep quality revealed a significant association between BIS sensitivity and ER (b = .144, t = 2.783, p = .007). Additionally, a significant association was found between BIS sensitivity and ER at low emotion regulation difficulties and good sleep quality (b = .102, t = 2.385, p = .20).

Conclusion: Results suggest that emotion regulation abilities and sleep can act as either a buffer or catalyst in regards to the degree of ER one may experience. Specifically, high emotion regulation difficulties and poor sleep quality predicted higher ER, while low emotion regulation difficulties and good sleep quality predicted lower ER. Future research should investigate if specific emotion regulation difficulties affect the relationship between BIS, sleep, and ER.

0791
EFFECTIVENESS OF INTERVENTIONS FOR PARASOMNIAS AMONG SOLDIERS WHO HAVE POST TRAUMATIC STRESS DISORDER
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Introduction: Symptoms of insomnia and other abnormal sleep behaviors have accounted for more than half of all traumatic brain injury patients, which interferes with soldier’s daily functioning, exacerbating their cognitive deficits, depression, and fatigue (Epstein, Babcock-Parziale, Haynes, & Herb, 2012). As many as 94% of soldiers from Operation Iraqi Freedom and Operation Enduring Freedom experience difficulty with sleep onset and maintenance, which may show a positive correlation between stress related experiences and the increased prevalence of sleep disorders (Epstein et al., 2012). There are various alternatives to initiate in terms of treatment for these disturbing sleep issues, including pharmacological interventions, non-pharmacological interventions, and combination therapy. Purpose is to identify, summarize and critique current research regarding interventions for parasomnias among soldiers who have PTSD.

Methods: Inclusion Criteria: RCTS, experimental studies, and literature reviews. Participants 18+, active in military for at least 6 months, diagnosis of PTSD and parasomnias. Studies which examined non-
pharmacological, pharmacological, and/or combination treatment interventions for insomnia. Exclusion Criteria: cohort studies, self-administered sleep interventions, and any participants that did not fit the inclusion criteria. Information obtained from CINAHL, PubMed, and Sleep.

Results: Non-pharmacologic: Sleep improved 34% on Epworth Sleepiness Score (ESS) following routine sleep schedule, planned naps prior to night shift, and bright light during early part of the shift (Williams, Collen, Wickwire, Lettieri, Mysliwiec, 2014). Pharmacologic: Limited studies available on effectiveness of melatonin and clonazepam for use of sleep (Williams et al., 2014). Combination: 60% responded well to treatment, remission rates around 50% at 3 month post-intervention sessions (Bramoweth & Germain, 2013).

Conclusion: Sleep hygiene teaching methods 96% effective in achieving normal sleep onset latency compared to 14% of participants prior to intervention (Ulmer, Edinger & Calhoun, 2011). CBT more effective vs. pharmacological considering long-term management, acutely, both interventions share similar effectiveness towards parasomnia treatment.

**0792**

**FEASIBILITY OF INTEGRATED CBT-I AND PROLONGED EXPOSURE IN VETERANS WITH POSTTRAUMATIC STRESS DISORDER AND INSOMNIA**

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Introduction: Among Veterans with PTSD, sleep disturbances are nearly universal with 70 - 87% reporting comorbid insomnia. Untreated insomnia can persist for years, does not resolve following PTSD treatment, and can exacerbate daytime PTSD symptoms. Prolonged exposure (PE) is an efficacious treatment for Veterans with PTSD, though 25 to 45% of PTSD patients still meet diagnostic criteria following treatment. Importantly, insomnia may interfere with the mechanisms of PE and yet it is rarely targeted for intervention. It is critical to evaluate whether treating insomnia integrated with trauma-focused PE can help sleep and augment PTSD outcomes. Here we present initial results of an ongoing study integrating CBT-I and PE.

Methods: Participants were three Veterans (Age = 33.33 ± 7.23; 100% male) with PTSD and insomnia. Integrated insomnia and PTSD treatment addresses insomnia first through CBT-I before starting PE at week 6 for a total of 14 sessions. Measures included the PCL-5 (PTSD), ISI (insomnia), sleep diary, and PHQ-9 (depression) pre and post integrated CBT-I and PE treatment. Paired t-tests were used to examine treatment outcome.

Results: Comparing pre to post scores following CBT-I plus PE there was a 10 point decrease in PTSD symptoms (t(2) = 4.15, p = .05; r = .95); a 15 point decrease in self-reported insomnia severity (t(2) = 3.25, p = .08; r = 0.92); an 18% increase in sleep efficiency (sleep diary; t(2) = -4.21, p = .05; r = .95); 83 minutes increased average total sleep time (sleep diary; t(2) = -4.75, p = .04; r = 0.96); and a 10 point decrease in depression (t(2) = 2.00, p = .18; r = 0.82). All findings are considered clinically significant.

Conclusion: Veterans reported before and after treatment that the protocol was logical, credible, and expected to see improvement on both PTSD and insomnia indices. Integrated treatment is feasible and promising as indicated by decreases in insomnia, PTSD symptoms, depression, total sleep time, and sleep efficiency from pre- to post-treatment. Integrated treatment represents an innovative and logical method for augmenting therapy to optimize PTSD and sleep outcomes.

Support (If Any): Center of Excellence for Stress and Mental Health

**0793**

**THE RELATION BETWEEN SLEEP DISTURBANCES AND TRAUMATIC EVENT EXPOSURE, EMOTIONAL ATTENTION AND CLARITY, AND SENSITIVITY TO EMOTIONAL CONTEXT**

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Introduction: Sleep disturbances, such as nightmares and insomnia, and emotional processing difficulties are highly prevalent among individuals who have experienced a traumatic event. Some trauma victims have been found to have lower levels of emotional intelligence, and nightmares may be related to emotional attention and clarity. Research has also shown that insufficient sleep has a direct effect on emotional intelligence (including emotional attention and clarity). Furthermore, while other PTSD symptoms such as emotional numbing have been examined in relation to sensitivity to emotional context, very little research examines the relation with sleep disturbances.

Methods: College students with trauma histories (N = 90) completed the Contextual Recognition of Affective Faces Task (CRAFT), a facial affect recognition task in which emotional faces are superimposed upon emotional and neutral context images. Exposure to potentially traumatic events was measured using the Life Events Checklist (LEC). PTSD symptoms, including nightmares and trouble falling or staying asleep, were measured using the PTSD Checklist Civilian version (PCL-C). Emotional attention and clarity was measured using the Trait Meta-Mood Scale (TMMS).

Results: Frequency of traumatic event exposure was positively correlated with experiencing moderate levels of nightmares and difficulties falling and staying asleep (r’s = .21 & .22, respectively, p’s < .05). Experiencing trauma-related nightmares was negatively related to emotional clarity (r = -.21, p < .05) but not significantly related to attention to emotion. Initial analyses did not reveal any relationship between emotional context and sleep disturbances.

Conclusion: Increased frequency of traumatic event exposure was associated with higher frequency of sleep disturbances, and the more frequently participants experienced nightmares, the less clear they were at identifying which emotions they were experiencing. However, there was no evidence of insomnia or nightmares affecting attention to emotion. Additionally, sleep disturbances did not affect individuals’ sensitivity to emotional context or emotional processing. Limitations, future directions and implications are discussed.

**0794**

**POSTTRAUMATIC STRESS DISORDER AND POSITIVE AIRWAY PRESSURE THERAPY COMPLIANCE**

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Introduction: Past research has depicted low CPAP compliance (~30%) for PTSD patients; however, we previously reported PTSD patients found ABPAP or ASV devices more comfortable because these modes can better treat residual breathing events known as RERAs without causing subjective/objective expiratory pressure intolerance (EPI). Our data indicated higher PAP use rates compared to CPAP. The current study examined PTSD patient compliance using advanced PAP modes.

Methods: This retrospective chart review included 82 adult patients from Maimonides Sleep Arts & Sciences, Albuquerque, NM meeting these criteria: 1) completed intake; 2) scored ≥ 21 on PTSD Symptom Scale (PSS) (moderate-severe symptoms); 3) objectively diagnosed...
with OSA/UARS, 4) manually titrated during attended polysomnography on auto-adjusting pressure modes to aggressively resolve RERAs while preventing EPI after previously failing CPAP (lab or home); and, 5) initiated treatment with ABPAP or ASV. Compliance was determined from objective data downloads (ODD).

**Results:** Average intake PSS = 30.55 (7.53). Patients were objectively diagnosed [OSA (n = 78): AHI = 22.20 (21.54), RDI = 52.88 (26.51); UARS (n = 4); AHI = 1.84 (1.78), RDI = 47.10 (36.31)]; and, 69 were current PAP users and 13 were non-users. ODD identified three compliance sub-groups: Compliant-Regular Users, C-RU, n = 42 (51.2%), Sub-Compliant Regular Users, SC-RU, n = 14 (17.1%), and Non-Compliant Minimal Users, NC-MU, n = 13 (15.9%). Average PAP hrs/week: C-RU = 38.7 (13.8); SC-RU = 14.0 (6.7); NC-MU = 2.35 (4.2). Of 42 C-RU patients, 25 (59.5%) were currently using ASV and 17 (40.5%) ABPAP.

**Conclusion:** Contrary to past research, we found PTSD patients suffering from moderate-severe symptoms and co-morbid SDB not only demonstrated a high proportion of clinically relevant PAP use (68%; 56/82) but also showed higher than usual adherence rates (51%; 42/82) when prescribed advanced pressure mode devices. Frequent anecdotal reports by patients indicated these devices were more comfortable and resulted in a better response compared to previous experiences with CPAP (home or lab).RCTs should explore the benefit of advanced PAP modes versus standard CPAP in PTSD patients with co-morbid SDB. The concept of sub-compliance should also be investigated as a potential transitional step towards eventual compliance.

**Support (If Any):** Maimonides Sleep Arts & Sciences

**0795**

**POTENTIAL DOSE-RESPONSE RELATIONSHIP BETWEEN NIGHTLY PAP HOURS AND NIGHTMARE FREQUENCY IMPROVEMENT IN PATIENTS WITH CO-MORBID NIGHTMARE DISORDER AND OSA/UARS**

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**Introduction:** Tamanna et al. (2014) previously showed PTSD patients with co-morbid OSA had significantly fewer PTSD-related nightmares when treated with CPAP (from ~10 to 5/week). Furthermore, nightmare episodes decreased one/week for every 10% increase in nights PAP used > 4 hours. Our study builds on Tamanna's work and looks for a possible dose-response relationship between actual PAP hours/night and decrease in chronic nightmares.

**Methods:** This retrospective non-randomized controlled study included 54 adult patients seen at Maimonides Sleep Arts & Sciences, Albuquerque, NM meeting these criteria: 1) completed intake; 2) scored > 10 on Disturbing Dreams and Nightmare Severity Index (DDNSI), consistent with a clinical nightmare disorder; 3) objectively diagnosed with OSA/UARS; 4) manually titrated with and prescribed advanced auto-adjusting PAP device due to CPAP failure; and 5) completed follow-up DDNSI and ODD. The DDNSI consists of 5 questions assessing nightmare severity and frequency; score range = 0-37. PAP use and compliance (based on Medicare criteria) were determined using ODD obtained during most-recent clinic appointments, resulting in two comparison groups: Compliant (n = 39) and Non-Compliant (n = 15).

**Results:** DDNSI scores for our total sample (n = 54) significantly decreased with SDB treatment [14.27(6.13) vs 5.89(5.89); p = .001; g = 1.38]. PAP therapy was subjectively cited as a reason nightmares decreased by 35.2% of patients. Consistent with Tamanna et al. (2014), Compliant patients experienced significantly greater DDNSI improvement [14.53(6.17) vs 4.75(5.02)] than Non-Compliant patients [13.63(6.20) vs 8.85(7.05), p = .02, g = 0.69]. Also, a significant inverse correlation between PAP hours/night and decreased DDNSI score (p = .02; r = -0.32) demonstrates support for a dose-response relationship.

**Conclusion:** This study showed a significant decrease in DDNSI scores after SDB treatment, with greater effects seen in PAP compliant patients. Anecdotal, subjective responses suggest patients perceived their decrease in nightmares was associated with PAP use. A putative dose-response relationship warrants further investigation. Future research should also compare PAP therapy to evidence-based treatments for nightmares, such as imagery rehearsal therapy or prazosin.

**Support (If Any):** Maimonides Sleep Arts & Sciences

**0796**

**COGNITIVE BEHAVIORAL THERAPY FOR POST-TRAUMATIC STRESS DISORDER IS ASSOCIATED WITH NEGligible CHANGES IN DAILY SLEEP DIARY VARIABLES**

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**Introduction:** Cognitive behavioral therapy (trauma-focused CBT/ exposure therapy) is the first-line treatment for PTSD. Several CBT for PTSD trials have found that sleep disturbance, as assessed by the Pittsburgh Sleep Quality Index (PSQI), is a frequent residual complaint in patients who have otherwise responded well to therapy. The type and extent of residual sleep disturbances has not been well quantified due to global assessment methods. In order to quantify these sleep symptoms, we administered research consensus daily sleep diaries to a naturalistic sample of veterans before and after CBT for PTSD.

**Methods:** Across two VA sites, we examined 34 Veterans at baseline and 30-days after receiving CBT for combat-related PTSD with trained VA providers. Approximately 85% of participants had an ICSD-2 diagnosis of Insomnia Disorder at baseline. Participants completed daily sleep diaries one-week before and one-week after the completion of CBT. The following daily sleep diary variables were analyzed: wake time after sleep onset, sleep onset latency, sleep efficiency, number of awakenings, total sleep time, and sleep quality. Participants were identified as having a clinically significant response with a 15-point drop on the Clinician Administered PTSD Scale, DSM-IV version.

**Results:** There were no main effects for Time or Therapy Response x Time interactions for all sleep variables. At post-treatment, Veterans in the responder group continued to have clinically significant levels of wake time after sleep onset (M = 43 minutes, SD = 39 minutes), sleep onset latency (M = 42 minutes, SD = 54 minutes), and relatively low levels of total sleep time (M = 5.25 hours, SD = 1.86 hours).

**Conclusion:** This is one of the first studies to examine sleep across the course of CBT for PTSD using the gold-standard research consensus daily sleep diary. Results indicate that insomnia symptom indices do not improve, even when PTSD symptoms do improve. These negative findings have significant clinical implications, supporting the notion that veterans receiving CBT for PTSD should be separately assessed and treated for Insomnia Disorder.

**Support (If Any):** U.S. Army Medical Research and Materiel Command, Award W81XWH-10-1-0745
SLEEPINESS AND FATIGUE ASSOCIATED WITH AVOIDANCE BEHAVIOR IN MODERATELY SEVERE PTSD PATIENTS PRESENTING TO A COMMUNITY-BASED SLEEP CENTER
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Introduction: Avoidance behavior in PTSD patients attempts to block reminders of traumatic events, which leads to disengagement from activities, emotions, or emotional connections previously found enjoyable. Avoidance prevents emotional processing and impedes recovery. We examined the relationships among sleepiness, fatigue, and avoidance.

Methods: This chart review includes 310 adults at Maimonides Sleep Arts and Sciences who scored > 20 (moderate-severe) on the PTSD Symptom Scale (PSS), a 17-question survey of PTSD severity [0 (not at all) to 3 (very much/always)]; score range = 0-51. Avoidance is measured through seven PSS questions, generating an inter-item average score. The influence of Trauma, Fatigue, and Sleepiness (TFS) is subjectively measured using three additional sub-queries [scale 0 (no impact) to 10 (high impact)] for each of these seven avoidance behaviors. An inter-item average score is generated for each TFS sub-query, along with total scores for each of the three separate TFS factors (range = 0-70).

Results: Average PSS scores were moderately severe [29.4 (7.28)]. The inter-item average avoidance behavior score was moderate [1.71 (0.57)]. TFS totals were moderate with trauma [37.22 (17.86)] being slightly more influential than fatigue [34.62 (17.86)] and sleepiness [31.42 (18.76)] but without significant differences. For each of the seven avoidance behaviors, the inter-item average for Trauma, Fatigue, and Sleepiness were similar; however, patients rated Fatigue [6.87 (2.96), p = .001, d = 0.26]] but not Sleepiness [6.12 (3.23), p = .88, d = 0.01] more influential than Trauma [6.08 (3.16)] for “loss of interest in activities”, but small effect sizes suggest minimal clinical relevance.

Conclusion: Trauma influence was rated similar to Fatigue and Sleepiness across seven avoidance behaviors. Although sleepiness and fatigue likely occur as specific outcomes in the posttraumatic stress condition, these two indicators of nonrestorative sleep commonly arise in undiagnosed sleep disorders (e.g. insomnia, nightmares, leg jerks). This retrospective study suggests fatigue and sleepiness are associated with avoidance behavior. Speculatively, treating sleep disorders might diminish avoidance behavior and improve PTSD. Further research must determine whether fatigue and sleepiness are characteristic of the posttraumatic process or evidence of a comorbid sleep disorder in PTSD patients.

Support (If Any): Maimonides Sleep Arts & Sciences

DREAM SEVERITY AS A PREDICTOR OF POSTTRAUMATIC STRESS DISORDER CHECK LIST (PCL-S) AND PITTSBURGH SLEEP QUALITY INDEX (PSQI) IN PTSD VETERANS
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Introduction: PTSD is often undiagnosed and prevalent particularly amongst the Veteran population, and it is inflicted with substantial societal and economic burden. Currently the optimal therapy for afflicted patients is unclear, leading to efforts to improve our understanding of the underlying pathophysiology. Troubling dreams and disrupted sleep are common complaints which might influence PTSD pathogenesis. We sought to test the hypothesis that dream content was an important predictor of sleep quality in PTSD patients as judged by the PSQI and PTSD severity as judged by the PCL-S.

Methods: A cross sectional study was performed in patients diagnosed with PTSD and obstructive sleep apnea (OSA). Level III portable home sleep test, PSQI, and PCL-S data were collected for analysis of dream content, sleep quality, and PTSD severity. As PSQI and PCL-S both contain dream questions, we analyzed data with and without dream-related questions to isolate the correlations between the variables. We are concomitantly studying potential benefits to treating sleep disorders in afflicted patients.

Results: We analyzed 58 (50 M; 41 Caucasian) OSA/PTSD patients. Mean age = 50 ± 14 years, 34 Persian Gulf veterans, and 23 Vietnam War veterans. There was a significant correlation between severity of dream symptoms and sleep quality as observed by PSQI with or without dream questions included (R = 0.568; p < 0.001 and R = 0.434; p = 0.007 respectively). Dream symptom severity was predictive of PTSD symptoms as judged by PCL with or without dream questions (R = 0.535; p < 0.001 and R = 0.472; p = 0.0002 respectively).

Conclusion: Dream content and symptom severity may be important predictors in determining sleep quality and PTSD severity. The reduction in correlation coefficient when the dream questions are removed suggest that dreams account for some but not all of the variance in severity of symptoms. Further data are required to determine underlying causal mechanisms, the effect of OSA, and whether therapeutic strategies targeting dream phenomena may be viable approaches for afflicted patients.

Support (If Any): American Sleep Medicine Foundation 2013 Junior Faculty Research Award

AN EXAMINATION OF RELATIONSHIP QUALITY AND SLEEP IN VETERANS WITH PTSD AND THEIR BED PARTNERS
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Introduction: Veterans with Post Traumatic Stress Disorder (PTSD) suffer from sleep disruptions and overall poor sleep quality. In addition, stress disorders like PTSD are frequently associated with marital dissatisfaction. While many studies have focused on sleep in PTSD and intimate relationships in PTSD, there has been less research examining how relationship quality affects sleep in PTSD patients (PTSD-P) and their bed partners (BP). We hypothesized that the sleep of PTSD-P and BP would differ as a function of perceived relationship quality.

Methods: Twenty-eight individuals (14 couples; 14 men and 14 women) were recruited from the University of Arizona and the Southern Arizona VA Health Care System. Mean age of PTSD-P was 54.50 years (SD = 10.20). All individuals were administered the Dyadic Adjustment Scale (DyAS) and asked to complete daily sleep diaries for one week. We employed hierarchical linear regression to examine the interaction between partner (PTSD vs. BP) and relationship quality on sleep indices (total sleep time, time in bed, wake time after sleep onset, sleep onset latency, and sleep efficiency).

Results: A significant partner status x relationship quality interaction emerged in predicting TST (B = -4.035, SE = 1.54, p < .05) and TIB (B = .05, SE = .02, p < .05). Decreased relationship quality was associated with less TST and less TIB in PTSD-P. In BP, there was no relationship between relationship quality and TST / TIB.
Conclusion: These findings suggest that sleep behavior in veterans with PTSD may be associated with relationship quality. Given that the hallmark feature of PTSD is avoidance, veterans with PTSD and poor relationships may be avoiding their partner by manipulating the times they retire or arise from bed. Alternatively, sleep restriction may be negatively influencing relationship quality. Future research with a larger sample size is necessary to examine the directionality of partner relationship dynamics focused on bedtime and sleep behavior.

Support (If Any): The University of Arizona Honor College

0800
REGIONAL REDUCTIONS IN SLEEP EEG POWER IN GULF WAR ILLNESS: A HIGH-DENSITY EEG INVESTIGATION
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Introduction: Approximately 25% of U.S. veterans who served in the 1990-1991 Persian Gulf War are affected by Gulf War illness (GWI), a chronic multi-symptom illness that includes symptoms of neuropathic pain, changes in mood/cognition, sleep disturbance and fatigue. Although there is no clear consensus on the causes of GWI, chemical exposures have become the focus of etiologic research because of the prominence of nervous system symptoms in GWI as well as the abundance of neurotoxicant exposure in theater, particularly toxins with effects on the cholinergic system. Although subjective sleep disturbance is a central feature of the disorder, objective analyses of sleep in GWI are limited.

Methods: We used high-density EEG (256-channels) to assess regional patterns of NREM and REM sleep in 9 men with GWI (ages 40-46) relative to otherwise healthy men matched on age and severity of obstructive sleep apnea. Absolute and normalized topographic comparisons of NREM and REM sleep were made between groups for all frequency bands.

Results: Standard sleep architecture variables were not different between control and GWI subjects. However, topographic analysis of hEEG data revealed a broadband reduction in EEG power in a circumscribed region overlaying the frontal cortex in GWI subjects. This frontal reduction in neural activity was present, to some extent, across all frequency bands in NREM and REM sleep.

Conclusion: This circumscribed frontal reduction in sleep EEG power may partially explain symptoms of fatigue as well as the impairments in daytime function commonly reported in GWI. Whether this functional deficit is secondary to structural changes within the frontal cortex is unclear. Structural imaging analyses of GWI do support and grey and white matter loss in frontal regions. In addition, functional MRI analyses have shown abnormal neural recruitment patterns during the performance of prefrontal tasks, further supporting the notion of regional alterations in neural integrity. Interestingly, poor sleep quality, regardless of psychiatric condition, is also associated with structural and functional changes in the frontal lobes. This raises the question of whether effective treatment of disturbed sleep in GWI may lead to improved structural and functional integrity of the frontal lobes.

Support (If Any): Department of Defense

0801
EXAMINING THE LINK BETWEEN NIGHTMARES AND EMOTION DYSREGULATION IN A CROSS-SECTIONAL STUDY OF ADULTS AT RISK FOR SUICIDE
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Introduction: Research has identified nightmares as an evidence-based risk factor for suicide, and emotion regulation (ER) deficits are implicated in the link between nightmares and PTSD. A study has yet to evaluate the role of emotion dysregulation in nightmares among an at-risk sample, above and beyond PTSD. The current investigation explored associations between nightmare severity, PTSD symptoms, and ER among adults at elevated risk for suicide.

Methods: Data were collected among N = 61 adults (aged 23-73 years; 25% female; 67% veterans) screened for inclusion in an insomnia treatment trial for suicidal behaviors. Data were collected during pretreatment phases of the study, using the following measures: The Disturbing Dreams and Nightmare Severity Index (DDNSI), PTSD Checklist (PCL), and Difficulties in Emotional Regulation Scale (DERS). Multiple linear regression analyses were employed to test associations between nightmare severity, PTSD symptoms, and ER among adults at elevated risk for suicide.

Results: Participants demonstrated clinically significant nightmare symptoms (DDNSI: M = 10.0 ± 9.1), PTSD symptomatology (PCL: M = 49.3 ± 16.4), and ER difficulties (DERS M = 98.0 ± 25.8). Regression analyses revealed a significant positive association between DDNSI and DERS total scores (p = 0.001). Though after controlling for PCL totals, this relationship emerged as a nonsignificant trend in the expected direction (p = 0.17, t = 1.39). When evaluating individual DERS subscales, DDNSI scores were positively associated with the DERS-Impulse subscale (p = 0.01, t = 2.64), controlling for PCL and other DERS subscales. No other subscales showed unique associations with DDNSI (p > 0.05).

Conclusion: Findings revealed strong associations between nightmares and ER deficits. After accounting for PTSD, this relationship was attenuated. However, a unique link emerged between nightmares and impulse control ER difficulties, even after covarying for PTSD symptoms. Such findings indicate that emotion dysregulation—and impulse control in particular—may be a novel therapeutic target among at-risk individuals with nightmares, and may point to etiologic factors in the development and prevention of PTSD.

Support (If Any): This work was supported in part by K23MH093490 and the Military Suicide Research Consortium (MSRC), an effort supported by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. W81XWH-I0-2-0178.

0802
SLEEP, DEPRESSION, AND HEALTH OUTCOMES IN VETERANS WITH POSTTRAUMATIC STRESS DISORDER AND SERIOUS MENTAL ILLNESS
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Introduction: Depressive symptoms and sleep disturbance are common complaints among veterans with posttraumatic stress disorder (PTSD) and serious mental illness (SMI; e.g., schizophrenia spectrum disorders, bipolar disorder). Depression and insomnia are both related to poor health outcomes in the general population, though little is known about these symptoms in those with a dual diagnosis of PTSD.
and SMI, and sleep is not currently a primary focus of treatment in this population. The current study examined sleep quality as a mediator between symptoms of depression and both emotional and physical health outcomes, while controlling for PTSD symptoms.

**Methods:** Participants (N = 45) were veterans with a dual diagnosis of PTSD and SMI, recruited as part of a larger treatment study. Participants completed the Clinician Administered PTSD Scale (CAPS), and each participant completed the Beck Depression Inventory (BDI), Pittsburgh Sleep Quality Index (PSQI), and Short Form Health Survey (SF-12).

**Results:** The mean score on the BDI for the sample fell in the severely depressed range. The overall mediation model for physical health outcomes was significant (p < .005), with predictive factors accounting for approximately 22% of the variance in physical health (R² = .215), and sleep quality demonstrated full mediation of the relationship between depressive symptoms and physical health functioning. However, the analyses of sleep quality as a mediator between depressive symptoms and mental health produced non-significant results, as sleep quality was not a significant predictor of mental health functioning.

**Conclusion:** Depressive symptoms were predictive of physical and mental health in this sample of veterans with PTSD and SMI, even after controlling for PTSD symptoms. Sleep quality mediated the relationship between depression and physical health but was not a mediator in the relationship between depression and mental health. Limitations and implications are discussed.

**Support (If Any):** Veterans Affairs Health Services Research & Development grants CD207015 and IIR 11-306 awarded to Anouk L. Grubaugh, Ph.D.

**0803**

**ASSOCIATIONS BETWEEN NOCTURNAL SLEEP EPISODE PATTERNS AND MENTAL HEALTH DIAGNOSES IN VETERANS OF THE IRAQ AND AFGHANISTAN CONFLICTS**

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**Introduction:** Military service involves irregular sleep patterns and sleep curtailment. Evidence suggests these patterns may persist beyond military discharge. Despite high co-morbidity between sleep difficulties and mental health diagnoses (MH dx), little is known about how sleep episodes (timing/duration) may be related to MH dx in Veterans.

**Methods:** Military veterans (N = 2,254) who served since 9/11 were evaluated for MH dx and completed the Pittsburgh Sleep Quality Index (PSQI). PSQI items were used to find the sample modal sleep episode (11pm to 6am), and 4 sleep episode categories were created: short sleeper (bedtime after 11pm and rise before 6am, 28%); long sleeper (bedtime before 11pm and rise after 6am, 31%); delayed sleeper (bedtime after 11pm and rise after 6am, 21%); and advanced sleeper (bedtime before 11pm and rise before 6am, 20%). Veterans were also categorized as: No MH dx (48%); Depression (7%); PTSD (15%); PTSD with Depression (15%); and Other MH dx (15%). Veterans with/without MH dx were compared on: 1) bed time; 2) rise time; and 3) sleep episode group.

**Results:** Compared to no MH dx, those with Depression, Depression and PTSD, and other MH dx endorsed significantly later bedtimes (all ps < .01), and those with PTSD endorsed an earlier rise time (p = 0.02). Each of the 4 MH dx groups differed significantly from no MH dx group in terms of sleep episode (all ps <.01). A delayed sleep episode was the most common pattern among those with Depression (17.3%), Depression with PTSD (31.2%), and other MH dx (30.9%), whereas a short sleep episode was the most common pattern among those with PTSD (30.8%).

**Conclusion:** Delayed sleep timing is common in Veterans with MH dx. Short sleep duration and earlier rise time are frequent in PTSD. Understanding the timing/duration of sleep in Veterans is important for tailoring sleep and circadian interventions to this population.

**Support (If Any):** This work was supported by the VA Mid-Atlantic (VISN 6) Mental Illness Research, Education and Clinical Center, and by a VA CDA Award (#09-218) from the United States (U.S.) Department of Veterans Affairs Health Services Research and Development Service. The contents do not represent the views of the U.S. Department of Veterans Affairs or the United States Government.

**0804**

**INCREASED RELATIVE ALPHA POWER DURING REM SLEEP DISTINGUISHES TRAUMA-EXPOSED SUBJECTS WITH PTSD FROM THOSE WHO SHOW RESILIENCE**

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**Introduction:** Sleep disturbances including insomnia and recurrent nightmares are core features of posttraumatic stress disorder (PTSD) and have been associated with poor clinical outcomes. Reduced sleep depth has been reported with PTSD, and fragmented rapid-eye-movement (REM) sleep has been reported during the early development of PTSD. Increased activity in the alpha frequency range (8-12 Hz) during REM sleep has been associated with micro-arousals and transitory events suggested to underlie the perception of poor sleep. In nightmare sufferers, increased alpha power has also been linked to nightmare activity. The goal of this study is to compare EEG activity in the alpha frequency range between two groups of trauma-exposed subjects with diagnoses of PTSD or those who demonstrated resilience.

**Methods:** Physically healthy non-treatment seeking African Americans (age 18 - 35) with PTSD and those who demonstrated resilience completed two consecutive nights of PSG recordings. Night two recordings were scored for sleep stages. Relative alpha (8-12 Hz) spectral power was computed for early, mid, and late REM time points for bilateral frontal and central leads. A 2 (Hemisphere) x 3 (Time) x 2 (Group) ANOVA was performed to examine effects of these factors on relative alpha power.

**Results:** We found a significant main effect of group (F = 6.532; p = .016) indicating higher alpha power in the PTSD group compared with the resilient group (M = 13.364 vs. M = 10.622). Neither the main effect of time (F = 2.048; p = .149) nor hemisphere (F = .593; p = .448) was significant. A trend-level Group x Hemisphere interaction (F = 3.549; p = .07) was found. In the PTSD group, relative alpha power was higher on the right than the left hemisphere; the resilient group showed a reverse pattern. Neither the Time x Group nor the three-way interaction was significant.

**Conclusion:** Results suggest that increased alpha activity may be a feature of REM sleep disturbances in PTSD.
VIII. Psychiatric Disorders and Sleep

0805
DIRECT CORRELATION BETWEEN PERCENTAGE DEEP SLEEP AND PERCENTAGE REM SLEEP ACROSS THE SPECTRUM OF AUTONOMIC NERVOUS SYSTEM (ANS) ACTIVATION IN POSTTRAUMATIC STRESS DISORDER (PTSD): PRELIMINARY RESULTS USING HOME SLEEP TESTING
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Introduction: Functional neuroimaging studies of PTSD have shown hypo-activation of the anterior cingulate and medial prefrontal cortex (mPFC), structures that are involved in the modulation of the autonomous nervous system (ANS) and generation of slow-wave sleep (SWS) (by mPFC). We examined sleep in PTSD using home sleep testing (HST) which made it possible to obtain sleep studies under varying conditions of ANS activation. We are presenting results from the baseline cross-sectional data.

Methods: We studied 13 consecutive consenting women (ages 26-67 years) with PTSD (fulfilling DSM-5 criteria, 10/13 had Clinician-Administered PTSD Scale for DSM-5 [Past Month] score > 60). Patients remained on their PTSD medications. The Pennebaker Inventory of Limbic Languidness (PILL) was used as an index of daytime somatic autonomic symptoms. The Watch-PAT200 [Itamar Medical, Israel] was used for HST. The respiratory events index (REI) and mean pulse rate (MPR) during sleep were measures of ANS activation during sleep.

Results: The sleep efficiency (range 64.6%-95.04%; mean ± SD: 82.26 ± 8.16), REI (range 1.10-45.10 events/hour, mean ± SD: 11.97 ± 13.24) and MPR (range 58-95 bpm, mean ± SD: 71.08 ± 11.84) were consistent with a wide range of ANS activation. The PILL was directly correlated with the REI (Pearson r = 0.67, p = 0.048) and MPR (Pearson r = 0.79, p = 0.012) consistent with diurnal and nocturnal ANS dysregulation. There was a wide range of %REM (11.83% to 31.75%, mean ± SD: 21.82% ± 6.49%), %Deep sleep (SWS) (5.18% to 25.36%, mean ± SD: 16.53 ± 5.19%), and %Light sleep (46.73% to 79.88%, mean ± SD: 61.64 ± 10.82%). There was a direct correlation between the %Deep sleep and %REM sleep (Pearson r = 0.712, p = 0.006).

Conclusion: The robust and direct correlation between %Deep and %REM sleep in PTSD in the background of ANS activation has not been previously reported. Deep sleep (function of mPFC) may modulate REM sleep, which regulates ANS functions during sleep. A weakness of the study design is the use of HST, however the Watch-PAT200 is FDA approved to stage sleep.

0806
SLEEP CHARACTERISTICS AND VARIABILITY IN PTSD WITH PTSD AND COMORBID ALCOHOL USE DISORDER
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Introduction: Sleep disruptions are prevalent in patients with PTSD, patients with alcohol use disorders (AUD), and particularly in patients with both disorders. Some authors have argued the most unique feature of sleep difficulties in PTSD is high variability of sleep from night to night. Night-to-night variability has not been investigated in comorbid PTSD samples.

Methods: Participants consisted of Veterans (n = 42, age = 42.58 ± 14.62, 4F) who met criteria for PTSD and AUD and were enrolled in a treatment study. Veterans tracked the number of alcoholic drinks they consumed daily over one week of baseline. Sleep diaries were also collected for the week. Sleep continuity measures included Sleep Latency (SL), Wake After Sleep Onset (WASO), Total Sleep Time (TST), and Sleep Efficiency (SE). The Root Mean Squared of Successive differences (RMSSD) was used as an index of night-to-night variability and was calculated for all diary variables. Approximately one third of the sample (n = 15) remained completely abstinent from alcohol for the week, and the rest of the Veterans in the sample reported consuming at least one alcoholic beverage. Independent samples t-tests were used to compare the group of Veterans who abstained from alcohol to the group of Veterans who were actively drinking during the baseline week.

Results: SL and WASO averaged > 30 minutes for both patient groups, indicating clinically significant insomnia symptoms. For patients who consumed alcohol during the week, the average number of drinks per night was 4.48 ± 5.5. On their sleep diaries, these Veterans showed lower SE (t = 2.26, p = .03) and higher WASO (t = 2.24, p = .03) compared to the patients who remained abstinent from alcohol during the baseline week. The patients who consumed alcohol during the baseline week also showed more night-to-night variability in SL (t = 3.02, p < .01), WASO (t = 2.51, p = .02), and SE (t = 2.27, p = .03) than the patients who remained abstinent.

Conclusion: Veterans who met criteria for PTSD and AUD showed clinically significant insomnia symptoms regardless of whether or not they were actively drinking. Veterans who consumed alcohol had more significant sleep continuity problems and greater night-to-night variability of sleep in comparison to the Veterans who remained sober. Future research should examine the directionality of this relationship. As poor sleep and greater night-to-night variability of sleep is associated with greater symptom severity and poorer treatment outcomes, Veterans with PTSD and AUD are likely to benefit from adjunctive treatments (e.g., CBT-I) to reduce sleep disturbances in the early phases of treatment.

Support (If Any): VA Merit Grant

0807
POLYSOMNOGRAPHIC SLEEP AND NEUROBEHAVIORAL FUNCTION IN OEF/OIF VETERANS WITH PTSD
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Introduction: Posttraumatic stress disorder (PTSD) has been associated with disturbed sleep and neuropsychological deficits. The present study examined the relationship between objectively measured sleep and neurobehavioral function in Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF) Veterans with PTSD compared to a control group.

Methods: Thirty subjects (PTSD, n = 20; combat-exposed control, n = 10) were participants in a study examining neurobiological and neuropsychological factors associated with arousal. Veterans’ symptomatology was assessed using the Clinician-Administered PTSD scale (CAPS). Additionally, two nights of polysomnography (PSG) were conducted. The second night polysomnogram was examined for sleep continuity and sleep architecture (total sleep time (TST); stages N1, N2, and N3 sleep; and rapid eye movement (REM) sleep). Veterans
also completed the Penn Computerized Neurocognitive Battery (CNB), a validated battery of tests assessing attention, cognitive control, learning and memory, and visuospatial processing. 

**Results:** PTSD (r = -.51, p = .004), TST (r = .44, p = .020), and stage N2 sleep (r = .55, p = .003) were significantly associated with verbal memory. Multivariate (MANOVA) analyses showed that the PTSD subjects exhibited less stage N3 sleep and greater verbal memory deficits compared to the combat-exposed controls (λ = .646, F(4,23) = 3.15, p = .033). Group differences were confirmed for stage N3 sleep (p = .028) and verbal memory (p = .009). There were no significant group differences for other sleep variables. 

**Conclusion:** Findings indicate that the PTSD group had reduced N3 sleep and poorer verbal memory. These results support the role for slow wave sleep and its importance in memory processing. 

**Support (If Any):** This study was supported by the Defense Advanced Research Projects Agency (DARPA), United States Department of Defense, grant W91NF10100093.

### 0808 SLEEP DISTURBANCE AND NEUROBEHAVIORAL FUNCTION IN OEF/OIF VETERANS WITH PTSD

**Introduction:** Sleep disturbances are prominent features of post-traumatic stress disorder (PTSD) and have been associated with neuropsychological deficits. The present study examined the relationship between subjective sleep disturbance and neurobehavioral function in Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF) Veterans with PTSD. 

**Methods:** Thirty subjects (PTSD, n = 20; combat-exposed control, n = 10) were participants in a study examining neurobiological and neuropsychological factors associated with biomarkers of arousal. Veterans’ symptomatology was assessed using the Clinician-Administered PTSD scale (CAPS), Insomnia Severity Index (ISI), Nightmare Frequency Questionnaire (NFQ), Nightmare Distress Questionnaire (NDQ), and the Pittsburgh Sleep Quality Index (PSQI). Veterans also completed the Penn Computerized Neurocognitive Battery (CNB), a validated battery of tests assessing attention, cognitive control, learning and memory, and visuospatial processing. 

**Results:** PTSD (r = -.51, p = .004), NFQ (number of nights; r = -.57, p = .001), NDQ (number of nightmares; r = -.58, p = .001), NDQ (r = -.42, p = .023), and PSQI (r = -.39, p = .031) were significantly associated with poorer verbal memory. Multivariate (MANOVA) analyses showed that the PTSD subjects exhibited greater nightmare frequency, nightmare distress, and insomnia severity; poorer sleep quality; and greater verbal memory deficits compared to combat-exposed controls (λ = .245, F(6,21) = 10.80, p < .001). These findings were confirmed across all dependent variables: (NFQ number of nights (p < .01); NFQ number of nightmares (p < .01); NDQ (p < .01); ISI (p < .01); PSQI (p < .01); verbal memory (p = .004)). 

**Conclusion:** Findings indicate that sleep disturbances (i.e. nightmare frequency, nightmare distress, and insomnia severity) and verbal memory impairment may have important clinical implications for OEF/OIF Veterans. 

**Support (If Any):** This study was supported by the Defense Advanced Research Projects Agency (DARPA), United States Department of Defense, grant W91NF10100093.

### 0809 COMPARISON OF EFFECT OF CPAP THERAPY ON NIGHTMARES AND PCL SCORES AMONG VETERANS WITH AND WITHOUT PTSD

**Introduction:** Post-traumatic stress disorder (PTSD) affects one-third of US Veterans and the prevalence of obstructive sleep apnea (OSA) is three times higher in this sub-population. Previous studies reported improvement in PTSD symptoms with continuous positive airway pressure (CPAP) therapy, but objective tools have not been used to validate CPAP compliance. We performed a prospective study on Veterans with OSA (with and without PTSD) and compared the effects of validated CPAP compliance on their (PTSD check-list)PCL score and nightmares. 

**Methods:** The Veterans who came to an appointment at the VA sleep lab to have their CPAP set up after being diagnosed with OSA by polysomnography were recruited for the study. After appropriate consent, a PTSD check list was completed and the average weekly number of nightmares in the last 30 days were recorded at this visit (PTSD n = 47, non-PTSD n = 27). The polysomnography data and presence of a diagnosis of PTSD were extracted from chart. After 6 months, the PCL score and weekly nightmare numbers were reassessed for these Veterans and CPAP compliance data were downloaded from their machine. 

**Results:** The mean PCL score (baseline = 66.3, post-CPAP = 59.33, p = 0.004) and the weekly mean number of nightmares (baseline = 5, post-CPAP = 3.19, p = 0.001) decreased significantly after 6 months of CPAP therapy in the PTSD group. In non-PTSD group, these scores did not change significantly. But when the CPAP compliance was taken into account in this group, the mean PCL score (baseline = 40.88, post-CPAP = 49.64, p = 0.004) and the weekly nightmares (baseline = 1.17, post-CPAP = 1.35, p = 0.045) actually increased among patients with poor CPAP compliance (CPAP use for < 75% of nights for >= 4 hours). 

**Conclusion:** Treating OSA with CPAP decreases PCL score and nightmares among Veterans with PTSD. Conversely, inadequate treatment resulting from poor CPAP compliance increases PCL score and nightmares among those without PTSD. This indicates that optimum CPAP compliance may prevent progression of occult PTSD symptoms and future development of overt PTSD. 

**Support (If Any):** South Central VA Network Pilot Grant
B. Clinical Sleep Science

Impact of PTG on the likelihood that individuals would experience replicative nightmares.

Results: The logistical regression model was significant X2(1, N = 54) = 7.13, p < .01, indicating that PTG did effect the likelihood of experiencing a PTSD nightmare replicative to the triggering trauma. The model as a whole explained between 13.3% (Cox & Snell R Square) and 18.8% (Nagelkerke R Square) of the variance in replicative nightmare content, and correctly classified 70.0% of cases. PTG recorded an odds ratio of 1.83, indicating respondents were 1.83% more likely to experience nightmares replicative to the original trauma as scores of PTG increase.

Conclusion: The current results suggest that higher levels of PTG actually increase the likelihood that one will experience a replicative nightmare. Our findings align with previous research that suggests dreams are a way of processing emotional stimuli, thus replicative dreams may actually be contributing to PTG. Given the novelty of these findings, future research should examine the longitudinal relationships between PTG, PTSD symptoms, and nightmare content.

0811 REM SLEEP FAVORS RETENTION OF FEAR MEMORIES IN INDIVIDUALS WITH PRIMARY INSOMNIA

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Introduction: Insomnia increases risk of anxiety disorders, which may be associated with deficient fear extinction. We examined relationships between sleep and fear/extinction memories in Primary Insomnia (PI) and good-sleepers (GS).

Methods: Ten PI (8 female, mean 37.9y) and 7 GS (5 female, 43.6y) underwent 2 weeks of home sleep monitoring then completed a 2-session fear conditioning/extinction protocol during fMRI. Sleep before both sessions was recorded using ambulatory PSG. Sessions occurred 4-8 PM, 24 h apart. Session 1: During Fear-Conditioning, a shock established skin-conductance responses (SCR) to 2 differently colored lamps (CS+). One CS+ (CS+E) but not the other (CS+U) then underwent Extinction-Learning. Session 2: all 3 CSs were presented during Extinction-Recall. Because extinction memory opposes fear memory, higher SCR to initial presentations of CS+E at Extinction-Recall indicates poorer extinction memory. Higher SCR to initial presentations of CS-U at Extinction-Recall indicates greater recovery of unopposed fear memory.

Results: PI vs. GS showed higher scores on the Pittsburgh Sleep Quality Index (p < .0000), Insomnia Severity Index (p < .0000), and Epworth Sleepiness Scale (p = .018). PI showed greater diary sleep latency (p = .00009) and wake-after-sleep-onset (p = .001), and lower sleep efficiency (p = .00001) and total sleep time (p = .028). On the night between sessions, among PI, SCR to both CS+E and CS+U varied positively with REM% (r = 0.698, p = 0.025 and r = 0.630, p = 0.051 respectively) and minutes of REM (r = 0.863, p = 0.001 and r = 0.776, p = 0.008). SCR to both CS+E and CS+U varied negatively with REM latency (r = -0.636, p = 0.048 and r = -0.639, p = 0.047). No such relationships appeared in GS. Spectral analysis of F4 EEG across all subjects showed that increased theta power in REM predicted higher SCR to CS+E (r = 0.567, p = 0.021) and marginally greater SCR to CS+U (r = 0.431, p = 0.09).

Conclusion: In PI but not GS, greater amounts and more rapid entry into REM favors retention of fear memories both when opposed by extinction memory (for CS+E) and when unopposed (CS+U).

Support (If Any): R21MH101567

0812 INTERRELATIONSHIP BETWEEN ALERTNESS AND ANXIETY

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Introduction: It is often presumed that anxious individuals are alert and hypervigilant. However, given the dearth of measures of alertness, this has never been formally tested. The objective of this study was to evaluate subjective alertness in anxious and non-anxious individuals.

Methods: An online survey identified 404 individuals with high anxiety using the Hospital Anxiety and Depression Scale in three countries (UK, US, Canada). The mean Toronto Hospital Alertness Test (THAT) score of the anxious sample was compared to the mean THAT score of a sample of 202 individuals without clinically significant anxiety. The optimal score discriminating between anxious and non-anxious individuals was determined from a ROC curve.

Results: There was a significant difference between the mean score of the anxious and non-anxious individuals (M = 20.6 versus M = 39.7). There was minimal, non-significant difference in the mean scores across countries. The ROC curve showed that the THAT discriminated between anxious and non-anxious individuals at the score of 30 with 88.5% sensitivity and 89.3% specificity.

Conclusion: The THAT test may be a useful, single tool for evaluating aspects of alertness, including low energy, poor concentration, and decreased ability to focus in patients with anxiety. The THAT could discriminate between individuals with and without anxiety; therefore it may be a useful tool in clinical and research situations when there is some uncertainty concerning the veracity of a subjective complaint of anxiety.

0813 EFFECTS OF POST-EXPOSURE NAPS, HOME SLEEP QUALITY AND CHRONOTYPE ON TREATMENT OUTCOME IN EXPOSURE THERAPY FOR SOCIAL ANXIETY: PRELIMINARY FINDINGS

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Introduction: Sleep enhances consolidation and generalization of memory for fear extinction—the basis of exposure therapy. We examined effects of post-exposure naps, sleep quality and chronotype on exposure treatment for social anxiety.

Methods: Nineteen participants aged 18-39 (12 females) with mean Liebowitz Social Anxiety Scale (LSAS) scores of 79 (84% > 60) completed a 5-session, exposure-based, group therapy for social anxiety. One week before Session 1 and after Session 5, participants underwent physiologically monitored Trier Social Stress Tests (mTSSST) with skin conductance response (SCR), orbicularis blink-startle electromyography (EMG) and electrocardiography. Participants underwent two 10-min, auditory startle procedures before and after meeting a 2-person “audience” for whom they prepared an 8-min speech during the second startle procedure. Therapy sessions 3 and 4 concluded with a speech exposure and then either completion of a 120-min, polysomnographically-monitored nap opportunity (Nap, 10 Ss) or viewing of a
non-arousing video (Wake, 9 Ss). Sleep during the 7-week study period was monitored with actigraphy and diaries. Self-report assessments were completed before each mpTSST.

Results: The Nap group showed greater Pre-Post therapy improvement on the Social Cost Questionnaire (p = .034). During the mpTSST, the Nap group showed greater Pre-Post change in subjective units of distress at the conclusion of the final recovery phase (p = .046) and for startle SCR during speech preparation (p = .01). No Pre-Post changes for the Wake group significantly exceeded the Nap group. Median split of LSAS Pre-Post change showed that high improvers had higher diary-assessed sleep efficiency (p = .024) and lower sleep latency (p = .044). High improvers showed significantly greater morningness on the Morningness-Eveningness questionnaire (p = .01) and, although not significant, their sleep midpoint compared to low improvers showed moderate effect size (d = .66 actiwatch, .59 diary).

Conclusion: Post-exposure naps, better subjective sleep and greater morningness show preliminary indication of better treatment outcome. A larger sample is required to confirm these early findings.

Support (If Any): R21MH103484

0814
REM SLEEP AND STRESSFUL LIFE EVENT INTERACTIONS DIFFER FOR YOUTH WITH GAD AND HEALTHY CONTROLS
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Introduction: Decreased latency to rapid eye movement (REM) sleep and increased REM sleep duration are robust biological markers of depression and depression risk. The presence of REM-based risk in youth with affective disorders that commonly precede depression such as generalized anxiety disorder (GAD) has received little attention in comparison. Whether life stress might amplify such risk is also unknown. The current study examined REM sleep patterns and associated life stress in both healthy and non-depressed children with primary GAD.

Methods: Participants included children between the ages of 6-11 years (M age = 8.78, SD age = 1.36; 56% female). Both healthy children (n = 37) and children at risk for depression (i.e., with early-onset GAD; n = 29) completed structured diagnostic interviews and reported recent life events and depressive symptoms. Children also completed one night of standard polysomnography (PSG) scoring using AASM pediatric criteria.

Results: Among children at risk for depression, increased negative life events (beta = -.395, p = .045) and increased REM% (beta = .459, p = .013) predicted greater levels of depressive symptoms, but this relationship did not differ for those with high or low levels of life stress. In healthy children, a significant interaction (beta = -.363, p = .037) indicated greater REM% was related to fewer depressive symptoms for youth experiencing high life stress (slope = -3.227, p = .003), but was unrelated in those with low levels of life stress (slope = .06, p = .953).

Conclusion: Results suggest that increased REM% is related to higher levels of depressive symptoms in youth with primary GAD regardless of current life stress. However, in healthy youth increased REM% may be protective against depressive symptoms in the context of greater life stress. Implications and future directions will be discussed.

Support (If Any): This work was supported by NIMH grant #K23MH081188 awarded to the last author.

0815
SLEEP-ISOLATED TRICHOTILLOMANIA: A SURVEY-BASED CHARACTERIZATION
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Introduction: Sleep-isolated trichotillomania is a form of trichotillomania that occurs only in sleep and may account for unexplained hair loss in some patients. Little has been published to characterize it. Our objective was to characterize sleep-isolated trichotillomania through the use of an online survey.

Methods: A ten-question survey was published online and responses were collected anonymously from September 2010 until July 2014.

Results: A total of 90 individuals self-reporting sleep-isolated trichotillomania completed the survey: 16 males (17.8%) and 74 females (82.2%). The mean age of onset was 20 years (range: 8 months-52 years, SD 11.3, n = 85). Eighty-one subjects pulled hair from their heads (90.0%) and most subjects had not tried any treatments (n = 68, 75.6%). Eighty-two subjects (91.1%) reported that sleep-isolated trichotillomania had some impact on their life.

Conclusion: Among respondents, sleep-isolated trichotillomania most commonly affects the scalp and often has significant life impact. Almost none reported effective treatment. As this may represent a treatable sleep disorder, clinical recognition and further characterization of sleep-isolated trichotillomania may improve outcomes of patients with unexplained hair loss.

0816
SLEEP QUALITY IN INDIVIDUALS WITH HAIR PULLING DISORDER, SKIN PICKING DISORDER, AND HEALTHY CONTROLS
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Introduction: Hair Pulling Disorder and Skin Picking Disorder are characterized by repetitive pulling out of one’s hair resulting in hair loss, and picking of one’s skin resulting in skin damage. Research on sleep quality in body-focused repetitive behaviors is limited. Therefore, the objective is to assess differences in sleep quality between individuals with Hair Pulling Disorder, Skin Picking Disorder, and healthy controls.

Methods: Participants were respondents to internet surveys on sleep in adults (M = 34.80; SD = 12.97) with hair pulling (N = 371; 96.56% female), skin picking (N = 304; 95.65% female), and healthy controls (N = 148; 99.30% female). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI).

Results: Analyses were performed for participants meeting diagnostic criteria for HPD (N = 260) and SPD (N = 182). Significant age differences were found between groups (F(2,579) = 16.00, p < .001), such that the HPD group was significantly younger (M = 31.60, SD = 12.23) than control (M = 38.61, SD = 12.29) and SPD groups (M = 36.20, SD = 13.49). Univariate ANCOVA, controlling for age, was performed to assess between-group differences in PSQI Total. Results showed significant group differences (F(2,484) = 10.00, p < .001), with controls endorsing significantly lower sleep disturbance than HPD and SPD groups, and no differences found between affected groups. Multivariate ANCOVA, controlling for age, was used to explore specific aspects of sleep disturbance (PSQI subscale scores). Significant group differences were found for sleep disturbance (p = .04), needing medications to sleep (p < .001), daytime dysfunction due to sleepiness (p < .001), and a trend towards sleep quality (p = .08). Specifically, there were low-
er subscale scores found in controls relative to HPD and SPD groups, and no differences found between HPD and SPD groups. Potential effects of anxiety and depression on outcomes will be explored.

Conclusion: Findings suggest sleep quality is reduced in those with hair pulling and skin picking symptoms relative to controls. Findings have implications for treatment, as increased sleep disturbance may be associated with symptom exacerbation.

0817
EVALUATION OF SLEEP DISRUPTION IN ADULTS WITH NEURODEVELOPMENTAL DISORDERS
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Introduction: Autism Spectrum Disorders (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) are often associated with sleep problems. However, there is limited understanding of sleep pathology in these conditions, especially in adults.

Methods: The Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI) were used to assess sleep patterns in 164 (111 male, 53 female) adult patients attending ASD and ADHD specialist diagnostic services at the Maudsley Hospital, London, UK. Of these, 30 had a diagnosis of ASD (ICD10), 98 had a diagnosis of ADHD (DSM-V), and 34 received a dual diagnosis of ASD and ADHD. Self-reported symptoms of ASD, ADHD, depression and anxiety were rated using the Autism-spectrum Quotient (AQ), Barkley’s scale, and the Hospital Anxiety and Depression Scale (HADS), respectively.

Results: Overall, 91% of participants had “poor” sleep on the PSQI (total score 5+) and 44% had either “moderate” or “severe” insomnia on the ISI (score 15+) regardless of their diagnosis ASD and/or ADHD (group comparison t-tests, all p > 0.23). Insomnia scores across the entire cohort correlated with the HADS Anxiety score (r = 0.477, p = 0.001) but not the Depression rating (p = 0.15). Insomnia scores also correlated with symptoms of hyperactivity (r = 0.380, p = 0.001), but not inattentive symptoms (p = 0.15). PSQI total score correlates were similar. Anxiety scores tended to be higher in those with ASD (p = 0.055); whereas Barkley hyperactivity scores were significantly higher in those with ADHD (t-test, p = 0.009).

Conclusion: This preliminary study indicates a similar high burden of sleep disturbances in adults with ADHD and ASD. However the origins may well be different in each condition, and this could have important implications for management. Further work to characterize the causes of, and possible interventions for, sleep disorders in adults with neurodevelopmental conditions is therefore underway.

0818
SLEEP EEG CHARACTERISTICS IN PATIENTS WITH SCHIZOPHRENIA
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Introduction: This study aimed to assess the sleep EEG characteristics in patients with schizophrenia compared to normal comparisons via quantitative spectral power analyses.

Methods: Sleep EEG in bilateral frontal, central, occipital regions were recorded in schizophrenic patients (N = 10) and age- and sex-matched healthy control subjects (N = 11) during standard nocturnal polysomnography (Profusion PSG3, Compumedics). We analyzed spectral powers in delta (0.5-4.5Hz), theta (4.5-8Hz), alpha (8-12Hz), slow sigma (12-13.5Hz), fast sigma (13.5-15Hz), slow beta (15-20Hz), fast beta (20-32Hz) frequency bands using the qEEG-PSA program (CIRUS, Australia).

Results: The sleep onset was significantly delayed in schizophrenic patients than healthy controls (min, 39.70 ± 38.78 vs. 10.50 ± 7.78, p = 0.029). Schizophrenic patients showed significantly higher beta power than controls during N2 sleep in the left occipital region, which was more prominent in the fast beta (20-32Hz) frequency range (%: 4.02 ± 5.20 vs. 1.50 ± 0.96; 2.74 ± 4.38 vs. 0.75 ± 0.53, p = 0.043, p = 0.036 respectively). Increased theta power in schizophrenic patients than in healthy controls during N2 sleep in the left frontal region was found (%: 7.74 ± 3.72 vs. 5.16 ± 1.74, p = 0.043).

Conclusion: Schizophrenic patients showed distinctive sleep EEG characteristics from healthy controls. The authors suggest these results may reflect the pathophysiology, or medication effects in patients with schizophrenia.

0819
AGE AND SEX EFFECTS ON SLEEP ARCHITECTURE IN PATIENTS WITH PSYCHOTIC DISORDERS AND BREATHING RELATED SLEEP DISORDERS
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Introduction: Breathing related sleep disorders (BRSD) are known to be more severe in males than in females and in older compared to younger individuals. BRSD and other sleep abnormalities commonly exacerbated by aging, such as reduced N3 sleep and poorer sleep efficiency, are commonly found in people with psychotic disorders. This cross-sectional retrospective study investigated the potential additive effects of BRSD and psychotic disorders on sleep and their modulation by age and sex.

Methods: Polysomnography was conducted in 90 patients (43% females, 18-70 y.o.) diagnosed with BRSD: 45 patients with psychotic disorders (BRSD+P) and 45 age- and sex-matched ‘controls’ without any mental disorders (BRSD). All patients with psychotic disorders were using psychoactive medication, with similar rates of antipsychotics use in males (69%) and females (75%). Correlations between age and sleep variables were conducted for males and females of each diagnostic subgroup separately. Sleep variables were submitted to three-way ANOVAs: age (< / ≥ 40y.o.), sex and diagnostic group (BRSD/BRSD+P).
Results: Regardless of age and sex, the BRSD+P group had higher %N2 (p = .011), lower %N3 (p = .016) and lower %REM (p = .020) than the BRSD group. Within the BRSD+P group, males tended to have lower sleep efficiency than females (p = .051), but there was no significant sex difference in the BRSD group [sex by diagnosis interaction: F(1,82) = 3.8, p = .056)]. Within the BRSD+P group, sleep duration was shorter in older compared to younger individuals (p = .005), but there was no significant age difference for the BRSD group [age by diagnosis interaction: F(1,82) = 4.1, p = .046)]. In the BRSD+P group, older age correlated with: i) shorter sleep duration (r = -.48, p = .014), poorer sleep efficiency (r = -.44, p = .026) and lower %N3 for males (r = -.57, p = .003), and ii) higher %N2 for females (r = -.50, p = .024). In the BRSD group, a weaker correlation between age and %N3 was found for males (r = -.42, p = .039) and there was no significant correlation for females.

Conclusion: These preliminary findings suggest that psychotic disorders may worsen sleep disturbances in the context of BRSD. Furthermore, the effects of age and sex on sleep seem to be more pronounced in individuals with psychotic disorders than in those with BRSD alone. While this should be confirmed by longitudinal studies, psychotic disorders may complicate the evolution of sleep disturbances linked to BRSD across aging, especially in males. Future studies should decipher the contribution of antipsychotic medication and weight gain on these complex interactions.

0820

ADDRESSING INSOMNIA IN INDIVIDUALS WITH SERIOUS MENTAL ILLNESS

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Introduction: Insomnia is highly prevalent and significantly impacts functioning of people with serious mental illness (SMI), yet few with SMI receive evidence-based non-pharmacological insomnia treatments. There is a lack of knowledge about implementation of these interventions with this group. Using a mixed-methods approach, this study examined the sleep treatment needs of Veterans with SMI and how to best implement evidence-based treatments for insomnia in this underserved population.

Methods: Participants were Veterans with SMI (n = 60) who reported sleep dissatisfaction. Medical records were reviewed to determine rates of screening/assessment and treatments for insomnia. Participants completed the Sleep Disturbance Questionnaire, Dysfunctional Beliefs and Attitudes about Sleep, and Sleep Hygiene Inventory. Multiple regression was used to predict insomnia severity assessed with the Insomnia Severity Index from these factors. Qualitative interviews explored patient treatment experiences and preferences.

Results: Most participants (81.66%) reported moderate to severe insomnia, with over 76% taking medication for sleep at least once per week. Per medical records, 5% received evidence-based behavioral sleep treatment, and less than 1% were diagnosed with insomnia. Multivariate analyses revealed a significant proportion of variance explained in insomnia severity scores, R² = .31, F(6,53) = 4.00, with worry and helplessness about sleep, \( b = 5.45, t(53) = 2.47, p < .05 \), and higher arousal \( b = 1.89, t(53) = 2.55, p < .05 \) predicting greater insomnia severity. Some Veterans perceived providers as helpful despite a consistent lack of treatment efficacy; others were reluctant to seek treatment because they were unaware of evidence-based behavioral interventions and therefore felt responsible for improving their sleep on their own.

Conclusion: Veterans with SMI present with symptoms that would be well-addressed by existing evidence-based interventions, yet few were receiving and most were unaware of these treatments. Despite this, Veterans expressed a strong desire to find solutions for sleep difficulties. An evidence-based intervention, such as CBT-I, can capitalize on this motivation and provide a treatment option likely to create lasting change.

Support (If Any): This research was supported by a U.S. Department of Veterans Affairs Health Services Research and Development (HSR&D) Mental Health Quality Enhancement Research Initiative (MH QUERI) Locally Initiated Project (LIP) (QLP 55-016) and the Department of Veterans Affairs Office of Academic Affiliations Advanced Fellowship Program in Mental Illness Research and Treatment. It is the result of work supported with resources and the use of facilities at the VA Capitol Health Care Network (VISN 5) MIRECC.

0821

A PROSPECTIVE DAILY DIARY EXAMINATION OF SLEEP AND PSYCHOTIC-LIKE EXPERIENCES: A COMPARATIVE INVESTIGATION OF GOOD AND POOR SLEEPERS

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Introduction: Individuals at risk for psychosis can present with sleep and circadian rhythm disturbance (SCRD). This study aims to investigate which parameters of sleep confer the greatest increase in risk of experiencing psychotic-like experiences (PLEs).

Methods: 47 students took part in a three-week in-depth sleep and circadian phenotyping study. Sleep quality was measured subjectively with the Pittsburgh Sleep Quality Index (PSQI) and objectively with the CamNtech actigraph to assess rest-activity pattern. Trait sub-clinical PLEs were assessed using the Prodromal Questionnaire-16. Participants were given daily questionnaires of paranoia and dissociation to assess ‘state’ PLEs. A multivariate Poisson regression model was fit to the data to assess the relation between sleep and PLEs.

Results: From the 47 subjects (24 good sleepers, 23 poor sleepers as rated by the PSQI), a Mann-Whitney test indicated PLEs were more common in poor sleepers (Median = 3) compared to good sleepers (Median = 1), (W = 64, p < 0.001). The model of best fit included main effects of PSQI and total sleep time (TST), plus the interaction between PSQI and TST. This model suggests that subjective poor sleep quality with objective shorter sleep puts an individual at the highest risk of experiencing PLEs. Generalised estimating-equation models were fit to the daily ‘state’ data. Higher wake after sleep onset (OR = 2.10; p = 0.003) and lower TST (OR = 0.69; p = 0.006) both increase the probability of a dissociative experience the following day.

Conclusion: Interestingly, the study indicates a disassociation between retrospective self-report (PSQI) and daily state measures of sleep. While an interaction between objective and subjective sleep was found to be predictive of trait PLEs, daily fluctuations in PLEs were found to only be associated with objective measures of sleep. This highlights the need for objective and subjective sleep parameters as well as high-resolution sampling when investigating sleep’s role in psychotic-like experiences.

Support (If Any): The study is supported by both the Medical Research Council (studentship to JC) and a Wellcome Trust Strategic Award (098461/Z/12/Z) to the Oxford Sleep and Circadian Neuroscience Institute (SCNi).
B. Clinical Sleep Science

0822
RELATIVE DISTRIBUTION OF SLEEP DISORDERS SUBTYPES IN PATIENTS WITH A HISTORY OF PSYCHIATRIC DISORDERS REFERRED TO A SLEEP CLINIC: PRELIMINARY FINDINGS

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Introduction: Most mental disorders are linked to sleep disturbances. While the specificity of sleep complaints and sleep architecture abnormalities across subtypes of mental disorders has been questioned, little is known about the relative prevalence of formal diagnoses of sleep disorders across mental disorders. The present retrospective study compared the distribution of clinician-based diagnoses for common sleep disorders in patients with a history of anxiety, depression, bipolar or psychotic disorders who were referred to a specialized sleep clinic.

Methods: Diagnostic information was collated for 625 patients with a history of mental disorders. Psychiatric diagnoses were retrieved from medical charts and included: anxiety disorders (n = 76, 37% females, X(SD) = 42.4(16.1)), depressive disorders (e.g. MDD, dysthymia; n = 439, 40% females, X(SD) = 42.7(17.4)), bipolar disorders (n = 64, 68% females, X(SD) = 45.8(14.6)) and psychotic disorders (n = 53, 45% females, X(SD) = 42.3(13.9)). Sleep diagnoses were established by sleep psychiatrists based on level 1 polysomnography studies. The proportions of individuals diagnosed with breathing related sleep disorders (BRSD), sleep related movement disorders (SRMD), and narcolepsy/hypersomnia were compared across the four mental disorders subgroups.

Results: There was no significant difference in the proportions of patients diagnosed with BRSD, SRMD and narcolepsy/hypersomnia across the four mental disorders subgroups. Formal diagnoses of BRSD were given to 80-83% of patients with anxiety, depression or bipolar disorders and to 68% of those with psychotic disorders (Chi2 = 5.1, p = .161). The rate of SRMD was a slight, but non-significantly higher in patients with psychiatric disorders (Chi2 = 6.0, p = .14). The rate of SRMD in patients with psychiatric disorders (11%) was in those with anxiety (5%), depression (4%) or bipolar disorder (5%). Narcolepsy/hypersomnia were diagnosed in 2% of patients with depression and in 2% of those with psychotic disorders (Chi2 = 7.4, p = .048).

Conclusion: According to these preliminary results, the overall prevalence of different sleep disorders in patients referred for sleep assessment seems fairly similar across individuals with a history of anxiety, depression, bipolar or psychotic disorders. For all mental disorders, BRSD were the most frequent sleep disorders, followed by SRMD. Slightly elevated rates of SRMD were found in psychotic disorders, a phenomenon which may be linked to the use of dopamine antagonists. Further investigations should determine how medication intake, multiple comorbidities, and current psychiatric symptoms severity relate to the presence of formal sleep disorders.

Support (If Any): RR is supported by a postdoctoral fellowship from the Fonds de recherche du Québec - Santé (FRQS).

0823
SLEEP AND CIRCADIAN RHYTHM AND THE RISK OF SEVERE MENTAL DISORDER: FINDINGS FROM LARGE EPIDEMIOLOGICAL DATASETS

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Introduction: Sleep disturbance is very common in those with established severe mental disorders, such as a schizophrenia or bipolar disorder. However ‘sleep disturbance’ is an umbrella term which captures many different disorders. The objective of the current work was to test for associations between specific sleep disturbances and symptoms of severe mental disorders.

Methods: Data from large epidemiological datasets will be presented. Study One investigated the association between both sub-types of sleep disturbance (specifically, insomnia and nightmares) and features of sleep timing (chronotype and social jet lag) and risk for severe mental disorders. Risk group (high, medium or low) was determined from cluster analysis of subsyndromal symptoms (N = 1403). Study Two investigated the cross sectional and longitudinal association between insomnia and hallucinations using nationally representative datasets (N = 8850, N = 7403).

Results: In Study One it was found that insomnia and nightmares increased in a dose response manner with risk for severe mental disorder. Insomnia and nightmares were associated with all individual symptoms, including paranoia, hallucinations, (hypo)mania, depression, and anxiety. Chronotype was associated with depression and (hypo) mania only. In Study Two it was found that chronic insomnia was associated with four times greater odds of reporting hallucinations. Insomnia also increased the odds of reporting hallucinations 18 months later, even controlling for affective symptoms and paranoia.

Conclusion: The studies provide evidence indicating that specific sleep and circadian rhythm disorder symptoms are associated with risk for severe mental disorder. In addition, insomnia specifically may be a risk factor for later hallucinations. The clear next step is to treat the sleep disturbance and assess the impact on the development of individual symptoms. This work is already underway.

Support (If Any): BS, KP, GMG, AT, CAE, PJH, RF, KW & DF receive research support from a Wellcome Trust Strategic Award (098461/Z/12/Z) to the Oxford Sleep and Circadian Neuroscience Institute (SCNI).

0824
COMBINED HYPNOTIC AND ANTIDEPRESSANT TREATMENT: POTENTIAL MODERATOR OF CHANGE IN PERINATAL DEPRESSION SEVERITY OVER TIME

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Introduction: Sleep disturbance during the perinatal period has been shown to increase risk of depression. Few studies have examined the role of hypnotics on perinatal depression symptoms. We investigated whether or not there was a unique effect of hypnotic treatment on the course of perinatal depression severity in women with and without major depressive disorder. We hypothesized that depression severity would decrease over time significantly more in women taking both an antidepressant and a hypnotic compared with taking an antidepressant alone.
B. Clinical Sleep Science

**Methods:** 235 perinatal women (average age 27.98 [SD = 5.85]; 32.1% minority; 96 [41%] with major depressive disorder; 16 [6.6%] taking hypnotic medication; 76 [32%] taking antidepressant medication) participated in the study throughout pregnancy and the first 6 postpartum months. The Inventory for Depressive Symptomatology (IDSC) was used to assess the outcome variable of depression severity during each time point. Pittsburgh Sleep Quality Index was used to assess sleep disturbance, which was used as a covariate in the GLM.

**Results:** GLM revealed a significant DEPRESSION (MDD yes/no) by MEDICATION (no med, antidepressant only, or both antidepressant and hypnotic) by TIME interaction: Wald Chi Square = 18.22 (6), p = .006. There was one significant first order interaction: DEP*TIME among non-medicated women, Wald Chi Square = 12.7 (3), p = .005. Nonsignificant trends included 1) greatest IDSC mean difference from trimester 2 to trimester 3 occurring in the non-depressed group treated with both antidepressant and hypnotic medication: 10.72 to 3.72 and 2) mean changes in the opposite directions from trimester 3 to postpartum month 1 for the depressed versus nondepressed women using both antidepressants and hypnotic. Whereas these nondepressed women’s depression severity increased (3.72 to 17.68), their depressed counterparts’ depression severity decreased (27.67 to 18.52). Both groups experienced an increase in depression severity from 1 to 6 months postpartum.

**Conclusion:** These results point to further investigation of whether or not perinatal hypnotic treatment could enhance antidepressant treatment effectiveness.

**Support (If Any):** NIH R01MH078033 (PI: Amy Salisbury, PhD).

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**0825**

**RELATIONSHIP BETWEEN INSOMNIA AND DEPRESSION MODERATED BY CAFFEINE**

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**Introduction:** Insomnia is a risk factor and may also exist comorbid with depressive disorder. Previous studies have also shown that caffeine may mitigate some daytime effects of sleep loss and may also elevate mood. The present study explores whether the relationship between insomnia and depression is moderated by caffeine intake.

**Methods:** Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used. SHADES is a community-based study of adults in southeastern Pennsylvania (N = 1007). Depression was assessed as total score on the Patient Health Questionnaire-9 (PHQ), a validated screening tool. Insomnia was assessed with the Insomnia Severity Index and categorized as None (≤ 7; N = 350), Mild (8-14; N = 389), or Moderate-Severe (≥ 15; N = 268). Regular caffeine consumption was self-reported (yes [N = 839] or no [N = 168]). Logistic regression analyses adjusted for age, sex, education, race/ethnicity, body mass index, Fatigue Severity Scale score, Epworth Sleepiness Scale score, and Perceived Stress Scale score.

**Results:** After adjusting for demographics, depression was associated with both mild insomnia (OR = 4.19, p < 0.0005) as well as moderate-severe insomnia (OR = 9.45, p < 0.0005). After adjusting for covariates, sleepiness, fatigue, and stress, depression was still related to both mild (OR = 1.66, p < 0.0005) and moderate-severe (OR = 4.75, p < 0.0005) insomnia. A significant insomnia-by-caffeine interaction was seen (p < 0.0005). Among caffeine non-users, mild (OR = 1.98, p = 0.023) and moderate-severe (OR = 7.25, p < 0.0005) insomnia were associated with depression. Among caffeine users, these relationships were dampened somewhat, for mild (OR = 1.60, p < 0.0005) and especially moderate-severe (OR = 4.40, p < 0.0005) insomnia. Significance testing for the differences between these ORs is underway.

**Conclusion:** The relationship between insomnia and depression was weaker among caffeine users. The role of caffeine in mitigating daytime effects of insomnia should be explored further.

**Support (If Any):** The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216.
0827
MATERNAL SLEEP QUALITY AND EMOTIONAL STATUS DURING PREGNANCY
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Introduction: Women's sleep quality and their emotional status have been well studied. However, such relationship has been under explored during different stages of pregnancy. The objective of this study is to examine whether sleep disturbance during the third trimester of pregnancy is associated with depression/anxiety and whether sleep disturbance in the second trimester of pregnancy predicts depression/anxiety during the third trimester. We also aim to identify which trimester has worse sleep problems.

Methods: Participants included 197 pregnant women aged 26.69 (SD = 3.56) years. Sleep problems were assessed during the second and third trimester by the Pittsburgh Sleep Quality Index (PSQI). Depression/anxiety symptoms were measured by the Beck Depression Inventory (BDI) and Beck Anxiety Inventory (BAI) during the third trimester only. PSQI contains 10 items whereas both BDI and BAI contain 21 items, all of which having higher the total score, indicating more problems. Linear regression model were used to test the association between sleep quality and depression/anxiety symptoms, while controlling for sociodemographic variables.

Results: Results showed that women have worse sleep quality at the third trimester than those at the second trimester (t = -7.145, P < 0.001). Linear regression analysis showed that at the third trimester women with more sleep disturbance had increased anxiety (B = 0.307, P < 0.001) and a marginally increased depression (B = 0.150, P = 0.077). Moreover, women with more sleep disturbance during the second trimester had more depression/anxiety at the third trimester (P < 0.01). As hypnotized, sleep disturbance in the second trimester of pregnancy predicts women's depression/anxiety at the third trimester (P < 0.001) and women with short sleep duration had more anxiety (B = 0.151, P < 0.05).

Conclusion: Sleep disturbance during pregnancy affects anxiety/depression. Better sleep quality during pregnancy may help women's emotional status.

Support (If Any): Support for this research was provided by NIH/NIH R01-ES018858 and K02ES019878

0828
NIGHTMARES IN A COMMUNITY SAMPLE: PREVALENCE AND ASSOCIATIONS WITH DAYTIME FUNCTION INDEPENDENT OF POOR SLEEP QUALITY AND DEPRESSION
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Introduction: Frequent nightmares have been associated with stress, poor sleep quality, anxiety, and suicide risk. Yet, few epidemiological studies on nightmares have been performed in community samples. Further, it is unclear the degree to which the effects of nightmares is mediated by sleep disturbance and mood.

Methods: Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used. SHADES is a community-based study of adults in southeastern Pennsylvania (N = 1007). Nightmares were assessed with, “I have nightmares” with options of “Never,” “Seldom (once/year),” “Sometimes (once/month),” “Often (once/week),” or “Frequently (more than 3 times/week).” Linear regression examined multinomial nightmare frequency (ref = Never) with total scores on the Perceived Stress Scale (PSS), Fatigue Severity Scale (FSS), and Well-Being Assessment of Productivity (WBA-P), adjusted for age, sex, education, race/ethnicity, and overall health. Additional models included Pittsburgh Sleep Quality Index (PSQI) global score alone and with Patient Health Questionnaire (PHQ) depression score.

Results: Prevalence of nightmares was Never: 14.8%, Seldom: 28.0%, Sometimes: 36.1%, Often: 12.9%, and Frequently: 8.2%. After adjusting for covariates, compared to “Never,” “Sometimes” was associated with PSS (B = 2.35, p = 0.002) and WBA-P (B = 1.30, p = 0.001) scores, “Often” was associated with PSS (B = 3.35, p < 0.0005), FSS (B = 4.93, p < 0.0005), and WBA-P (B = 2.30, p < 0.0005) score (indicating worse productivity), and “Frequently” was associated with PSS (B = 6.60, P < 0.0005), FSS (B = 7.23, p < 0.0005), and WBA-P (B = 2.72, p < 0.0005) score. When PSQI was added to the model, effects were attenuated by remained significant. When WHQ was added also, associations only remained for WBA-P.

Conclusion: Nighttime frequency was associated with stress, fatigue, and work productivity. Effects on productivity persisted even after adjusting for poor sleep quality and depression.

Support (If Any): The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216.

0829
POSITIVE AND NEGATIVE MOOD RATINGS ACROSS 24-HOURS
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Introduction: Recently, it was shown that completed suicide occurs disproportionately at night (during the traditional sleep period). A possible implication of this is that simply being awake at night may confer risk. One way to further explore this possibility is to examine whether mood systematically varies across the 24-hour day.

Methods: Data from N = 493,758 unique Luminosity users was available. As part of the app's basic functionality, all participants rated their mood when they logged in. Hour of assessment was recorded. Mood was rated along a 5-point analog scale. Mean scores, as well as percent positive (4-5) or negative (0-1) were evaluated by hour. To determine whether an overall pattern exists, ANOVA was performed on mean score and chi-square tests were performed on percentage scores. Time of day was then binned in 4-hour increments (0:00-3:59, 4:00-7:59, 8:00-11:59, 12:00-15:59, 16:00-19:59, and 20:00-23:59) and similarly evaluated. A subsample was formed, with N = 400 in each age_x_sex_x_hour bin (N = 76,800) and all analyses were repeated.

Results: Overall, mean mood ratings varied across the day (F = 42.98, p < 0.0001), as did the proportion of both positive and negative ratings separately (p < 0.0001). Positive mood peaked at approximately 3:00pm (50.5%) and then slowly declined until 9:00am (43.3%), at which point it began rising again. The pattern for negative mood was similar, with a trough at 2:00pm (7%), slowly rising until 9:00am (11.5%) before dropping. When the 24h period was divided into 6 periods, there was a significant difference among them (p < 0.0001), with all pairwise differences significant (p < 0.0001), except 12:00-15:00 and 16:00-19:00. This pattern did not change in the subsample balanced for age and sex.

Conclusion: The present analysis suggests that negative affect is high and positive affect is low at night. Being awake at night may serve to exacerbate negative mood. Future research should also examine the role of decision making during this time as well.
**Support (If Any):** Dr. Grandner is supported by K23HL110216. Dr. Perls is supported by R01AG041783. Lumosity provided the raw data for use in these analyses.

**0830 RED LIGHT AND TIME MANAGEMENT: A PILOT SLEEP STRATEGY TO AUGMENT DEPRESSION TREATMENT IN ADOLESCENTS**

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**Introduction:** Depression during the adolescent years is common with 20% of adolescents experiencing a depressive episode by 18 years of age. Circadian and psychosocial factors can promote a preference to stay up later. These changes limit the developmentally appropriate total hours of sleep. Sleep deprivation has been shown to exacerbate depression. This study sought to evaluate the effectiveness of a time management program plus nightly evening exposure to light in the orange-red spectrum (above 600 nanometers) on mood, fatigue, and suicidality.

**Methods:** Depressed teens (scoring > 33 on the CDRS) were randomized to waitlist control (WLC) for 1 week or an immediate start. Participants met with a psychologist and received psychoeducation about sleep requirements, biological rhythms, and the impact of light on rhythms. They received a personalized time management program to prioritize sleep. They received red goggles and a prescribed sleep schedule. Participants completed Quick Inventory of Depressive Symptomatology (QIDS), Suicide Inventory Questionnaire (SIQ), and Multidimensional Fatigue Inventory (MFI) at baseline, after 2 weeks (Posttx), and at a 3 month follow up. Sleep diaries were collected during WLC.

**Results:** 25 participants (6 Males; 13 WLC) ages 14-19 years of age (M = 16.5, SD = 1.4) were studied. Paired t-tests of survey scores revealed improvements in QIDS from baseline to post treatment (p < .001) and to 3 month follow up (p = .017). MFI decreased from baseline to post treatment (p = .035) and to follow up (p = .006). SIQ decreased from baseline to post treatment (p = .031) and to follow up (p = .012). Neither sleep schedules nor total sleep differed from baseline (23:52-8:22; 7hr 46 m) to post treatment (23:25-8:32; 7 hrs 47 m) to 3 month FU (23:34-6:50; 7 hrs 36 m) compared to WLC (23:42-8:14; 7 hrs 36m).

**Conclusion:** Limiting evening light in the blue spectrum and prioritizing sufficient sleep in depressed adolescents was associated with improvements in mood, fatigue, and a reduction of suicidality over time. Larger trials focused on these interventions are needed in depressed adolescents.

**Support (If Any):** Jack and Barbara Berman Foundation.

**0831 SLEEP DURATION’S IMPORTANT ROLE IN THE RELATIONSHIP AMONG DIFFICULTY CONCENTRATING, FATIGUE, STRESS, AND DEPRESSED MOOD: DATA FROM THE SHADES STUDY**

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**Introduction:** Poor sleep is linked to neurocognitive deficits, including attention and memory. The degree to which fatigue, stress, and mood play a role is not yet clear.

**Methods:** Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used. SHADES is a community-based study of adults (N = 1007). Daytime cognitive impairment was assessed by, “Over the last 2 weeks, how often have you been bothered by trouble concentrating on things, such as reading the newspaper.” Responses were dichotomized as Yes (at least “Several days”) or No. Sleep duration, assessed using the NHANES question (typical weekday/weekday), was categorized as very short (≤ 4h), short (5-6h), normal (7-8h), or long (≥ 9h). Potential moderators included fatigue (Fatigue Severity Scale), stress (Perceived Stress Scale), and depressed mood (“Feeling down, depressed, or hopeless” at least “Several days” in the past 2 weeks). Covariates included age, sex, race/ethnicity, and education.

**Results:** Difficulty concentrating was associated with very short (OR = 2.9, p < 0.0005) and short (OR = 2.1, p < 0.0005) sleep, as well as stress (OR = 1.1/point, p < 0.0005), fatigue (OR = 1.1/point, p < 0.0005), and depressed mood (OR = 4.9, p < 0.0005) in separate models. In combined models, effects were attenuated but still significant for short sleep, fatigue, stress, and depression. Interaction terms for short duration by fatigue, stress, and mood were also significant. The relationship between fatigue and difficulty concentrating became weaker with shorter sleep duration, though there was a significant relationship among all sleep groups (p < 0.05). Similarly, the relationship between stress and difficulty concentrating was attenuated in the shorter groups, with no significant relationship among very short sleepers. Depressed individuals had difficulty concentrating regardless of sleep duration, whereas in non-depressed individuals, very short and short sleep were associated with difficulty concentrating.

**Conclusion:** Shorter sleep duration, fatigue, stress and depression are associated with daytime cognitive difficulties. However, among short sleepers, effects of fatigue and stress are attenuated, perhaps due to stronger effects of insufficient sleep.

**Support (If Any):** The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216.
SLOW WAVE ACTIVITY IN OBSTRUCTIVE SLEEP APNEA AND DEPRESSION

**Introduction:** Depression and obstructive sleep apnea (OSA) are highly comorbid disorders, with shared symptomology, posing diagnostic challenges. For each disorder individually, studies examining sleep architecture have observed reduced slow wave electroencephalography (EEG) activity and decreased percentage of slow wave sleep (SWS) in patients. The current study aimed to compare slow wave EEG activity (SWA) between OSA patients and healthy sleepers, and OSA patients with high and low depressive symptoms to identify potential diagnostic biomarkers.

**Methods:** Seventy-five participants underwent polysomnography and completed the Hospital Anxiety and Depression Scale (HADS) to indicate severity of depression. Power spectral analysis was used to quantify the SWA (0.5-4.5 Hz) of frontal EEG (F4/M1) from overnight polysomnography recordings.

**Results:** Participants with OSA (AHI ≥ 10; n = 63) had significantly lower SWA during SWS (M = 564.94, SD = 337.96) than healthy controls (n = 12; M = 950.92, SD = 326.83; p < .001), and significantly increased SWA% (M = 30.59, SD = 14.09) compared to controls (M = 20.33, SD = 5.80; p < .001). OSA patients with high depressive symptoms (HADS-D > 11; n = 18) had an increased REM latency (M = 173.58, SD = 81.04), and greater REM% (M = 16.80, SD = 3.79), than those with OSA with low depressive symptoms (HADS-D < 8; n = 29; M = 127.36, SD = 69.83 and M = 13.17, SD = 6.89 respectively; p < .05), but did not differ on SWA during SWS. A trend was also found for a relationship between OSA severity and level of depression, where those with high depressive symptoms had more severe OSA (apnea hypopnea index M = 42.45, SD = 29.08) than those with low depressive symptoms (M = 28.75, SD = 23.99; p = .06).

**Conclusion:** Study findings reflect the presence and complexity of the OSA-depression relationship. While no apparent biomarker of SWA was observed in the current study, the novel examination of SWA in likely depressed and non-depressed individuals with OSA raises questions for further research, and highlights the importance of examining these highly comorbid conditions together.
females or males, 18 to 60 year-old, with diagnosis of major depression (DSM IV), without drug treatment, and significant comorbidities, including electroencephalographic abnormalities. All participants gave their signed informed consent and underwent a structured diagnostic interview to establish diagnosis. Sleep quality and insomnia were weekly assessed with the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI), respectively. Subjects were randomly allocated to receive fluoxetine 20 mg/day during 8 weeks or rTMS over the left dorsolateral prefrontal cortex. TMS consisted of 5 sessions/week (5 Hz, 100% motor threshold) during 3 weeks followed by 1 maintenance session/week during 5 weeks.

**Results:** Eleven patients were treated with fluoxetine and 10 with rTMS. There were no significant gender and age differences between groups. A repeated measures ANOVA showed a significant reduction of PSQI scores \( F(147.9 \ df \ 1, \ p < 0.001) \) without significant group treatment effect. ISI scores significantly decreased \( F(15.5 \ ± \ 1.9 \ to \ 6.3 \ ± \ 1.6 \ (F(127.9 \ df \ 1, \ p < 0.001)) \) with a marginal nonsignificant difference between groups \( (F \ 41.1 \ df \ 1, \ p = .057) \).

**Conclusion:** Our results suggest that rTMS produces significant improvement of sleep quality and insomnia in major depression, comparable to the one obtained with fluoxetine.

**0836**

**NEGATIVE MOOD REGULATION EXPECTANCIES AND TRAUMA SYMPTOMS FOLLOWING A RANDOMIZED CONTROLLED TRIAL OF COGNITIVE BEHAVIORAL SOCIAL RHYTHM GROUP THERAPY FOR MALE VETERANS WITH PTSD, MAJOR DEPRESSIVE DISORDER, AND SLEEP PROBLEMS**

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**Introduction:** This double-blind, RCT compared 12-weeks of group-based Cognitive Behavioral Social Rhythm Therapy (CBSRT, cognitive-behavioral therapy based on the social rhythm model of depression) to Present Centered Group Therapy (PCGT, active process therapy based on Yalom’s interpersonal learning) in male veterans with PTSD, Depression, and sleep disturbances. This trial is one of the first comparing group behavioral circadian regulation treatment to gold-standard group PTSD treatment for veterans.

**Methods:** Forty-three male veterans \( (M = 48.42, SD = 13.51) \) were randomized to CBSRT \( (n = 21) \) or PCGT \( (n = 22) \). Mixed linear modeling (MLM) examined differential change trajectories, and between and within-group effect sizes were calculated for PTSD symptoms (Clinically-Administered PTSD scale; CAPS) and mood regulation expectancies (Negative Mood Regulation Scale; NMW) across therapy and follow-up.

**Results:** Analyses revealed no significant pre-to-post group \( x \) time interaction \( (\beta = .38; \ SE = .45, \ p = .39) \); between-group effect sizes: CAPS \( d = .21 \); NMR \( d = .16 \). CBSRT exhibited moderate effect sizes \( (CAPS \ d = .46; \ NMR \ d = .43) \), while PCGT exhibited small effect sizes \( (CAPS \ d = .26; \ NMR \ d = .21) \). No significant group \( x \) time differences were observed during follow-up \( (\beta = .60; \ SE = .61, \ p = .32) \), although between-group effect sizes for NMR \( (d = .40) \) were larger than CAPS \( (d = .17) \). At follow-up, moderate within-group effect sizes emerged in the CBSRT group with a reduction in NMR \( (d = .42) \), and small effect sizes emerged for CBSRT on CAPS \( (d = .14) \) and for PCGT on both CAPS \( (d = .30) \) and NMR \( (d = .08) \).

**Conclusion:** Veterans in CBSRT had moderate improvements in trauma-related symptoms and negative mood regulation expectancies, whereas Veterans in PCGT had small improvements. Despite the lack of adequate power, the results are meaningful considering the small between- and within-group effect sizes for PCGT and Trauma Focused Group Therapy \( (d \leq .26) \) from VA Cooperative Study 420 (a large scale, multi-site trial examining group therapy in PTSD). Findings from the NMR suggest that CBSRT might be used as an alternative to PCGT, best administered immediately prior to the commencement of individual exposure therapy.

**Support (If Any):** Department of Defense (Grant #W81XWH-08-2-0121)

**0837**

**INSomnia AND DEPRESSION: RESULTS FROM QUESTIONNAIRE SURVEY IN A JAPANESE CITY**

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**Introduction:** Interaction between insomnia and depression has been reported. However, this was not well analyzed in Japanese. Questionnaire survey was conducted among employees of Koga city, Shiga, Japan. This study was conducted to analyze associations between insomnia, depression, health-related quality of life (QOL), and sleepiness.

**Methods:** Paper-based questionnaire survey was analyzed to examine associations between insomnia (insomnia severity index: ISI), QOL (the Short Form-8: SF-8), depression (Patient Health Questionnaire-9: PHQ-9) and sleepiness (Epworth Sleepiness Scale: ESS). Statistical analysis was performed using MedCalc Statistical Software version 15.11.4 (MedCalc Software bvba, Ostend, Belgium).

**Results:** 843 city employees (male 423, age 18–61) participated this survey (participation rate: 93.1%). Mean (standard deviation: SD) of ISI, physical component summary score of SF-8 (PCS), mental component summary score of SF-8 (MCS), PHQ-9 and ESS are 7.13 (7.00), 48.2 (7.15), 49.0 (7.22), 4.81 (5.27) and 8.00 (4.60), respectively. 7.2% of the participants had ISI scores of ≥ 15. Compared with subjects with ISI < 15, those with ISI ≥ 15 had higher PHQ-9 (11.6 (5.55) vs. 4.90 (4.90), p < 0.0001), higher ESS (12.1 (5.20) vs. 7.80 (4.37), p < 0.0001), lower PCS (45.2 (8.77) vs. 48.4 (6.96), p = 0.0007), and lower MCS (40.0 (8.07) vs. 48.6 (6.77), p < 0.0001), respectively.

**Conclusion:** Insomnia symptom was associated with sleepiness, depression and lower QOL in a Japanese working population. We plan to perform longitudinal studies to analyze causal relationships in this population.

**Support (If Any):** Grant-in-Aid from the Japan Society for the Promotion of Science (grant no. 26507006) and an Intramural Research Grant(26-2) for Neurological and Psychiatric Disorders from the National Center for Neurology and Psychiatry.
MOLECULAR CIRCADIAN RHYTHM SHIFT TO ARTIFICIAL BRIGHT LIGHT AT NIGHT CORRELATED WITH MOOD BIPOLARITY
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Introduction: Normal subjects with mood bipolarity phenotype, even though not diagnosed bipolar disorder, are known to show distinct properties. In this study, we investigate the changes in molecular circadian rhythm after bright light exposure before sleep in normal subjects who show bipolarity phenotype.

Methods: 25 young male subjects were divided to 14 for bipolarity group and 11 for non-bipolarity group by score of mood disorder questionnaire (MDQ). During the first two study days, the subjects were exposed to the normal-living light (150 lux measured at eye level) for 2.5 hours before sleep, and the saliva and buccal cells of subjects were collected for a total six regular times periodically. During the subsequent five days, the subjects were exposed to the bright light (1,000 lux measured at eye level), and the saliva and buccal cells were collected in the same way. The molecular circadian rhythm of cortisol and circadian gene expression ratio (Per1/Bmal1) were analyzed with cosinor regression.

Results: Circadian rhythm of cortisol showed a delay of acrophase in both groups after bright light exposure (p < 0.001), and bipolarity group showed a significant delay of acrophase than non-bipolarity group (p = 0.008). Circadian rhythm of circadian gene expression ratio showed a delay of acrophase (p < 0.001) and a decrease of amplitude (p < 0.001) after bright light exposure in both groups, but there was no group difference.

Conclusion: From the results of the study, we found a significant change of molecular circadian rhythm after bright light exposure before sleep. Especially, bipolarity group showed hypersensitivity in cortisol rhythm than non-bipolarity group after bright light exposure, but not in circadian gene expression. These results suggest that the characteristic molecular circadian rhythm change of bipolarity group may be related to the biological process after circadian gene expression.

Support (If Any): This study was supported by the Future Environmental R&D grant funded by the Korea Environmental Industry and Technology Institute (No. RE201206020).

AN AGGREGATE MEASURE OF SLEEP HEALTH AND DEPRESSION IN OLDER WOMEN
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Introduction: Sleep problems are associated with prevalent and incident depression. Sleep and sleep problems can be measured across multiple dimensions of “sleep health,” but previous studies have not examined whether multidimensional measures of sleep health are associated with depression cross-sectionally or longitudinally. We investigated whether individual and aggregate measures of sleep health are associated with prevalent depression and longitudinal depression risk among community-dwelling older women.

Methods: Participants were older women who completed Visit 6 (n = 6,908) and Visit 8 (n = 4,013), approximately 6 years apart, in the Study of Osteoporotic Fractures. We used baseline sleep self-report measures to categorize sleep health over the past 12 months as “good” (0) or “poor” (1) in five dimensions: satisfaction, sleepiness, mid-sleep time, sleep onset latency, and sleep duration. An aggregate measure of sleep health was calculated by summing the number of dimensions with poor sleep health. Depression was evaluated using the Geriatric Depression Scale (GDS), with a cut-off value of 6 for defining depression at baseline and 6 years later. Multivariate logistic regression was
used, adjusting for multiple health problems, medications, and each of the other sleep health dimensions.

**Results:** Each individual dimension of sleep health, except sleep duration, was significantly associated with depression at baseline (p < .05 for each). Each dimension of poor sleep health, except mid-sleep time and duration, was also associated with greater odds of developing depression over 6 years (p < .05 for each). The aggregate measure of sleep health showed a gradient effect: Higher levels of poor sleep health were associated with greater odds of prevalent (OR 1.62-5.42) and incident (OR 1.46-3.16) depression.

**Conclusion:** An aggregate, multidimensional measure of sleep health was significantly associated with the presence and development of depression. Further studies on the reliability and validity of the sleep health construct are warranted.

**Support (If Any):** The Study of Osteoporotic Fractures is supported by National Institutes of Health funding. The National Institute on Aging (NIA) provides support under the following grant numbers: R01 AG005407, R01 AR35582, R01 AR35583, R01 AR35584, R01 AG005394, R01 AG027574, R01 AG027576, and R01 AG026720.

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**0841 ALTERATIONS IN WAKING EEG THETA ACTIVITY IN MAJOR DEPRESSIVE DISORDER WITH COMORBID HYPERSOMNOLENCE: A HIGH-DENSITY EEG INVESTIGATION**

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**Introduction:** Increases in electroencephalographic (EEG) power in the theta band during wake are a marker of sleep need in healthy individuals undergoing sleep deprivation. Depressed patients with hypersomnia endorse high levels of daytime sleepiness, despite self-reported increased nocturnal sleep duration. However, objective evidence of daytime drowsiness or increased sleep need occurring during wake in these patients has not been demonstrated. Thus, this study utilized high-density (hd) EEG to evaluate topographic differences in waking theta activity in patients with major depressive disorder (MDD) and comorbid hypersomnia.

**Methods:** Participants were monitored with sleep logs and actigraphy for a minimum of one week prior to in-laboratory recordings. Spontaneous eyes-open waking hdEEG was collected in twenty-two unipolar MDD patients with comorbid hypersomnia and matched healthy-sleeper controls prior to and after ad libitum polysomno graphy. After removal of artifacts using independent component analysis, spectral analysis of waking hdEEG was used to compare power density between groups, within a theta band of 5-9Hz.

**Results:** Despite greater total sleep time measured by sleep logs (8.30 ± 0.7 vs. 7.60 ± 0.7 hours; p = 0.002) and actigraphy (7.63 ± 0.7 vs. 7.03 ± 0.6 hours; p = 0.005) prior to in-laboratory measurements, depressed patients with comorbid hypersomnia exhibited significantly increased localized theta activity during wake prior to sleep at frontal electrodes (in proximity to Fp1) compared to healthy controls. However, after a night of ad libitum sleep, significant differences in theta activity in this frontal region were attenuated between groups.

**Conclusion:** Patients with MDD and comorbid hypersomnia demonstrated increased frontal theta activity during wake prior to sleep onset, which diminishes after a night of ad libitum sleep. Further research is warranted to determine the mechanisms that underlie this finding and its relationship to subjective complaints of hypersomnia in mood disorders.

**Support (If Any):** This research was supported by grants from the American Sleep Medicine Foundation, the Brain and Behavior Research Foundation, and NIMH (K23MH099234).

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**0842 PERFORMANCE ON A CONTINUOUS COMPENSATORY TRACKING TASK IN MAJOR DEPRESSIVE DISORDER WITH COMORBID HYPERSOMNOLENCE**

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**Introduction:** Hypersomnia is common in major depressive disorder (MDD) and is associated with treatment resistance, symptomatic relapse, and functional impairment. Decrements in alertness on performance tasks that utilize discretely cued behaviors or stimuli have not been demonstrated in these individuals. However, continuous task paradigms may be better suited to examine impairments in vigilance in these patients. Thus, this study utilized a continuous compensatory tracking task (CTT) to assess behavioral performance in patients with MDD and comorbid hypersomnia.

**Methods:** Twenty-two consecutive unipolar, unmedicated MDD patients with comorbid hypersomnia and matched healthy sleeper controls (HC) completed a 1-hour CTT, during which participants used frequent compensatory trackball movements to maintain a randomly buffeted disc within a central target. Disc error time series of the radial distance from the disc to center target were used to calculate the root mean square (RMS) disc error in 4 second (local) and 20 second (global) windows. In addition, normalized disc error (RMS during high-error relative to low-error perigees) and response lapses (absence of input for greater than 2 seconds) were calculated for each participant. Values for all behavioral measures were compared between groups using unpaired t-tests.

**Results:** No significant differences were observed for local (MDD 23.38 ± 9.4 vs. HC 26.26 ± 17.4 pixels; p = 0.54) or global (MDD 26.88 ± 12.6 vs. HC 29.91 ± 21.5 pixels; p = 0.62) RMS disc error. Local (MDD 2.93 ± 0.9 vs. HC 2.98 ± 1.4; p = 0.96) and global (MDD 2.31 ± 0.9 vs. HC 2.37 ± 1.3; p = 1.0) normalized disc error were not significantly different between groups. Number of behavioral lapses was not different between groups (MDD 4.86 ± 10.8 vs. HC 1.62 ± 3.4 lapses; p = 0.20).

**Conclusion:** Patients with MDD and comorbid hypersomnia demonstrate similar behavioral performance compared to healthy controls on a prolonged continuous compensatory visual tracking task. Further research is warranted to determine whether the degree of brain activity required to maintain comparable task performance during the CTT differs between these groups.

**Support (If Any):** This research was supported by grants from the American Sleep Medicine Foundation, the Brain and Behavior Research Foundation, and NIMH (K23MH099234).

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**0843 UTILITY OF THE FITBIT FLEX TO EVALUATE SLEEP IN MAJOR DEPRESSIVE DISORDER: A COMPARISON AGAINST POLYSOMNOGRAPHY AND WRIST-WORN ACTIGRAPHY**

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**Introduction:** Sleep disturbance is common in Major Depressive Disorder (MDD) and impacts the longitudinal course of the illness. However, routine clinical assessment of sleep quality and duration in MDD typically relies on self-report due to limitations of standard actigraphs and polysomnography (PSG). Novel commercially available activity monitors have the potential to surmount some of the shortcomings of standard objective sleep assessments, however, their ability to accurately measure sleep has not been assessed in affective disorders. This
study evaluated the utility of the Fitbit Flex (FBF) relative to standard actigraphy and PSG in patients with MDD.

**Methods:** Sixteen unmedicated patients with unipolar MDD were recruited as part of a larger study on biomarkers of sleep disturbance in MDD. Participants underwent ad libitum in-laboratory PSG with concurrent use of wrist-worn Actiwatch 2 (AW-2; Phillips Respironics) and FBF. Bland–Altman analysis was utilized to compare estimates of total sleep time (TST), sleep onset latency (SOL), wake after sleep onset (WASO), and sleep efficiency (SE).

**Results:** Relative to PSG, the FBF and AW-2 overestimated TST (mean differences 48 and 45 minutes) and SE (mean differences 8.3 and 7.6%), and underestimated WASO (mean differences 46 and 31 minutes) (all p < 0.01). The AW-2 significantly underestimated SOL relative to PSG (mean difference 14.7 minutes; p = 0.03); however, the FBF did not significantly differ from PSG in estimating SOL (mean difference 2.7 minutes; p = 0.72). When FBF and AW-2 were compared against each other, FBF significantly underestimated WASO compared to the AW-2 (p < 0.001), while AW-2 underestimated SOL compared to the FBF (p < 0.01), without significant differences in estimates of TST or SE.

**Conclusion:** The FBF and AW-2 demonstrate comparable performance in estimating TST and SE compared to PSG in MDD. Further research is indicated to assess the comparability of these devices in longitudinal assessments of sleep-wake patterns in psychiatric disorders.

**Support (If Any):** This research was supported by grants from the American Sleep Medicine Foundation, the Brain and Behavior Research Foundation, and NIMH (K23MH099234).

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**0844 EFFECTS OF SLEEP ON CEREBRAL ACTIVITY DURING VERBAL FLUENCY TASK IN PATIENTS WITH MAJOR DEPRESSIVE DISORDER: A NEAR-INFRARED SPECTROSCOPY STUDY**

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**Introduction:** Recent studies have indicated the potential clinical use of near-infrared spectroscopy (NIRS) as a tool in assisting the diagnosis of major depressive disorder (MDD). Although sleep disturbance is often manifested in MDD, no study has elucidated the association between the objective evaluation of sleep and NIRS signal in MDD.

**Methods:** Fifteen patients with MDD who were undergoing medication and had met the DSM-IV-TR criteria and 15 healthy controls were recruited in this study. All participants were requested to wear a waist actigraphy equipment before the NIRS scan to investigate sleep parameters such as total sleep time and sleep efficiency. The Hamilton Depression Rating Scale (HAMD), Pittsburgh Sleep Questionnaire Index (PSQI), and Epworth Sleepiness Score (ESS) were also assessed. We performed a 52-channel NIRS scan and measured changes of oxygenated hemoglobin activation during a verbal fluency task. The ethics committee of Jichi Medical University approved all protocols used in this study.

**Results:** In normal controls, sleep efficiency was negatively correlated with prefrontal reactivity (r = -0.51, p = 0.05). In patients with MDD, the HAMD indicated a significant negative correlation with the cerebral reactivity of both sides of the temporal region. The PSQI was negatively correlated with prefrontal reactivity (r = -0.51, p = 0.03), and that of the left Broca’s region (r = -0.56, p = 0.02). In comparison with the correlation coefficient of both groups, the correlation between sleep efficiency and the left temporal region was significantly increased in patients with MDD rather than in controls (p = 0.05).

**Conclusion:** Sleep quality tended to affect the cerebral reactivity of the temporal region in both groups. Persistent disturbance of sleep was associated with decreased prefrontal and temporal reactivity in patients with MDD. Sleep condition before the NIRS scan may have a substantial impact on cerebral hemodynamics. Our result demonstrates that the reactivity of the temporal region is susceptible to sleep disturbance, suggesting that it has a potential to function as a state marker rather than a trend marker.

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**0845 EFFECTS OF INSOMNIA TREATMENT ON COGNITIVE AND SOMATIC SYMPTOMS OF DEPRESSION AMONG PATIENTS WITH INSOMNIA-DEPRESSION COMORBIDITY**

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**Introduction:** Approximately 75% of depressed patients exhibit insomnia symptoms. The co-occurrence of insomnia and depression confers additional functional impairment, greater treatment resistance, and increased suicidality. The TRIAD study previously demonstrated that early improvement in insomnia mediates the effect of treatment on depression symptoms among patient with insomnia comorbid with depression. Because insomnia and depression share a moderate degree of overlap in somatic symptomatology, but relatively little overlap in the cognitive domain, the current study explored whether improvement in insomnia symptoms (measured with the Insomnia Severity index [ISI]) mediated both somatic and cognitive symptom clusters of depression.

**Methods:** The TRIAD study randomized 150 subjects with major depression and insomnia to 16 weeks of pharmacotherapy plus adjunctive insomnia treatment (Cognitive Behavioral Therapy for Insomnia (CBT-I; n = 75) or a pseudodesensitization control intervention (n = 75). Outcome variables were symptom clusters from the Hamilton Rating Scale for Depression (HRSD): cognitive (hypochondriasis, depressed mood, psychic anxiety, suicidal ideation, guilt feelings, lack of insight) and somatic (psychomotor agitation, gastrointestinal symptoms, general somatic symptoms, weight loss, engagement in work/activities, somatic anxiety, decreased libido, and psychomotor retardation). Analyses were conducted using the MacArthur mediation model.

**Results:** Reductions in ISI over the first 6 weeks of treatment mediated improvement in both cognitive and somatic symptom clusters (p = .01, p = .008). Mediation effects did not differ by treatment arm.

**Conclusion:** Reductions in insomnia severity mediate improvement not only in global depression severity, but also in cognitive and somatic symptom clusters among patients with comorbid insomnia and depression. Although insomnia shares greater construct overlap with somatic symptoms of depression, these findings suggest that improved insomnia also improves cognitive symptoms. Future research exploring the mechanisms by which improvements in insomnia impact depression, specifically cognitive symptoms of depression, may inform our understanding of the depression insomnia comorbidity.

**Support (If Any):** This research was supported by MH 078924, MH078961, and MH079256. Preparation of this abstract was supported by the Office of Academic Affiliations, Advanced Fellowship Program in Mental Illness Research and Treatment, Department of Veterans Affairs.
THE EFFECT OF NIGHTMARE FREQUENCY AND NIGHTMARE DISTRESS ON SUICIDAL IDEATION
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Introduction: The differential effect of nightmare distress and nightmare frequency has not been investigated in relation to suicidal ideation. Thus, the aim of the present study was to demonstrate the effect of nightmares on suicidal ideation, considering both of nightmare distress and nightmare frequency.

Methods: The study consisted of 301 university students (mean age 21.9 ± 2.17; 78.1% female) who answered “yes” to experiencing nightmares, which was defined as “an unpleasant and vivid dream that awakens the sleeper from sleep” in this study. All participants completed self-report questionnaires of nightmare frequency (Nightmare Frequency Questionnaire; NFQ), nightmare distress (Nightmare Distress Questionnaire; NDQ), and suicidal ideation (Depression Suicidality Index). ROC analysis was conducted to establish an optimal cutoff score for the NDQ in comparison with the NFQ. The relative contribution of nightmare frequency and distress to suicidal ideation was investigated through logistic regression analyses.

Results: Based on ROC analyses, Youden’s index indicated 8.5 on the NDQ as the optimal cutoff score for differentiating high and low nightmare distress groups (AUC = 0.80). Based on these cutoff scores, four nightmare groups were derived: Low frequency/low distress (n = 184), low frequency/high distress (n = 75), high frequency/low distress (n = 9), and high frequency/high distress (n = 33). Logistic regression analyses indicated that the high frequency/low distress and low frequency/high frequency/high distress groups were not associated with suicidal ideation compared to the low frequency/low distress group. However, suicidal ideation was 3.71 times higher in the high frequency/high distress group (odds ratio = 3.71; 95% confidence interval 1.72-7.97, p < .001) compared to the reference group.

Conclusion: These findings indicate the importance of exploring nightmare distress in addition to nightmare frequency when investigating risk factors for suicidal ideation in nightmare sufferers.

PERCEIVED INTERPERSONAL BURDENSOMENESS AS A MEDIATOR BETWEEN NIGHTMARE DISTRESS AND SUICIDAL IDEATION IN NIGHTMARE SUFFERERS
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Introduction: Previous studies have supported the strong association between nightmares and suicidal ideation, but the underlying mechanisms are largely unknown. The purpose of the present study was to investigate perceived burdensomeness and thwarted belongingness as mediators in the relationship between nightmare distress and suicidal ideation using the interpersonal theory of suicide as a theoretical framework.

Methods: This sample consisted of 301 undergraduate students who endorsed experiencing nightmares (mean age 21.87, 78.1% female). All participants completed questionnaires about nightmare distress (Nightmare Distress Questionnaire; NDQ), thwarted belongingness and perceived burdensomeness (Interpersonal Needs Questionnaire; INQ), and suicidal ideation (Depressive Symptoms Inventory; DSI). Mediation analyses using multiple regression scores were conducted to investigate whether perceived burdensomeness and thwarted belongingness mediated the relationship between nightmare distress and suicidal ideation.

Results: Results indicated that nightmare distress was associated with perceived burdensomeness and suicidal ideation (ps < .001), but not related to thwarted belongingness. Mediation analyses revealed that perceived burdensomeness partially mediated the relationship between nightmares and suicidal ideation, but thwarted belongingness did not. The indirect effect of perceived burdensomeness on the relationship between nightmare distress and suicidal ideation was estimated to be between .0294 and .0863 (95% CI), indicating significance (R² = .03, K² = .06).

Conclusion: These findings highlight the important role of interpersonal factors, especially perceived interpersonal burdensomeness, in the relationship between nightmares and suicidal ideation.

PREVALENCE OF CIRCADIAN RHYTHM SLEEP-WAKE DISORDERS AND ASSOCIATED FACTORS IN EUTHYMIC PATIENTS WITH BIPOLAR DISORDER
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Introduction: Recent studies have suggested that there are certain pathophysiological relationships between bipolar disorder (BD) and circadian rhythm dysfunction. However, apparently no studies have clarified the prevalence of circadian rhythm sleep-wake disorders (CRSWD) in patients with BD. This study was set out to investigate the prevalence of CRSWD and associated factors in patients with BD.

Methods: One hundred four euthymic BD outpatients participated in this study. The subjects were asked to answer questionnaires including demographic variables, clinical course of BD, and family history of psychiatric disorders and suicide. Severity of BD was assessed by the Montgomery-Åsberg Depression Rating Scale and Young Mania Rating Scale. CRSWD was diagnosed by clinical interview, together with sleep logs, according to the International Classification of Sleep Disorders, third edition (ICSD-3).

Results: Thirty-five subjects (32.4%) met the criteria for CRSWD. The age at the time of investigation and that at the onset of BD were both lower in the CRSWD group than in the non-CRSWD group. The rates of family history of psychiatric disorders and suicide in the CRSWD group were higher than those in the non-CRSWD group. Multiple logistic regression analysis revealed that the presence of CRSWD was significantly associated with younger onset age of BD and family history of suicide.

Conclusion: The prevalence of CRSWD could be quite high in BD patients. Younger onset age of BD and family history of suicide were associated with presence of CRSWD in BD patients, possibly implying the common pathophysiological backgrounds between BD and CRSWD.


THE Z-DRUGS AND THEIR ASSOCIATION WITH SUICIDALITY, MORTALITY, AND OVERDOSE: A SYSTEMATIC REVIEW
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Introduction: A link has been suggested between the use of sedative-hypnotic medications and all-cause mortality, particularly accidental...
B. Clinical Sleep Science

Death and suicide. The “z-drugs” (zolpidem, zaleplon, eszopiclone and zopiclone) are non-benzodiazepines that aid in the initiation of sleep by acting on gamma-aminobutyric acid-alpha receptors. Z-drug mechanisms suggestive of suicidality may include: 1) decreased inhibition for acting on impulsive thought, 2) agitation after discontinuation, 3) depression of the central nervous system, 4) and the indication, insomnia. This systematic review examines the potential effects of z-drugs on suicidal ideation and behavior, traumatic injury, mortality, and accidental poisoning.

**Methods:** On June 20, 2015 a systematic literature review of the PsycINFO and PubMed databases was conducted using the following search term: [(zopiclone OR zolpidem OR zaleplon OR eszopiclone) AND (suicide OR suicidal OR traumatic injury OR mortality OR drug overdose)]. Articles were included if they were available in English, reported human subjects data, original research or analyses of population-based datasets, and included z-drug utilization and at least one of the outcomes of interest as listed in the search terms. Included articles were used to identify additional articles through references.

**Results:** Of 178 abstracts, 147 were excluded if they were: not original research, a case-study, a duplicate, or did not report target outcome, z-drug usage, or data allowing interpretation of this relationship. The review covered 31 studies and overall suggested a possible association between exposure to z-drugs, particularly if used outside of clinical guidelines, and increased risk of mortality, drug overdose, and traumatic injury.

**Conclusion:** Z-drugs have demonstrated utility as a sleep aid and may be important in reducing overall mortality associated with sleep disturbance. Yet, they have been associated with increased somnolence and traumatic injury (e.g., motor vehicle accidents), particularly in women and those taking higher doses, resulting in significant dose change forms and relabeling by FDA.

**Support (If Any):** This work was supported, in part, by the VA Advanced Fellowship Program in Mental Health Illness Research and Treatment, VISN 2 Center of Excellence for Suicide Prevention at the Canandaigua VAMC.

**0850**

**ACCUMULATION AND DISSIPATION OF SLOW-WAVE ACTIVITY AND THE EFFECT ON MOOD DISTURBANCE**

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**Introduction:** Very recent research has demonstrated that manipulations to slow-wave activity in those with Major Depressive Disorder (MDD) can predict changes in mood. Previous work has also shown that slow-wave activity can be increased with a mild homeostatic challenge, a three-hour sleep delay. The aim of the current study was to determine if a sleep delay challenge (SDC) would likewise predict mood disturbance in a sample of depressed and healthy adults (HC).

**Methods:** Participants spent three consecutive nights in the sleep laboratory. On night three, participants bedtimes were delayed by three hours. The Profile of Mood States (POMS) questionnaire was administered to assess mood disturbance. In order to explore if the SDC had a significant effect on the amount of slow-wave activity (SWA), SWA across the night and during each NREM period were examined at baseline and following SDC. Subsequently, regression analyses were conducted with SWA at each of the four NREM periods, individually, as the predictor variable, and the POMS measure of total mood disturbance at post as the outcome variable. Amount of Stage 1 sleep, Stage 2 Sleep, REM, and Awake & Movement were entered as covariates to control for the non-slow wave components of sleep.

**Results:** As expected, the HC group exhibited significantly more SWA across the night following the sleep delay, and during the first and fourth NREM periods, specifically. In contrast, the SDC did not result in increased SWA across the night in the MDD group. Results from multiple regression revealed that following a 3-hour sleep delay, increased SWA, specifically in the 2nd NREM period, was predictive of increased mood disturbance in those with MDD. Healthy control participants did not show this relationship.

**Conclusion:** The present study demonstrated that an increase in the amount of SWA from the 2nd NREM period following a sleep delay paradigm predicted an increase in total mood disturbance in individuals with MDD. Following homeostatic sleep challenges, studies have shown that SWA increases during the first NREM period as an indicator of the increased homeostatic drive for sleep followed by a prompt decrease, indicative of the healthy dissipation and regulation of SWA. The results found presently may suggest that prompt accumulation and dissipation of SWA following a mild homeostatic sleep challenge may be essential for healthy emotional functioning.

**Support (If Any):** R01 MH061515 - Armitage

**0851**

**ASSOCIATION OF SLEEP QUALITY, PSYCHIATRIC DIAGNOSTIC SYMPTOMS, AND ALCOHOL CONSEQUENCES IN COLLEGE STUDENTS**

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**Introduction:** Associations between poor sleep quality, psychiatric symptoms, and heavy alcohol use have been documented in the literature; yet it is unclear how the combination of these factors may influence college students’ risk for alcohol-related consequences. This study explored associations between sleep quality, potential psychiatric disorders, and alcohol-related consequences among heavy-drinking incoming freshmen.

**Methods:** University students reporting three or more binge drinking episodes in the first nine weeks of their first semester of college (N = 278, 53% male) were categorized into four groups: (a) ‘good’ sleep quality and no psychiatric diagnosis (n = 89), (b) ‘good’ sleep quality and a potential psychiatric diagnosis (n = 66), (c) ‘poor’ sleep quality and no psychiatric diagnosis (n = 43), and (d) ‘poor’ sleep quality and a potential psychiatric diagnosis (n = 80). Sleep quality was assessed using the Pittsburgh Sleep Quality Index; psychiatric diagnosis, using the Psychiatric Diagnostic Screening Questionnaire; and alcohol-related consequences, using the Brief Young Adult Alcohol Consequences Questionnaire. Between-group differences in alcohol-related consequences were determined using analysis of variance.

**Results:** Forty-four percent of participants reported poor sleep quality, and half (53%) met established screening criteria for a psychiatric disorder. Those screening positive for both poor sleep quality and a psychiatric diagnosis reported a significantly greater number of alcohol-related consequences than those reporting either poor sleep quality or psychiatric symptoms alone.

**Conclusion:** Sleep may serve as a protective factor against alcohol-related problems among heavy-drinking college students reporting psychiatric symptoms that may warrant clinical diagnosis.

**Support (If Any):** This research was supported in part by grants MH079179 (PI: Mary A. Carskadon), T32-AA007459 (PI: Peter Monti), R01-DA033425 (PI: Brian Borsari).
VIII. Psychiatric Disorders and Sleep

0852
SOCIAL AND EMOTIONAL LONELINESS AND SLEEP DISTURBANCE IN A SAMPLE OF NORWEGIAN UNIVERSITY STUDENTS
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Introduction: Social and emotional loneliness experienced during early adulthood has negative effects on several areas of health, including sleep. However, there are few comprehensive and systematic population-based studies evaluating this relationship in young adults.

Methods: A sample of over 12,000 students aged 21-35 years who participated in the student survey for higher education in Norway (the SHoT study) were included for analyses. Demographic and lifestyle information was obtained. Loneliness was assessed using the Social and Emotional Loneliness Scale, and categorical responses were converted to quartiles, with the highest quartile being an indication of higher rated loneliness. Difficulty initiating and maintaining sleep (DIMS) was assessed by a single-item response on the depression scale of the Hopkins Symptoms Checklist (HSCL-25) and was analysed as a categorical variable with all four ordinal levels.

Results: The highest quartile of social loneliness was associated with experiencing DIMS (Unadjusted OR = 2.69, 95%CI = 2.46-2.95), however this association was attenuated following separate adjustment for anxiety (HSCL Anxiety subscale) (Adjusted OR = 1.92, 95%CI = 1.75-2.10) and depression (HSCL Depression subscale) (Adjusted OR = 1.48, 95%CI = 1.34-1.63). This association was not substantially altered when all demographics and psychological distress were accounted for (fully adjusted model OR = 1.46, 95%CI = 1.30-1.63). The highest quartile of emotional loneliness was also associated with DIMS (Unadjusted OR = 2.33, 95%CI = 2.12-2.57). Adjustment for anxiety (Adjusted OR = 1.96, 95%CI = 1.78-2.15) and depression (Adjusted OR = 1.64, 95%CI = 1.48-1.80) attenuated this relationship somewhat, and this association was further weakened, but not extinguished, in the fully adjusted model (Adjusted OR = 1.22, 95%CI = 1.09-1.31).

Conclusion: We observed an association between social and emotional loneliness and poor sleep, but this seemed embedded in a larger pattern of psychological distress. Examination of the mediating effect of underlying psychological symptomatology in the expression of this relationship is warranted.

0853
DEPRESSION, ANXIETY, AND TRAUMA PREDICT SLEEP DIFFICULTIES BEYOND DEMOGRAPHICS AND PHYSICAL CHARACTERISTICS
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Introduction: The relationship between psychopathology and insomnia is well established. Sleep difficulties are clinical features of depression, generalized anxiety disorder (GAD), and post-traumatic stress disorder (PTSD). Despite this well documented relationship, treating insomnia in individuals with these disorders is often over looked and undervalued. The present study sought to examine the relationship between sleep and symptoms of depression, worry, and trauma above and beyond demographics and physical characteristics that are also known to influence sleep and psychopathology.

Methods: Ninety female Veterans (M = 48.0 years) with sleep complaints were recruited to participate in a large randomized controlled trial examining two insomnia treatments. At baseline, Veterans completed self-report measures of sleep quality (Pittsburgh Sleep Quality Index, PSQI, M = 11.2) and insomnia severity (Insomnia Severity Index; ISI, M = 13.8), as well as symptoms of depression (Patient Health Questionnaire, PHQ-9, excluding two sleep-related items, M = 7.0), worry (GAD-7, M = 9.1), trauma (PTSD Checklist, PCL, excluding two sleep-related items, M = 21.8), and a WatchPAT home sleep apnea test to estimate apnea hypopnea index (AHI, M = 8.5 apneas/hour). We conducted three separate hierarchical multiple regression analyses with depression, worry, and trauma as outcome variables, respectively. The first step included basic demographics (age, ethnicity, education, income, employment status, and children status). The second step included physical characteristics known to impact sleep (e.g., BMI, health status, AHI). The final step included the ISI and PSQI.

Results: After accounting for demographics and physical characteristics, sleep quality and insomnia severity explained an additional 26.8% of the variance in depression, 27.3% of the variation in worry, and 29.2% of the variance in trauma status (all ps < .001).

Conclusion: These results highlight the strong impact of sleep on symptoms of psychopathology beyond what can be explained by demographics and physical characteristics. Findings highlight the importance of identifying and treating co-occurring and/or residual insomnia among women with psychopathology.

Support (If Any): HSR&D IIR 13-058-2 (Martin), Geriatric Research, Education, and Clinical Center, VA Greater Los Angeles Healthcare System

0854
PSYCHOTROPIC DRUG USE OF POLYSOMNOGRAPHY SUBJECTS
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Introduction: Patients who visit a sleep center complaining excessive sleepiness, insomnia, sleep apnea and snoring have already prescribed psychotropic drugs from the primary care. It is known that psychotropic drugs modify the results of polysomnography (PSG), such as a change of a sleep structure and a worsening of breathing pattern. It is important to grasp medication history before a PSG study. In this study we investigated proportion of psychotropic drugs users, and reviewed effects of antidepressants on PSG.

Methods: We enrolled 650 patients older than 20 years old that performed PSG in Ota Memorial Sleep Center for a period from January to December in 2014. Sleep technologists have interviewed to a patients of a medication history of psychotropic drugs before a PSG study. EEG (F3-A2, F4-A1, C3-A2, C4-A1, O1-A2, O2-A1), EOG (ROC, LOC), chin-EMG, oral-nasal air flow, respiratory movements, snoring, oxygen saturation, ECG, limb-EMG and body position were contained on the standard PSG. The indices of a sleep structure and respiratory events were calculated after manual scoring.

Results: Total 132 patients (20.3%) of the subjects were some psychotropic drug users, and 55 patients (41.7%) of those were antidepressant users. 80% of an antidepressant users were diagnosed for a sleep related breathing disorder after a PSG study. An extension of sleep latency and REM latency which antidepressant users compare these with
non-users. In addition, there were less stage REM and apnea hypopnea index in antidepressant users.

Conclusion: It was thought that to grasp medication history before a PSG study is beneficial for reasons of both consideration effects on sleep or breathing and background of a patient.

0855
THE EFFECTS OF AN 8-WEEK CBT-I TREATMENT ON PSYCHIATRIC SYMPTOMS, ALCOHOL CRAVING, AND RELAPSE TO DRINKING IN PATIENTS WITH CO-OCcurring INSOMNIA SYMPTOMS AND ALCOHOL DEPENDENCE
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Introduction: Insomnia, which is common in Alcohol Dependence (AD), is associated with mood and anxiety symptoms, alcohol craving, and risk of relapse to drinking. The aim of this pilot study was to evaluate the effects of an 8-week CBT-I treatment on anxiety and depressive symptoms, alcohol craving, and relapse to drinking in patients with co-occurring insomnia and AD.

Methods: We enrolled 22 medically and psychiatrically stable patients with AD who complained of insomnia. They were randomly assigned to either 8-week CBT-I (N = 11) or Monitor-Only (N = 11) arms. Assessments included the 16-item Quick Inventory of Depressive Symptoms (QIDS), the State-Trait Anxiety Inventory (STAI), Time Line Follow Back Inventory (TLFB) to measure drinking, and the Penn Alcohol Craving Scale (PACS). GLM repeated measures models evaluated for the PACS scores after 8 weeks. One subject in the CBT-I arm and 3 subjects in the MO arm relapsed to drinking during treatment.

Results: The sample consisted of males, abstinent for 26.4 ± 24.3 days prior to their baseline evaluation. The CBT-I group had significantly greater reductions on the QIDS [F(1,19) = 5.47, p = 0.03; effect sizes = 0.51 and 0.17 for CBT-I and MO, respectively] and on the STAI-Trait scale [F(1,19) = 6.01, p = 0.02; effect sizes = 0.14 and -0.08 for CBT-I and MO, respectively]. There was no difference between groups for the PACS scores after 8 weeks. Subject in the CBT-I arm and 3 subjects in the MO arm relapsed to drinking during treatment [χ2(1df) = 1.22, p = 0.27].

Conclusion: In addition to improving insomnia, as reported in a companion abstract in this volume, CBT-I treatment showed a large effect in reducing depressive symptoms and a small effect in reducing anxiety symptoms. Non-significantly fewer subjects in the CBT-I arm relapsed to drinking and there were no difference in alcohol craving between groups. This suggests that, by itself, CBT-I may not be efficacious in the treatment of AD despite reducing insomnia, depressive, and anxiety symptoms.

Support (If Any): This study was funded by the Competitive Pilot Project Fund (CPPF) of the VISN-4 VA and was supported by the following grants: R41MD008845 (JTA); NIH K24 AA013736 (HRK); NIH K23 HL110216 & NIH R21 ES022931 (MAG); and NIH R01 AG041783 (MLP); and VA grant IK2-CX000855 (SC).

0856
TIMING OF ALCOHOL INTAKE ASSOCIATED WITH INSOMNIA SYMPTOMS
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Introduction: acute and chronic alcohol consumption has been associated with insomnia and daytime sleepiness. Sleep fragmentation may occur even after the breath alcohol level is non-detectable. In this investigation we evaluated for the association between a temporal pattern of alcohol consumption with insomnia and daytime sleepiness symptoms.

Methods: Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used. SHADES is a community-based study of adults in southeastern Pennsylvania (N = 1007). Participants were asked, “How often do you drink alcohol?” Those who indicated once a month or less (N = 445) were excluded. Of the remaining N = 562, participants indicated whether they typically consume in the early morning (5am-8am), morning (8am-11am), noontime (11am-2pm), afternoon (2pm-5pm), early evening (5pm-8pm), evening (8pm-11pm), and/or late night (11pm-2am). Reports of consuming alcohol at each time window were evaluated relative to insomnia (Insomnia Severity Index score) and sleepiness (Epworth Sleepiness Scale score), as well as self-reported habitual sleep latency, wake after sleep onset, and early morning awakening, recorded in minutes. Covariates included age, sex, race/ethnicity, education.

Results: Higher Epworth scores were seen for those who consume alcohol in the late evening (B = 1.07, p = 0.008), and late night (B = 1.07, p = 0.034). Higher Insomnia scores were seen for those who consumed at noontime (B = 2.72, p = 0.023), and late night (B = 1.70, p = 0.009). Longer sleep latencies were seen among those who consumed late at night (B = 9.05, p = 0.001). Longer early morning awakenings were seen among those who consumed at noontime (B = 20.33, p = 0.010), afternoon (B = 13.51, p = 0.008), early evening (B = 8.29, p = 0.010), and late night (B = 10.16, p = 0.018).

Conclusion: The occurrence of sleep disturbances, especially early morning awakenings, was related to alcohol and depended on the time of day that alcohol was consumed.

Support (If Any): The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216. Dr. Chakravorty is supported by VA grant IK2-CX000855.

0857
SLEEP DURATION AND SATISFACTION WITH LIFE, HEALTH, FINANCES AND RELATIONSHIP
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Introduction: Life satisfaction is an important predictor of psychological and medical health. We predicted that short sleepers may exhibit lower quality of life.

Methods: Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study was used. SHADES is a community-based study of adults in southeastern Pennsylvania (N = 1,007). Participants rated on a 0–100 scale their overall satisfaction with life, health, finances, and relationship. Weekday/workday sleep duration was assessed with the NHANES item and categorized participants as very short (≤ 4h), short (5-6h), normal (7-8h), and long...
(≥ 9h) sleepers. Relationships were assessed using linear regressions adjusted for age, sex, education, and race/ethnicity. Additional models included proxies of health (global health), finances (income quintile), and relationships (multivariable scale of perceived social support total score). Potential mediation by stress (Perceived Stress Scale score), depressive symptoms (depressed mood item from PHQ9), and insomnia symptoms (Insomnia Severity Index score) was explored.

**Results:** Very short sleepers reported lower overall satisfaction with life (B = -14.98, p < 0.0005), health (B = -17.87, p < 0.0005), finances (B = -14.96, p < 0.0005), and relationships (B = -16.35, p < 0.0005). Short sleepers also reported lower satisfaction with life (B = -7.20, p < 0.0005), health (B = -8.60, p < 0.0005), finances (-10.14, p < 0.0005), and relationships (B = -8.84, p < 0.0005). When accounting for proxies, effects were still evident for health (very short B = -10.25, p < 0.0005; short B = -4.33, p = 0.004), finances (very short B = -14.14, p < 0.0005; short B = -9.88, p < 0.0005), and relationships (very short B = -7.35, p = 0.027; short B = -5.10, p = 0.009). Whilst the associations for health and finances remained significant after adjusting for stress, depression, or insomnia, including any of these variables rendered associations with satisfaction with relationships non-significant.

**Conclusion:** Short sleepers have lower life satisfaction overall and in the separate domains of health, finances, and relationships. These persisted even after adjusting for levels of these domains, suggesting that given similar exposure, they maintain a negative outlook. Also, these relationships are not mediated by symptoms of insomnia, depression, or stress.

**Support (If Any):** The SHADES study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216.
**0858**

**IDENTIFICATION OF PEDIATRIC OBSTRACTIVE SLEEP APNEA SYNDROME IN PRIMARY CARE**

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**Introduction:** Despite clinical practice guidelines on the diagnosis and management of pediatric obstructive sleep apnea syndrome (OSAS), rates of screening, identification, and management of OSAS in pediatric primary care remain low. The objectives of the current study are to 1) describe current rates at which primary care providers (PCPs) are identifying pediatric OSAS and 2) examine factors that contribute to OSAS identification by PCPs.

**Methods:** We employed a computer decision support system (Child Health Improvement through Computer Automation; CHICA) to screen all patients ages 1-11 for snoring in five urban, primary care health clinics. PCPs received an automated prompt in the electronic medical record when a child snored, asking them to conduct an evaluation and indicate whether or not OSAS was suspected. No additional information from the guidelines was provided. We used logistic regression to examine factors that contributed to OSAS identification.

**Results:** Out of 3,491 caregivers, 22.3% responded affirmatively to an item indicating that their child snored three or more nights per week. PCPs responded to 54.7% of prompts asking them to indicate whether or not they suspected OSAS. For completed prompts, PCPs suspected OSAS in only 18.9% of snoring children. None of the demographic (age; gender; race; insurance status) or health-related factors (BMI percentile; ADHD symptoms) significantly predicted OSAS identification amongst snoring children. Despite comparable snoring rates across the five clinics (ranging from 17.3% to 27.2%), rates of suspected OSAS were highly variable between clinics (ranging from 4.5% to 50%), and even more so between providers (0% to 100%).

**Conclusion:** Only a small proportion of snoring children were identified as having suspected OSAS. These findings highlight the need for enhanced implementation strategies to address unwarranted practice variation and low PCP adherence to evidence-based guidelines for OSAS identification.

**Support (If Any):** This study was supported by funding from the Indiana University School of Medicine, Section of Pulmonary, Allergy, and Sleep Medicine.

**0859**

**THE ECG-BASED CARDIOPULMONARY COUPLING BIOMARKER HIGH-FREQUENCY CARDIOPULMONARY COUPLING CAN HELP TRACK IMPROVEMENT OF PEDIATRIC SLEEP APNEA**

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**Introduction:** The randomized controlled clinical trial—Childhood Adenotonsillectomy Trial (CHAT) found that adenotonsillectomy improved sleep disordered breathing and quality of life, but not cognition. Some children without surgery (46%) had spontaneous polysomnographic improvement after 7-month follow-up. It would be useful to have a method to track improvement or not, short of polysomnography. High frequency coupling (HFC) on the ECG-based sleep spectrogram cardiopulmonary coupling (CPC) analysis estimates periods of stable breathing. We hypothesized that spontaneous improvement of pediatric sleep apnea could be detected by CPC analysis.

**Methods:** A retrospective signal analysis of the CHAT study dataset. The fully-automated ECG-derived sleep spectrogram technique was applied to 344 (of the original 464) polysomnograms from the CHAT. Data loss was from ECG data drop out or movement-related artifacts more than 10% of the recording. An increase in HFC of 5% was taken as an index of improvement (a “responder”).

**Results:** The data included 169 in the adenotonsillectomy and 175 in the watchful waiting (WW) groups, with mean age of 6.5 ± 1.4 years. A greater improvement of AHI and arousal index in responders (average AHI 7.30 ± 6.20/h before and 4.86 ± 6.56/h after, P = 0.005; arousal index 8.49 ± 2.57/h before and 7.37 ± 2.57/h after, P = 0.006) than non-responders (average AHI 6.28 ± 5.07 before and 6.25 ± 11.47 after, P = 0.974; arousal index 8.28 ± 3.45/h before and 9.13 ± 5.70/h after, P = 0.102) in WW group. In the early adenotonsillectomy group, AHI decreased regardless of responder status. In the early adenotonsillectomy group, at baseline, responders’ average diastolic blood pressure was lower than those non-responders (61.22 ± 6.82 vs. 64.69 ± 7.0, P = 0.004). Across all subjects, the change in AHI correlated inversely with the change in HFC (Pearson Correlation: -0.175, p: 0.001).

**Conclusion:** The ECG-spectrogram biomarker of stable sleep, HFC, may help track sleep apnea during WW conditions in pediatric OSAS. A wearable device which can track CPC variables is available, to enable clinical translation.


**0860**

**CARDIOVASCULAR SEQUELAE IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** Although cardiovascular consequences of obstructive sleep apnea (OSA) are well characterized in adults, these consequences in children aren’t well understood. We previously demonstrated an association between inflammatory mediators and vascular stiffness. The aim of this study was to confirm this association using pulse transit time (PTT) and examine changes in PTT and pulse wave velocity (PWV) during wake and sleep in children with OSA.

**Methods:** Children with OSA and healthy matched controls, aged 5 to 13 years, were recruited to a prospective cohort study. Plasma inflammatory chemokines were measured on the day of polysomnography. PTT and PWV were calculated from electrocardiogram (EKG) and beat-to-beat blood pressure for awake, NREM and REM states. Correlation, adjusted for age, gender, and body mass index, between inflammatory chemokines, PTT and, PWV was estimated.

**Results:** Sixty-two children with mild OSA, 53 with severe OSA, and 106 controls were recruited. Adiponectin negatively correlated with PWV while awake (P = 0.05). Interleukin (IL)-6 was negatively correlated with PTT for awake, NREM and REM states (P = 0.02, 0.05, 0.05). TNF-alpha negatively correlated with NREM and REM sleep states (P = 0.03, 0.02). Although CD40 ligand (CD40L) was significantly higher in children with OSA (P < 0.0001), it did not correlate with PWV or PTT. Neither PTT nor PWV differed significantly between controls or children with OSA in awake, NREM or REM states.

**Conclusion:** In children with OSA, increased IL-6 and TNF-alpha and decreased adiponectin are correlated with decreased PTT. There was no association between CD40L and PTT. The absence of group differences in PTT and PWV during wake and sleep states suggests that longer duration of disease is required before vessel stiffness develops in children with OSA.

**Support (If Any):** R01HL080670-01
0861
SLEEP-DISORDERED BREATHING IS ASSOCIATED WITH HIGHER MORTALITY AMONG HOSPITALIZED INFANTS WITH CONGENITAL HEART DISEASE
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Introduction: Both central and obstructive sleep apnea are prevalent and associated with an increased risk of mortality in adults with heart failure. No prior studies have evaluated infants with congenital heart disease (CHD) for a similar risk. We evaluated clinical and economic outcomes associated with sleep-disordered breathing (SDB) among inpatient infants with CHD in the U.S. from 1997-2012.

Methods: This retrospective cross-sectional study utilized pediatric inpatient discharge data from the Agency for Healthcare Research and Quality’s Kids’ Inpatient Database. Inclusion criteria included diagnosed CHD and age < 1 year. Exclusion criteria included apnea of prematurity, cardiac surgery during current admission, and invasive mechanical ventilation. Generalized linear models (binomial/logistic, negative binomial, gamma) were used to assess outcomes of mortality, length of stay, and total charges after controlling for type of SDB (obstructive, central, not specified), sex, regional income, year, hospital characteristics (i.e., children’s and teaching status, location and region), payer, Deyo-Charlson comorbidity index, presence of other congenital disorders (including trisomy 21), prematurity, sepsis, and use of non-invasive respiratory support.

Results: Across 461,778 inpatient infant cases of CHD from 1997-2012, 4,968 involved SDB (13.7% obstructive, 3.9% central, 82.4% not specified). After controlling for numerous patient, clinical, and hospital-related factors, multivariable analyses suggested that central sleep apnea was independently associated with 285.7% higher odds of inpatient mortality, 87.9% longer inpatient stay, and 104.4% higher total charges (p < 0.05). Relative to other CHD cases, obstructive and unspecifed SDB were also associated with longer lengths of stay by 59.6% and 17.7%, respectively, and higher charges of 57.7% and 18.9% (p ≤ 0.001).

Conclusion: SDB, in particular central sleep apnea, is associated with significantly worse outcomes in hospitalized infants with CHD. Prospective research studies need to verify these findings, explore underlying mechanisms, and evaluate the possible benefits of treatment.

Support (If Any): Salary support to DC from the Arizona Respiratory Center.

0862
INFLAMMATION IN CHILDHOOD PREDICTS SLEEP APNEA AND BLOOD PRESSURE REACTIVITY IN ADOLESCENCE: A LONGITUDINAL STUDY
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Introduction: While a number of studies have reported systemic inflammation and cardiovascular aberrations in individuals with obstructive sleep apnea (OSA), the direction of these associations is not clear. The aim of this longitudinal study was to examine the role of inflammation levels during childhood in predicting sleep apnea and cardiovascular outcomes in adolescence.

Methods: The Penn State Child Cohort is a random general population sample of 700 children (5-12y), of whom 421 followed up 8 years later as adolescents (12-23y). At both time points, participants underwent a single 9h polysomnography, where apnea/hypopnea index (AHI) was ascertained. A blood draw was taken upon awakening (7:00), and plasma levels of C-reactive protein (CRP) and tumor necrosis factor alpha (TNFα) were measured via ELISA. At follow-up, systolic and diastolic blood pressure (BP) reactivity (standing minus supine BP) was determined. Linear regressions were calculated with baseline and Δ inflammation as predictors, and follow-up AHI and BP reactivity as outcomes, adjusting for baseline age, time to follow-up, follow-up BMI percentile, ethnic minority, baseline inflammation (for Δ analyses), and baseline AHI (for follow-up AHI analyses).

Results: In total, n = 56 participants (n = 24 boys) provided a blood sample at both time points. In boys, greater ΔCRP and ΔTNFα predicted higher follow-up AHI (standardized β = 1.02, p < 0.001 and β = 1.13, p = 0.04, respectively). Furthermore, CRP levels in childhood predicted systolic BP reactivity in adolescent boys (β = 0.56, p = 0.02) and girls (β = 0.32, p = 0.08), and ΔCRP predicted diastolic BP reactivity in adolescent girls (β = 1.67, p = 0.03).

Conclusion: Our longitudinal findings point to a model in which systemic inflammation is not simply a result of hypoxia, but rather strongly contributes to the development of OSA and cardiovascular problems.

Support (If Any): NIH R01 HL63772, R01 HL97165, ULI TR000127, C06 RR16499

0863
DEVELOPMENTAL CHANGES OF SLEEP-RELATED RESPIRATORY PARAMETERS IN INFANTS WITH PIERRE ROBIN SEQUENCE MANAGED CONSERVATIVELY: A LONGITUDINAL ANALYSIS
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Introduction: Although Pierre Robin Sequence (PRS) is a major cause of neonatal obstructive sleep apnea (OSA), literature regarding developmental changes in respiratory pattern is sparse. We aimed to describe the changes in sleep related respiratory parameters of PRS neonates treated conservatively.

Methods: A retrospective, 13-year, single institution, study was undertaken of all neonates with PRS who underwent a diagnostic PSG (PSG) followed by at least one follow-up polysomnogram (PSG). Those treated with surgery were excluded. Data was analyzed to identify trends in respiratory parameters using paired t-test.

Results: In a cohort of 130, Ninety-three (72%) underwent surgery (tracheostomy or mandibular distraction) and thirty-seven (28%) were treated conservatively. Nineteen (14%) met inclusion criteria (10 treated with supplemental oxygen, 2 with CPAP, 1 with nasopharyngeal airway). Eight (42%) were syndromic. Baseline PSG, (at mean age of 1.4 ± 1.5 months) showed a total apnea hypopnea index of 25.9 ± 20.1, obstructive apnea hypopnea index(0I) of 18.2 ± 16.1, central index (CI) of 8.1 ± 16.3 and an arousal index of 26.1 ± 7.9. Paired comparison of PSG, with the corresponding follow-up PSGs showed a sequential reduction in CI with advancing age ((16.6 ± 14.5 [PSG1] vs. 6.7 ± 5.3 [PSG2]; n = 17, p = 0.006, PSG1, age 6.1 ± 2.9 months), (16.2 ± 17.0 [PSG1] vs. 3.3 ± 2.9 [PSG2]; n = 9, p = 0.05, PSG1,age 11.9 ± 6.6 months) and (17.5 ± 17.7 [PSG1] vs. 3.0 ± 3.6 [PSG2]; n = 8, p = 0.07, PSG1, age 24.6 ± 12.4 months)). A trend towards improvement in CI was observed ((8.8 ± 17.2 [PSG1] vs. 8.9 ± 18.3 [PSG2]; n = 17, p = 0.97, PSG1, age 6.1 ± 2.9 months), (12.6 ± 23.8 [PSG1] vs. 2.8 ± 1.5 [PSG2]; n = 9, p = 0.27, PSG1, age 11.9 ± 6.6 months) and (4.5 ± 6.7 [PSG1] vs. 1.8 ± 1.1 α)
9864 SLEEP DISORDERED BREATHING IS ASSOCIATED WITH BEHAVIORAL PROBLEMS AT AGE 2 YEARS
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Introduction: Childhood sleep disordered breathing (SDB) is associated with significant behavioral morbidity such as ADHD. SDB at age 2 years may be under-reported and the consequent impact on behavioral difficulties underappreciated.

Methods: Data from the Canadian Healthy Infant Longitudinal Development (CHILD) birth cohort study were used to examine the impact of SDB on behavioral problems in children. SDB was determined using the Pediatric Sleep Questionnaire (PSQ) administered quarterly. Behavior was assessed using the Child Behavior Checklist (CBCL; standardized parent report) at age 2. Sleep duration, determined using group-based trajectory analysis, was based on quarterly Brief Infant Sleep Questionnaire (BISQ) and home polysomnography (PSG) at 1 year. Linear regression examined the impact of SDB (a positive PSQ (score > 0.33) on two or more occasions) on attention/hyperactivity CBCL t-scores (primary outcome) and anxiety/depression (secondary outcome).

Results: A total of 568/815 (70%) CHILD Edmonton families had sleep and behavior data at 2 years. Children with SDB (8.5%; 48/568) had a 1.79 point increase in CBCL attention/hyperactivity t-scores (indicating greater behavioral problems) at age 2 (95% CI: 0.50-3.08, p = 0.007) than children without SDB in univariate and multivariate analysis after adjustment for nighttime sleep duration, sleep-wake onset, gender, socioeconomic status, social emotional development at 1 year, language at 2 years, maternal depression at 1 year. Relative to children without SDB, children with SDB also had a 1.47 point increase in their CBCL anxiety/depression t-score at age 2 (95% CI: 0.53-2.42, p = 0.002) in univariate and multivariate analysis. Short nighttime sleepers (Mean = 8.97 hrs, SD = 0.45) (group-based trajectory analysis) also had a 1.66 point increased attention/hyperactivity problems (95% CI: 0.25, 3.06, p = 0.021) compared to long nighttime sleepers (Mean = 11.12 hrs, SD = 0.39), in univariate and multivariate analysis.

Conclusion: SDB symptoms and short sleep duration during early childhood are associated with increased ADHD and anxiety/depression problems at age 2 years.

Support (If Any): CIHR, AllerGen

9865 SLEEP DISORDERED BREATHING IS ASSOCIATED WITH REDUCED COGNITIVE DEVELOPMENT BETWEEN 1 AND 2 YEARS OF AGE
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Introduction: Sleep Disordered Breathing (SDB), from habitual snoring to obstructive sleep apnea, affects up to 10% of children. Few data examine how SDB and nighttime sleep patterns from 1 to 2 years of age, a period of significant neuroplasticity, impacts cognitive development.

Methods: Data from Edmonton families in the CHILD longitudinal birth cohort study (n = 815) were used to examine the relationship between sleep and change in cognitive development between 1 and 2 years. SDB was determined using the Pediatric Sleep Questionnaire (PSQ) administered quarterly. The Bayley Scales of Infant Development (BSID-III) was completed at 1 and 2 years. Sleep duration, determined using group-based trajectory analysis, was based on quarterly Brief Infant Sleep Questionnaires (BISQ) and home polysomnography (PSG) at 1 year. Multivariate linear regression was completed to determine the impact of SDB (a positive PSQ (score > 0.33) on two or more occasions) and nighttime sleep trajectories on the change in cognitive performance from 1-2 years of age.

Results: A total of 575/815 (71%) CHILD Edmonton families had sleep and cognitive development data collected at 1 and 2 years. Children with SDB (8.7%; 50/575) had a 4.77 reduction (95% CI -9.58, 0.03; p-value = 0.05) in BSID-III cognitive standard scores from 1 to 2 years of age. Three trajectory groups for nighttime sleep duration were identified: short sleepers (6.6%), medium sleepers (38.7%) and long sleepers (54.6%). Infants in the short sleeper group exhibited a 10.24 reduction (95% CI -16.81, -3.68; p = 0.002) in their BSID-III cognitive standard scores from 1 to 2 years of age while infants in the medium sleeper group exhibited a 2.81 reduction (95% CI 5.63, 0.00; p-value = 0.05).

Conclusion: SDB and low-medium nighttime sleep during infancy contribute unique variance in cognitive development from 1-2 years, both exhibiting a deleterious effect upon cognitive outcomes.

Support (If Any): CIHR, AllerGen

0866 NEURODEVELOPMENTAL OUTCOMES AT 2 YEARS OF AGE FOR PREMATURE INFANTS DIAGNOSED WITH NEONATAL SLEEP APNEA
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Introduction: Neurocognitive deficits and poor academic performance have been shown in school age children with sleep apnea. Sleep apnea is more prevalent in preterm babies. The impact of sleep apnea on the neurodevelopmental outcome of preterm infants is unknown.

Methods: After IRB approval, a retrospective chart review was performed for all preterm infants (less than 37 weeks) who had a neonatal polysomnogram (PSG) and completed neurodevelopmental assessment with the Bayley Scales of Infant and Toddler Development III, at 24-26 months of age between 2012 to 2015 at Riley Hospital. Exclusion criteria included Grade IV intraventricular hemorrhage, tracheostomy, cyanotic heart disease, severe retinopathy of prematurity or craniofa-
Obstructive sleep apnea (OSA) is known to negatively affect spatial planning, spatial working memory and working memory levels in school-aged children, but little is known about the degree of impairment in this population prior to initiation of CPAP therapy for OSA. These findings support the need for careful clinical evaluation of neuropsychological function in adolescents with OSA and suggest that further exploration of potential mediators, such as AHI, are warranted.

**Support (If Any):** NIH CTSA grants UL1TR001073, KL2TR001071 and TL1TR001072.
(CANTAB) then subsequently underwent full in-lab polysomnography to determine percentage of time spent in N1, N2, N3 and REM sleep, respiratory distress index (RDI), arousal index (AI) and minimum percent oxygen saturation levels (MinO2). CANTAB battery consisted of tests of spatial planning (Stockings of Cambridge (SOC)), spatial working memory (SWM), and working memory capacity (spatial span (SSP)). Z-scores were computed for all raw scores in the CANTAB battery.

**Results:** Children spent an average of 16.1% (±5.2) of total sleep time in N1, 36.3% (±5.8) in N2, 31.8% (±6.5) in N3 and 16.9% (±3.9) in REM sleep. Mean RDI, AI and MinO2 were 5.4 ± 6.6, 21.6 ± 8.4, and 88.7 ± 5.2, respectively. Average composite KBIT-2 score was 97.4 ± 14.15. For the CANTAB battery tests: raw SOC score (number of problems solved in minimum number of moves) 8.6 ± 1.6, z = -0.48 ± .81; raw SWM score (strategy) 38.0 ± 4.4, z = -0.60 ± 0.93; raw SSP score (span length) 4.7 ± 1.6, z = -0.28 ± 0.97.

**Conclusion:** Prior to PAP treatment, children with OSA demonstrate below average performance levels on computerized tests of spatial planning, spatial working memory and working memory capacity. Future analyses will compare performance for these children on the same tests after use of PAP therapy for a three- and 6-month period.

**Support (If Any):** HL 102151

**0870**

TELEPHONE SCREENING TO IDENTIFY CHILDREN WITH PERSISTENT SYMPTOMS OF OBSTRUCTIVE SLEEP APNEA AFTER ADENOTONSILLECTOMY

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**Introduction:** Pediatric obstructive sleep apnea (OSA) is a common condition that can result in a range of adverse health outcomes if left untreated. Approximately one-third of children who undergo adenotonsillectomy (T&A) for OSA will have persistent symptoms. This low rate of success emphasizes the need to identify effective screening methods for persistent OSA in order to identify children at risk and limit the morbidities associated with the disease. When a post-operative follow-up visit after T&A is recommended at our institution, a large percentage of families either do not schedule an appointment or fail to come to the scheduled appointment. Therefore, a study using an alternative approach to screening children for persistent symptoms of OSA was needed.

**Methods:** One hundred parents of children undergoing T&A consented to completing the Pediatric Sleep Questionnaire (PSQ) Sleep-Disordered Breathing (SRBD) Subscale via telephone 6-8 weeks after the procedure. Children 2-17 years of age who underwent T&A for OSA (n = 49) or sleep-disordered breathing (SDB, n = 51) were prospectively enrolled. Each question on the SRBD scale was answered by caregivers as yes = 1, no = 0, or don’t know = missing. The number of symptom items answered “yes” was divided by the total number of items minus the missing items. The child was considered at high risk for persistent OSA if the PSQ score was > 0.33.

**Results:** Eighty-five telephone follow up calls were completed (85%). The percentage of children identified as being at risk for persistent OSA was 33% (n = 28). There was no significant difference in age, gender, race/ethnicity, smoke exposure, body mass index category, health conditions, OSA/SDB category, or severity of pre-operative OSA between children at risk or not at risk for persistent OSA.

**Conclusion:** This study found a number of children with persistent symptoms of OSA suggesting that health care providers consider the use of a telephone screening method to identify children at risk for persistent OSA. The use of a telephone questionnaire is a practical and low cost method to screen children for persistent OSA after T&A.

**0871**

DEFINING OPTIMAL SELECTION CRITERIA FOR REFERRAL TO SATELLITE PEDIATRIC SLEEP LABORATORIES

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**Introduction:** Satellite pediatric sleep laboratories improve access to care, but operate at a distance from pediatric hospitals. Careful selection criteria are needed to minimize the likelihood of referring children with severely abnormal sleep disordered breathing to satellite labs. We sought to examine the effectiveness of our current triage protocol and to determine if additional patient characteristics were associated with severe obstructive sleep apnea (OSA) in our patient population.

**Methods:** Retrospective data were collected for 109 pediatric patients studied in our satellite lab between January 2014 and July 2015. Initial exclusion criteria were age < 5 years, asthma requiring controller medication, chronic disease, and neurodevelopmental or craniofacial abnormality. Additional characteristics examined included age, gender, body mass index (BMI), history of asthma, and report of choking or gasping during sleep. The primary analytic endpoint was the obstructive apnea hypopnea index (AHI), with severe pediatric OSA defined as AHI ≥ 10 obstructive events/hour. Logistic regression was used to assess association between severe OSA and the various patient characteristics.

**Results:** 20 of 109 children (18%) selected using our triage protocol had severe OSA. A significant difference in mean BMI was seen for children with and without severe OSA. Children with AHI ≥ 10/hour had mean BMI 29.29 kg/m2 (± 10.77), whereas those with AHI < 10/hour had mean BMI 24.48 kg/m2 (± 7.04) (two sample t-test, p = 0.0205). An association between BMI and severe OSA was also seen (OR = 1.07, 95%CI = 1.01-1.13, p = 0.028). No statistically significant association was seen with other characteristics, including BMI percentile.

**Conclusion:** BMI was not included in our exclusion criteria, but is easy to ascertain. Including BMI criteria may reduce the percentage of patients with severe OSA referred to satellite sleep labs. Analysis of a larger sample size may better define BMI cutoff and identify additional factors associated with severe OSA in our pediatric population.

**0872**

PEDIATRIC OSA: A COMPARISON OF TWO SCREENING TOOLS

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**Introduction:** Untreated obstructive sleep apnea (OSA) results in significant medical and psychological morbidity in children. The development of a reliable OSA screening tool could improve physician detection of children at risk of having OSA.

**Methods:** Parents of children undergoing polysomnographic testing at the Youthdale Child and Adolescent Sleep clinic were asked to complete a 6-item and an 8-item (IF SLEEPY) OSA screening tool. Children (> 7 years) were asked to complete the IF SLEEPY-Child. The IF SLEEPY (Yes/No responses) queried a range of pediatric OSA...
features while the 6-item questionnaire (Likert responses) asked questions about the level of effort related to breathing.

Results: Data were collected from 112 children and their parents: 51.8% of the children (n = 58) were diagnosed with OSA (AHI ≥ 1.5). Analyses were conducted to find optimal cutoff levels. The 6-item scale (parent responses only) performed with a sensitivity of 0.56 and specificity of 0.44 at a cutoff of ≥ 5. The IF SLEEPY-Parent performed with a sensitivity of 0.59 and specificity of 0.53 at a cutoff of ≥ 4 and the IF SLEEPY-Child had a sensitivity of 0.63 and specificity of 0.32 at a cutoff of ≥ 3. Sensitivity and specificity levels were not improved by either combining responses of the IF SLEEPY-Parent and 6-item scale, or those of the IF SLEEPY Parent and Child.

Conclusion: Based on parental responses, both the 6-item and IF SLEEPY scales performed with modest but comparable sensitivities and specificities. A comparison of parental versus child IF SLEEPY found that the specificity of the parental responses was better than that of their children. This study suggests that the IF SLEEPY OSA screening tool, with its Yes/No responses rendering it easier to complete and quicker to score, produces comparable results to the more complicated Likert-based screening tool. The future challenge is to modify the IF SLEEPY to improve sensitivity and specificity.

0873
FEASIBILITY AND PARENTAL ACCEPTANCE OF HOME SLEEP APEA TESTING IN PEDIATRICS
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Introduction: The gold standard test for diagnosis of OSA in children, laboratory polysomnography (PSG), leads to patient inconvenience, is expensive, and isn’t always readily available. We sought to evaluate the feasibility and ease of use of home sleep apnea testing (HSAT) in the pediatric population.

Methods: A prospective, case-controlled study was conducted in children, ages 2-17. Subjects completed in-lab polysomnography simultaneously with ambulatory monitoring. Caregivers attempted home studies on two subsequent nights. A post-home study survey, consisting of four 10-point scale questions assessing the feasibility and ease of administration, was then given to caregivers.

Results: Twenty patients completed home sleep studies, with 16 completing 2 nights of monitoring. Sixteen post-home study surveys were completed by caregivers. Of the 16 who completed the surveys, 12 subjects had downloadable data for 2 nights. On a scale from 1 (easy) to 10 (difficult), average overall ease of use, technical difficulty of the device, caregiver’s impression of child’s sleep, and ability to use the device were evaluated. Average overall ease of use of the portable monitor, technical difficulty, and care givers impression of their child’s sleep were rated as 4. Ability to use the device while asleep was rated as 5. Using cumulative link modeling, there was no evidence that age of child significantly contributed to parental responses.

Conclusion: This study aimed to evaluate the feasibility and ease of use of a HSAT for pediatric OSA. Caregivers did not rate overall ease of use, technical use, or their child’s ability to sleep while using the device as difficult. Children’s subjective sleep was not significantly affected by the use of the home monitor. If HSAT can be used successfully, it may decrease the wait time for testing, provide more readily available testing, and reduce overall costs and inconvenience for caregivers.

0874
THE USEFULNESS OF TWO OBSERVATION SCALES IN ATTENDING POLYSOMNOGRAPHY FOR PEDIATRIC OBSTRUCTIVE SLEEP APNEA
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Introduction: The aim of the current study was to evaluate the usefulness as supplementary diagnostic tools of two observation scales, Obstructive Sleep Apnea-18 (OSA-18, Franco RA Jr 2000) and ObS. We conducted the correlation analysis and receiver operating characteristic (ROC) analysis between Apnea - Hypopnea index (AHI) and two observation scales to evaluate the ability of those for diagnosis pediatric OSA as the primary study. Moreover, we evaluated the degree of improvement before and after adenotonsillectomy (AT) of those as the secondary study.

Results: Total score of the OSA - 18, the score of the category, “Sleep Disorder”, and ObS had significant correlation with AHI (r = 0.201, 0.476, 0.527, p < 0.05, 0.01, 0.01). The ROC analysis revealed that the cut-off value of those scores for predicting AHI higher than or equal to 8.0 were 42.5, 11.5, 4.5 (area under the curve = 0.591, 0.753, 0.875, sensitivity = 0.716, 0.657, 0.821, specificity = 0.488, 0.732, 0.707). The degree of improvement of those scores did not have significant correlation with the change of AHI before and after AT.

Conclusion: ObS may be able to objectify the subjective symptoms mentioned on the diagnostic criteria for pediatric OSA. Even if observation scales improve after AT, PSG must be conducted to confirm the improvements of OSA.

0875
CHAT SCORE: A NOMOGRAM TO PREDICT RESOLUTION OF OBSTRUCTIVE SLEEP APNEA WITH WATCHFUL WAITING
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Introduction: The purpose of this study was to develop a nomogram to predict resolution of obstructive sleep apnea (OSA) with watchful waiting.

Methods: Data from the watchful waiting arm of the childhood adenotonsillectomy trial (CHAT) were submitted to secondary analysis. Candidate predictor variables were selected a priori based on prior literature as well as clinical intuition, and included age, gender, obesity, obstructive apnea hypopnea index (OAHI), history of allergies, tonsil size, race, Friedman tongue position (FTP), % N1 sleep, arousal index, and primary caregiver smoking status. A multivariate logistic regression model was built to predict the outcome of resolution of OSA. All candidate variables were initially added in the full model, and step-down modelling was implemented to construct a final parsimonious model.

Results: Of 203 patients in the watchful waiting CHAT arm, 92 (45%) had resolution of OSA. Of the original candidate variables, the seven that were included in the final nomogram were obesity, OAHI, tonsil size, FTP, history of allergies, % N1 sleep, and primary caregiver smoking status. The final model had good discrimination with a c-statistic of 0.770 (95% CI, 0.712-0.836) and appeared well-calibrated.
**Conclusion:** We present the CHAT Score, a simple nomogram that accurately predicts resolution of childhood OSA with watchful waiting. The nomogram can be easily implemented bedside with pen and paper, and the underlying statistical model is programmed in an online calculator. Our hope is that this tool will help to facilitate family counseling regarding management options for childhood OSA.

### 0876

**URINE PROTEOMIC PROFILING OF JUVENILE IDIOPATHIC ARTHRITIS CHILDREN WITH AND WITHOUT OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** Several urine protein biomarkers have been linked to OSA in children, but there have been no equivalent studies in children with JIA nor do we understand the underlying mechanisms of OSA in JIA. OSA may reflect a comorbidity that is particularly important to address in JIA, but which is often overlooked during clinical care. To define the proteomic signature of OSA in JIA, we performed a preliminary study using shotgun proteomics on urine samples in JIA children with and without OSA.

**Methods:** First morning urine samples from fifteen children, 6-to-11 years, with JIA and OSA (n = 8) and JIA without OSA (n = 7) were examined following an overnight polysomnography. JIA children with and without OSA were matched for age, sex, and apnea hypopnea index (AHI). Shotgun proteomics was applied and to assess the differences in relative protein abundance between subject populations, individual protein spectral counts were normalized using the spectral index (SI) metric.

**Results:** Approximately 900 unique proteins were identified, of which 315 were detectable in more than half of the samples and were further analyzed. Using the statistical methods, 35 proteins were identified as differentially expressed between the two groups. Several candidates including LPA (Apolipoprotein a), FLNB (Filamin B), MT1A (Metallothionein 1A), and RNASE1 (Ribonuclease E1) were selectively upregulated in JIA children with OSA. Several previously reported OSA-associated urine proteins (uromodulin, orosomucoid, and kallikrein) were also detected, but no significant difference in their abundance was found between JIA children with OSA vs. JIA without OSA.

**Conclusion:** Using an unbiased proteomics approach, we identified putative biomarkers of OSA in children with JIA. Whether these proteins are linked directly to OSA or represent a more generalized inflammatory response through an interaction with JIA is unknown. Our study is a first step in developing mechanistic models to understand the complex relationship between OSA and JIA in at-risk children.

**Support (If Any):** National Institute of Nursing Research at the National Institute of Health, (NR012734) [TMW]; Center for Research on Management of Sleep Disturbances, National Institute of Nursing Research at the National Institute of Health, (NR01400) [TMW, SAG], and University of Washington, School of Nursing, Research Intramural Funding Program (TMW, SAG).

### 0877

**SUBJECTIVE REPORTS OF PAIN IN PEDIATRIC OBSTRUCTIVE SLEEP APNEA PATIENTS: RELATIONSHIP WITH POLYSOMNOGRAPHIC PARAMETERS**

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**Introduction:** In pediatric OSA, lower SpO2% nadir related to lower post adenotonsillectomy need for morphine, suggesting hypoaesthesia. However, in adult OSA pain sensitivity was reduced by CPAP, and opposing effects of sleep fragmentation and hypoxemia were proposed. Presently, child- and parent-reported pain ratings were related to PSG variables.

**Methods:** Parents of 28 children referred for PSG (15 girls; 2-17y.o.; free from neurological, endocrine and psychiatric conditions) filled out parts of PedsQL on the PSG evening. Twelve children ≥ 5y.o. completed PedsQL items and Wong-Baker FACES in the evening and following morning. Visual analog measures of present and prior week’s pain and, separately, frequency of hurt/aches over the prior 7 and 30 days were averaged per rater. All PSG and pain measures were ranked due to skew. Pain scores were separately regressed on PSG measures, controlling for age and BMI.

**Results:** Mean AHI = 13.3 ± 27.3. Increase in children’s morning FAC-ES-rated pain, relative to evening, was associated with lower SpO2% nadir (p = 0.036), longer time below SpO2 90% (p = 0.049), greater 4% desaturation index (p = 0.008) and higher AHI (p = 0.018). Longer time spent below SpO2 90% related to higher parent-rated child’s pain on visual analog scales (p = 0.008) and on hurt/aches frequency items (p = 0.086). No child- or parent-rated pain measures related to sleep efficiency, sleep stage percentages, spontaneous and total arousal indices after controlling for age and BMI.

**Conclusion:** These preliminary data suggest a hyperalgesic effect of both respiratory event frequency and associated oxyhemoglobin desaturations in pediatric OSA. The acute hyperalgesia was evident on the child-reported increase in post-PSG morning pain ratings, while the chronic effect, albeit less robust, was evident on parent-reported increase in retrospective pain measures. The present link between OSA-related hypoxemia and elevation in subjective pain is not consistent with the prior research, likely due to differences in pain measures employed.

### 0878

**THE PREDICTIVE VALUE OF INDIVIDUAL EPWORTH SLEEPINESS SCALE QUESTIONS FOR OBSTRUCTIVE SLEEP APNEA IN PEDIATRIC PATIENTS**

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**Introduction:** The Epworth Sleepiness Scale (ESS) is widely used to assess daytime sleepiness in adults. It has been previously demonstrated that the total ESS score is lower in children than in adults in general, and in children < 5 years old, there is no difference in the ESS for patients with and without Obstructive Sleep Apnea (OSA). This study addresses the correlation between each of the ESS questions and the outcomes of polysomnogram evaluation for OSA in children. We hypothesize that the ESS questions will vary in their predictive value for OSA, and that one or more of the ESS questions can be useful to predict OSA.

**Methods:** A retrospective chart review was conducted to identify 100 consecutive patients ages 0-17 that were evaluated in the Sleep Disor-
WORSHIP OF THE ESS QUESTIONS IN THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA IN ADOLESCENTS AGED 12-17 YEARS

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Introduction: The WatchPAT is a Home Sleep Testing (HST) device which has been shown to be accurate for diagnosing sleep disordered breathing (SDB) in adults. It is based on Peripheral Arterial Tone (PAT) signal, pulse rate, oxygen saturation and actigraphy. Most previous validation studies so far focused on adults (age 17 and up). In the current study we sought to examine the accuracy of the WatchPAT in detecting SDB in patients aged 12-17 years.

Methods: 20 patients (14 males), age 13.2 ± 1.1 years, with suspected SDB, who were referred for a sleep study in either Soroka Medical Center or Carmel Medical Center underwent a full night in-lab simultaneous polysomnography (PSG) and WatchPAT (Itamar-Medical, Caesarea, Israel) recording. Manual PSG scoring was performed by experienced PSG technologists, who were blinded to the automatic scoring of the WatchPAT.

Results: Twenty adolescent patients participated (average BMI 22.4 ± 6.7 kg/m2) after their parents had signed an informed consent. No side effects were recorded and there was no termination of participation due to inconvenience. Using a threshold AHI ≥ 10, the sensitivity and specificity of the WatchPAT were both 100%. Pearson correlation between WatchPAT AHI and PSG AHI was 0.92, p < 0.001. The overall accuracy of the WatchPAT in detecting sleep stages based on an epoch by epoch comparison with PSG was 64.6%. Kappa agreement was 0.51 (compared to 0.47 previously reported in adults).

Conclusion: These findings indicate that the WatchPAT can accurately detect SDB events and sleep stages in adolescents aged 12-17 years with suspected SDB and it can be applied safely with no apparent inconvenience. Larger scale studies are required to confirm these findings.

Support (If Any): The study was supported by a none-restricted grant from Itamar Medical

CAN THE OSA-18 BE IMPROVED FOR USE AS A TRIAGE TOOL FOR SLEEP DISORDERED BREATHING SEVERITY IN PEDIATRIC RESPIRATORY MEDICINE CLINICS?

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Introduction: The OSA-18, a health-related quality of life measure, has been implicated as a possible triage tool to prioritize children with suspected severe sleep disordered breathing (SDB) for specialist consultation. Validation studies show the OSA-18 is a poor predictor of SDB severity. We aimed to increase the diagnostic accuracy of the OSA-18 by improving its psychometric performance.

Methods: Parents of snoring children and non-snoring controls completed the OSA-18 at the time of overnight oximetry (n = 366, 6 mo-16.4y, 34% male), or polysomnography (n = 216, 2-12.5y, 57% male). The OSA-18 is a 7 scale Likert type questionnaire with 18 questions in five domains. Rasch measurement was used to construct a scale on which category thresholds for each OSA-18 item were located with a thorough analysis of fit of the data to the model.

Results: Four response categories for each item was reliably scored with poor discrimination between “Hardly any of the time” and “A little of the time”, and between “A good bit of the time” and “Most of the time”. Analysis of fit confirmed the 18 items reflected a single scale construct after collapsing of categories. Questions 2 (breath holding spells), 15 (worry about child’s general health), 16 (concern child not getting enough air), 17 (interfered with ability to perform daily activities) and 18 (made you frustrated) were the most discriminating. Differences in mean Rasch measures were observed between the controls and children with SDB (mean ± STD 4.8 ± 0.75), but not between SDB severity categories (2.1 ± 1.4, primary snoring; 1.6 ± 1.3 mild OSA; 1.6 ± 1.2 moderate/severe OSA).

Conclusion: Improving the psychometric performance of the OSA-18 is possible by collapsing the Likert scale categories, however this did not improve its ability to determine SDB severity. Prospective studies examining the efficacy of modified response categories and focussing on better performing discriminatory items to identify SDB severity merits further investigation.

Support (If Any): This study was supported by a National Health and Medical Research Council of Australia project grant (491001 and I010810) and the Victorian Government’s Operational Infrastructure Support Program.
ATTAINING AN INTERNATIONAL CONSENSUS IN TREATING CHILDREN WITH POSITIVE AIRWAY PRESSURE (PAP): APPLICATION OF THE NONINVASIVE AIRWAY PRESSURE IN PEDIATRIC SURVEY (NAPPS)


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Introduction: Positive airway pressure (PAP) is frequently used to treat sleep disordered breathing (SDB) in children. Administration of PAP to treat SDB in children is highly variable, and a consensus is needed to determine the best practices towards managing this challenging population.

Methods: Data collection of opinions by practitioners who routinely manage children for sleep-disordered breathing was conducted using the global NAPPS survey. In brief, experts in the field assembled questions seeking to determine the demographic of practitioners using PAP in children; parameters they used to decide when to initiate PAP and finally how they effectively maintained children on PAP. The NAPPS online survey was created using REDCap and invitations were sent to practitioners electronically using various mechanisms.

Results: 137 respondents participated in NAPPS for which 129 were eligible on their experiences administering PAP in children < 18y. 106 respondents participated in a PAP demographic survey, 90 in an OSA survey, and 72 in a survey on nocturnal hypoventilation. Not all respondents answered all questions and participation reduced as practitioners sought to determine the best practices towards managing this challenging population.

Notwithstanding, there is considerable variability observed in describing practitioners who routinely implement PAP in children.

Introduction: Positive airway pressure (PAP) is considered mainstay to treat many children with sleep disordered breathing. Initiation and titration of PAP therapy in children is highly variable and strategies are sought to determine the best practice when starting a child on PAP.

Methods: Data collection of opinions by practitioners who routinely manage children for sleep-disordered breathing was conducted using the global NAPPS survey. In brief, questions seeking to determine the demographic of practitioners who routinely use PAP in children; parameters they use to decide when to initiate PAP and finally how they effectively maintain children on PAP. The NAPPS survey was created using REDCap and invitations were sent to practitioners electronically using various mechanisms.

Results: 137 respondents participated in NAPPS, which 129 were eligible; not all respondents completed every question as a result each question was examined individually. The majority of respondents were from North America (70/106). PAP was most frequently initiated (97/106-92%) in the sleep lab; in contrast to in hospital (35/106-33%) and finally at home (6/106-6%). Polysomnography mounting varied substantially amongst respondents. Pulse oximetry was most frequently used (101/106-95%), EEG monitoring was used by (89/106-84%), PAP pressure signals were used by (83/106-78%) and Transcutaneous carbon dioxide (PtcCO2) monitoring was used by (65/106-61%). PAP titrations mostly performed by sleep technologists (88/106-83%) followed by respiratory therapists (33/106-31%) and nurses (16/106-15%). Most cited having personnel with formal certification (85/106-80%). Application of PAP titration guidelines was observed by 58 of 83 respondents (70%) for obstructive sleep apnea and 41 of 62 respondents (66%) for nocturnal hypoventilation.

Conclusion: There is considerable variation for initiation and titration of PAP therapy in children. It may be difficult to attain consensus on ideal Polysomnography monitoring for PAP titration given the dissimilarity of resources available to most respondents.

THE ROLE OF POLYSOMNOGRAPHY IN MONITORING CPAP SETTINGS OVER TIME IN CHILDREN WITH OSA

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Introduction: Obstructive sleep apnea (OSA) is a common childhood condition with multiple potential sequelae. Adenotonsillectomy is the preferred first-line treatment. However, some children have residual OSA after surgery and require CPAP. Prior studies have demonstrated CPAP therapy improves symptoms and polysomnographic (PSG) findings in children with OSA. There is little to no data on how often CPAP requirements for children may change over time. The goal of this study
was to determine which patient characteristics (e.g. age < 1 year, obesity, change in weight, Down's syndrome, low tone/neuromuscular, length of time between titrations, severity of OSA) were associated with a significant change in CPAP settings (+/− 2 cmH2O or greater) or change in mask / interface at the first follow up titration within one year of baseline PSG.

Methods: This study was a retrospective chart review of children aged 0 - 18 years who had a baseline PSG and at least 2 CPAP titration studies in the past two years at a single academic institution. Patient characteristics collected include demographics, medical history, surgical history, body mass index (BMI), and baseline PSG measures. Outcome measures were a CPAP pressure change of at least 2 cm H2O or mask change.

Results: We identified a convenience sample of 9 children meeting inclusion criteria. Three out of nine children (33%) had an increase in BMI by 2 kg/m2 and a subsequent increase in PAP setting with or without a change in mask used. Three subjects (33%) had no significant change in BMI, CPAP settings, or mask. Three subjects (33%) had a CPAP and/or mask change without a change in BMI.

Conclusion: Our pilot study suggests that change in BMI may correlate with change in CPAP settings in children. A planned future study of a larger cohort will help elucidate this relationship.

0884
IMPROVING PEDIATRIC CPAP ADHERENCE: EXAMINING THE COST-EFFECTIVENESS OF AN INTENSIVE PEDIATRIC CPAP PROGRAM

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Introduction: Continuous positive airway pressure (CPAP) is effective in treating obstructive sleep apnea in children, but adherence to therapy is generally low. Our center created an intensive CPAP program that aimed to improve adherence among pediatric patients. Our objective was to estimate the efficacy, cost, revenue and break-even point in a generalizable manner for an intensive CPAP program relative to a standard approach.

Methods: The intensive program included a device consignment program enabling immediate access to CPAP, behavioral psychology counselling and frequent follow-up/counseling telephone calls. Economic modeling considered the costs, revenue and break-even point in a generalizable manner for an intensive CPAP program relative to a standard approach.

Results: Prior to the intensive CPAP program, only 67% of 244 patients initiated on CPAP appeared for a follow-up clinic visit and only 38% had titration polysomnograms. In contrast, 84% of 275 patients initiated on CPAP after beginning the intensive program appeared for follow-up visits (p < 0.0001) and 75% of those patients had a titration polysomnograms (p < 0.0001). For a hypothetical 150-patient program, Medicare reimbursement levels are insufficient to cover the estimated costs of the intensive program; break-even points would need to be 1.2-1.85 times higher to cover component costs of the intensive program.

Conclusion: An intensive CPAP program leads to substantially higher follow-up and titration rates, but costs of the intensive program are higher. While affordable at our institution due to the local payer mix and revenue, Medicare reimbursement levels are not sufficient to cover estimated costs. This study highlights the need for enhanced funding for pediatric CPAP programs, due to the special developmental needs of this population, and the long-term health risks of suboptimally treated obstructive sleep apnea.

Support (If Any): LEND Fellowship, The Children’s Hospital of Philadelphia

0885
GROUP EDUCATION AND TELEMEDICINE IN ADOLESCENTS WITH OBSTRUCTIVE SLEEP APNEA: A QUALITY IMPROVEMENT PROJECT

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Introduction: Positive Airway Pressure (PAP) adherence for treatment of obstructive sleep apnea (OSA) is poor in both the adult & pediatric populations. Telemedicine and group education in adults have resulted in some improvement in PAP adherence; however, no literature is available using these interventions with pediatrics. Purpose: To determine if telemedicine and group education increases PAP adherence in previously nonadherent adolescents with OSA with a long distance commute to the Sleep Center. Aims: Upon completion of the program, we will: 1) Determine how many participants are adherent (using PAP greater than 4 hours 70% of the time); 2) Determine if there is improvement in the group’s overall PAP adherence compared to previous adherence.

Methods: Eighty-five charts of patients who were lost to follow up were reviewed. Forty-one patients were excluded and 44 were contacted. Exclusion criteria were developmental delay, non-English speaking, and those who have had 2 discontinued PAP machines by medical provider due to noncompliance. Five patients have been enrolled in the program. The 8 month program consists of group education sessions every other month with a respiratory therapist, pediatric psychologist, and advanced practice registered nurse (APRN) who is supervised by a certified sleep specialist. Telemedicine follow up is conducted on alternating months. This includes a wireless download of the patient’s PAP adherence and a phone call by the APRN to the patient and caregiver twice within that month. Final results will be available when the program ends in March 2016.

Results: Preliminary results: All participants have used PAP to some degree since intervention. One participant is adherent (92.9%). One participant’s adherence has increased from 0% to 35.7%. The group’s overall total usage increased by 44.5% and 4 hour nightly usage by 26.1%. Only 2 patients have participated in all telemedicine and group sessions.

Conclusion: Conclusions will be determined after data analysis in March 2016.

0886
CLINICAL AUDIT STUDY OF HOME-BASED INITIATION OF CPAP IN CHILDREN

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Introduction: Obstructive Sleep Apnoea (OSA) is a serious cause of morbidity during childhood. The mainstay of treatment of OSA in children is adenotonsillectomy. CPAP is the second line of treatment for children with residual OSA after adenotonsillectomy and in children with other risk factors for OSA. This study compiles the experience of CAPAC (Community Acute Post-Acute Care or “Hospital in the Home”) in home-based CPAP initiation in children.
Methods: A retrospective clinical audit was undertaken with review of the electronic medical records (EMR) of all the patients with OSA admitted to CAPAC for home-based CPAP initiation from April 2010 to September 2013 under the Respiratory team of a tertiary Paediatric Hospital.

Results: Over a period of 3 years and 5 months, the CAPAC initiated CPAP at home for 115 children with obstructive sleep apnoea. On analyzing the aetiology and predisposing conditions of OSA, 91 patients (79%) had adenotonsillar hypertrophy of which 88 (97%) eventually underwent adenotonsillectomy. Postoperatively, 61 children out of 88 (69%) could cease CPAP. Other predisposing conditions to obstructive sleep apnoea included obesity, neuro-muscular disorders, Down syndrome, prematurity < 30 weeks, cleft palate, choanal atresia, achondroplasia, cerebral palsy, Treacher-Collins Syndrome and other syndromes.

Conclusion: This audit demonstrates the success, safety and acceptance of a community-based service in the initiation of CPAP at home for children with OSA, with the potential of significant savings on bed-days needed in hospital.

0887 INTERNATIONAL TRENDS IN TREATMENT OF NOCTURNAL HYPOVENTILATION (NH) IN PEDIATRICS: INSIGHTS FROM THE NONINVASIVE AIRWAY PRESSURE IN PEDIATRIC SURVEY (NAPPS)

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Introduction: The importance of optimizing noninvasive respiratory support in children with NH is well understood, but guidelines pertaining to initiation and management of positive airway pressure (PAP) in this population remain undefined. This study describes current practice in the field as a step towards establishing such guidelines.

Methods: Data collection of opinions by practitioners who routinely manage children with sleep-disordered breathing was conducted using the global NAPPS survey. In brief, questions seeking to determine the demographic of practitioners using PAP in children; parameters they use to decide when to initiate PAP and finally how they effectively maintain children on PAP. The NAPPS survey was created using REDCap and invitations were sent to practitioners electronically using various mechanisms.

Results: Of the 129 eligible respondents, 72 (53%) participated in NAPPS for which 90 (71%) participated in questions on OSA; not all completed each question as such questions were examined individually. OAHI, followed by AHI, and then clinical suspicion was considered critical or mostly relevant to start PAP (OAHI: 72(80%) vs. AHI: 57(63%) vs. clinical suspicion: 36(40%) of 90. OAHI cutoff criteria to start PAP varied: OAHI > 1: 19(21%), OAHI > 5: 42(47%), OAHI > 10: 20(22%) of 90 respondents. Most (31/90-34%) participants defined > 6 hours of PAP usage as adherent compared to > 4 hours (23/90-26%). Most defined > 80% of night usage as adherent (44/90-49%) compared to 70-80% of nights (23/90-26%). For non-adherent children, only 30 (33%) reported using formal behavioral modification therapy, this compared to 22 (24%) of respondents who sought additional surgery. Modalities of PAP therapy, as well as mechanisms to follow children were also addressed in NAPPS.

Conclusion: Administration of PAP in children with OSA was found to be highly variable amongst respondents. Notwithstanding, any consensus on how to administer PAP in children with OSA should critically incorporate what is most frequently practiced globally as deciphered through NAPPS.
**0889**

**QUALITATIVE STUDY OF PEDIATRIC CPAP NON-ADHERENCE FACTORS**

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**Introduction:** Non-adherence to continuous positive airway pressure therapy (CPAP) is a major hurdle in pediatric obstructive sleep apnea. The purpose of this qualitative study was to examine findings from interviews between sleep medicine clinical nurses and the parents of children who returned CPAP equipment.

**Methods:** For children whose CPAP equipment was returned to the durable medical equipment supplier between 2012-2015, a phone questionnaire was conducted between the parent and a sleep medicine clinical nurse. Questions ranged from the process of obtaining CPAP equipment to nightly problems with the equipment. Data were statistically analyzed.

**Results:** There were 36 completed questionnaires; children ranged 2-19 years of age, mean age 10y, with a mean CPAP setting of 7 cmH2O. The most frequently reported problems included: child’s age 18/36 (50%), mask 12/36 (33%), insurance/payment 10/36 (28%), machine 4/36 (11%), hassle 4/36 (11%), patient refused 11/36 (31%), humidifier 2/36 (6%), understanding of CPAP 1/36 (3%), tubing 1/36 (3%), pressure too low 1/36 (3%). No parents reported problems with: ramp, pressure too high, cleaning, and dislike of equipment supplier. The parents of eight (44%) children under 10 years of age and 10 (56%) children over 10 years of age, believed the child’s age attributed to non-adherence. Thirteen (36%) of the children’s parents did not feel the CPAP was helpful during the time period that his/her child had it.

**Conclusion:** The most common factors related to CPAP non-adherence were the child’s age, mask problems and insurance/CME issues. Interestingly, one third of parents reported no benefit from CPAP therapy.

**0890**

**SLEEP STUDY SUCCESS: A RETROSPECTIVE REVIEW FROM A PEDIATRIC PAP DESENSITIZATION CLINIC**

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**Introduction:** Positive airway pressure (PAP) is an effective therapy for treatment of obstructive sleep apnea (OSA); however adherence to the regimen is often poor. Prior to using PAP therapy at home, patients must undergo an overnight titration to determine optimal settings. Youth, particularly those with developmental delays, often have difficulty tolerating the titration and thus treatment is prematurely discontinued. Few interventions examining PAP tolerance and adherence have been developed and empirically studied for youth with OSA. Our Desensitization Clinic offers an outpatient-based program utilizing behavioral principles such as extinction and differential attention to optimize child tolerance to PAP therapy. We aim to describe the patient demographics and outcomes following treatment in our PAP Desensitization Clinic.

**Methods:** A retrospective chart review was conducted for all patients who were seen in the Desensitization Clinic in 2014, or had a titration study in 2014 following at least one session in the clinic. A query of the electronic medical record system was utilized to identify patients, and staff examined the patient charts for relevant data. Descriptive statistics are reported.

**Results:** 101 patients were included in the review, 57.4% male, and 50% Caucasian. Average age was 7.47 years (SD = 4.59) and mean apnea-hypopnea index was 19.1 (SD = 25.74). The majority of patients had a diagnosis of Down Syndrome (54.5%). On average, patients completed 1.8 sessions in the clinic (SD = 1.2), with 8.79 follow-up phone calls from clinic staff (SD = 7.08). Of the 60 patients that attempted a titration during the study period, 98.3% had successful completion. Time from initiation of treatment to titration was on average 225.55 days (SD = 285.57).

**Conclusion:** Behavioral strategies such as those utilized in the Desensitization Clinic may be effective in increasing PAP tolerance and preparing children for a successful titration study. Further research is needed in order to evaluate treatment on long-term PAP adherence.

**0891**

**CHILD’S PLAY: THE UTILITY OF PAP NAPS FOR CPAP COMPLIANCE**

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**Introduction:** Obstructive sleep apnea affects 1.2-5.7% of children. Adenotonsillectomy is curative in 76-90% of cases. However, if OSA persists postoperatively or if T&A is not performed, positive airway pressure is recommended as treatment. There is a paucity of literature on PAP adherence in the pediatric population. What does exist shows 50-80% adherence, with improved adherence observed at institutions with intensive inpatient and/or outpatient support. Dr. Barry Krakow demonstrated that PAP naps can be successful at improving PAP adherence in adults with insomnia. The impact of PAP naps on pediatric PAP adherence has not been studied. Thus, we hoped to assess if PAP naps could lead to rates of compliance on par with the more intensive protocols used at other institutions.

**Methods:** We performed a retrospective chart review of 24 pediatric patients who had PAP naps, PAP titration, and routine follow up. Exclusion criteria included children who did not show for follow up appointments or PAP titration, or never obtained PAP device.

**Results:** We found that children who underwent PAP naps had similar rates of PAP compliance within one year to those previously demonstrated in other PAP adherence data. Compliance was defined as > 70% of days used or > 4 hours of use. To date, 62% of patients were compliant. This included patients with trisomy 21, developmental delay, craniofacial anomalies, psychiatric conditions, and adolescents.

**Conclusion:** PAP naps are a billable procedure that results in rates of compliance that are comparable to compliance rates achieved with intensive, non-billable inpatient and/or outpatient resources, and would be an effective tool for smaller centers and community clinics to improve their rates of CPAP adherence.

**0892**

**ADHERENCE PATTERNS IN PAP USE AMONG PEDIATRIC PATIENTS**


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**Introduction:** Positive airway pressure (PAP) is an effective treatment for pediatric OSA, but studies suggest wide variability in adherence. Few data are available on the natural course of acclimatization to PAP or predictors of adherence.

**Methods:** Children aged 5-12 were randomized to PAP or routine care for 6-8 months following adenotonsillectomy. A subset of subjects (n = 38) randomized to PAP and who completed participation in this ongoing trial, provided data for the current report. Electronic adherence monitoring, phone and text follow-up, and when needed study visits with a nurse and child psychologist, were used to promote adher-
FREQUENCY OF OVERJET AND OVERBITE DENTAL MALOCCLUSION PATTERNS IN CHILDREN BEING EVALUATED WITH PSG FOR OSA: PRELIMINARY DATA

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Introduction: Dental malocclusions may be associated with obstructive sleep apnea (OSA), but little is known about the rate at which these patterns occur in children subsequently diagnosed with OSA. The purpose of this study was to determine the rate of overjet and overbite patterns in children suspected of OSA following in-lab polysomnography (PSG).

Methods: A retrospective chart review was performed on all children (N = 130, ages 2-18 years) in a 7-month period (12/2014 - 6/2015) who were initially seen in clinic for suspected OSA and subsequently studied with in-lab PSG. Dental malocclusions were characterized as: ‘overjet’ (upper front teeth significantly ahead of lower front teeth), ‘overbite’ (vertical overlap of upper and lower front teeth) or ‘normal’ by attending physicians and/or sleep MD fellow trainees in initial clinic visit patient summary reports. OSA was measured by the apnea hypopnea index (AHI). SPSS 22.0 was used to report descriptive and Chi-square analyses between groups (p < 0.05).

Results: Occlusal patterns were documented in 45 of 130 charts (34.6%). These subjects were 62% (n = 28) Black and 20 (44%) were female. Average age (mean ± s.d.) was 8.8 ± 4.4 and AHI was 8.1 ± 21.4. Overjet was found in 35.6% (n = 16) and overbite in 26.7% (n = 12) of subjects. African American and White subjects did not differ significantly on rates of overjet (10 vs. 6, χ2 = 1.86, p = .395) and overbite (6 vs. 6, χ2 = 3.74, p = .154), neither did rates for females vs. males.

Conclusion: Of children with documented evidence of dental malocclusion, overjet was most frequently observed. Overbite may be more prevalent in African American children, but further study and larger sample sizes are needed. Moderate OSA (AHI = 8.8) was found in children with both of these malocclusions indicating the need for symptom assessment when seen in dental or medical settings.

FREQUENCY AND SEVERITY OF OSA IN CHILDREN WITH DENTAL MALOCCLUSION (OVERJET AND OVERBITE) PATTERNS: PRELIMINARY DATA

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Introduction: Dental malocclusions may be associated with obstructive sleep apnea (OSA) in childhood, but little is known about how these bite patterns are associated with polysomnographic (PSG) measures of OSA. The purpose of this study was to examine how two common dental malocclusions (overjet and overbite) may be related to PSG-measured OSA severity in children.

Methods: A retrospective chart review was performed on all children (N = 130, ages 2-18 years) in a 7-month period (12/2014 - 6/2015) who were initially seen in clinic for suspected OSA and subsequently studied with in-lab PSG. OSA severity was measured by the apnea hypopnea index (AHI) and rapid eye movement AHI (REM AHI). Dental malocclusions were characterized as: ‘overjet’ (upper front teeth significantly ahead of lower front teeth), ‘overbite’ (vertical overlap of upper and lower front teeth) or ‘normal’ by attending physicians and/or sleep MD fellow trainees in initial clinic visit patient summary reports.
SPSS 22.0 was used to report descriptive and Student t-test analysis between groups (p < 0.05).

**Results:** Occlusal patterns were documented in 45 of 130 charts (34.6%). These subjects were 62% (n = 28) Black and 20 (44%) were female. OSA was diagnosed in 22 (48.9%), OSA plus additional sleep disorders in 10 (22.2%) and nonOSA/other sleep disorders were found in 13 (28.9%). Overjet and overbite were seen in 16 (35.6%) and 12 (26.7%) patients, respectively. AHI was not significantly different between those with either malocclusion. REM AHI was significantly lower in those with overbite (3.0 vs. 23.1, t = -3.06, p = 0.009) but not overjet (9.1 vs. 21.4, t = -1.35, p = 0.191).

**Conclusion:** OSA is frequently diagnosed in children with dental malocclusions. It may be that milder levels of OSA are associated with overbite and overjet patterns, but further research on larger sample sizes is needed.

**0896**

**POLYSOMNOGRAPHY (PSG) GUIDED MANDIBULAR ADVANCEMENT SURGERY FOR CHILDREN WITH MICROGNATHIA - TAKING AWAY THE GUESSING**

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**Introduction:** Congenital micrognathia result in obstructive sleep apnea (OSA) due to decreased pharyngeal airway. With the early use of mandibular distraction surgery (MDS), tracheostomy can be avoided.

**Methods:** Between January and December 2015 children with micrognathia resulting in severe OSA/respiratory failure from one tertiary care center were recruited. All patients underwent MDS and had PSGs. PSG was performed prior to surgery, if possible. MDS was performed until the surgeon (JMN) determined the advancement was appropriate by traditional technique. PSG was performed then, and if not significantly improved, advancement continued with repeated PSGs every 2 days until significant improvement, defined as apnea hypopnea index (AHI) < 5 events per hour with no associated desaturations.

**Results:** Five children met the inclusion criteria. Average age at presentation was 13 months (range: 0.3 - 60 months). There was 1 female. Three were diagnosed with Pierre Robin sequence. Two patients were diagnosed within the first 2 weeks of life and underwent MDS in the Neonatal Intensive Care Unit. Three patients presented at an older age with complaints of snoring, failure to thrive, stridor and gastroesophageal reflux. Four patients had baseline PSG showing severe OSA and one patient presented with respiratory failure prior to PSG. Baseline PSGs showed average AHI of 40.5 events per hour, associated with severe oxygen desaturations. Advancement end point per surgery was on average at day 8 (range 5-10). One patient had normal PSG at the point advancement determined sufficient by the surgeon, 2 patients showed significant improvement at the second post operative PSG, and 2 patients required further distraction for 2 extra days.

**Conclusion:** This is the first case series utilizing post operative PSGs as a guide for MDS in patients with micrognathia. This study shows the superiority of using PSGs over the traditional technique of determining adequacy of MDS.

**0897**

**SLEEP DISORDERED BREATHING AND MAGNETIC RESONANCE IMAGING FINDINGS IN CHILDREN WITH CHIARI MALFORMATION TYPE I**

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**Introduction:** Chiari malformation type I (CM-I) has been associated with sleep disordered breathing (SDB) with a variable prevalence in pediatric population (24-70%). The aim of this study was to evaluate the prevalence of SDB and magnetic resonance imaging (MRI) findings in a pediatric cohort with CM-I.

**Methods:** This was a single center retrospective study that included all children with a history of CM-I who underwent overnight polysomnography (PSG) in the University of Louisville pediatric sleep center over a period of 3 years. We performed a retrospective chart and MRI review. Apnea hypopnea index (AHI) > 1 was used to define SDB.

**Results:** We identified a total of 37 subjects. After excluding 11 patients who had decompression surgery prior to PSG, the prevalence of SDB was 61.5%. We divided the patients who never had decompression surgery into 2 groups. Group with SDB (group I) and a group with no SDB (group II). The median age for group I was 8 years (IQR: 2.5-11) versus 5 years (IQR 4-6; P = 0.633) in group II. The median BMI z-score in group I was 0.855 (IQR: -0.05-1.71) and 0.49 in group II (-0.25-0.98; P < 0.001). Group I had more females (56.2%) than group II (30%). Group I had higher AHI 3.1 (IQR: 2.1-6.3) than group II 0.45 (IQR: 0.2-6.6; P < 0.001) as well as lower oxygen nadir of 86.5% (IQR: 85.5-91.5) versus 94% (IQR: 92.9-96; P = 0.0023). The median tonsillar herniation was 9.5 mm in group I (IQR: 6.5-11) and 7.5 mm in group II (IQR: 5-9; P = 0.21). Group I had more megged cerebellar tonsils (68.75%) than group II (40%). Spinal cord syrinx was found in 12.5% of group I but none in group II.

**Conclusion:** Sleep disordered breathing has a high prevalence in children with CM-I. Screening for SDB is prudent in this population.

**0898**

**INCREASED PLASMA LEVELS OF ASYMMETRIC DIMETHYLARGININE (ADMA) IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA**

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**Introduction:** Obstructive Sleep Apnea (OSA) in children is associated with cardiovascular morbidity. Increased asymmetric dimethylarginine (ADMA) levels have been implicated as possible mechanisms for development of cardiovascular diseases.

**Methods:** Children aged 6 to 12 years who were diagnosed with OSA after overnight polysomnography (PSG) and control children matched on the basis of age and gender underwent blood draw before their adenotonsillectomy (T&A) surgery. Plasma ADMA levels were estimated by using the HPLC technique. OSA was classified as Mild (1 < AHI < 4.99 events/hr), Moderate (AHI ≥ 5-9.99 events/hr) and Severe OSA (AHI ≥ 10 events/hr). AHI ≤ 1/hr. was considered as No-OSA, p < 0.05 was considered statistically significant.

**Results:** Fifty-three children were included in this study (23 Female and 30 Male) with mean age of 5.5 ± 2.7 years. The mean AHI was 11.7 ± 9.8 events/hr. Nine (16.7%) children had Mild-OSA, 14 (25.9%) had Moderate-OSA, 23 (42.6%) had Severe-OSA and the remaining 8 (14.8%) had No-OSA. ADMA levels were significantly increased in
patients with OSA compared to patients without OSA (p < 0.05). After dividing patients into Mild, Moderate and Severe OSA groups, stepwise increased ADMA levels were observed in patients with increased severity of OSA (p < 0.05).

**Conclusion:** ADMA levels are increased in children with OSA. In addition, plasma ADMA levels were increased with the increasing severity of OSA in children. This may be related to the increased cardiovascular disease in OSA patients.

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### 0899 CARDIOVASCULAR BIOMARKERS IN OBESE CHILDREN WITH OBSTRUCTIVE SLEEP APNEA: LIPOPROTEIN A AND HIGH SENSITIVITY C-REACTIVE PROTEIN (HS-CRP)


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**Introduction:** Increased systemic inflammation is associated with cardiovascular risk and adult obstructive sleep apnea (OSA). Limited data exists in obese children with OSA. We postulate that inflammatory markers, C-reactive protein (hs-CRP) and lipoprotein A, are increased in obese children with OSA.

**Methods:** Retrospective review of a tertiary pediatric obesity clinic was performed between 2013-2015. Patients with polysomnogram (PSG) and laboratory tests were included. Significant OSA was defined as apnea-hypopnea index, (AHI) ≥ 5)/percentage/ sleep time with oxygen saturation < 90% (Sat < 90). Linear and nonlinear relationships were examined using multivariable regression analysis with lipoprotein A and hs-CRP as outcome variables and AHI as predictor. Age and body mass index (BMI, kg/m²) were included as covariates. Coefficients (95% confidence intervals) are presented.

**Results:** In 53 patients: mean age was 11.3 ± 7.4 years; average BMI was 99.4[98.6, 99.8] percentile; 43% were female; 17%, 44% and 35% were Hispanics, Caucasian and African American respectively. A positive linear association of hs-CRP relative to AHI (β = 0.025 (0.003, 0.047), p = 0.046) and Sat < 90 (β = 0.19 (0.072, 0.317) p = 0.002) was observed after adjusting for confounders. There was no associations of lipoprotein A with AHI (β = -0.015 (-0.059, 0.028), p = 0.48) or Sat < 90 (β = -0.02 (-0.23, 0.195), p = 0.84). 66% patients with significant OSA (AHI ≥ 5) vs. 50% patients without significant OSA (AHI < 5) had high risk category hs-CRP levels (hs-CRP > 3). (p = 0.4). Lipoprotein A (AHI ≥ 5) was elevated in 50% of patients with OSA (AHI ≥ 5) vs. 40% without (p = 0.55). There were no group differences in BMI, age, gender, ethnicity, or in co-morbidities such as hypertension, dyslipidemia and insulin resistance/pre-diabetes prevalence.

**Conclusion:** In this obese pediatric clinic-based sample, a significant association was observed with hs-CRP and OSA indices (AHI and Sat < 90); a findings not observed with lipoprotein A. However, both groups had elevations in lipoprotein A. These biomarkers may have different pathways that affect cardiovascular outcomes and the effects of OSA needs further evaluation.

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### 0900 SYSTEMIC INFLAMMATION MEDIATES THE ASSOCIATION BETWEEN VISCERAL ADIPOSENESS AND OBSTRUCTIVE SLEEP APNEA IN ADOLESCENTS


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**Introduction:** Only a handful of studies, and primarily in clinical samples, have reported associations between central obesity, systemic inflammation, and obstructive sleep apnea (OSA) in children and adolescents. No study has examined this relationship in a general population, nor explored the potential direction of the association.

**Methods:** Adolescents (n = 392) followed up from the Penn State Child Cohort (age 17.0 ± 2.2y, 53.9% male, 22.3% ethnic minority) underwent a single 9h polysomnography. OSA was defined as an apnea/hypopnea index (AHI) ≥ 5. Visceral fat area was measured via DXA scan. A blood draw was taken upon awakening (7:00), and plasma levels of interleukin-6 (IL-6) and C-reactive protein (CRP) were measured via ELISA. The mediating effect of inflammation on the relationship between visceral fat area and OSA was assessed via mediation analysis. Those with AHI ≥ 5 at baseline (n = 6) were excluded.

**Results:** Of 392 participants, 11.2% had OSA. Visceral fat was highest in those with OSA (87.3 ± 5.9 cm²) compared to those with no sleep-disordered breathing (50.9 ± 3.3 cm²), primary snoring (55.8 ± 3.9 cm²), and 2 ≤ AHI < 5 (67.2 ± 3.8 cm²; all p < 0.01). Plasma levels of IL-6 (1.9 ± 0.2 pg/mL) and CRP (2.1 ± 0.2 mg/L) were also elevated in those with OSA (all p < 0.01), even after adjusting for age, gender, BMI percentile, and ethnic minority status. Visceral fat area significantly predicted levels of IL-6 (standardized β = 0.33, p < 0.05) and CRP (β = 0.41, p < 0.001), even after further adjusting for baseline AHI. Mediation analysis revealed that 82% of the association between visceral fat and OSA was mediated by CRP (p = 0.01), while 42% of the association was mediated by IL-6 (p = 0.03).

**Conclusion:** Our findings point to a model in which the link between visceral adiposity and development of OSA is strongly mediated by systemic inflammation. These findings add to our understanding of the developmental pathogenesis and potential treatments for OSA.

**Support (If Any):** Our findings point to a model in which the link between visceral adiposity and development of OSA is strongly mediated by systemic inflammation. These findings add to our understanding of the developmental pathogenesis and potential treatments for OSA.

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### 0901 RELATIVE ASSOCIATION OF SLEEP DISORDERED BREATHING AND CENTRAL OBESITY WITH BEHAVIORAL PROBLEMS IN ADOLESCENTS FROM THE GENERAL POPULATION

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**Introduction:** Sleep-disordered breathing (SDB) has been associated with behavioral problems in young children; however, this association has been less studied in adolescents. We examined whether SDB is associated with behavior problems in a large sample of adolescents.

**Methods:** 421 adolescents (17.0 ± 2.2y, 53.9% male) from the Penn State Child Cohort, a representative general population sample, underwent a 9-hour polysomnography recording, and completed the Child (12-17y) or Adult (18-23y) Behavior Checklist (CBCL/ABCL). Moderate SDB was defined as AHI ≥ 5, mild SDB as 2 ≤ AHI < 5, primary snoring as snoring + AHI < 2, and no-SDB as the absence of any of these categories. Measures of obesity included body mass index (BMI) and waist circumference based on physical examination as well as visceral fat area, as measured via DXA scan. MANCOVA and linear regression analyses assessed the association of SDB, obesity, and metabolic syndrome with various behavioral problems, adjusting for age, gender, race, insomnia, total sleep time, and evenness.

**Results:** There were no significant differences between SDB groups across any subscale of internalizing (e.g., anxiety/depression, somatic) or externalizing (e.g., inattention, rule-breaking) behaviors. When measures of body weight were added to regression models, waist circumference and visceral fat were significantly associated with greater internalizing and externalizing behaviors (p < 0.05), while BMI percent-
tile was marginally or non-significantly associated (p < .10). A composite score of metabolic syndrome was a better predictor of greater internalizing (p < .01) than externalizing (p < .15) behaviors.

**Conclusion:** SDB alone was not associated with internalizing or externalizing behavioral problems in adolescents. Central obesity, an etiopathogenic mechanism of SDB, is a better predictor of behavioral problems than SDB per se in adolescents. These data further support that SDB is a component of the metabolic syndrome and its associated behavioral morbidity.

**Support (If Any):** NIH's R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499

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### 0902

**CHARACTERIZING CHRONIC RESPIRATORY DISEASES OF INFANCY**


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**Introduction:** Premature infants have risk of chronic respiratory disease, apnea of prematurity (AOP) and chronic lung disease prematurity (CLD). We characterized their baseline characteristic and response to therapy.

**Methods:** We retrospectively reviewed infants < 1 year old and evaluated at our sleep center (Kaiser Permanente, Fontana) and diagnosed with a chronic respiratory disease. Most underwent nap polysomnography (PSG), but occasionally overnight PSG. Repeat PSGs performed every 1-2 months until therapy weaned. Baseline clinical characteristic/history and response to therapy parameters were assessed.

**Results:** From January 2013 to May 2015, 65 (30 girls; 35 boys) infants were diagnosed with AOP and/or CLD. 22 infants (mean gestational age 26.1 ± 3.2 weeks) were diagnosed with CLD only: baseline AHI 6.2 ± 6.1, T90% 11.9 ± 18.0, minimum oxygen saturation 81.5 ± 8.4%. Oxygen (median 0.125 LPM; range 0.01562-0.75) improved AHI 2.5 ± 2.0 and mean age of disease resolution (therapy weaned) was 9.0 ± 5.1 months. 22 infants (mean gestational age 35.1 ± 4.7 weeks) were diagnosed with AOP only: baseline AHI 45.6 ± 66.4, T90% 5.7 ± 9.2, minimum saturation 81.9 ± 5.3%. Oxygen (median 0.1875 LPM; range 0.01562-0.75) improved AHI 4.7 ± 4.0 (p < .01) and mean age of disease resolution was 5.9 ± 3.9 months. 21 infants (mean gestational age 25.9 ± 6.6 weeks) were diagnosed with both AOP and CLD: baseline AHI 36.6 ± 34.3, T90% 14.1 ± 21.4, minimum saturation 75.6 ± 19.1%. Oxygen (median 0.125 LPM; range 0.01562-0.75) improved AHI 14.4 ± 11.8 (p < .01) and mean age of disease resolution was 8.8 ± 4.7 months. AHI mostly reflected central sleep apnea. All 4 patients with Apparent Life Threatening Events were in the AOP group (none after initiating therapy).

**Conclusion:** While AOP and CLD commonly occurred together, AOP (compared to CLD) were less premature, had more central sleep apnea, and resolved at younger age (but similar post-conception age). Oxygen was effective at stabilizing both central apneas and hypoxemia.

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### 0903

**INFLAMMATION AND ASTHMA CONTROL IN CHILDREN WITH COMORBID SLEEP APNEA**

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**Introduction:** Asthma is a chronic inflammatory airway disease affecting 9% of U.S. children. Obstructive sleep apnea (OSA), another inflammatory disorder, is common in children with asthma, and co-morbid OSA is associated with decreased asthma control. Treatment of OSA by adenotonsillectomy improves asthma control, suggesting a role for OSA-associated inflammation in asthma exacerbation. This ongoing study tests the hypotheses that upper airway and systemic inflammation increase as OSA severity increases, and that increased inflammation is associated with decreased asthma control.

**Methods:** Thirty non-morbidly obese children aged 4-12 years with persistent asthma are being recruited (10 controls, 20 OSA). All children undergo standard in-lab polysomnography. Children with OSA undergo clinically indicated adenotonsillectomy. Upper airway inflammation is measured by exhaled nitric oxide (FeNO) and, in children having adenotonsillectomy, by an 11-cytokine panel measured in a tonsil harvested during surgery. Serum of all children is tested for the same cytokines and 12 aeroallergens. Asthma control is measured by the Child Asthma Control Test (cACT) and missed school days, hospitalizations and emergency visits for asthma exacerbations.

**Results:** To date, 12 children have completed the study including 9 with OSA who underwent adenotonsillectomy, mean BMI z-score -0.016(0.8), mean cACT 20.2(3.3), mean positive aeroallergens 6.1(4.7) and mean apnea-hypopnea index (AHI) in children with OSA 14.9(9.8). Cytokines detected in tonsils and serum of children with OSA were IL-2, IL-4, IL-5, IL-10, IL-12, IL-13, IL-17a, IFN-γ, TNFα; and in serum of controls IL-10, IL-12, IL-13, IFN-γ, TNF-α. Mean levels of nearly all detectable cytokines, and FeNO (47.2 vs. 30.2), were higher in children with OSA than controls, and cACT was lower (worse) in controls than in children with OSA (17.3 vs. 21.1), but none achieved statistical significance.

**Conclusion:** Although the study is ongoing, preliminary results suggest that asthmatic children with OSA may have greater airway and systemic inflammation than controls.

**Support (If Any):** This study is supported by American Lung Association Biomedical Research Grant #RG-307793.

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### 0904

**TRANSITIONING CHILDREN WITH CONGENITAL CENTRAL HYPOVENTILATION SYNDROME (CCHS) FROM INVASIVE VENTILATION (IV) TO NONINVASIVE VENTILATION (NIV)**

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**Introduction:** CCHS is a rare disorder characterized by alveolar hypoventilation particularly during sleep, and patients often need lifelong ventilatory support. As infants, they usually require mechanical ventilation 24 hours/day; necessitating tracheotomy. As they get older, many are able to maintain normal ventilation during wakefulness but require nocturnal ventilatory support and can be safely and successfully transitioned from IV to NIV.

**Methods:** A retrospective chart review was performed on 4 children with PHOX2B mutation positive CCHS transitioned from IV to NIV at Children’s Hospital of Wisconsin. Data was collected to describe the transition process.

**Results:** All 4 children underwent tracheotomy (3 within the 1st 2 months of life and the fourth at age 7 months). Prior to transition, all were on IV during sleep with the Pulmonetics LTV® in SIMV mode. Two transitioned to NIV on the LTV, and 2 on the Respironics Trilogy ventilator. All transitioned from NIV to NIV in Assist Control (volume) mode, and underwent polysomnography (1 child required 4 polysomnograms) with the tracheostomy capped and NIV prior to decannulation. Decannulation was scheduled at a mean age of 9.75 years with a mean ICU stay of 3.25 days. The size of the tracheostomy tube prior to transi-
tion to NIV and decannulation ranged from 3.5-5 mm. Mean interval to tracheocutaneous fistula closure was 1.19 years after decannulation. Three had home nursing while cannulated; 1 retained home nursing after decannulation. None required re cannulation. The services involved in transition included Pediatric Pulmonology, Otolaryngology, Sleep Medicine, Critical Care, respiratory therapy, advanced practice nurses, and durable medical equipment companies.

Conclusion: Transition of children with CCHS from IV to NIV is feasible and can be accomplished safely using an organized, multidisciplinary approach.

0905

OBESITY HYPOVENTILATION IN CHILDREN WITH SUSPECTED SLEEP APNEA
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Introduction: As childhood obesity becomes epidemic, clarifying potential co-morbidities is vital. Relatively little is known regarding the development of obesity hypoventilation syndrome (OHS) as compared to obstructive sleep apnea (OSA). This study explores the prevalence of OHS among obese children referred for suspected OSA.

Methods: Polysomnographic results from January to December 2015 were reviewed. Inclusion criteria: age 3 to 15 years with obesity (BMI ≥ 95th percentile for age and gender) referred for suspected OSA. Known neuromuscular disease or insufficient capnometry data was excluded. Data including demographics, sleep architecture, apnea-hypopnea indices, oxygen saturation nadir, and capnometry were collected. OHS and OSA were defined per the International Classification of Sleep Disorders, version 3, except the obstructive apnea-hypopnea index (OAHI) utilized was ≥ 1.5 apneas and hypopneas per hour of sleep. Simple OSA was OSA without OHS. Simple obesity was obesity without OSA or OHS.

Results: Eighty-two patients were included: 18% had OHS, 57% had simple OSA, 25% had simple obesity. There was no significant central apnea. The baseline pCO2 and %sleep time with pCO2 ≥ 50 were significantly higher in the OHS group as compared to simple OSA (p = 0.007, p = 0.001); there was no significant difference in OAHI (p = 0.1) or oxygen saturation nadir (p = 0.1). There were fewer children referred as part of a tonsillectomy evaluation in the OHS group (47%) than simple OSA (60%). There were more males in the OHS group (73%) than those with simple OSA (57%) or simple obesity (55%). There were no significant differences in age (mean age = 8.4 years), BMI, or sleep architecture among the 3 groups.

Conclusion: Obesity hypoventilation syndrome is common among obese children referred for suspected OSA. There were no clear distinguishing characteristics among children with OHS except a male predominance.

0906

POLYSOMNOGRAPHIC CHARACTERISTICS OF ADOLESCENTS WITH MODERATE TO SEVERE ASTHMA AND LOW RISK FOR SLEEP DISORDERED BREATHING
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Introduction: Asthma impacts approximately 10% of adolescents. Youth with asthma are at increased risk for sleep disturbances, even when their asthma is well-controlled. Only a handful of studies have examined polysomnographic characteristics of youth with asthma, and most of these have only included youth with asthma who present with significant sleep disordered breathing (SDB). Few studies have examined objective sleep in youth with asthma who are at low risk for SDB. The purpose of this study was to examine polysomnographic characteristics in a sample of adolescents with moderate to severe asthma who were at low risk for SDB.

Methods: Participants were 16 non-obese adolescents (56% female, 56% white, mean age = 14.8 years, range 12-17, mean BMI = 21.7) with moderate to severe asthma who scored < 0.33 on the Pediatric Sleep Questionnaire (mean = 0.14), suggesting low risk for sleep disordered breathing. Participants completed the Asthma Control Questionnaire (ACQ), the PROMIS Asthma Impact Scale (PAIS), and overnight polysomnography (PSG).

Results: Five adolescents (31%) had mild SDB (AHI > 2, range 2.3 to 5.8). Compared to normative data (Scholle et al., 2011, n = 25), adolescents with moderate to severe asthma had significantly poorer sleep efficiency (81.9% vs. 94.9%, p = .005), lower mean oxygen saturation (93% vs. 97%, p = .005), lower oxygen saturation nadir (89% vs. 94%, p = .03), longer REM latency (180 min vs. 133 min, p = .001), and less REM (13.1% vs. 19.0%, p = .005). Adolescents with asthma and SDB reported poorer asthma control, F(1,14) = 4.56, p = .05, and more negative symptoms and impact of asthma, F(1,14) = 6.39, p = .02, compared to adolescents with asthma and no SDB.

Conclusion: This study highlights the importance of careful screening for SDB in adolescents with moderate to severe asthma. While participants in this study were considered low risk for SDB, almost a third of them had notable SDB, which can cause poorer quality sleep, and in turn, increased daytime sleepiness. As the relationship between sleep and asthma is complex and bidirectional, additional research is needed to better clarify the pathways between sleep disordered breathing and asthma in adolescents.

Support (If Any): NIH/NHLBI R01 HL119441

0907

PULMONARY HYPTERTENSION IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA
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Introduction: Although obstructive sleep apnea (OSA) is a known risk factor for pulmonary hypertension (PH) in adults, clinical guidelines regarding diagnostic testing for PH, in otherwise healthy OSA children, are lacking. The size and function of the right ventricle have been shown to be critical determinants of outcome in patients with PH. We hypothesized that children with OSA have a higher estimated pulmonary artery pressure and right ventricular dimension compared to matched controls. Moreover, we sought to determine whether treatment for OSA with adenotonsillectomy (T&A) improved these cardiac parameters.

Methods: We reviewed data from two prospective case-control, interventional studies, at a single institution. Children aged 7-13 years with polysomnography confirmed OSA (and without comorbid medical conditions) and those without OSA were evaluated using non-invasive doppler echocardiography. Peak systolic right ventricular pressure (RVSP) (based on estimated flow of the TR jet) and right ventricular (RV) dimensions were calculated. OSA subjects underwent T&A and repeat measures were obtained at sequential follow-up visits.

Results: 242 subjects were ultimately included (113 with OSA and 129 controls); Among OSA patients 38.05% were males, 13.27% were obese (BMI > 30), 49.56% had mild OSA and 50.44% had moderate to severe OSA respectively. After adjusting for potential confounders, es-
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0908
INCIDENTAL FINDING OF HYPOCAPNIA NOTED IN SLEEP
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Introduction: Hypercapnia can implicate the presence of sleep disordered breathing. Conversely, the occurrence of hypcapnia is often overlooked. We report a case series of hypcapnia in children on topiramate (TPM).

Methods: This is a case series of 5 children, all treated with TPM. They presented with symptoms of sleep disordered breathing and underwent diagnostic polysomnography (PSG). 3 were prescribed TPM for epilepsy, 2 for migraine.

Results: Subject age ranged from 6 months to 18 years. 2 subjects were male and 3 were female. None had clinically significant obstructive sleep apnea or central sleep apnea on PSG, though one had periodic breathing. AHI ranged from 0.4-2.1/hr and obstructive index ranged from 0.3-0.7/hr. All had hypcapnea based upon capillary blood gas (CBG) (pCO2 range 27-30.9 mmHg), which correlated with end tidal pCO2 (range 28 to 31 mmHg). CBGs showed low bicarbonate (range 17 to 18 mM, median 17.25 mM), base excess (range -7 to -8 mM, median -8 mM), and pH between 7.35 and 7.40 (median, 7.37). None of the subjects showed clinical signs of hyperventilation, hypoxemia, respiratory instability, or sleep architecture abnormalities.

Conclusion: Hypocapnia was noted in 5 children taking TPM. TPM inhibits carbonic anhydrase, and likely led to metabolic acidosis and compensated respiratory alkalosis. Case reports have shown respiratory alkalosis in children and adults on TPM, though none have included PSG results. Based on this observation, we would suggest that acid-base metabolism should be monitored in children who receive TPM. Most cases of metabolic acidosis and compensated respiratory alkalosis are asymptomatic, though some may result hyperventilation, confusion, and, rarely, coma. During sleep, hypocapnia can cause ventilatory instability and contribute to central apneas and periodic breathing, as seen in one of our subjects. If hypocapnia is found incidentally on PSG, clinicians should explore the possibility of TPM as the cause.

Support (If Any): Cincinnati Children’s Hospital medical center, Department of Pulmonology

0909
INCLUSION OF DIVERSE SAMPLES IN PEDIATRIC BEHAVIORAL SLEEP INTERVENTION STUDIES
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Introduction: Behavioral sleep interventions for infants and young children include a variety of approaches including preventive guidance, modified and unmodified extinction, positive routines, and scheduled awakenings. Studies designed to assess the efficacy of these approaches report improvements in sleep for most young children but the generalizability of these results to children of diverse backgrounds is rarely assessed. The present study is a systematic review of the sociodemographic, racial, and ethnic diversity of previous behavioral sleep intervention studies in young children.

Methods: Twenty-five studies (published 1988-2013) were reviewed assessing behavioral sleep interventions for 2,164 children from birth to 5 years of age. Studies were included from three review papers on pediatric behavioral sleep intervention. Each study was assessed for racial or ethnic composition, parental educational attainment, and country of origin. If this information was not provided in the published article the corresponding author was contacted via email.

Results: Of the 25 studies assessed only four (16%) reported sample racial or ethnic composition and sociodemographic information (e.g., socio-economic status or parental education attainment). We obtained additional information from six studies (24%) via correspondence with the lead author. Of the studies with racial or ethnic data, none of them reported samples that were more than 20% non-Caucasian. Overall, 24 (96%) of the studies were completed in predominantly Caucasian countries and one in a predominantly Asian country. Of the 11 studies with parental education attainment information over half of all participants in the samples had a college degree (and in seven of these studies over 80% of the sample had a college degree).

Conclusion: Previous behavioral sleep intervention studies included samples with minimal racial or ethnic diversity and most participating families were from mid- to high-education households. This study highlights a gap in pediatric sleep intervention research and the need to include families from diverse backgrounds.

0910
CHILDHOOD HIGH-FREQUENCY EEG DYNAMICS ARE ASSOCIATED WITH INCIDENT INSOMNIA IN ADOLESCENCE: A LONGITUDINAL STUDY
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Introduction: We have previously reported that insomnia is associated with cortical hyperarousal, as measured by increased beta power during sleep, in adolescents. However, it is unknown whether increased beta power during sleep is present in individuals with insomnia before they develop the disorder. This is the first longitudinal study to examine the association of childhood high-frequency EEG dynamics with incident insomnia during adolescence.

Methods: We studied a case-control subsample of 28 children (8.5 ± 1.6y, 75% girls) who participated in the Penn State Child Cohort, a population-based random sample of 421 children who were followed-up after 8 years as adolescents (17.0 ± 1.8y). All children underwent a 9-h polysomnography (PSG), clinical history and physical examination. We defined high-frequency bands at C3 and C4 during NREM and REM sleep as low-beta (15-25 Hz) and high-beta (25-35 Hz). Incident insomnia was defined as the absence of parent-reported insomnia.
IX. Pediatrics

A SURVEY OF PRACTICING SLEEP COACHES
Ingram D,

Introduction: Sleep coaches are individuals of various backgrounds who offer services to families struggling with childhood sleep problems. We conducted a survey of coaches to further elucidate scope of practice, practice patterns, geographic distribution, education, training, and beliefs regarding qualification requirements.

Methods: 142 sleep coaches (response rate = 39%) were identified via certifying/training organizations websites, Google search, and word-of-mouth and completed a web-based anonymous survey.

Results: The responding sleep coaches were distributed across 17 countries and 5 continents. Within the United States, coaches were generally located in more affluent and well-educated zipcodes near large metropolitan centers. Overall, 65% of coaches served clients in countries beyond their home country. Among coaches in the United States, 91% served clients beyond their home state and 56% served clients internationally. Educational background varied across coaches (12% high school degree, 51% bachelor’s degree, 32% master’s degree, 2% doctoral degree, 1.5% JD degree). Few coaches (20%) were or had not been licensed healthcare providers or carried malpractice insurance (38%), while a larger portion (67%) had business liability insurance. Coaches usually provided services for children < 4 months of age to about 6 years of age, with few providing services for children with comorbid neurodevelopmental (32%) or significant medical disorders (19%). Coaches reported an average of 3 new/6 total clients per week and working 20 hours per week on average. Most coaches (76%) felt that a formal sleep coach training program was the most important qualification for practice.

Conclusion: The current study is an important advance in our understanding of sleep coach characteristics and practice patterns, and represents the first report that we know of that is a direct survey of sleep coaches. These results may help inform discussions regarding guidelines for training and credentialing of sleep coaches.

B. Clinical Sleep Science

0912 SENSORY PROFILE IN YOUNG CHILDREN WITH BEHAVIORAL INSOMNIA AND FEEDING DISORDER
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Introduction: Behavioral insomnia (BI) and feeding difficulties (FD) are two prevalent conditions among young children. We have recently shown that feeding difficulties are more prevalent among children with BI and sleep problems are more frequent in children with FD. In addition, maternal cognitions about sleep and feeding are different in these two disorders compared with controls. Our objective was to investigate the sensory profile of children with BI and children with FD in comparison with healthy controls.

Methods: Children 7-36 months of age with either BI or FD were recruited. Children 7-36 months of age who attended the well-baby care clinics were recruited and served as controls. Sensory profile was assessed using the validated Infant/Toddler Sensory Profile questionnaire.

Results: Twenty-five children with BI, 28 with FD and 32 controls were recruited. No difference in child’s age and gender and in parental age and education level were found among the three groups. Significant differences in raw scores of oral processing section (24.2 ± 3.2 vs. 27.2 ± 4.0; p = 0.0002) and in sensation avoiding and low threshold quadrants were found between the BI group compared to controls (48.4 ± 7.0 vs. 52.6 ± 5.0; p = 0.001 and 89.6 ± 13.2 vs. 97.8 ± 9.6; p = 0.001 respectively). Auditory processing and oral processing section scores (37.2 ± 3.3 vs. 39.3 ± 2.8; p = 0.028 and 20.8 ± 3.8 vs. 27.2 ± 4.0; p < 0.0001) were found to be significantly different in the FD group compared with controls. Oral processing score was also different in the FD group compared with the BI group (20.8 ± 3.8 vs. 24.2 ± 3.2; p = 0.005). Significant differences in low registration, sensory sensitivity, sensation avoiding and low threshold quadrants were found between the FD group compared to controls (low registration: 48.7 ± 4.6 vs. 51.2 ± 2.6; p = 0.027, sensory sensitivity: 40.6 ± 7.5 vs. 45.2 ± 6.1; p = 0.025, sensation avoiding: 45.5 ± 6.4 vs. 52.6 ± 5.0; p = 0.001, low threshold: 87.1 ± 11.8 vs. 97.8 ± 9.6; p = 0.001).

Conclusion: Considerable alterations in sensory profile were found in children with BI and FD. These alterations may contribute to the development of these two disorders.

0913 WHAT MAY INFLUENCE PARENT SUPPORT FOR LATER SCHOOL START TIME?
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Introduction: Short sleep is associated with poor academic performance and adverse health consequences. Adolescents often have insufficient sleep and school schedules that overlook their innate circadian rhythms. The American Academy of Pediatrics (AAP) recommends teens have school start times (SSTs) at 8:30am or later. However, only 10% of teens currently have SST at 8:30am or later. We investigated potential barriers to public support for later SSTs.
B. Clinical Sleep Science

IX. Pediatrics

Methods: In Nov/Dec 2014, we conducted a cross-sectional, Internet-based survey of a nationally representative sample of US parents as part of the C.S. Mott Children’s Hospital National Poll on Children’s Health. Parents with teens aged 13-17 years (n = 554) reported their children’s sleep patterns and school schedules, and whether the parents supported a SST of 8:30am or later. Census-based post-stratification weights were used in all analyses to permit national inferences.

Results: Fifty percent of parents supported latter SSTs (SST at 8:30am or later). One-half of parents (49%) thought that < 7 hours’ sleep is sufficient for adolescents. Among parents who agreed with AAP recommendations, 70% supported later SSTs. Sociodemographic characteristics and sleep patterns (e.g. sleep duration, bedtime, and consistent bedtime) were not associated with support for later SSTs. Support for later SSTs was associated with support for SST before 8am (OR = 2.1, 95%CI [1.0,4.3]), parental opinion of their teen’s current SST as ‘too early’ (OR = 4.2, [2.0,8.8]), and agreement with AAP recommendations (OR = 5.2, [2.8,11.0]). Support for later SSTs was also associated with perceived positive impact on academic performance (OR = 3.1, [1.6,6.2]) and increased sleep duration (OR = 4.7, [2.1,10.3]). Conversely, parents expecting disruption of afterschool activities (OR = 0.5, [0.3,0.9]) and transportation plans (OR = 0.4, [0.2,0.7]) were less likely to support later SST.

Conclusion: These data suggest that parental education about healthy sleep needs and benefits, and strategies to address afterschool activity schedules and transportation challenges, may increase parental support for later SST.

Support (If Any): NIH T32 NS007222

0915

PRENATAL DEPRESSION AND INFANT SLEEP: A MEDIATION MODEL OF MATERNAL SLEEP QUALITY

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Introduction: Prenatal depression has long-term effects on infant sleep yet mechanisms of this relationship are unknown. The current study evaluated maternal prenatal sleep quality as a potential mediator of the relationship between maternal prenatal depression and infant sleep.

Methods: Maternal sleep quality and depression were assessed using the Pittsburg Sleep Quality Index (PSQI) and Edinburgh Postnatal Depression Scale (EPDS), respectively. Sleep questions were removed from the EPDS to assess maternal sleep quality mediation. Data was collected from 272 women at three time points: early pregnancy (Time 1 [T1]: < 22 weeks gestational age [GA]); late pregnancy (T2; 32 weeks GA); postnatal period (T3; 6 month postnatal). Infant nighttime sleep duration was defined as total time (in minutes) spent asleep from 1900 to 0700 hours and assessed by maternal responses on the Brief Infant Sleep Questionnaire (BISQ) at T3. Mediation was assessed using a bootstrapping procedure and product of coefficients approach (PROCESS for SPSS).

Results: Participants (N = 272) were primarily married (85.5%), Caucasian (78.9%), and university educated (67.6%) with an average age of 31.0 years (SD 3.80). Average infant nighttime sleep at T3 was 10.2 ± 1.5 hours/night. Higher early prenatal depression (T1) significantly predicted lower infant nighttime sleep duration at T3 over and above covariates of maternal education, maternal age, income, parity, infant sex, preterm birth, and postnatal depression, F (8, 218) = 6.50, β = -76.84, p < .01. PSQI scores at T2 were a significant partial mediator of the relationship between prenatal depressive symptoms and infant nighttime sleep duration at T3 (β = -9.95, SE = 7.30, 95% CI [-30.25, -0.20]).

Conclusion: Results replicate findings showing that higher prenatal depression is associated with lower nighttime sleep duration in infants and provide evidence that worse maternal sleep quality in late pregnancy is a plausible mechanism linking maternal depression to infant sleep.

Support (If Any): This work was supported by the generous donors of the Alberta Children’s Hospital Foundation (LT), Alberta Children’s Hospital Research Institute (EC), Social Science and Humanities Research Council of Canada (EC), Canadian Institute for Health Research (GG; TC), and Alberta Innovates-Health Solutions (GG; TC).
B. Clinical Sleep Science

0916 DEVELOPMENT OF A NOVEL TOOL, THE OWL-SLEEP INVENTORY, FOR THE ASSESSMENT OF SLEEP DISORDERS IN CHILDREN WITH ADHD OR AUTISM
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Introduction: Sleep disorders are common in children with psychiatric illnesses but are rarely part of the clinical routine due to the lack of short, efficient assessment tools. We developed a short questionnaire filled by parents, the OWL-Sleep Inventory (OWL-SI), and compared it to a standard, longer questionnaire: the Children Sleep Habit Questionnaire (CSHQ).

Methods: The OWL-SI contains 9 questions scored 1 to 3: “never/rarely” (1 point), “sometimes” (2 points), “usually” (3 points). Medical charts of 408 pediatric patients with primary psychiatric diagnosis referred to a specialized sleep clinic were reviewed. Within this group, 261 parents/caregivers had completed both the CSHQ and OWL-SI questionnaires between 2011 and mid-2015. Children were 195 boys, 67 girls aged 7.13 ± 3.54 years most of which were diagnosed with autism spectrum disorder (ASD, 46.6%) or attention deficit hyperactivity disorder (ADHD, 25.6%). Internal consistency of the items for both the CSHQ and the OWL-SI was evaluated as well as the correlation between the two sleep measures.

Results: Most parents took less than 45 seconds to fill the OWL-SI and 10-15 minutes to fill the CSHQ. Total scores for the OWL-SI and the CSHQ were significantly correlated (r = 0.623, p < 0.001). Using with a cut-off score of 41, the CSHQ successfully identified more than 98% of patients later confirmed by a clinician as having sleep disturbance. ASD and ADHD patients scored positively on the CSHQ (55.25 and 55.60). Using a cut-off score of 16, the OWL-SI identified 53% of patients, with mean scores of 16.17 and 15.25 for patients with ASD and ADHD, respectively. When the cut-off was lowered to 11, the questionnaire identified 95.4% of children needing a specialized services referral.

Conclusion: Parental response to the OWL-SI correlated significantly with the CSHQ scores. This tool could prove to be useful in pediatric clinics. Control studies in children in without sleep complaints are under way.

Support (If Any): This work was partly supported by “Fondation Petits trésors de l’hôpital Rivière-des-Prairies” and the Bell Canada Mental Health Research Initiatives Support Program.

0917 SLEEP IN CHILDREN WITH SICKLE CELL DISEASE AND NEUROBEHAVIORAL PROBLEMS: A PILOT STUDY
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Introduction: Neurobehavioral problems are common among children with sickle cell disease (SCD), due to disease-related pathology. Disturbed sleep and sleep-disordered breathing (SDB) have been associated with neurobehavioral problems. Sleep disorders are widespread in children with SCD, and may present an additional risk factor for neurobehavioral problems. The aim of this study was to explore associations between neurobehavioral function and sleep disturbances in children with SCD and neurobehavioral problems.

Methods: Children with all SCD types, aged 5-18 years, who had undergone or were willing to undergo neurodevelopmental testing were recruited. The Behavioral Rating Inventory of Executive Function (BRIEF) and Wide Range Achievement Test-4 (WRAT-4) were administered. Medical record and questionnaires provided information on variables known to affect cognition, behavior, sleep and SCD. Children wore an actigraph for 7 days and parents or older children concurrently kept a sleep diary.

Results: There were 19 study completers, 7 male, 10 with hemoglobin-SS disease, mean age 12.1(3.4) years. Six (31%) were on hydroxyurea, 4(21%) on chronic transfusions and 4(21%) had an overt or silent stroke. Ten children (52.6%) screened at high risk for sleep-disordered breathing (SDB) using the Pediatric Sleep Questionnaire. Sleep measured by actigraphy was disturbed, with mean 24h total sleep time (T24) 7.44(0.88) hours, sleep onset latency (SOL) 35.8(26.3) min, and wake after sleep onset (WASO) 65.6(25.4) min. Contrary to predicted, neither sleep variables nor SDB were significantly associated with any subscale of the BRIEF or WRAT-4. However, several subscales of both were significantly associated with parent-reported fatigue (PedsQL General, Cognitive and Total Fatigue Scales). Child-reported fatigue was significantly associated with several actigraphic sleep parameters including SOL, SE and WASO.

Conclusion: Fatigue, rather than sleep, appears more closely associated with neurobehavioral problems in children with SCD. Associations between several sleep measures and child-reported fatigue suggest that fatigue may moderate the relationship between sleep and neurobehavioral problems.

Support (If Any): The authors received no financial support for this study.

0918 WITHDRAWN

0919 SERUM INTERLEUKIN-6 (IL-6) AND TUMOR NECROSIS FACTOR (TNF-Α) IN RELATION TO DISTURBED SLEEP AND FATIGUE IN PEDIATRIC PATIENTS UNDERGOING TREATMENT FOR BRAIN TUMORS
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Introduction: Pediatric brain tumor survivors exhibit disrupted sleep and fatigue, but little is known regarding sleep during treatment. Patients undergoing chemotherapy are at increased risk for poor sleep and fatigue, which can be exacerbated during hospitalization. Increased inflammatory cytokines are seen in cancer patients and decreased sleep is associated with alterations in cytokines. Given the limited information regarding sleep and serum cytokines in pediatric oncology patients, we sought to examine the relation between IL-6 and TNF-α, objectively measured sleep, and subjective fatigue ratings in patients undergoing autologous stem cell transplants.

Methods: Participants included 36 patients with medulloblastoma ages 4-19 (M = 9.65 ± 4.22 years) and their parents during a scheduled 4-6-day hospitalization for high-dose chemotherapy and stem cell rescue. Daily serum cytokine levels were drawn with routine morning labs via venous catheter. Children wore an actigraph throughout the hospitalization and subjective ratings of fatigue (Childhood Cancer Fatigue Scale (CCFS)-Child, CCFS-Adolescent, CCFS-Parent) were completed daily (late afternoon or early evening). Multiple regressions were conducted to examine the relation between cytokines and sleep variables, after accounting for medical and sociodemographic covariates.
Results: Higher IL-6 levels were associated with higher fatigue for adolescents ($\beta = 0.01$, $SE = 0.005$, $p < 0.05$), a longer sleep latency ($\beta = 0.02$, $SE = 0.0047$, $p < .0001$), and more daytime sleep minutes ($\beta = 0.03$, $SE = 0.013$, $p < 0.5$). The relation between TNF-α and actigraphy-based sleep variables was non-significant; however, higher TNF-α levels were associated with higher fatigue for adolescents self-reported ($\beta = 0.02$, $SE = 0.009$, $p < 0.05$) and parent-proxy reports ($\beta = 0.009$, $SE = 0.004$, $p < 0.05$).

Conclusion: Children and adolescents hospitalized for high-dose chemotherapy and stem cell rescue as treatment for medulloblastoma exhibit poor sleep, which is associated with an inflammatory response and fatigue. High risk patients had poorer sleep and IL-6 and fatigue were associated with adolescents. The findings suggest biological mechanisms for increased fatigue in this vulnerable population.

0920 SLEEP DISTURBANCE, SLEEP-RELATED IMPAIRMENT, DAYTIME SLEEPINESS, AND SLEEP PATTERNS IN ADOLESCENTS WITH PAX6 HAPLOINSUFFICIENCY

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Introduction: PAX6 haploinsufficiency (+/-) can occur due to point mutations and microdeletions involving only PAX6 in patients with isolated anirida or as part of contiguous 11p13 gene deletions that involve PAX6 and adjacent genes in patients with WAGR (Wilms tumor, Aniridia, Genitourinary anomalies, cognitive impairnment) syndrome. Pineal hypoplasia, reduced melatonin concentration, and parental reports of sleep disturbance in children have been previously reported in patients with PAX6+/-; however, self-report measures and sleep patterns have not been described. This study examined self-reported sleep disturbance, sleep-related impairment, daytime sleepiness, and sleep patterns in adolescents with PAX6+/-.

Methods: The sample included 9 adolescents with PAX6+/- (age 15.5 ± 3.3y) and 25 healthy adolescents (13.6 ± 2.3y). The PROMIS SLEEP Disturbance, PROMIS Sleep-Related Impairment (v. 1.0; 8a and 8b), and the Cleveland Adolescent Sleepiness Questionnaire (CASQ) were administered to adolescents, and sleep patterns were assessed using actigraphy (7-day recording, during school year, using the Philips Respironics Actiwatch Spectrum device). ANCOVAs compared groups (covariates: age, sex, & race).

Results: Total scores on all sleep questionnaires were similar in PAX6+/- vs. healthy comparison group; however, PAX6+/- was associated with nominally greater time from lights off to sleep onset after adjustment for age, sex, and race (adjusted mean ± 95% CI for PAX6+/- vs. healthy comparison group: 20.1 [8.1-49.7] vs. 6.2 [3.7-10.4] minutes, $p = 0.04$).

Conclusion: The present study is the first to demonstrate greater time from lights off to sleep onset in patients with PAX6+/- vs. healthy adolescents. Our findings support the view that PAX6 plays an important role in sleep regulation. Further research is needed to determine if melatonin replacement could be particularly beneficial in reducing sleep latency in patients with PAX6+/-, and potentially also in individuals in the general population with common genetic variants affecting PAX6 functioning.

Support (If Any): This study was supported by the Intramural Research Programs of the Eunice Kennedy Shriver National Institute of Child Health and Human Development and National Institute of Nursing Research, NIH.

0921 SLEEP DISTURBANCES FOLLOWING PEDIATRIC INTENSIVE CARE HOSPITALIZATION

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Introduction: Sleep disturbances are extremely common among adult intensive care survivors and are significantly associated with reduced long term health. However, very little is known concerning sleep disturbances among pediatric ICU (PICU) survivors. Therefore, our aim was to examine the prevalence of sleep disturbances in PICU survivors up to 1 month following hospitalization, and to examine associated behavioral (depressed mood, anxiety) and clinical risk factors (e.g., pain, organ dysfunction).

Methods: This observational study included 170 children ages 8-17 years and their parents, who presented to our institution with critical illness requiring PICU admission between January 1, 2012 and June 30, 2015. Participants completed questionnaires, including the Pediatric Quality of Life Inventory 4.0 Generic Core Scale documenting sleep, anxiety, and depressive symptoms. Clinical factors were collected from PICU databases. Our primary approach to the analysis was multivariable ordered logistic regression models, controlling for baseline sleep disturbances in order to identify clinical and behavioral risk factors associated with the presence and severity of sleep disturbances at 1 month following PICU hospitalization.

Results: In our cohort 15.3% of children demonstrated sleep disturbances at baseline prior to PICU admission which increased to 24.2% at post-PICU hospitalization follow-up, a relative increase of 63%. Multivariable analysis identified children's functional outcomes (adjusted odds ratio (OR) = 4.49, $p = 0.004$) following PICU stay as the only clinical factor associated with sleep disturbances. Among behavioral factors, concurrent anxiety (OR = 4.75, $p = 0.002$) and depressive (OR = 3.71, $p = 0.012$) symptoms were significantly associated with an increased risk for sleep disturbances among survivors.

Conclusion: Sleep disturbances are common among PICU survivors and are associated with depressive and anxiety symptoms. Future studies are needed to provide more comprehensive assessment of children’s sleep during and following PICU hospitalization admissions to begin to understand the potential impact of sleep disturbances on long term health and quality of life among PICU survivors.

Support (If Any): CBG was supported by National Institutes of Health Ruth L. Kirschstein National Research Service Award Institutional Research Training Grant T32GM086270 (PL TMP).

0922 SLEEP DURATION AND ASTHMA IN ADOLESCENTS AND YOUNG ADULTS

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Introduction: The purpose of this study is to examine the impact of short sleep duration and gender in adolescents on the diagnosis of asthma in their adolescence and young adulthood.
**Methods**: Using data from three waves of the National Longitudinal Study of Adolescent to Adult Health (years 1994 - 2002), we used multivariate logistic regression to conduct cross-sectional and longitudinal analyses of the association between sleep duration at baseline (average of sleep duration at waves I & II) and asthma. Outcomes were measured at two points in time: “current asthma” at baseline, and a report of asthma diagnosis at wave III in an adolescent who was free of asthma at baseline. Sleep duration was measured by self-report.

**Results**: The prevalence of current asthma in wave I was 12.3% in males and 11.2% in females. The prevalence of ever being diagnosed with asthma by wave 3 was 16.4% in males and 18.6% in females. Cross-sectional analysis at baseline showed a significant association between short sleep duration (< 8 hours) and asthma (OR = 1.31, 95% CI 1.09, 1.58), after adjusting for potential confounders. This association was mostly limited to females with an OR of 1.57 (95% CI 1.21, 2.04) while it was non-significant in males (OR = 1.10, 95% CI 0.82, 1.49). The longitudinal analysis did not reveal a significant association between sleep duration at baseline and new onset asthma by wave 3 in males or females.

**Conclusion**: Female adolescents with asthma have significantly shorter sleep durations than their non-asthmatic counterparts, while this difference was not observed in males. However, short sleep duration in adolescent males and females does not predict new-onset asthma in young adulthood. The lack of longitudinal association might indicate that asthma has an impact on sleep duration in this age group rather than the reverse.

**0923**

**CAREGIVER, CHILD AND ENVIRONMENTAL FACTORS REPORTED TO AFFECT SLEEP IN FAMILY CAREGIVERS OF CHILDREN WHO DEPEND ON MEDICAL TECHNOLOGY**

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**Introduction**: An increasing number of family caregivers are providing ‘around the clock’ care for children who depend on medical technology (CMT). Sleep in these family caregivers has been characterized as too short, highly disrupted, of poor quality, and associated with low mood, daytime sleepiness and fatigue. Evidence is needed that describes the potential sources of sleep disruption in this vulnerable group.

**Methods**: In a prospective study that employed objective sleep measurement (i.e. actigraphy) 43 family caregivers completed customized sleep diaries over 6 days/7 nights. Diary entries included standardized sleep reporting items (e.g. time to fall asleep) and evidence-informed investigator-designed items. Validated measures of sleep hygiene (SHI) and child’s sleep problems (CSHOT) were administered at study conclusion.

**Results**: Of 301 diarized nights, caregivers’ (n = 43) negative thoughts and feelings interfered with sleep on almost a third of the nights (n = 85, 29.8%). Caregiver sleep hygiene was more problematic than reported in non-clinical samples (29.10 [5.8]). Care needs of the child were diverse (e.g. comfort and reassurance, doing ADLs) and family caregivers were required to get out of bed at least two-thirds of the nights (191 nights, 67.0%) for reasons related to the child’s care. Child sleep problems were common (CSHT > 43 cut-off; 50.88 [10.0]). Homecare nurses were present in the environment for half of the nights (144 nights, 50.3%) and family caregivers were kept awake by noises or other intrusions in the home nearly half of the nights (147 nights, 49%). The most commonly reported intrusive noise at night was made by technology/monitor alarms (n = 83, 31.0%).

**Conclusion**: This study has documented factors reported to affect sleep by a diverse sample of family caregivers of CMT. Findings suggest there were multiple caregiver, child and environmental influences on sleep disturbance that may inform the development and testing of future sleep promoting interventions.

**Support (If Any)**: This study was funded by the Canadian Lung Association; Ontario Lung Association; SickKids Foundation; and the CIHR Team Grants in Sleep & Biological Rhythms, and Better Nights & Better Days.
**B. Clinical Sleep Science**

**0925**

**SLEEP ARCHITECTURE ABNORMALITIES IN CHILDREN WITH SICKLE CELL DISEASE (SCD)**

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**Introduction:** Previous studies have shown that sleep disordered breathing (SDB) such as OSA can affect clinical outcomes of children with SCD. However, there is limited information on sleep architecture in children with SCD. Several factors associated with SCD can affect sleep quality in this population. Therefore, we conducted this study to evaluate this issue.

**Methods:** This is a retrospective review of medical records in children with SCA who were referred to sleep clinics for evaluation of SDB. Only children who had no SDB from polysomnography were included. African American children of similar ages without SCD and SDB and were used for comparison.

**Results:** 529 met the criteria for entry into analysis, 32 SCD, 497 controls. The average age of SCD was 7.6 years (mean ± SD). There was no significant difference in the BMI between the two groups. Analysis of sleep architecture revealed that children with SCD had prolonged sleep latency (61.3 ± 56.2 mins [SCD] vs 36.2 ± 41.4 [C], P < 0.05) and decreased REM sleep cycles (4.2 ± 1.6 [SCD] vs 4.8 ± 1.6[C]; P < 0.05). There were no significant differences in any sleep stage distributions (NREM 1, 2, 3 and REM) or arousal index. Analysis of respiratory parameters showed no significant differences in O2 nadir (97.3% ± 2.3[SCD] vs 97.9 ± 4.8[C], P < 0.01), but no difference in end-tidal CO2.

**Conclusion:** Compared to African American controls, SCD children without SDB have longer sleep latencies and fewer REM cycle periods. In addition to SDB, other factors such as chronic pain, medications, and psychosocial factors can lead to sleep disruption in this population. Further prospective studies will be needed to evaluate both subjective and objective sleep quality and the impact of sleep disruption on long term outcome in children with SCD.

**Support (If Any):** Cincinnati Children’s Hospital medical center, Department of Pulmonology

**0926**

**SLEEP-DISTURBANCE IS INADEQUATELY ASSESSED IN CHILDREN WITH ALLERGIC RHINITIS**


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**Introduction:** Sleep disturbance significantly impairs daily living of children and young adults with allergic rhinitis (AR), yet remains inadequately assessed. Our objective was to use patient self-report of disturbed sleep and its impact on physical, mental, and social health to determine the optimal assessment approach.

**Methods:** AR patients aged 8-30 y with controlled asthma from Chicago metropolitan area were recruited. All had clinical assessments and completed Allergic Rhinitis and Its Impact on Asthma (ARIA) disease severity questions, NIH Patient Reported Outcome Measurement Information System (PROMIS) Profile, Modified Epworth Sleepiness Scales (ESS), Pediatric Perceived Cognitive Function (pedsPCF) or if an adult, Applied Cognition-General Concerns-SF (ACGC).

**Results:** Of 136 patients (43% male; 59% white, 20% Latino, 13% African-American, 8% Asian), 67 were children aged 8-11 (n = 35) or 12-17 y (n = 32) and 78 were adults (18-30 y). 100 patients had moderate/severe AR with sleep disturbance reported in 66% adults versus 43% children. Overall, those with moderate/severe versus mild AR had more sleep disturbance (PROMIS, µ = 47.9 ± 8.2 vs 44.5 ± 9.1, p = 0.04). Patients who reported “My symptoms disturb my sleep,” were older (µ = 21.1 y ± 7.0 vs 17.6 ± 7.1, p < 0.01), and had more sleep disturbance (PROMIS, µ = 49.3 ± 6.9 vs 45.5 ± 9.2, p < 0.01), but no difference in sleep-related impairment. PROMIS sleep disturbance scores most strongly correlate with worse perceived cognitive function in children (pedsPCF, r = -0.52) and general cognition concerns in adults (ACGC, r = 0.51), p < 0.01. In participants 12-30 y, sleep disturbance correlated with depression, anxiety, fatigue, social participation (PROMIS). In contrast, with children 8-11 y, sleep disturbance (PROMIS) did not correlate with any measure of quality of life; however, sleep-related impairment/sleepiness (PROMIS/ESS) correlated with depression and fatigue (r = 0.597/0.583 & 0.579/0.714, p < 0.01).

**Conclusion:** Sleep disturbance in AR is more commonly reported in adults than children and in those with more severe disease. One question assessment of sleep disturbance is inadequate in screening for sleep-related impairment. Although child-specific PROMIS sleep assessments are not currently available, sleep assessments in children < 12 y with AR should address sleep-related impairment, depression and fatigue. Larger studies in a broader population will allow for generalizability of PROMIS tools in children with AR for clinical and research visits.

**Support (If Any):** N/A; IRB approval study #2015-363

**0927**

**HIGH CEREBROSPINAL FLUID OREXIN LEVELS IN SIDS INFANTS**


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**Introduction:** Sudden infant death syndrome (SIDS) is defined by the sudden death of an infant which remained unexplained after a complete evaluation of death scene, infant history and postmortem investigation. In industrialized countries, it is the first cause of postneonatal death between one month and one year. Polysomnographic studies have shown that arousability is altered in SIDS babies. However, it remains unknown which arousal systems are involved. The aim of this study is to determine whether orexin is involved in SIDS.

**Methods:** Orexin levels were measured in cerebrospinal fluid (CSF) from 31 infants who died of SIDS and from 60 control infants who underwent a lumbar puncture for meningitis suspicion (but with normal results).

**Results:** SIDS infants (median age : 19.4 weeks, range from 6.6 to 39 weeks, 58% boys) and control infants (median age : 7.1 weeks, range from 1.6 to 36 weeks, 53%) were included in the study. CSF orexin concentration was higher in SIDS infants compared to controls. This difference was observed specifically among infants above 2 months of age. Besides, no relations were found between CSF orexin levels and known risk factors of SIDS (prone sleep position, co-sleeping, in utero tobacco exposure, infections and prematurity). Moreover, among control infants, CSF orexin levels were lower in infants aged from 2 to 6 months compared to younger infants.
This project was funded by NIMH Grant R01-IX. Pediatrics.

25 healthy controls (CTL; age = 19.4 ± 2.7 years; 17 female). Sleep was monitored with actigraphy for 7-14 days prior to completing an adaptive version of the multi-source interference fMRI paradigm. Group status and sleep duration variability (intra-individual standard deviation) were examined as predictors of BOLD activity to a contrast of incongruent > congruent trials: within a fronto-limbic region of interest. Results: There was a significant group effect for bilateral ventromedial prefrontal cortex (vmPFC) activity to incongruent > congruent trials: BD exhibited reduced vmPFC deactivation relative to CTL. A group-by-sleep duration variability interaction was observed for bilateral dorsal anterior cingulate cortex (dACC) activity to incongruent > congruent trials (p < .05, corrected): sleep duration variability and dACC activity were negatively associated in BD (r = -0.65, p < .01), but not related in CTL (r = 0.33, p = 0.12). These patterns remained significant after controlling for age, sex, depressive symptoms, and average sleep duration.

Conclusion: In adolescents with BD, sleep duration variability may modulate dACC engagement during cognitive control. Stabilizing sleep patterns may improve cognitive control neural circuitry function in BD, which could in turn favorably improve emotional dysregulation.

Support (If Any): T32MH018269 (Soehner), The Pittsburgh Foundation (Franzen; Goldstein), UL1 RR024153, ULITR000005

0928

SLEEP DURATION VARIABILITY PREDICTS ALTERED DORSAL ANTERIOR CINGULATE ACTIVITY DURING A STRESSFUL COGNITIVE INTERFERENCE TASK IN ADOLESCENTS WITH BIPOLAR DISORDER

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Introduction: Altered function within fronto-limbic brain regions is observed during cognitive task performance in adults and adolescents with bipolar disorder (BD). However, modifiable factors that may be impairing brain function in BD remain under-characterized. Sleep patterns are highly variable in BD, but may be ameliorated with behavioral interventions. While links between disturbed sleep and altered brain function during cognitive tasks are well-established in healthy samples, such relationships remain under-characterized in BD. Thus, our aim was to test sleep duration variability as a predictor of neural response to a cognitive control fMRI task in adolescents with BD.

Methods: Two groups of adolescents (13-22 years old) participated: 15 with BD type I, II or NOS (BD; age = 18.1 ± 2.7 years; 11 female) and 25 healthy controls (CTL; age = 19.4 ± 2.7 years; 17 female). Sleep was monitored with actigraphy for 7-14 days prior to completing an adaptive version of the multi-source interference fMRI paradigm. Group status and sleep duration variability (intra-individual standard deviation) were examined as predictors of BOLD activity to a contrast of incongruent > congruent trials within a fronto-limbic region of interest.

Results: There was a significant group effect for bilateral ventromedial prefrontal cortex (vmPFC) activity to incongruent > congruent trials: BD exhibited reduced vmPFC deactivation relative to CTL. A group-by-sleep duration variability interaction was observed for bilateral dorsal anterior cingulate cortex (dACC) activity to incongruent > congruent trials (p < .05, corrected): sleep duration variability and dACC activity were negatively associated in BD (r = -0.65, p < .01), but not related in CTL (r = 0.33, p = 0.12). These patterns remained significant after controlling for age, sex, depressive symptoms, and average sleep duration.

Conclusion: In adolescents with BD, sleep duration variability may modulate dACC engagement during cognitive control. Stabilizing sleep patterns may improve cognitive control neural circuitry function in BD, which could in turn favorably improve emotional dysregulation.

Support (If Any): T32MH018269 (Soehner), The Pittsburgh Foundation (Franzen; Goldstein), UL1 RR024153, ULITR000005

0929

PREDICTING CHRONOTYPE: THE INFLUENCE OF INTERNALIZING DISORDERS

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Introduction: The concept of chronotype ostensibly captures underlying trait-like and stable circadian preferences that follow a predictable developmental pattern with a shift towards eveningness in adolescence. It is known that individuals with an eveningness preference are at higher risk for depression. However, depressive symptoms have palbable effects on activity/energy levels, sociability, and eating behaviors, that may also influence circadian processes.

Methods: 257 3rd (n = 84), 6th (n = 95), and 9th (n = 78) graders (academic year assessed at baseline) completed self-report measures of depressive (Children’s Depressive Inventory (CDI)) and anxiety (Multidimensional Anxiety Scale for Children(MASC)) symptoms at 3-month intervals over a 36-month period. At the 36-month timepoint, participants completed self-report measures of chronotype (Superscience Morningness/Eveningness Scale within the School Sleep Habits Survey) and pubertal development (Pubertal Development Scale(PDvS)). Sum scores were calculated for each measure within each timepoint and regression analyses were conducted.

Results: Higher depressive symptoms over time predicted a greater propensity for eveningness (r = -0.15, p < .05). However, the same relationship failed to prove significant with symptoms of anxiety. When controlling for pubertal development, age and gender, the relationship between longitudinal depressive symptomatology and eveningness remained significant (r = -0.15, p < .05).

Conclusion: Individual differences within depressive symptoms predict individual differences in chronotype such that an increase of depressive symptoms predicts greater eveningness preference in middle to late adolescence. These findings suggest that there may be factors in addition to pubertal development that contribute to the shift to eveningness during this developmental window. This type of predictive effect does not apply to internalizing disorders broadly, but seems to be depression specific.

Support (If Any): This project was funded by NIMH Grant R01-MH077195

0930

SLEEP AND SOCIAL DIFFICULTIES IN OVERWEIGHT GIRLS

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Introduction: Peer relationships can influence adolescent health. Positive peer relationships can be protective, while poor relationships put adolescents at-risk for health problems. Overweight/obese youth, especially adolescent girls, experience poorer social functioning compared to healthy weight peers. Similarly, emerging research demonstrates a link between poor sleep and social difficulties. Though the relationship between weight status and peer relationships is well studied, limited attention has been given to sleep problems. Furthermore, girls have been shown to be at a high-risk for sleep problems. Therefore, the aim of this study is to examine the relationship of sleep and peer relationships in a sample of obese adolescent girls.

Methods: Sleep duration was measured objectively with actigraphy. Participants completed self-report questionnaires including the Sleep Disturbances Scale for Children/Adolescents (SDSCA), Cleveland Adolescent Sleepiness Questionnaire (CASQ), and Adolescent Sleep...
Hygiene Scale (ASHS). Peer relationships were measured by the Peer Problems scale of the Strengths and Difficulties Questionnaire (SDQ).

**Results:** The final sample included 27 overweight (14.8%) and obese (85.2%) adolescent girls (Mean age = 15.78, SD = 1.65) from predominantly Hispanic (55.6%) backgrounds. Results revealed significant correlations between Peer Problems and questionnaire measures of sleep duration, daytime sleepiness, insomnia symptoms and sleep hygiene. Independent sample t-tests revealed significant differences in the Peer Problems scale of the SDQ for actigraphy-measured “short sleepers” (average sleep < 7 hours; Peer Problems M = 3.71; SD = 1.70) and “long sleepers” (average sleep ≥ 7 hours; Peer Problems M = 2.50; SD = 1.38); t(23) = 2.12, p = .045.

**Conclusion:** Preliminary findings suggest peer relationship problems are associated with sleep problems in overweight/obese adolescent girls. In particular, support for a protective effect of sleep duration was found, as girls who obtained more sleep experienced fewer peer difficulties compared to participants who slept for less than 7 hours.

**Support (If Any):** SLS: UC Denver Center for Women’s Health Research Junior Faculty Development Award MCG: NORC P30DK048520; BIRCWH 2K12HD057022, Boettcher Foundation; 1K23DK107871-01 CTRC: M01-RR00051; M01-RR00069

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**See the subsequent use of alcohol and cannabis in boys**

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**Introduction:** Although an association between sleep and adolescent substance use is supported by the current literature, evidence remains largely cross-sectional, and few studies have characterized the trajectory from sleep in early adolescence to subsequent substance use. The current study examined the prospective association between sleep quality and duration at age 11 and alcohol and cannabis use later in adolescence and emerging adulthood.

**Methods:** The sample included 170 boys from primarily low socioeconomic status backgrounds in Western Pennsylvania. When participants were 11, primary caregivers filled out the Child Sleep Questionnaire (modified from the Pittsburgh Sleep Quality Index); sleep duration and quality were calculated based on these reports. Neighborhood dangerousness, socioeconomic status, internalizing problem behavior, and externalizing problem behavior were also assessed at age 11. At ages 20 and 22, participants were interviewed regarding lifetime alcohol and cannabis use. Cox regression was used to determine the association between both the quality and duration of sleep at age 11 and the subsequent use of alcohol and cannabis.

**Results:** After accounting for concurrent socioeconomic factors as well as child internalizing and externalizing problem behavior, every hour less in sleep duration at age 11 was associated with a 21.4% acceleration to first use of alcohol (Hazard Ratio[HR] 1.21, p = 0.01) and a 21.7% acceleration to first use of cannabis (HR 1.22, p = 0.015). Every one-point of worse sleep quality was associated with a 9.1% acceleration to alcohol use (HR 1.09, p = 0.011) and a 7.6% acceleration to cannabis use (HR 1.106, p = 0.04). Sleep duration and quality were similarly associated with earlier intoxication and more significant alcohol and cannabis use across adolescence.

**Conclusion:** These results suggest that lower quality and duration of sleep in early adolescence may have implications for the development of alcohol and cannabis use throughout adolescence and into early adulthood.

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**Sleep in early adolescence is associated with the subsequent use of alcohol and cannabis in boys**

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**Conclusion:** These results suggest that lower quality and duration of sleep in early adolescence may have implications for the development of alcohol and cannabis use throughout adolescence and into early adulthood.

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**Support (If Any):** The authors would like to thank all of the participants and staff of the Pitt Mother and Child Project. This work was supported by grants from the National Institutes of Health, including T32HL082610 (Buysse), K01DA032557 (Hasler), R01MH050907 (Shaw), R01DA026222 (Shaw, Forbes).

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**ATTENTION DEFICIT/HYPERACTIVITY DISORDER TREATMENT AND PERIODIC LIMB MOVEMENTS IN SLEEP**

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**Introduction:** Children with attention deficit hyperactivity disorder (ADHD) experience sleep disturbances with an estimated prevalence of 25-50%. These children may also be at higher risk for sleep disorders, including periodic limb movement disorder in sleep (PLMDS). It is unknown if the severity of PLMDS is different in children with ADHD or if stimulant therapy impacts PMLDS. The purpose of this study was to compare sleep parameters in children with PLMDS with and without ADHD.

**Methods:** A retrospective study of 607 pediatric patients ages 3-17 years with PLMDS who underwent polysomnography were evaluated. Patient demographics, medications, study results including: periodic limb movement index (PLMI), periodic limb movement arousal index (PLMAI), apnea/hypopnea index (AHI), sleep efficiency and sleep maintenance efficiency were evaluated.

**Results:** 140 (23%) patients reported a diagnosis of ADHD. This group was more commonly male (67% vs 54%, p = 0.005) and older (mean difference 2.1 years [95%CI 1.3, 2.9]). Patients with ADHD had a higher PLMI (mean difference 1.1 [95%CI 0.02, 2.2]) and PLMAI (mean difference 0.2 [95%CI 0.03, 0.43]) than non-ADHD patients. The ADHD group also demonstrated a lower AHI (mean difference 1.6 [95%CI 0.38, 2.99]). There was no difference in sleep efficiency or maintenance efficiency between the two groups. 55% of patients in the ADHD group reported stimulant or alpha-2 agonist use which demonstrated no effect on PLMI and PLMAI.

**Conclusion:** In our study population, patients with ADHD tend to be evaluated later with a sleep study and have a higher PLMI than non-ADHD patients. Stimulant drug therapy did not affect PLMI in those with ADHD, however the effectiveness of stimulant therapy in our population is unknown. These findings are important clinically given the prevalence of sleep disturbances in ADHD and warrant further investigation, including the potential impact of effective ADHD management on sleep quality.

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**IS THERE A CONNECTION BETWEEN ADHD-LIKE SYMPTOMS AND DISTURBED SLEEP IN CHILDREN?**

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**Introduction:** The aim of this study was to investigate ADHD-like symptoms in children undergoing sleep assessment.

**Methods:** Charts of children aged 2 to 18 years and undergoing overnight diagnostic polysomnographic testing were reviewed. Children with a history (confirmed or unconfirmed) of ADHD were excluded. Scores on the SNAP rating scale were used to determine ADHD-like symptoms (inattentive, hyperactive/impulsive and combined
subtypes). In addition, children were asked to complete the Pediatric Daytime Sleepiness Scale (PDSS), the Centre for Epidemiologic Studies Depression Scale for Children (CES-DC) and the Screen for Child Anxiety Related Disorders (SCARED). To summarize sleep pathology, a 13-item Sleep Composite Scale consisting of sleep architectural variables and the PDSS was developed for this study; a binary score (0 or 1) was assigned based on whether variables were outside the established age-based cutoff.

**Results:** Charts of 58 children were analyzed: 32.7%, 36.2% and 29.3%, respectively, scored above the cutoffs for inattention, hyperactivity/impulsivity and combined subscales of the SNAP. No single sleep architectural variable was significantly correlated with SNAP scores. However, scores on the Sleep Composite Scale were consistently elevated for those children scoring above versus below the cutoffs for the inattention (6.2 ± 2.2 vs. 6.1 ± 1.8), hyperactivity/impulsivity (6.2 ± 1.6 vs. 6.0 ± 2.1) and combined (6.3 ± 1.8 vs. 6.0 ± 2.0) subscales of the SNAP, although this differences did not reach significance. Of note, 72.4% and 43.1% of the children, respectively, scored above the cutoffs for the CES-DC and SCARED scales.

**Conclusion:** Our findings suggest that ADHD-like symptoms are common in children with disturbed sleep. It appears that overall greater sleep pathology and no specific sleep architectural variable was linked to greater ADHD-like symptoms. Further, children with sleep problems also had a greater frequency of symptoms of depression and anxiety.

**0934 SLEEP AND DEVELOPMENTAL PROGRESS IN INFANTS AT HIGH-RISK FOR AUTISM**

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**Introduction:** Language learning and social skills are core areas of difficulty for young children developing at elevated risk for autism spectrum disorder (ASD). Recent studies highlight the important roles of sleep in both of these areas. This brief report aimed to assess associations between sleep regulation and language, social, and visual reception skills within young children at elevated risk for ASD across two independent samples.

**Methods:** In two samples child actigraph-derived sleep/activity patterns were classified as regulated or dysregulated. Infant/toddler developmental progress was indexed with the Mullen Scales of Early Learning and the Vineland Adaptive Behavior Scales. The first cross-sectional sample included 55 toddlers at 24 or 36 months of age. Within this sample, 27 toddlers were younger siblings of children with ASD (high-risk group) and 28 had siblings with no known diagnosis (low-risk group). The second sample included 118 assessments between 6 and 30 months of age for 80 children (high-risk group = 41, low-risk group = 39).

**Results:** Using multivariate general linear models, the present study demonstrated a modest but significant association between sleep regulation and concurrent language and visual reception skills. However, this influence was not robust for infants developing at high risk for ASD.

**Conclusion:** Although children with ASD and their infant siblings have more parent-reported sleep problems, the present study does not support a strong association between sleep dysregulation and concurrent language, social, and visual reception skills. Future research should assess time-lagged developmental effects.

**0935 SLEEP IN CHILDREN WITH AUTISTIC SPECTRUM DISORDERS AND EPILEPSY**

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**Introduction:** It is well known the association of sleep disturbances in patients with autistic spectrum disorders (ASD), it is also well known the increased risk of epilepsy in ASD, as epilepsy and sleep deprivation increase the chances of seizures and as insomnia and disturbed sleep are rather common. We wanted to analyze the prevalence of epilepsy in patients with autism and sleep deprivation manifested by insomnia.

**Methods:** From a population of 2185 patients we included 83 patients diagnosed with ASD that were evaluated in a university affiliated pediatric neurology clinic in south Texas and Mexico; the variables that included epilepsy and insomnia were evaluated. All the cases were diagnosed with either sleep initiation or maintenance insomnia. All patients fulfilled the DSM V criteria for ASD, and the presence of partial or generalized epilepsy. We included patients that had at least 1 seizure either partial or generalized in a period of 2 years or less. Patients were included regardless of the use of anticonvulsants. The patients treated with at least another medication for behavior were not excluded. The variables related to seizure control were included in our study. Total sleep time (TST) in insomnia cases was always decreased by 1.5 hours less than expected for age. Our patients kept the same TST for at least 90 days.

**Results:** The mean age of the patients was 6.8 years. Of all the patients with insomnia 6.3% of the cases the presence of epilepsy was found, in non-insomniac patients the diagnosis of epilepsy was 5.7% (P of 0.9974, not significant at p < 0.05). All the cases were compliant with current medical treatment as evidenced by therapeutic blood levels of anticonvulsants. No changes on the insomnia variable were seen for at least 3 months.

**Conclusion:** The pediatric patients diagnosed with autistic spectrum disorders are not associated with a higher chance of epilepsy if the variable sleep deprivation is present; an underlying increased epileptogenic potential suggested in ASD in some series was not evident in our data, or at least not related to a decreased total sleep time.

**0936 CONNECTIONS BETWEEN SLEEP AND FMRI MEASURES OF THREAT REACTIVITY AMONG ADOLESCENTS WITH AND WITHOUT ANXIETY DISORDERS**

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**Introduction:** Sleep disturbance is a prominent feature of anxiety disorders, yet its role as a cause or consequence of anxiety is unknown. The current study investigates relationships between sleep and functional magnetic resonance imaging (fMRI) measures of threat reactivity in adolescents with and without generalized anxiety disorder (GAD).

**Methods:** Thirty-four adolescents (ages 12-17), 19 with a primary diagnosis of GAD, and 15 healthy controls, participated in this study. Each completed a sleep questionnaire (Children’s Report of Sleep Problems (CRSP)) and seven nights of actigraphy and sleep diaries, followed immediately by fMRI scanning. We contrasted hemodynamic responses to dynamically changing threatening face images versus shapes using whole-brain analyses (thresholded at p < .005, k < 15). Parameter estimates were extracted from activated regions and combined into
a single value to capture threat reactivity. After stratifying by group, correlations were conducted to examine associations between threat reactivity and multiple sleep variables: mean total sleep time (actigraphy), mean nightly satisfaction with sleep (sleep diary), and insomnia severity ratings (CRSP).

**Results:** Groups did not differ in terms of threat reactivity, however all participants demonstrated robust activation in limbic and face processing regions, including the amygdala, fusiform face area, and inferior frontal gyrus. Among healthy participants, satisfaction with sleep was negatively associated with threat reactivity ($r = -.533, p = .049$), and CRSP Insomnia score was positively associated with threat reactivity ($r = .489, p = .076$). Sleep variables were not associated with threat reactivity among participants with GAD.

**Conclusion:** Dissatisfaction with sleep and insomnia severity ratings were associated with greater threat reactivity, but only among healthy participants. For most adolescents, adequate, satisfying sleep may play an important role in tempering response to threat. For anxious adolescents, neural reactivity to threat may be unrelated to these particular sleep variables.

**Support (If Any):** Research Scholar Award from Children’s Hospital Colorado Research Institute, and 1K23MH10864 to BCM.

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**0937 SLEEP AND PSYCHOSOCIAL IMPAIRMENT IN CHILDREN RAISED BY GRANDPARENTS IN KIN TECH RANDOMIZED CONTROLLED TRIAL**

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**Introduction:** Although 1 in 11 of all children and 1 in 5 African American children live with a grandparent at some point before the age of 18, little is known about sleep behavior for the children in their care. While children raised by grandparents experience more risks of psychological difficulties than children in the general population, few studies have examined sleep and psychosocial impairment for children raised by grandparents.

**Methods:** This study identified child sleep behavior and psychosocial impairment using 12 month follow up self-report data obtained from the KIN-Tech randomized controlled trial funded by the US Children’s Bureau. General sleep behavior, waking up at night, and medication usage were assessed. Descriptives and ANOVAs were used to examine sleep and psychosocial problems in children in their care.

**Results:** 100 middle-aged (m = 46 years), single (65.7%), African-American (46%), low income (m = $24,000) grandparents (88% female) caring for younger children (50%; < 5 years) participated. In general, 19% (n = 17) of children experience troubled sleep and 10% (n = 10) are prescribed sleep aids. Average child sleep time is 9.52 hours (sd = 1.6). Child incidence of clinical psychosocial impairment is between 28% (n = 26) and 31% (n = 29). There is a significant effect of troubled sleep and clinical sleep problems with attention [F(1, 81) = 10.25, p = .002], anxiety/depression [F(1, 79) = 11.17, p = .001], and conduct [F(1, 81) = 12.98, p = .001]. Children with psychosocial impairment are more likely to be prescribed sleep aids [F(2,86) = 19.02, p = .000] and have a caregiver prescribed sleep aids [F(2, 92) = 3.13, p = .048].

**Conclusion:** This research suggests that children living with grandparents have a higher rate of psychosocial impairments than average children (28-31% vs. 12%) associated with troubled sleep. While growing evidence indicates a bidirectional relationship between psychopathology and sleep, more research is needed to better understand this relationship to inform the development of tailored interventions for grandparents to promote healthy sleep for children.

**Support (If Any):** This Project is funded by a demonstration project from the US Children’s Bureau Child Welfare/TANF Collaboration in Kinship Navigation Program Grant #: HHS-2012-ACF-ACYF-CF-0510 (90CF0050). CHI CW/TANF Kinship Interdisciplinary Navigation Technologically-Advanced Model (KIN-Tech), Juvenile Welfare Board of Pinellas County, Children’s Board of Hillsborough County, and the United Way of Tampa Bay. Patient-Centered Outcomes Research Institute PCORI (1IP2 PI000781).

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**0938 MATERNAL SOCIOECONOMIC STATUS IS ASSOCIATED WITH CHANGES IN INFANT SLEEP DURATION FROM 3- TO 6-MONTHS OF AGE**

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**Introduction:** Lower socioeconomic status (SES) is associated with worse sleep quality and shorter sleep duration in children and adults; however, associations between measures of SES and infant sleep have yet to be examined. Using a prospective cohort of 1,092 mother-infant dyads followed from pregnancy to 6-months postpartum, relationships between individual- and neighbourhood- socioeconomic status and infant sleep duration and consolidation at 6-months postpartum were investigated.

**Methods:** Infant sleep duration (minutes between 7 pm and 7 am) was assessed using the Brief Infant Sleep Questionnaire (BISQ). Maternal SES was assessed via maternal education (High school above or below), annual household income, and a neighbourhood deprivation index (a census-based tool assessing average neighbourhood education, income, employment, single parent families and home ownership). Maternal ethnicity (White/Other), maternal age and parity were included as covariates in all analyses. Regression analyses were used to investigate relationships between SES variables and infant sleep duration. All SES variables were included simultaneously in the model.

**Results:** At 6-months postpartum, longer infant sleep duration was reported by mothers with higher household income (B = 10.72, SE = 2.44, p < .0001), higher education (B = 19.83, SE = 8.07, p = .01) and those living in neighbourhoods with higher SES (B = -8.40, SE = 3.71, p = .02). To investigate change in infant sleep duration from 3- to 6-months, 3-month sleep duration was included as an additional covariate in the model. Increasing night time infant sleep duration from 3- to 6-months was predicted by higher household income (B = 9.65, SE = 2.44, p < .0001) and higher neighbourhood SES (B = -9.14, SE = 3.79, p = .02).

**Conclusion:** Individual- and neighbourhood- SES was associated with infant sleep duration at 3- and 6-months postpartum. Future studies should examine potential environmental and behavioural mediators of the relationship.

**Support (If Any):** This work was supported by grants from Alberta Innovates Health Solutions, and the generous donors of the Alberta Children’s Hospital Foundation (L.T.M.)

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A335  SLEEP, Volume 39, Abstract Supplement, 2016
SLEEP DISORDERED BREATHING IS ASSOCIATED WITH DIFFERENTIATED METHYLATION IN OBESITY RELATED GENES

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Introduction: Sleep disordered breathing (SDB) has been related to obesity and other cardiometabolic dysfunctions in adults. However, the epigenetic alternations associated with SDB on obesity-related genes are less investigated in adolescents.

Methods: We used data from a random sample of 142 adolescents from the population-based Penn State Child Cohort follow-up exam (N = 421). Among which, 20 were SDB cases (AHI ≥ 5) and 122 non-SDB (AHI < 5). Peripheral leukocytes DNA was extracted and subject to enhanced reduced representation bisulfite sequencing. The high-throughput assay provided single nucleotide resolution of DNA methylation in CpG sites and surrounding regions. The R package methylKit was used in the post-processing and analysis. Bases with < 10x coverage were excluded in the assay, resulting in a total of 529,109 methylation sites with a minimum of 10 samples per group. Logistic regression was used in the differential methylation calculation. We decided a priori to define sites with ≥ 25% difference in methylation with a q value < 0.01 as substantially differential methylated sites.

Results: The mean (SD) age of the study sample was 16.3 (2.3) years, with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white. We identified a total of 907 bases with 53% males and 82% white.

Conclusion: SDB in adolescents is significantly associated with substantially differentiated methylation in obesity-related genes. These preliminary results indicate that SDB is related to early changes in epigenetic profiles related to obesity and potentially future cardiometabolic health.

Support (If Any): NIH R01 HL063772, R21HL087858, R01 HL097165, C06 RR016449, UL1 TR 000127

SHOULD SDB BE CONSIDERED ONE OF THE COMPONENTS OF THE METABOLIC SYNDROME IN ADOLESCENTS: THE PENN STATE CHILD COHORT?

Penn State University, Hershey, PA

Introduction: The purpose of this study was to assess whether sleep-disordered breathing (SDB) could be considered as one of the several components of the metabolic syndrome (MetS) as opposed to being an independent condition contributing to cardiovascular risk.

Methods: A sample of 376 adolescents (16.9 ± 2.2 years, 54.5% male) from the Penn State Child Cohort, a representative general population sample, underwent a single 9-hour polysomnographic (PSG) recording and physical examination. Resting seated systolic and diastolic blood pressure (SBP/DBP) was assessed in the evening and fasting blood was collected in the morning to assess glucose, insulin, HDL-cholesterol, and triglycerides. MetS risk was based on age, race, and gender standardized residuals of inversely-HDL, triglyceride, homeostatic model assessment (HOMA), waist circumference (WC) and mean arterial pressure (MAP). SDB was defined as AHI ≥ 5. Using the 90th percentile as the cutoff point to define binary abnormalities of MetS and its components, we used the one sample binomial test to assess whether the observed clustering of SDB with MetS and its components were significantly different from their co-occurrences by chance alone.

Results: The observed age-, gender- and race-adjusted prevalence of MetS and its components were 10.11% while the observed prevalence for moderate SDB was 11.17%. The expected co-occurrences by chance of SDB and MetS and its components would be 1.13%. The observed clustering (p-value for difference between observed and expected co-occurrence) of SDB with MetS, WC, SBP, DBP, HOMA, lower HDL, and TG were 2.93% (p < 0.01), 2.66% (p = 0.02), 2.39% (p = 0.05), 2.13%, (p = 0.33) 1.33% (p = 0.84), 1.06% (p = 0.77), and 2.32% (p = 0.06), respectively.

Conclusion: In this population-based sample of adolescents, the clustering of moderate SDB with higher burden of MetS, and its central obesity and SBP components are significantly higher than their co-occurrence by chance, which suggest that SDB should be considered as one of the MetS components.

Support (If Any): NIH R01 HL063772, R01 HL097165, C06 RR016449, UL1 TR 000127

THE RELATIONSHIP BETWEEN SLEEP QUALITY, DAYTIME NAP AND NEUROCOGNITIVE FUNCTION IN ADOLESCENTS

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Introduction: Nighttime sleep duration and quality have been reported to associate with neurocognitive function. However, this relationship has been underexplored in adolescence, and the role of daytime nap remains unclear. The aim of this study was to examine the association of nighttime sleep quality and daytime nap with neurocognitive domains in adolescents.

Methods: This study represents a sub-analysis of the China Jintan Child Cohort Study of 235 children in early adolescence (12.13 ± 0.55 years old) enrolled from June to July 2013. Adolescents were asked to fill in the sleep questionnaire. Daytime nap was assessed by the question of habitual nap duration, and sleep quality was measured by the Pittsburgh Sleep Quality Index (PSQI), with higher score indicating worse sleep. Adolescents were also asked to perform seven neurocognitive tests (accuracy and speed) using the computerized neurocognitive battery developed by the University of Pennsylvania. The general linear regression models were used to analyze the relationships, while age, gender, and parental education levels were adjusted for and schools were clustered.

Results: Results: The global PSQI scores ranged from 0-14 (4.27 ± 2.44). The prevalence rates of short (< 30 minutes), middle (30-60 minutes) and long naptime (> 1 hour) in adolescents were 24.23% (n = 55), 44.49% (n = 101) and 31.28% (n = 71) respectively. The global sleep quality by total PSQI scores was negatively associated with the accuracy score of the Visual Object Learning test (β = -0.165, p = 0.02), indicating a possible role of poor sleep quality in the episodic memory of adolescents. In terms of the daytime nap, the middle daytime-nap group was associated with better abstraction and mental flexibility (β = 2.48, p = 0.032) relative to the short-nap group, suggested by higher scores of accuracy in the Penn Conditional Exclusion Test. In contrast, the long daytime-nap showed a negative association with sensorimotor speed, with longer reaction time in the Mouse Practice task (β = 16.97, p = 0.017).

Conclusion: Our findings suggest that a good nighttime sleep quality contributes to the neurocognitive function in early adolescence. Daytime nap remains unclear. The aim of this study was to examine the association of nighttime sleep quality and daytime nap with neurocognitive function.
A total of 141 articles (110 unique samples), including 592,215 unique participants from 40 different countries, met inclusion criteria. Overall, longer sleep duration was associated with lower adiposity indicators, better emotional regulation, better academic achievement, and better quality of life/well-being. The evidence was mixed and/or limited for the association between sleep duration and cognition, harms/injuries, and cardiometabolic biomarkers. The quality of evidence ranged from very low to high across study designs and health indicators.

**Conclusion:** We confirmed previous investigations showing that shorter sleep duration is associated with adverse physical and mental health outcomes. However, the available evidence relies heavily on cross-sectional studies using self-reported sleep. In order to better inform contemporary sleep recommendations, there is a need for sleep restriction/extension interventions that examine the changes in different outcome measures against various amounts of objectively-measured sleep to have a better sense of dose-response relationships.

**Support (If Any):** Canadian Society for Exercise Physiology, Healthy Active Living and Obesity Research Group, Conference Board of Canada, and Public Health Agency of Canada.

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**ASSOCIATION BETWEEN SDB AND METABOLIC SYNDROME IN ADOLESCENTS: THE PENN STATE CHILD COHORT**


Penn State University, Hershey, PA

**Introduction:** The association of sleep-disordered breathing (SDB) with metabolic syndrome is not well established in children, especially...
in population samples. Thus, the purpose of this study was to assess the association between SDB and metabolic syndrome in our population sample of adolescents.

**Methods:** A sample of 376 adolescents (16.9 ± 2.2 years, 54.5% male) from the Penn State Child Cohort, a representative general population sample, underwent a single 9-hour polysomnographic (PSG) recording and physical examination. Resting seated blood pressure was assessed in the evening and a single fasting blood draw was collected in the morning (assayed for glucose, Insulin, HDL-cholesterol, and triglycerides). Metabolic syndrome risk was based on age and gender standardized residuals of inverse-HDL, triglyceride, HOMA, waist circumference and seated MAP (Eisenmann 2010). SDB was defined as none (AHI < 2), mild (2 ≤ AHI < 5), and moderate (AHI ≥ 5).

**Results:** SDB was significantly (p < 0.01) associated with metabolic syndrome risk (-0.19 ± 0.25, 0.75 ± 0.32, 1.49 ± 0.49) for AHI < 2, 2 ≤ AHI < 5, and AHI ≥ 5 respectively after adjusting for multiple potential confounding factors. SDB was significantly associated with central obesity (waist circumference) and MAP, especially in individuals with moderate SDB (defined by AHI ≥ 5). The associations between SDB and other metabolic syndrome components (HOMA, triglycerides, and HDL) are trending toward significance in this adolescent population-based sample.

**Conclusion:** SDB, especially moderate SDB defined as AHI > 5, was significantly associated with a higher burden of metabolic syndrome in this population-based sample of adolescents. The adverse metabolic syndrome burden was mostly driven by the contribution of central obesity and elevated blood pressure, while other metabolic syndrome components, such as insulin resistance and dyslipidemia, are starting to emerge in these adolescents. The results from this population-based sample of adolescents suggest that moderate SDB is one of the metabolic syndrome components, as we have previously proposed in middle-aged adults with obstructive sleep apnea.

**Support (If Any):** NIH R01 HL063772, R01 HL097165, C06 RR016499, UL1 TR 000127

**0945**

SLEEP DISTURBANCES ARE ASSOCIATED WITH MORNING HEADACHE IN A CLINICAL PEDIATRIC POPULATION

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**Introduction:** There is some evidence of an existing relationship between headache and sleep disturbances in children. Thus, we aimed to investigate the sleep pattern and complaints of children with morning headache in a cross-sectional study from a pediatric clinical population.

**Methods:** A total of 1,927 children fitted research criteria and underwent polysomnography. This pediatric clinical population was referred for sleep problem in a pediatric sleep clinic. Parents answered sociodemographic questionnaires and the Sleep Disturbances Scale for Children. The presence of headache was subjectively reported by parents, allowing the distribution of children into control (CTRL - no headache), headache occasionally (OCC) or weekly (WK).

**Results:** Parents reported that their children with headache had a poorer sleep quality compared to CTRL in a frequency-dependent manner. Headache WK was significantly associated with more sleep complaints such as insomnia, snoring and sleep bruxism compared to CTRL. However, no marked changes were observed in the polysomnographic parameters.

**Conclusion:** Children referred to sleep laboratory with headache seems to have poorer sleep quality compared with controls, but without changes in objective sleep pattern. As sleep plays an important role in well-being and development of the central nervous system, pediatricians and parents whose children complaint about headache should be alert about the quality of their sleep for better treatment approach.

**Support (If Any):** This work was financially supported by Associação Fundo de Incentivo a Pesquisa (AFIP) and São Paulo Research Foundation (FAPESP) grant #2014/15259-2 for CH. MLA and ST are recipients of CNPq fellowship (grant #305177/2013-3 to MLA and grant #301974/2011-0 to ST).

**0946**

ESTIMATING ‘USUAL’ SLEEP DURATION AMONG ADOLESCENTS: COMPARISON OF MULTIPLE SELF-REPORT MEASURES AND ACTIGRAPHY

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**Introduction:** Self-report measures of sleep duration among adolescents may produce inaccurate estimates due to recall bias or the wording of the question. We compared measurement of adolescent sleep duration using estimation (self-report), calculation (self-report), and actigraphy (objective), and determined which self-report method most closely reflects the objective measurement of sleep.

**Methods:** Healthy adolescents (n = 46) ages 11-15 years completed two stays in the sleep laboratory as part of a within-subjects crossover study. Participants wore wrist actigraphs before and between the two laboratory stays. Actigraphy-based average sleep duration was calculated for each participant who had at least 4 days of actigraphy data. During the laboratory stay, participants completed a self-report of ‘usual’ sleep, from which we derived a self-report estimate of usual sleep duration, and a calculation of usual sleep duration based on the actual sleep onset and offset times and minutes awake that participants reported. We utilized linear mixed models to examine differences in sleep duration among the three methods.

**Results:** Participant average sleep duration was estimated at 9:05h (S.D. = 2:07h) and was calculated at 9:43h (S.D. = 1:24h), while actigraphy showed an average sleep duration of 7:17h (S.D. = 00:49h). We observed a main effect of measurement method (F = 54.16, df = 44.20, p < 0.001) such that participants overestimated sleep duration using the estimation method (1.48h difference, df = 37.11, p < 0.001) and using the calculation method (2.26h difference, df = 46.93, p < 0.001) as compared to actigraphy. The two self-reports of sleep duration did not differ significantly from each other (00.37h difference, df = 45.35, p < 0.118).

**Conclusion:** Our findings confirm that self-report measures of usual sleep duration do not accurately reflect actigraphy-determined sleep duration, whether based on habitual summary measures, or measures of sleep duration calculated from more specific sleep variables. Insufficient sleep may be an even larger problem in adolescents than originally thought, if these results generalize to normative samples collected in epidemiological studies.

**Support (If Any):** This work was funded by NIH grants T32- HL082610, R01-DA033064, and UL1-RR024153.

**0947**

IMPACT OF MIDDLE SCHOOL START TIMES ON SLEEP HEALTH

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**Introduction:** Healthy school start times have been identified as key contributors to student health. This is one of only a few studies that focuses on middle school students’ sleep habits. The study takes ad-
 vantage of differences in school start-times of 7th and 8th graders in one of the largest and most socio-economically diverse US suburban school district. Individual school start times varied between 7:20am and 8:15am.

Methods: Drawing on newly collected student and parent survey data (n = 969), the present study used Inverse Probability of Treatment Weighted regression analysis to generate estimates of the relationship between school start time and sleep and sleepiness variables, accounting for grade, age, race and ethnicity, gender, home language, family structure, and parent education. Analysis of heterogeneity was conducted and average comparisons were evaluated with OLS regression.

Results: Seventh and eighth grade students attending schools with later start times get an estimated average of 17 minutes more sleep per weeknight (n = 604; actual mean = 8.39hrs) than students attending schools with earlier school start times (n = 322; actual mean = 8.15hrs), despite their going to bed later, on average (early start = 9:31pm; late start = 10:04). There was no difference in weekend sleep duration (actual combined mean 10.13hrs). This means that students attending schools with later school start times get an estimated extra hour and twenty-five minutes sleep per school week. Students with later start times were less likely to report daytime sleepiness during the week than were students with earlier school start times (e.g., 43% of late start vs. 35% of early start times reported being ‘wide awake’).

Conclusion: This is one of the first large scale studies of school start times to demonstrate that middle school students benefit from later school start times. Students reported significantly longer sleep duration, later bed times and decreased daytime somnolence.

Support (If Any): Support was provided by a generous grant from the Robert Wood Johnson Foundation

0948 ASSOCIATIONS BETWEEN SLEEP, COPING, AND DISINHIBITED EATING AMONG OVERWEIGHT ADOLESCENT GIRLS

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Introduction: Poor sleep behavior and maladaptive coping strategies are associated with energy intake patterns that may promote excess weight gain. These factors have not been evaluated concurrently in the context of obesity-promoting disordered eating patterns. The current study examined associations among sleep, coping, and energy intake assessed with subjective and objective methods that characterize disinhibited eating. We hypothesized that poor sleep and maladaptive coping would be both independently and jointly associated with greater disinhibited eating.

Methods: Participants included a convenience sample of 105 female adolescents (age = 14.5 ± 1.6y) with overweight/obesity (BMIz = 1.9 ± 0.5), mild-to-moderate depressive symptoms, and a family history of diabetes. Sleep behaviors were assessed with the Sleep Habits Survey. Coping was examined via the Responses to Stress Questionnaire-Social Stress Version. Disinhibited eating behaviors were assessed with the: Eating in the Absence of Hunger (EAH) Questionnaire for Children, Emotional Eating (EE) Scale Adapted for Children, Eating Disorder Examination interview (to assess binge eating), and standardized lunch buffet (total intake, kcal). Depressive symptoms were evaluated with the Children’s Depression Inventory and included as a covariate. Other covariates included age, race, puberty, height, and body composition.

Results: Only 13% of participants endorsed the minimum amount of sleep recommended for adolescents (9 hours). Daytime sleepiness (ps < .02) and sleep/wake problems (ps < .01) were associated with greater EAH and odds of binge-eating in the previous month. Disengagement (e.g., avoidance), involuntary engagement (e.g., rumination) and involuntary disengagement (e.g., escape) coping strategies were associated with greater EAH (ps < .04) and EE (ps < .04). Neither sleep nor coping were associated with observed energy intake (ps ≥ .07). Interactions between sleep and coping were non-significant after correcting for multiple comparisons.

Conclusion: Sleep quality and maladaptive coping strategies were independently associated with more self-reported disinhibited eating behaviors, but not observed intake, among overweight/obese girls. These individual factors do not appear to function jointly to increase girls’ risk for disinhibited eating.

Support (If Any): Supported by K99/R00HD069516 (PI: Shomaker) from NICHD, NIH Intramural Research Program Grant 1ZI-AHD000641 (PI: Yanovski) from NICHD with supplemental funding from the NIH Bench to Bedside Program (Pls: Yanovski, Tanofsky-Kraff, Shomaker), the Office of Disease Prevention, NIH (PI: Yanovski), and the Office of Behavioral and Social Sciences Research (PI: Yanovski).

0949 EARLY LIFE PREVENTION OF OBESITY BY TARGETING SLEEP, OR FOOD AND ACTIVITY: A RANDOMIZED CONTROLLED TRIAL

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Introduction: Obesity prevention initiatives targeting sleep in infants are rare despite emerging evidence of potential benefit. The aim of our Prevention of Overweight in Infancy (POI) study was to determine whether a conventional approach targeting food, activity, and breastfeeding, or an approach targeting sleep, would decrease BMI at 24 months, relative to usual care.

Methods: The POI RCT studied 802 parent/infant dyads randomized antenatally to one of four groups: Control, FAB (food, activity, and breastfeeding), Sleep, or Combination (FAB and Sleep). All received standard well-child care. FAB participants received additional guidance/support promoting breastfeeding, healthy eating, and physical activity (to 18 months). Sleep participants attended an antenatal education session covering normal development of sleep and self-settling techniques, received a home visit at 3 weeks addressing prevention of sleep problems, and a sleep treatment programme upon request (from 6 months). Body mass index (BMI) was measured at 24 months, and secondary outcomes including diet, physical activity and sleep, assessed by questionnaire, diary or accelerometry, at multiple time points.

Results: Although there was no significant intervention effect for BMI at 24 months, there was a group difference in the prevalence of obesity (overall P = 0.027) driven by lower rates of obesity in the Sleep (OR 0.46, 95% CI 0.25-0.83, P = 0.011) and Combination (0.51, 95% CI 0.28-0.90, P = 0.022) groups compared with FAB, but not compared with Control. Exploratory analyses found a protective effect for those receiving the Sleep interventions (Sleep and Combination compared to non-sleep groups: OR 0.54, 95% CI 0.35-0.82) but not for those receiving the FAB interventions.
Conclusion: An early life sleep intervention halved the odds of obesity in children at two years of age. The obesity analysis was exploratory, so requires confirmation by other studies. Analysis of the 3.5-year follow-up data will determine whether effects are sustained.

Support (If Any): Funding: Health Research Council of New Zealand

SLEEP EEG DYNAMICS ASSOCIATED WITH CARDIOMETABOLIC AND NEUROCOGNITIVE OUTCOMES IN ADOLESCENTS: A PRELIMINARY STUDY
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Introduction: We have previously reported that insomnia in adolescence is associated with increased high-frequency EEG dynamics. However, no study to date has examined whether spectral EEG dynamics are associated with poorer cardiometabolic and neurocognitive outcomes in adolescence.

Methods: We studied a case-control subsample of 44 adolescents who participated in the Penn State Child Cohort, a population-based random sample of 421 adolescents (17.0 ± 2.2 y). All subjects underwent a 9-h polysomnography (PSG), clinical history and physical examination. We defined low- and high-frequency bands during sleep onset latency (SOL) and NREM sleep as delta (0.4-4 Hz), low-beta (15-25 Hz) and high-beta (25-35 Hz). Insomniacs (n = 23) and controls (n = 21) were absent of sleep disordered breathing (SDB) or overweight and were matched in terms of sex, race, age, Tanner stage, and eveningness.

Results: Our pilot data showed that 1) decreased δ during NREM sleep (r = -.331, p = .030) and wake (r = -.301, p = .066 and r = -.305, p = .089 for SOL and WASO) and increased low-β (r = -.277, p = .072) and high-β (r = -.295, p = .055) during NREM sleep were associated with poorer executive functioning, as measured by Stroop interference score, 2) no association was found between these sleep EEG dynamics and lower-order cognitive processes such as processing speed, 3) increased low-β and high-β during wake were associated with increased blood pressure (r = .385, p = .017, r = .338, p = .038, and r = .536, p = .002 for SOL and WASO), 4) increased low-β during wake was associated with increased insulin resistance (r = .347, p = .048 and r = .449, p = .011 for SOL and WASO), and 5) increased high-β during wake was associated with higher evening salivary cortisol (r = .275, p = .095 and r = .484, p = .005 for SOL and WASO).

Conclusion: Together, these data suggest that sleep EEG dynamics may play a modifying role in the association of sleep disorders, such as Insomnia and SDB, with cardiometabolic and neurocognitive outcomes.

Support (If Any): NIH’s R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499

COMPARATIVE ANALYSIS OF SLEEP CHARACTERISTICS BETWEEN KOREAN SCHOOL STUDENTS AND UNITED STATES SCHOOL STUDENTS IN HIGH SCHOOL AGE
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Introduction: The purpose of this study is to investigate the differences in sleep pattern Korean and American high school students.

Methods: Participants were 102 high school students (64 Korean students and 38 American students). Each student completed the Epworth sleepiness scale (ESS), Pittsburgh sleep quality assessment (PSQI), and insomnia severity index test (IS). Descriptive statistics and t-test were used for the statistical analysis.

Results: The actual sleep time of Korean high school students was 2 hours less than the time of American high school students (p < 0.001). The Korean high school students went to the bed 2 hours later than American student, even got up at the same time. The Koran high school student showed poor sleep quality(PSQI 5.67, p < 0.001) than American students.

Conclusion: The Korean high school student have shorter sleep time, late time in bed, and poor sleep quality than American high school student.

Support (If Any): Seoul Sleep Center
0953  
BARRIERS TO CHANGE OF SLEEP BEHAVIOR IN TYPICALLY DEVELOPING ADOLESCENTS  
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Introduction: High school students in North America are increasingly getting less than the recommended amount of sleep. Sleep deprivation has negative impact on adolescents’ mental and physical health. To date sleep promotion programs have focused on enhancing sleep knowledge, with limited success in improving sleep behaviour. The goal of this study was to identify barriers to sleep behavior change and other relevant psychological variables in typically developing adolescents.  
Methods: Thirteen interviews were conducted with typically developing adolescents (6 males, Mage = 15.5 years, SD = 1.4). Qualitative data from the interviews were transcribed and analyzed using thematic content analysis in relation to barriers to sleep, self-efficacy in overcoming the barriers, intentions to improve behaviour related to the barriers and general attitudes towards sleep.  
Results: The most frequently reported barriers to obtaining adequate sleep were technology use in bed (e.g. phone use, television watching) and experiencing extreme emotions (e.g. high stress). Participants reported having low self-efficacy with regards to minimizing their use of technology and in changing their emotional experiences. Most participants did not intend to minimize their electronic use at bedtime despite reporting that it was a barrier. They expressed intention to counteract barriers related to experiencing extreme emotions. The majority of adolescents reported positive attitudes towards sleep.  
Conclusion: There was consistency between the barriers adolescents’ experience (e.g. emotions, technology) and their low self-efficacy to change reported barriers. Depending on the barrier, there were high (e.g. emotions) or low (e.g. technology) intentions to minimize those barriers. Overall, attitudes towards sleep were positive, indicating some foundational knowledge of the importance of sleep. Future interventions should target perceived barriers precursors to sleep behaviour change as a means of increasing their effectiveness.

0954  
IMPLEMENTATION OF A NIGHTLY BEDTIME ROUTINE: HOW QUICKLY DO THINGS IMPROVE?  
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Introduction: Institution of a consistent bedtime routine has been demonstrated to improve sleep in young children within two weeks. However, no studies have investigated the trajectory of this change. Thus, the purpose of this study was to examine the change in infant sleep and maternal perceptions on a day-by-day basis following implementation of a bedtime routine.  
Methods: 134 mothers and their infant (ages 7-18 months) were randomly assigned to an intervention (bedtime routine) group in a larger study that also included a control group. During the first week (baseline) the mothers were instructed to follow their child’s usual bedtime routine. On day 8, mothers were instructed to conduct a specific bedtime routine. All mothers completed a daily sleep diary and reported their perceptions of their child’s bedtime, nighttime sleep, and mood.  
Results: The bedtime routine resulted in significant reductions in sleep onset by day 2, with changes in sleep consolidation by day 3. Improvements in sleep continued daily until day 10. The average rate of change in sleep variables from baseline through the second night of intervention was 5 to 13 times faster than the change observed from the third to final night of intervention. Maternal perceptions of bedtime behaviors improved by the first night of intervention, and perceptions of nighttime sleep and infant morning mood improved by the second night.  
Conclusion: These results suggest that instituting a consistent nightly bedtime routine, which included a bath, massage, and quiet activities, results in improvements within two days. The majority of benefit was observed by day 10. The relatively fast improvements in sleep may be a result of physiological changes, such as core body temperature and cortisol, in addition to the institution of a consistent routine.  
Support (If Any): Support for this research was provided by Johnson & Johnson Consumer Inc.

0955  
SLEEP IN YOUNG CHILDREN IN THE MIDDLE EAST: SLEEP PATTERNS AND DAILY MOOD  
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Introduction: The aim of this study was to characterize sleep and daily mood in a large sample of young children in the Middle East (birth to 3 years).  
Methods: Parents of 669 young children (birth to 3 years) from Saudi Arabia (n = 163), Egypt (90), Algeria (77), Iraq (29), Jordan (44), United Arab Emirates (45), Morocco (34), Kuwait (22), Oman (22), Libyan Arab Jamahiriya (15), Palestinian Territories (20), Bahrain (14), Israel (11), and other Arab countries (83) completed the Brief Infant Sleep Questionnaire (BISQ) and the Daily Infant Mood Scale (DIMS). All questionnaires were completed online in Arabic.  
Results: Young children in the Middle East have late bedtimes (22.75), get 9.15 hours of sleep at night, and 2.57 hours of daytime sleep, for a total of 11.72 hours of sleep across 24 hours. The average number of nightwakings was 2.2 times per night for an average duration of 41 minutes. The majority of children room-share with their parents (86.8%), although fewer bed-share (40.2%). Parent perceived sleep problems also were common (37%). Furthermore, after controlling for age significant correlations in the expected directions were found between parent reported daily mood of their child, especially upset and needy, with parent perceptions of sleep problems (r = .18 to .31) and sleep onset latency (r = .13 to .24).  
Conclusion: Overall, young children in Middle East countries have later bedtimes and less nighttime, daytime, and total sleep time than studies report of those in predominantly Caucasian and Asian countries/regions. The majority of children share a room with their parents, but less than half bed-share. As expected, shorter sleep, sleep problems, and night-wakings are associated with more negative mood and less positive mood manifestations in young children.  
Support (If Any): This study was sponsored Johnson & Johnson Consumer Inc

0956  
EFFICACY OF IRON THERAPY IN PEDIATRIC PARASOMNIA PATIENTS WITH RLS/PLMD  
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Introduction: Parasomnias and restless legs syndrome/periodic limb movement disorder (RLS/PLMD) commonly co-exist in children. Our recent study has shown that iron supplementation therapy (IST) leads to significant improvement in RLS and PLMD and resolution of parasomnia suggesting that RLS/PLMD may precipitate parasomnia. The
mechanism underlying the association between RLS/PLMD and parasomnia may involve the arousal process. We aim to evaluate arousals in children with RLS/PLMD and parasomnia, and the effect of iron therapy on PLMS, arousals, and parasomnias.

**Methods:** This retrospective study looked at a cohort of pediatric patients diagnosed with parasomnias and either RLS or PLMD. Subjects who had sleep studies before and after iron therapy were included. Polysomnograms were scored using AASM-2014 guidelines. Follow-up studies were compared to baseline with attention to limb movements, arousals, and other EEG paroxysms.

**Results:** Of 51 patients diagnosed, 31 received IST, and 14 met inclusion criteria. The average age was 8.0 years at the initial PSG and 9.4 years at the follow up PSG. Ferritin levels improved significantly from an average of 23.7 ng/mL at baseline to 60.0 ng/mL at follow-up ($p = 0.0074$). The PLMS index improved significantly from an average of 24.52/hr at baseline to 7.46/hr at follow up ($p < 0.0001$). The PLMS related arousal index improved significantly from an average of 4.71/hr at baseline to 1.35/hr at follow up ($p < 0.0001$). 57% of subjects demonstrated subjective improvement in RLS symptoms and 43% demonstrated improvements in parasomnias following IST.

**Conclusion:** This study demonstrates statistically significant improvement in RLS/PLMD symptoms, PLMS index, and arousal indices in pediatric parasomnia patients following IST. Our findings suggest that PLMS may precipitate parasomnia through an arousal mechanism. These findings warrant the exploration of larger and more controlled studies of the effect of IST on parasomnias, and the relationship between RLS/PLMD and parasomnias.

**Support (If Any):** Cincinnati Children’s Research Foundation

### 0957 CHILDHOOD AND ADOLESCENCE RESTLESS LEGS SYNDROME: A LONGITUDINAL STUDY OF PREVALENCE AND FAMILIAL AGGREGATION

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**Introduction:** The objective of the study was to assess the prevalence of RLS during childhood and adolescence and evaluate the degree of association with parental history of RLS.

**Methods:** Data from the large prospective Quebec Longitudinal Study of Child Development on 1856 children born in 1997-1998 in the province of Quebec were studied. The prevalence of RLS was assessed at ages 7, 8, 10, 12, 13 and 15 years through a questionnaire completed by the mother (all 4 standard criteria present). Parental history of RLS was also queried when children were 12 years old.

**Results:** Between 7 and 15 years of age, the yearly prevalence of RLS ranged from 2.3 to 3.1%. The prevalence of RLS at any time between 7 and 15 years was 8.6%. This prevalence rate was higher when there was parental history of RLS: 6.9% (95% CI: 6.2-9.9) for children without parental history, 13.0% (95% CI: 8.3-17.7) for children with at least one parent with RLS. Children with at least one parent with a history of RLS had 2.1 (95% CI: 1.2-3.8) the odds of having RLS themselves at one time point and 6.5 (95% CI: 1.8-23.4) the odds of having recurrent RLS. However, only 1.8% of children scored positively for RLS at 2 time points or more during the longitudinal data collections.

**Conclusion:** These findings confirm results of previous studies regarding the prevalence of RLS. They also corroborate the presence of familial aggregation for RLS and reveal for the first time that children of parents with RLS (at least one of the two parents) have at least twice the odds of having RLS at any time between 7 and 15 years of age. The small number of children with recurrent RLS should be kept in mind when deciding to treat childhood RLS.
**0959**

**RACIAL DIFFERENCES IN SLEEP PATTERNS AND PROBLEMS AMONG YOUNG CHILDREN PRESENTING TO AN OUTPATIENT SLEEP CLINIC**

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**Introduction:** Community research indicates that in early childhood, Black children are at higher risk for OSA and tend to have later bedtimes, increased bedtime difficulties, and shorter total sleep duration compared to White children. This study examined racial differences in presenting sleep patterns and problems among young children in an outpatient sleep clinic.

**Methods:** Data were collected from electronic medical records for 77 children ages 2-6 years (M = 3.55 years, 66% White, 34% Black; 46% female) presenting at a pediatric sleep clinic in an academic medical center. Neighborhood income data were based on zip codes entered into the US Census Bureau’s American Fact Finder.

**Results:** Black and White children did not differ on their bedtime, sleep-onset latency, night wakings frequency, total sleep time, or nap frequency. Nap duration was longer among Black children (120 minutes vs. 89 minutes for White children; t = 2.16, p < .05), and Black parents were more likely to report child caffeine consumption (33%) than White parents (8%, χ² = 5.4, p < .05). White children were more likely to sleep in their own room (78% vs. 35% for Black children, χ² = 14.28, p < .001) and less likely to bed-share with a parent (4% vs. 31% for Black children, χ² = 10.94, p < .01). Groups did not differ on whether children fell asleep independently at bedtime. Whereas White children were more likely to present with difficulty falling/staying asleep (61% vs. 15% for Black children, χ² = 14.28, p < .001), Black children were more likely to present with OSA-related concerns (88% vs. 45% for White children, χ² = 13.46, p < .001). Findings held when presenting concerns were examined via logistic regressions controlling for child age, gender, z-scored BMI, and neighborhood income.

**Conclusion:** Despite few differences in presenting sleep patterns, White children were more likely to present with difficulty falling/staying asleep at an outpatient sleep clinic, while Black children were more likely to present for OSA-related concerns. Findings underscore the need to consider parent perceptions and other socio-cultural variables that may contribute to differential rates of presentation for sleep services.

**0960**

**PEDIATRICS AND MED-PEDS RESIDENTS’ KNOWLEDGE OF OBSTRUCTIVE SLEEP APNEA SYMPTOMATOLOGY IN PATIENTS WITH DOWN SYNDROME**

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**Introduction:** Approximately 50% of Down syndrome (DS) patients are diagnosed with obstructive sleep apnea (OSA). The sooner OSA is diagnosed in DS, the earlier effective treatment strategies can begin to improve their quality of life and prevent complications. The purpose of this study was to determine the DS patient age at which general pediatrics and internal medicine-pediatric residents begin discussion of OSA symptomatology with parents, the frequency of these discussions and DS patient age for initial polysomnogram (PSG) referral.

**Methods:** A short, multiple choice questionnaire was distributed to 60 residents (45 general pediatrics, 15 Medicine-Pediatrics) which included questions about training year status, DS patient age at initial discussion of symptoms of OSA with parents, frequency of this discussion and patient age at initial PSG referral.

**Results:** Surveys were returned from 41 general and 13 Internal medicine Pediatric residents for a total of 54 respondents (90% total response rate). ‘Less than 6 months age’ (correct response) as initial age for OSA symptom discussion with parents of DS patients occurred in 44% (25/54) of residents, across all training levels. ‘Less than 4 years’ (correct response) as patient age for initial PSG referral occurred in 42% (23/54) of respondents. Correct responses about when to assess presence of expected OSA symptoms (i.e., heavy breathing, snoring, uncommon sleep positions, daytime sleepiness, apneic pauses, behavior problems at each annual health maintenance visit), were found in 70% (38/54) of respondents.

**Conclusion:** Results suggest there may be widespread delays in educating parents of DS patients regarding symptom recognition for OSA, given that 56% of the sample answered this question incorrectly. Continued efforts to teach resident trainees about when to educate parents to recognize symptoms of OSA and to know the correct age to refer their DS patients for PSG must be made.

**0961**

**ASSOCIATIONS BETWEEN SOCIO-DEMOGRAPHIC FACTORS AND RECOMMENDATIONS GIVEN IN A PEDIATRIC SLEEP CLINIC**

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**Introduction:** This study examined whether variation in socio-demographic factors was associated with sleep recommendations given to patients presenting to a pediatric sleep clinic.

**Methods:** We collected socio-demographic and sleep recommendation data from electronic medical records for 258 youth (57% male, 47% White, age M = 7.64 years) presenting for an initial consultation at a pediatric sleep clinic in an academic medical center with concerns related to either difficulty falling/staying asleep (55%) or obstructive sleep apnea (OSA; 45%). Neighborhood income data were obtained based on zip codes entered into the US Census Bureau’s American Fact Finder.

**Results:** The most frequent patient recommendations were polysomnography (PSG; 63%), behavioral follow-up (36%), and an adjusted sleep schedule (22%). Across broad domains, 70% of patients received assessment recommendations (e.g., PSG, actigraphy). 51% received behavioral recommendations (e.g., bedtime routine, stimuli control), and 31% received medical recommendations (e.g., CPAP, medication). Logistic regressions were conducted to examine whether the socio-demographic factors of age, gender, race (White vs. non-White), and median neighborhood income were associated with variation in these three recommendation categories, controlling for patients’ presenting problem (difficulty falling/staying asleep vs. OSA). Older children and males were more likely to receive medical recommendations. No socio-demographic factors were associated with the provision of behavioral recommendations beyond patients’ presenting concerns of difficulty falling/staying asleep. Older children and those of White racial background were less likely to receive recommendations for further assessment.
Conclusion: Older age, male gender, and White background were associated with variation in medical and assessment-related recommendations given in a pediatric sleep clinic. However, no socio-demographic factors were associated with the provision of behavioral recommendations. Further examination of these practices among heterogeneous pediatric samples is warranted to ensure that medical, behavioral, and assessment-related needs are comprehensively addressed for all youth, regardless of presenting sleep concern.

0962
MATERNAL SLEEP AND TODDLER SOCIAL-EMOTIONAL DEVELOPMENT
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Introduction: Links between maternal sleep and early childhood sleep are well established. Further, there is emerging evidence of the relationship between sleep and social-emotional development in toddlers. However, little is known about the connections between maternal sleep and social-emotional development. Thus, the purpose of this study was to examine the relationship between maternal sleep and child social-emotional development in toddlers.

Methods: Participants included a subsample (n = 117) from a larger study of healthy, typically developing mother-child dyads across five cohorts. Maternal sleep was assessed when children were 12- and 18-months-old using the Pittsburgh Sleep Quality Inventory (PSQI). Child social-emotional development was assessed at 12-, 18-, and 24-months old with the Infant Toddler Social Emotional Assessment (ITSEA). Problem behaviors (i.e., internalizing, externalizing, and dysregulation) and social competence were assessed.

Results: Results revealed significant relationships among maternal sleep and toddler problem scores concurrently at child ages 12-months (r = .26, p < .05 to .44, p < .001) and 18-months (r = .27 to .42, p < .001). Furthermore, maternal sleep assessed when toddlers were 12-months-old was longitudinally associated with problem behavior six (r = .23, p < .05 to .35, p < .001) and twelve (r = .32, p < .05 to .44, p < .001) months later. Finally, PSQI (12 months) explained approximately 89.5% of the variance in the ITSEA one year later (Wilks’ Λ = .105 (F(36, 102.92) = 2.36, p < .001)). Maternal sleep was only related to social competence when maternal sleep (12 months) was compared to development at 24-months, p < .05.

Conclusion: These results suggest that maternal sleep is associated with and predictive of several domains of toddler social-emotional development both concurrently and longitudinally, as long as one year later. Interventions to improve maternal sleep may support social-emotional development and mitigate risk for emergence of problem behaviors.

Support (If Any): Support for this research was provided by Johnson & Johnson Consumer Inc

0963
SLEEP SPINDLES CHARACTERISTICS IN SCHOOL-AGE CHILDREN ARE ASSOCIATED WITH INTERNALIZING PROBLEMS
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Introduction: An association between sleep spindle characteristics and emotional/behavioural characteristics has been found in preschool children, but no study has explored this topic in school-aged children. The goal of this study was to examine the association between spindle activity and behavior in school-age children. We examined whether spindle frequency, amplitude, duration, and/or density were associated with children’s daytime behavior.

Methods: We recruited 30 typically developing school-age children who were free of sleep disorders or medical problems. Children did not consume caffeine containing products, and parents were instructed to keep a sleep diary containing detailed information on sleep and medications given in the week prior to participation in the study. Standard overnight multichannel PSG evaluation was performed in the home by an experienced sleep technician using a portable PSG device. Spindle detection was performed with an automated algorithm using a band-pass filter (-3dB at 11.1-14.9 Hz), then thresholding the RMS values of the filtered signal at the 95th percentile. Spindle mean density (nb/min), duration (s), amplitude (μV) and frequency (Hz) were analysed using artefact-free sections of NREM sleep for F3, C3, P3, and O1 derivations (linked-ears). Parents completed the Child Behavior Checklist (CBCL)

Results: Multiple linear regression analyses were performed to determine possible associations between the frequency, amplitude, duration, and density of sleep spindles and CBCL Internalizing and Externalizing Scores. Sleep spindle amplitude, duration, and density were associated with the CBCL Internalizing score (R2 = 0.43, p < 0.01) independent of age, gender, and pubertal status. Sleep spindle amplitude, duration, or density were not associated with CBCL externalizing score.

Conclusion: These data suggest the existence of a relationship between sleep spindles and internalizing symptoms in school-age children.
the VENT families, controlling for level of education, longer mean WASO was associated with a worse Metacognition Index (p = .02) and marginally associated with worse Global Executive Composite (p = .05).

**Conclusion:** The results from this study highlight the impact of caring for a child with a chronic illness on parent functioning, in particular executive functioning areas of working memory, planning, and organizing. Further, sleep disruptions are significantly associated with these negative outcomes. Support for nocturnal caregiving and other interventions are needed to improve the daytime functioning of parental caregivers.

**Support (If Any):** This study was funded by K23 MH077662

**0965**

**SLEEP AND CAREGIVING FOR A CHILD WITH TYPE 1 DIABETES**

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**Introduction:** Type 1 diabetes (T1D) is a complex, potentially life-threatening disease that requires 24-hour a day monitoring and care. Caregiving does not end at the child’s bedtime as constant vigilance during the nighttime is necessary for prevention and treatment of hypoglycemia in T1D. However, little is known about the sleep of caregivers of school-age children with T1D. The purpose of this study is to describe sleep in caregivers of children with T1D.

**Methods:** Caregivers (N = 22) of children ≥10 years of age with T1D were recruited for this descriptive study. Recruitment occurred while caregivers were checking their child in for an overnight diabetes summer camp. Anonymous questionnaire contained demographic and open-ended questions that focused on caregiving as it related to sleep. Open-ended questions were reviewed to help understand the effect of nocturnal caregiving activities on parental sleep.

**Results:** The sample (mean age 43 years; 96% graduated high school; 68% married or partnered, 100% Caucasian) were primarily the child’s parent (n = 21) with one grandparent caregiver. The children had been diagnosed with T1D for a mean of 5 years. Caregivers reported short sleep duration, a mean of 6 hours (range 3-8) per night. Over half (55%) of participants reported they required 7 or more hours of sleep a night to feel their best. 63% reporting trouble sleeping at night, and 86% reported that caregiving interfered with their nighttime sleep, while 54% responded that sleep was “very important” to them. Initial content analysis of the open-ended questions revealed three themes 1) Anxiety due to hypoglycemia, 2) Waking at night to check blood sugar, and 3) Feeling the child’s needs come first.

**Conclusion:** Caregivers of children with T1D are not reporting adequate sleep at night, although they value sleep. Caregiving duties, anxiety, and sleep fragmentation may contribute to their poor sleep.

**0966**

**BRUXISM AND OTHER SLEEP FACTORS ASSOCIATED WITH MORNING HEADACHE IN CHILDREN**

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**Introduction:** Bruxism and headache are prevalent in children. Bruxism can lead to headache due to repetitive or sustained muscle activity. Other sleep factors (habitual snoring, parasomnias, arousals, obstructive sleep apnea, periodic limb movement disorder, and epilepsy) can also lead to morning headache (MH). Our purpose is to investigate risk factors associated with sleep and bruxism related to MH in children.

**Methods:** Retrospective, cross-sectional study. Inclusion criteria: ≥ 7 and < 18 years, polysomnographic evaluation between April 1995 and November 2014 at Instituto do Sono, São Paulo, Brazil. Exclusion criteria: cerebral palsy, neurodevelopment delay, and genetic syndromes. An ordered logistic regression with hierarchical approach was used with bruxism as exposure and MH as outcome. A Principal Component Analysis was performed to generate a score to evaluate quality of sleep (QoS). Quartiles for QoS were calculated and the association with it and the frequency of MH was performed.

**Results:** We evaluated 2885 patients, mean age 12.6 ± 3.2 years, 37.2% female. On adjusted analysis, MH was associated with age (OR 1.04, 95% CI 1.02 - 1.06), female sex (OR 1.83, 95% CI 1.57 - 2.13), family income (<2 minimum wage OR 1.48, 95% CI 1.25 - 1.76, 2 - 10 minimum wage OR 2.28, 95% CI 1.80 - 2.88), parent’s education (9 - 11 years OR 1.36 95% CI 1.10 - 1.70), and bruxism (1 - 5 / week OR 1.22, 95% CI 1 - 1.49, everyday OR 1.53, 95% CI 1.13 - 2.08). Parasomnia was inversely correlated with MH (OR 0.60, 95% CI 0.51 - 0.72). Higher quintiles of QoS (poorer QoS) were associated with higher frequency of MH.

**Conclusion:** Higher frequency of MH was associated with increasing age, female sex, higher family income, higher parent’s education, higher frequency of bruxism and poorer QoS. Parasomnia was inversely correlated with MH.

**Support (If Any):** Associação Fundo de Incentivo à Pesquisa (AFIP)

**0967**

**WITHDRAWN**

**0968**

**CHILDREN EXPOSURE TO SECOND HAND SMOKE (SHS) DURING UTERO AND CHILDHOOD ARE ASSOCIATED WITH INCREASED RISK FOR SLEEP DISTURBANCE**

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**Introduction:** Second hand smoking during childhood has been linked to several sleep problems. Little is known about the long-term impact of utero SHS exposure on childhood sleep disturbance. This study examined the association between SHS exposure during utero and at and childhood stage and childhood sleep disturbance in a sample of Chinese children.

**Methods:** As part of China Jintan Cohort Project, around 1000 school-aged children participated in this study. SHS exposure contained two stages: utero exposure (mother recall of pregnancy history when child was 4-6 years old) and childhood exposure (reported by children when they were 10-12 years old). Childhood sleep disturbance was examined via parent’s report using Chinese version of Children’s Sleep...
Habits Questionnaire (CSHQ) and children's self report using Youth Self Report questionnaire (YSR). Higher scores indicate worse sleep problem. A total of around 400 children who have available SHS exposure history and sleep data were included for the current study. Linear regression was used to examine the impact of SHS exposure on sleep disturbance.

**Results:** Mean age at sleep assessment was 10.74 years old (SD = 0.88), 54.5% were males. There were significant positive correlations between childhood SHS exposure and 2 CSHQ subscales: sleep anxiety (b = 0.086, p = 0.021), daytime sleepiness (b = 0.059, p = 0.038); and 1 YSR subscale: snoring/ coughing during sleep (b = 0.275, p = 0.022). Utero SHS exposure has a long-term effect on childhood sleep disturbance, contributing to a significant score increase for snoring/ coughing during sleep (b = 7.468, p = 0.036), assessed via YSR.

**Conclusion:** Our findings suggest that both utero and childhood SHS exposure are associated with increased risk for sleep disturbance. Further research is needed to examine the underlying mechanism of the influence of prenatal and postnatal SHS exposure on childhood sleep disturbance.

**Support (If Any):** Support for this research was provided by NIH/NIEH R01-ES018858 and K02ES019878
0969

NREM SLOW WAVE ACTIVITY < 1HZ AS A BIOMARKER AND LONG-TERM PREDICTOR OF B-AMYLOID BURDEN IN OLDER ADULTS
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Introduction: Accurate early biomarkers of Alzheimer’s disease (AD) pathology are urgently needed to determine individual risk and offer effective pre-disease or early disease stage treatment interventions. Building on recent evidence linking β-amyloid (Aβ) burden with sleep disruption, here we examine whether < 1Hz NREM SWA can accurately discriminate between individuals with and without Aβ pathology (Aβ+/- classification), and forecast Aβ burden years later.

Methods: 26 older adults (75.1 ± 3.5 years) received [11C]PIB PET scans to assess Aβ pathology, with a subset (n = 13, 75.3 ± 3.8 years) receiving a second scan 3-5 years later. Sleep was recorded at baseline using polysomnography, focused a priori on < 1Hz NREM SWA to discriminate Aβ+/- status and forecast Aβ burden at baseline and 3-5 years later.

Results: < 1Hz NREM SWA offered 75% sensitivity and 79% specificity to accurately categorize older adults (Aβ+/-; positive predictive value = 61%, negative predictive value = 87%, Diagnostic Odds Ratio = 11, accuracy = 77%). Providing context, this discrimination accuracy was similar to APOE genotype; a known risk factor for Aβ pathology. < 1Hz NREM SWA accurately predicted PIB status even when controlling for age and gender (logistic regression; P = 0.012). Moreover, lower < 1Hz NREM SWA increased Aβ+ risk by 30%, while higher < 1Hz NREM SWA reduced risk by 27%. Finally, < 1Hz NREM SWA not only predicted the severity of Aβ burden at baseline (r = -0.69, P = 0.009), but also 3-5 years later (r = -0.68, P = 0.011) and the 3-5 year change in Aβ accumulation (r = -0.41, one-tailed P = 0.084).

Conclusion: These data support the potential utility of < 1Hz NREM SWA as a novel surrogate biomarker of Aβ pathology, one that is non-invasive, safe, inexpensive, and suitable for AD-risk screening within the broader community setting, even before onset of clinical symptoms. Furthermore, this AD biomarker is predictive, heralding Aβ burden years later, underscoring the benefit of greater clinician sensitivity to sleep disruption as a predisposing AD-risk factor.

Support (If Any): Supported by National Institutes of Health; NIH NIA [ROIAG031164] (MPW), [ROIAG034570] (WJ), [ROIAG08415] (SA), [F32AG039170](BAM)

0970
WITHDRAWN

0971

STANDING BALANCE AND TEMPORAL AND SPATIAL ASPECTS OF GAIT ARE IMPAIRED UPON NOCTURNAL AWAKENING IN OLDER ADULTS
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Introduction: Approximately one-third of adults over the age of 65 experience at least one fall each year and over one-quarter of these occur during the night. Here we examined whether mid-sleep arousal impacts gait and standing balance parameters. Furthermore, since visual input can affect both alertness and balance, we tested whether changes in the lighting environment during the mid-sleep arousal could impact gait and standing balance.

Methods: Twenty-one healthy, older (65 ± 8.0 years) adults participated in this repeated-measures design consisting of four separate overnight laboratory stays, each preceded by one week of an at-home, regular sleep-wake schedule. At each stay, participants completed baseline gait and standing balance testing prior to bedtime. After a two hour sleep opportunity, they were awakened for 13 minutes into one of four lighting conditions: very dim white light (< 0.5 lux); dim white light (~28.0 lux); dim orange light (~28.0 lux); or white room-level light (~200 lux). During this awakening, participants completed the same sequence of testing as at baseline. Modeling used likelihood ratio testing to compare full with stepwise reduced models were used in gait and balance analyses.

Results: Results of the modeling procedures revealed that variation in stride velocity and center of pressure path length were significantly worse during the mid-sleep awakening compared to pre-sleep baseline values across all lighting conditions. Lighting conditions during the awakening did not influence these parameters. In secondary analyses conducted only in room-level light, over one-third of the tested gait and standing balance parameters significantly differed from baseline (p < 0.05), and nearly one-quarter had medium to large effect sizes (Cohen’s d ≥ 0.5; r ≥ 0.3).

Conclusion: Several aspects of both standing balance and gait are significantly impaired during mid-sleep awakenings among healthy older adults. This impairment is not ameliorated by exposure to room lighting, when compared to dim lighting.

Support (If Any): VA RR&D: I12RX000773-01A2, VA Sierra Pacific Mental Illness Research Education and Clinical Center

0972

A MULTIDIMENSIONAL CONSTRUCT OF SLEEP HEALTH IS ASSOCIATED WITH BODY MASS INDEX AND BLOOD PRESSURE
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Introduction: Healthy sleep is important for physical health. Key components of sleep, including sleep duration, quality, daytime alertness, timing (sleep midpoint), regularity (variability in sleep midpoint), and efficiency, are associated with physical health. Yet, the epidemiological and empirical data that support these findings have often focused on sleep disorders, and more recently sleep deficiency, to the detriment of understanding the role of positive sleep attributes for health. The aim of the current study was to operationalize sleep health as a multidimensional construct and to test its association with physical health.
ADULTS: 1998 VS 2010

Leisure screen time increased from 2.3 hours to 2.6 hours per day, respectively. These trends were seen in the 1998 and 2010 cycles of the General Social Survey, response rates between sleep health, BMI, and BP.

Results: SEM confirmed that these six observed components of sleep health represented one underlying continuous latent variable as indicated by model fit indices (CFI = .959; TLI = .964; SRMR = .026). The latent sleep health variable was negatively associated with resting systolic BP (b = -.05), diastolic BP (b = -.13), and BMI (b = -.23), after controlling for age and sex (all ps < .001). Follow-up multiple regression analyses that included age, sex, and individual components of sleep health into a single model indicated that daytime alertness (b = -.078, p < .05) and sleep regularity (b = -.05, p < .001) were negatively associated with BMI.

Conclusion: A multivariate measure of sleep health was significantly associated with health indicators including blood pressure and BMI. Future research will examine longitudinal associations between sleep health and physical health.

Support (If Any): HL08610, HL104607, HL112646, AG020667, HL025767, MH061566, DA033064, MH024652, MH074012

0973 SLEEP DURATION AND SCREEN TIME IN CANADIAN ADULTS: 1998 VS 2010

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Introduction: The effect of expanding use of electronic media for communications and entertainment and its effect on sleep duration are examined comparing two large cross-sectional surveys before and after widespread use of electronic media.

Methods: Data on sleep duration and screen time were obtained from adults > 15 years by random digit dialing telephone interviews to landlines from 24 hour time use questions about 5 minute activity changes in the 1998 and 2010 cycles of the General Social Survey, response rates 80% and 55% respectively. N = 10,749 and 15,390 respectively.

Results: Weighted mean sleep duration increased from 8.1 hours in 1998 to 8.3 hours per day in 2010. Leisure screen time increased from 2.3 hours to 2.6 hours per day, respectively. These trends were seen in all sex and age groups and were positively correlated overall.

Conclusion: Despite the common belief that sleep durations are decreasing and decreasing at the expense of increasing screen time this large population-based analysis demonstrates the reverse: increasing screen time positively correlated with increasing sleep duration in Canadian adults compared before and after the surge of electronic media usage.

0974 IS POOR SLEEP ASSOCIATED WITH COGNITIVE PERFORMANCE IN CAREGIVERS OF PERSONS WITH DEMENTIA?

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Introduction: Caregivers of persons with dementia report poorer sleep, higher rates of depressive symptoms and problems with cognitive performance. What is unclear is whether poor sleep and depressive symptoms impact cognitive performance. Therefore, the aim of this study is to understand the relationships among these variables in caregivers of persons with dementia.

Methods: Caregivers who met the definition of insomnia were purposively sampled. At study baseline, they completed a 14-days of sleep diary, the CES-D, and the cognitive battery of the National Institutes of Health Toolbox. We computed descriptive statistics and one sample t-tests to compare the sample means with the general population on the cognitive function variables and bivariate correlations to examine the relationships among the sleep variables, depressive symptoms, and cognitive performance.

Results: The sample consisted of 28 caregivers (82% female, 79% Caucasian) with a mean age of 65.14 years (SD = 10.07) and 15.14 years, SD (± 2.53 years) of education. Poor sleep was confirmed with high sleep onset latency (34.93 minutes), wake after sleep onset (47.77 minutes), and low sleep efficiency was (79.12%). While the average CES-D score was 14.36, approximately 41% of the caregivers reported depressive symptoms suggestive of a diagnosis of depression. The average fluid cognition score was 93.21 which was significantly less than the general population norm of 116.68. While there were no significant correlations between the sleep variables, depressive symptoms, and crystallized, fluid, and total cognition, there were small correlations between sleep and depressive symptoms and crystallized cognition.

Conclusion: These poor sleeping caregivers had significantly worse fluid cognition than the population norms. It is possible that sleep problems in these caregivers are associated with poorer performance in this domain because fluid cognition tasks occur in the prefrontal cortex which is thought to be affected by sleep problems. Data collection is ongoing.

Support (If Any): Support for this work comes from the National Institute on Aging (IR01AG039495-01) and National Institutes of Health, National Research Service Award (T32HL07713) at the National Institutes of Health and the National Hartford Center of Gerontological Nursing Excellence.

0975 SHORT-TERM CHANGES IN SLEEP DISTURBANCES, INFLAMMATORY NUCLEAR FACTOR-KAPPA B AND DEPRESSIVE SYMPTOMS IN OLDER ADULTS

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Introduction: Sleep disturbances and late-life depression are commonly reported health problems in older adults and often occur comorbidly. Increased NF-κB inflammatory activity may explain the link between sleep disturbances and depression. Our objective was to test whether changes in sleep disturbances are prospectively associated with changes in depressive symptoms in older adults, and whether inflammatory NF-κB mediates this association.

Methods: Prospective data were obtained from older adults (N = 49) aged 55 to 90 with active sleep disturbances (Pittsburgh Sleep Quality Index > 5) who participated in behavioral treatment for sleep problems. Structural equation modeling was conducted with StataMP13. Measures were assessed 10 weeks apart. We first generated a composite latent variable representing change in sleep disturbances using change scores for the Pittsburgh Sleep Quality Index, Athens Insomnia Scale, and the Pre-Sleep Arousal Scale and tested direct effects on change in depressive symptoms using the Beck Depression Inventory. We then tested this same association while accounting for NF-κB as a mediator.

Results: Changes in sleep disturbances were strongly associated with changes in depressive symptoms over a 10-week interval (β = 0.59,
p < 0.001). Changes in NF-κB mediated 6.2% of the effects of sleep disturbance on changes in depressive symptoms (β = 0.045, p = 0.026).

**Conclusion:** Short-term reductions in sleep disturbances aligned with reductions in depressive symptoms in our sample of older adults. Inflammatory NF-κB activation partially mediated this association such that NF-κB was inversely associated with both sleep disturbances and depressive symptoms. Our findings add knowledge about the impact of sleep disturbances and inflammation on depressive symptoms in older adults and inform possible mechanisms to be targeted by future intervention.

**Support (If Any):** Data were made possible by NIH grants P30-AG028748; 5T32-MH019925; UL1TR000124; and 1UL1RR033176; and the Cousins Center for Psychoneuroimmunology.

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**0976**

**HIPPOCAMPAL CONNECTIVITY STATISTI CALLY MEDIATES THE ASSOCIATION BETWEEN INSOMNIA SEVERITY AND DEPRESSION IN SEDENTARY OLDER ADULTS**

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**Introduction:** Insomnia is associated with depression, particularly in older adults. The mechanisms of this association are poorly understood. Both insomnia and depression have been linked to impairments in memory and memory-related circuits. Insomnia may confer risk for depression by impairing affective memory processes. The purpose of this study was to test whether functional connectivity of the hippocampus, a critical structure for memory processes, is related to the insomnia-depression association in older adults.

**Methods:** The study sample (M = 76 years old, range 70-87) included 25 sedentary older adults enrolled in the LIFE Study (Brain Ancillary Study). Participants completed the Insomnia Severity Index, a resting state magnetic resonance imaging scan at 7 tesla, and the Center for Epidemiological Studies-Depression Scale. A seed-to-voxel mediation analysis was conducted using bilateral hippocampi as the seed. Covariates included age, gender, education, and general health.

**Results:** Greater insomnia severity was associated with more depressive symptoms, r = 0.5, p = 0.01. The association between insomnia severity and depressive symptoms was statistically mediated by hippocampal connectivity with the right posterior insula, dorsal anterior cingulate gyrus, inferior parietal cortex, and parahippocampus (height threshold, p < 0.005; p < 0.05 AlphaSim corrected with minimum k = 156 voxels).

**Conclusion:** Hippocampal connectivity with major hubs of the salience (insula, anterior cingulate) and default mode (anterior cingulate, inferior parietal) networks may be related to the insomnia-depression association in older adults. Although speculative, one potential explanation for these findings is that insomnia impairs affective memory circuitry that in turn confers risk for depression. Supplementing cognitive behavioral therapy for insomnia with treatments that target hippocampal connectivity, such as memory therapeutics, may mitigate risk for depression in older adults with insomnia.

**Support (If Any):** The research upon which this publication is based was performed pursuant to NIA grant U01-AG022376. Dr. Kay is supported by T32 HL082610. Dr. Wilckens was supported by T32 MH019986

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**0977**

**PREDICTORS OF IMPROVED SLEEP QUALITY FOLLOWING SIX MONTHS OF EXERCISE TRAINING IN POSTMENOPAUSAL WOMEN**

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**Introduction:** Although exercise has been shown to improve sleep quality in a variety of populations, little is known about who may be most responsive to exercise as a behavioral sleep therapy. We examined whether baseline participant characteristics and intervention-related changes in fitness or weight predicted improved sleep following exercise training in a sample of postmenopausal women.

**Methods:** Inactive postmenopausal women were randomized to one of three aerobic exercise treatments (4, 8, or 12 kcal/kg/wk) or a non-exercise control group for 6 months. The Sleep Problems Index (SPI), derived from the 6-item Medical Outcomes Study Sleep Scale, provided a measure of sleep quality at baseline and post-intervention. Predictors of 6-mo SPI change were evaluated using multiple linear regression. Potential predictors included baseline SPI score, exercise treatment, sociodemographic characteristics (age, race, marital status), baseline behavioral and health markers (smoking, physical activity, sleep medication use, prior depression, prior anxiety, C-reactive protein, metabolic syndrome, body mass index, cardiorespiratory fitness), intervention adherence, and intervention-related changes in fitness and weight. Overall, 268 women (57.2 ± 6.4 y, 31.2 ± 3.8 kg/m2) were included in analyses after the control group and those with missing baseline or post-intervention data were excluded.

**Results:** Change in SPI score at 6 months did not significantly differ across the 3 exercise groups (P = .49). Higher baseline SPI score (β = -.62, P < .0001), lack of prior anxiety diagnosis (β = .11, P = .038), and less baseline physical activity (β = .11, P = .046) were associated with greater 6-month improvement in SPI score. Among the 125 women with significant baseline sleep disturbance (SPI > 25), baseline SPI score (β = -.48, P < .0001) was the only significant predictor of 6-month SPI change.

**Conclusion:** As expected, postmenopausal women who were less active and with sleep disturbance had greater sleep improvement with exercise training. Further work should be done to confirm whether women with a history of anxiety are less responsive to the sleep-improving effects of exercise.

**Support (If Any):** R01HL066262 (PI: Blair), K23HL118318 (PI: Kline)

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**0978**

**NIGHTTIME SLEEP PARAMETERS ARE LINKED TO SUBJECTIVE AND OBJECTIVE DAYTIME NAPPING IN OLDER WOMEN**

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**Introduction:** Growing evidence suggests an association between daytime napping and an increased health risk in the elderly, but it is unclear whether daytime napping is an indicator of disrupted nighttime sleep.

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Methods: Sleep and daytime napping habits were assessed by wrist actigraphy and self-administered sleep habit questionnaire in 2688 Caucasian women (mean age 84 years). Napping duration was defined as the mean minutes scored as sleep outside of the main sleep interval by actigraphy, and daily nappers were considered as those who reported napping 7 days per week. Logistic regression was used to examine the association between actigraphic nighttime sleep parameters, Pittsburgh Sleep Quality Index (PSQI), and dichotomized napping duration (≥ 60min/ < 60min) and reported daily nappers (yes/no).

Results: After adjustment for age, Body Mass Index, alcohol drinking, depression, diabetes, cardiovascular diseases, walking for exercise, mini-mental state examination score and antidepressants use, those sleeping for < 5h per night by actigraphy were 60% more likely to nap for ≥ 60min compared to those sleeping for 5-8h per night [OR = 1.60 (95% CI 1.16, 2.22)]. The probability of reporting daily naps almost doubled for those with short actigraphic nighttime sleep. However, those with a sleep efficiency of < 80%, wake after sleep onset time of ≥ 60min and sleep latency of ≥ 60min were less likely to take longer day naps, with an OR of 0.75, 0.77 and 0.72, respectively (p < 0.01). Higher PSQI score (indicating poorer sleep) was associated with lower odds of reporting daily naps [OR = 0.75 (0.61, 0.94)], but was not associated with actigraphic napping durations.

Conclusion: Older women with short nighttime sleep were more likely to take longer day naps, while napping durations were shorter among those with high sleep fragmentation and long sleep latency at night. Further analysis is needed to better understand the complex relationship between nighttime sleep and daytime napping in older adults.

Support (If Any): The Study of Osteoporotic Fractures (SOF) is supported by National Institutes of Health funding. The National Institute on Aging (NIA) provides support under the following grant numbers: R01 AG005407, R01 AR35582, R01 AR35583, R01 AR35584, R01 AG005394, R01 AG027574, and R01 AG027576.

0979 SLEEPINESS AND FATIGUE ASSOCIATED WITH BRAIN ATROPHY IN COGNITIVELY NORMAL ELDERLY: MAYO CLINIC STUDY OF AGING

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Introduction: Daytime sleepiness and fatigue increase with aging and are associated with significant functional and cognitive impairment. Few studies assessed their association with brain structure. The goal of this work was to assess the association between excessive daytime sleepiness (EDS) and fatigue with structural MRI measures.

Methods: In the Mayo Clinic Study of Aging (MCSA), we identified 1258 cognitively normal elderly, aged ≥ 50 years who had completed sleepiness and fatigue surveys and had a baseline structural MRI. Of these, 178 subjects had EDS, 25 had clinically significant fatigue, and 9 had both. Regional cortical thickness and hippocampal volume were obtained using Freesurfer. The left and right hemispheres were averaged. Linear regression models were used to explore the associations between EDS and Fatigue and cortical thickness, adjusting for multiple confounders.

Results: EDS was associated with a 27 µm lower global cortical thickness (-42.9; -11.0, 95%CI, p = 0.001). The regional association with EDS was maximal in temporal lobes with 34.8 µm lower thickness (-56.3; -13.4, 95%CI, p = 0.001). These changes were equivalent to more than 3 years of aging, when compared to cortical thickness reduction predicted by age. Fatigue was only associated with lower temporal thickness and hippocampal volume. Fatigue was associated with 83.7 µm lower temporal thickness (-138.4; -28.9, 95%CI, p = 0.003) and 419.2 mm³ lower hippocampal volume (-729.3; -109.0, 95%CI, p = 0.008). These estimated changes were equivalent to 6 and 8.5 years of aging, respectively. Subjects with EDS or fatigue not only had more disturbed sleep, but also significantly lower cognitive scores and more medical comorbidities.

Conclusion: Symptoms of EDS and fatigue were associated with reduced cognitive performance and altered brain structure, especially in regions implicated in mild cognitive impairment. We hypothesize that EDS and fatigue symptoms are clinical markers of accelerated brain aging, which may be associated with sleep and medical co-morbidities.

Support (If Any): The Study of Osteoporotic Fractures (SOF) is supported by National Institutes of Health funding. The National Institute on Aging (NIA) provides support under the following grant numbers: R01 AG005407, R01 AR35582, R01 AR35583, R01 AR35584, R01 AG005394, R01 AG027574, and R01 AG027576.

0980 PREDICTORS OF SLEEPING MEDICATION USE AND IMPACT OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA ON SLEEPING MEDICATION USE AMong OLDER ADULTS WITH CHRONIC INSOMNIA

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Introduction: Medications commonly used for insomnia (MCUI) such as benzodiazepines may improve insomnia symptoms. However, they also increase the risk of falls and cognitive impairment, especially in older individuals. Cognitive behavioral therapy for insomnia (CBTI) has the potential to promote MCUI discontinuation. We examined characteristics associated with MCUI use and the impact of CBTI on MCUI use in older individuals with chronic insomnia.

Methods: We analyzed baseline data of older individuals with insomnia enrolled in a randomized clinical trial comparing CBTI delivered by a supervised, sleep educator to an attention control condition (N = 159; 97% male, mean age 72 years). We classified individuals as MCUI users (N = 23) vs. non-users (N = 135) based upon medication diaries. Bivariate associations between MCUI status and the following variables were examined using logistic regression: age, education, race/ethnicity, employment, alcohol use, Patient Health Questionnaire-9, post-traumatic stress disorder, Insomnia Severity Index, Dysfunctional Beliefs and Attitudes about Sleep-16 (DBAS) total score and medication item, and Pittsburgh Sleep Quality Index (PSQI). We assessed frequencies of MCUI discontinuation in a subset of individuals (N = 17) who used MCUI at baseline and were randomized to CBTI.

Results: Worse score on the DBAS medication item (odds ratio [OR] 1.3, p < .001) and PSQI (OR 1.2, p = .046) were significantly associated with MCUI use. P-values for other logistic regression models were > .07. Few MCUI users (12%, 18%, and 23%) discontinued MCUI at post-treatment, 6-months, and 12-month follow-up, respectively, even though the trial found that CBTI improved sleep onset latency, total wake time at night (TWT), and sleep efficiency at 6 months follow-up (all p < .05).

Conclusion: Dysfunctional beliefs about MCUI and PSQI were associated with MCUI use in older adults with insomnia. MCUI use was persistent in the majority of individuals who underwent CBTI, even though CBTI improved sleep parameters. Additional strategies to specifically promote MCUI discontinuation are needed.
0982
SLEEP EXPLAINS THE ASSOCIATION BETWEEN DEPRESSION AND FRAMINGHAM HEART AGE IN WOMEN

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Introduction: Depression is associated with a 10-fold increase in risk for cardiovascular disease (CVD). Identification of modifiable pathways linking depression to CVD is critical to reducing risk. Disturbed sleep, which is often a hallmark of depression and has been independently linked to cardiovascular risk, may represent one such modifiable pathway. We examined whether objectively-assessed sleep predicts the association between depression and cardiovascular risk, as measured by Framingham heart age.

Methods: Participants were 72 women (M age = 59.4) without CVD or diabetes. Forty-five had a lifetime history of clinician-assessed major depressive disorder (MDD; 62%) and 27 (38%) did not. Laboratory sleep studies evaluated modifiable indices of sleep linked to both MDD and CVD including apnea-hypopnea index (AHI), total sleep time (TST), and sleep efficiency (SE). Age, sex, fasting cholesterol, smoking, blood pressure and antihypertensive medication use were used to calculate Framingham heart age.

Results: Depression was a significant predictor of heart age in bivariate analyses (p < .05). Although chronological age did not differ between participants with or without depression history, mean heart age was significantly higher in MDD participants compared to controls (65.1+14.4 yrs vs. 57.0+18.3 yrs, respectively; p<05), uniquely explaining 6.9% (AHI p < .05), 7.2% (TST p < .05), and 11.2% (SE p < .01) of the variance. Associations among sleep and heart age remained significant after additional adjustment for obesity and hypertension.

Conclusion: Sleep disordered breathing, sleep duration, and sleep efficiency fully attenuated the association between depression and Framingham heart age in middle to older age women with no history of cardiovascular disease or diabetes. These sleep-related associations were independent of other risk factors including obesity and hypertension. More research is needed to determine whether sleep health interventions reduce the impact of depression on cardiovascular morbidity and mortality in women.

Support (If Any): This research was supported by grants from the NIH including R01 HL104607, R01 GM11324, K23 HL118318, T32 HL082610, and T32 HL07560.
B. Clinical Sleep Science

0983
FATIGUE, DYSFUNCTIONAL BELIEFS ABOUT SLEEP, AND PAIN CATASTROPHIZING ARE PREDICTORS OF BOTH SLEEP COMPLAINT AND DAYTIME FUNCTION IN A LARGE COHORT OF OLDER ADULTS WITH CO-MORBID INSOMNIA AND OSTEOARTHRITIS PAIN

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Introduction: We hypothesized that predictors of nighttime sleep complaints and daytime function might be different in an older adult cohort of osteoarthritis (OA) patients with co-morbid insomnia and chronic pain.

Methods: We tested this hypothesis using the baseline data of a large randomized controlled trial. Three hundred sixty-seven older adults (mean age 72.9 ± 8.2 years; female 78.5%) with OA were studied. All had clinically elevated insomnia and pain. Sleep complaint was assessed using Insomnia Severity Index (ISI) items 1-3 and the Pittsburgh Sleep Quality Index (PSQI) Sleep Quality subscale. Daytime function was measured by ISI items 4-7 and PSQI Day Dysfunction subscale. Predictive variables included demographics, Geriatric Depression Scale (GDS), Graded Chronic Pain Scale (GCPS), Flinders Fatigue Scale (FFS), Dysfunctional Beliefs about Sleep Scale (DBAS), and Pain Catastrophizing Scale (PCS).

Results: Multiple regression analyses were performed testing two predictive models of the ISI and PSQI sleep complaint and daytime function measures: Model 1 included demographics, GDS, FFS, and GCPS; Model 2 added DBAS and PCS. All regressions resulted in significant predictive models with predictors accounting for greater variance in the ISI measures, particularly for daytime function (R2 = .24-.43). In Model 2, DBAS and PCS were significant predictors and accounted for some additional variance. Fatigue, dysfunctional beliefs about sleep, and pain catastrophizing were consistent predictors across all models.

Conclusion: Findings demonstrated no consistent differences in factors predicting nighttime sleep versus daytime function. Model 2 suggests that individual attitudes about sleep and pain were stronger predictors of sleep and daytime function than depression and pain. The two commonly used sleep measures (ISI and PSQI) yielded similar models. However, the predictors explained greater variance for the ISI, especially daytime functioning.

Support (If Any): Supported by NIH grant R01-AG031126.

0984
OLDER MINORITY MALES TAKE MORE FREQUENT, LONGER AND MORE OFTEN UNPLANNED NAPS IN A SAMPLE OF MEDICARE BENEFICIARIES

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Introduction: Daytime napping is an important aspect of sleep behavior, with estimated prevalence rates in older adults ranging from 22% to 61%. Napping has been associated with poor nighttime sleep and increased risk of mortality. Demographic characteristics increase the risk for short nighttime sleep duration, however their relationship to napping is poorly understood. The purpose of this study is to better describe daytime napping as a function of demographic characteristics.

Methods: A retrospective cohort of a nationally representative sample of Medicare beneficiaries ages 65 and older enrolled in the National Health and Aging Trends Study (NHATS) and who answered items related to daytime sleeping behavior (n = 1,292), including napping frequency, duration, and whether naps were planned was studied. Analyses included descriptive statistics and between group comparisons of napping behaviors among demographic groups including age, sex, and race/ethnicity using Chi square.

Results: Daytime napping was highly prevalent in this sample, with 29.57% of participants reporting that they napped 5 or more days per week. Of those who reported napping, 13.88% reported that some and 48.23% reported that all of those naps were unplanned. Older age, being male and being from a minority race/ethnic group were significantly associated with greater frequency of naps (p < 0.05). There were significant differences between racial/ethnic groups on the length of naps and presence of unplanned naps (p < 0.05), with minority racial/ethnic participants reporting more naps over 60 minutes in length and more unplanned naps.

Conclusion: The results of this study indicate that daytime napping is frequent, of long duration and often unplanned among Medicare beneficiaries, particularly among older, non-white men. Further research is needed to examine the relationship between napping and adverse health outcomes for age, sex and racial and ethnic minority groups in order to guide interventions to enhance health.

Support (If Any): K01HD076183 (DJF) and K01 HS 022907 (NEL).

0985
RELATIONSHIP BETWEEN NAPPING AND SLEEP AMONG COMMUNITY-DWELLING OLDER ADULTS

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Introduction: Sleep and circadian sleep-wake rhythms change significantly as people age. One commonly reported change is the increased prevalence of daytime and evening napping. No consistent relationships have been found between napping duration and disrupted nocturnal sleep among community-dwelling older adults. This study examined the relationship between objectively measured daytime and evening napping with objectively measured nocturnal sleep duration, sleep efficiency, and nocturnal awakenings; sleep quality as measured by the Pittsburgh Sleep Quality Index (PSQI) total score.

Methods: Community-dwelling older adults were recruited to participate in two studies investigating daytime activity and sleep quality. Participants completed baseline questionnaires, wore an actigraphy watch, and kept a sleep diary for 7 days.

Results: Twenty-six community-dwelling adults (19 females; mean age = 77.4 years; SD = 7.2; range 65 to 94 years) participated in the study. The majority was Caucasian (n = 23; 88.5%) living alone (n = 21; 73.1%) and retired (n = 20; 76.9%) although 65.4% (n = 17) reported volunteering part-time. Objectively measured sleep duration was short (Mean = 386.3 minutes; SD = 69.2 minutes) with mean wake after sleep onset of 69.6 minutes (29.3 minutes) and mean sleep efficiency of 79.1% (SD = 7.6). Napping was common during the day (mean = 103.8 minutes, SD = 73.52) and evening hours (mean = 40.6 minutes, SD = 57.9). Sleep quality overall was poor (PSQI total score mean = 5.42; SD = 2.8). Pearson’s Correlation analysis revealed a significant relationship between total sleep time and evening napping (r = -0.47, p < .05).

Conclusion: This study found that more evening napping was associated with lower nocturnal sleep duration. Further research is needed to investigate the relationship of evening napping duration and sleep duration among a larger more diverse population of community-dwelling older adults.

Support (If Any): Delta Lambda Chapter Sigma Theta Tau, Saint Louis University Presidents Research Fund
0986
EPIDEMIOLOGY OF MID-SLEEP TIME AMONG NORMAL SLEEPERS: AGE, RACE, AND GENDER
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Introduction: Mid-sleep time (MST) is frequently used as a phase reference point for sleep in chronobiology and sleep research. However, little epidemiological data exist characterizing MST in the general population. The present study aimed to explore how MST varies by age, race, and gender among a community-dwelling sample of normal sleepers.

Methods: Using random-digit dialing, we recruited a stratified sample of community-dwelling adults ranging in age from 20 to 80+. This study analyzed 2 weeks of self-reported sleep diary data from 509 normal sleepers (defined broadly as the absence of a sleep disorder). Participants’ MST was calculated as the average midpoint between sleep onset (time-entering-bed plus latency) and sleep offset across 14 nights. A three-way analysis of variance (ANOVA) was conducted to explore differences in MST by age (grouped into deciles), race, and gender.

Results: Results of the three-way ANOVA revealed a significant main effect of age - but not race or gender - on MST among normal sleepers (F(6, 481) = 9.2, p < .001). There were no significant interaction effects. Tukey’s post-hoc analysis revealed that normal sleepers aged 20 to 29 exhibited an average MST (M = 4:00 AM, SD = 1.2 hours) that was significantly later compared to the MST of normal sleepers of other age deciles. The average difference between the MST of 20 to 29 year olds and the MST of other age deciles (ages 30 - 80+) was approximately one hour.

Conclusion: Among normal sleepers, young adults in their twenties exhibit later MSTs of approximately one hour when compared to normal sleepers of other age deciles, regardless of race or gender. Together, these findings provide novel information toward better characterization of sleep phase among normal sleepers.

Support (If Any): Research supported by National Institute on Aging grants AG12136 and AG14738.

0987
ASSUMPTIONS ABOUT THE BENEFITS OF MORE SLEEP ARE CORRELATED WITH LONGER SLEEP DURATION IN OLDER ADULTS
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Introduction: Until recently, it was a commonly held belief that older adults obtain less sleep and that their sleep deteriorates as they age. However, recent studies suggest that older adults’ sleep is more affected by morbidity and medication than age itself. After age 60, sleep does not appear to change much in healthy, older adults.

Methods: Twenty-four healthy adults (3 male, M = 65.71 years) self-reported sleep and health information prior to a sleep extension study. Participants did not report any major health or sleep issues.

Results: Relationships were assessed with Spearman’s rho tests. Total sleep time (TST) was moderately positively correlated with age (r = .464, p = .023). TST was also moderately correlated with participants’ expectations (r = .432, p = .035). No associations were found between TST and Patient Health Questionnaire-9 (PHQ-9) scores, Mini Mental State Exam (MMSE) scores, or body mass index (BMI). No associations were found between age and expectancy.

Conclusion: Interestingly, as age increased, the total sleep time of the sample increased. These data are consistent with other data, suggesting that age is not necessarily associated with less sleep. Additionally, as participants reported increased sleep, they also demonstrated higher expectations that extended sleep would benefit them physiologically and psychologically. Relatively longer sleep duration in older adults might be explained, in part, by more expectations that sleep will have benefits, and the longer sleepers think that even more sleep would be better. A major limitation of the data include the small sample size.

Support (If Any): The research was supported by the Laura Griffin Award (University of South Carolina) and NIH R01-HL095799.

0988
POSITIVITY RATIO: PREDICTING SLEEP ACROSS THE ADULT LIFESPAN
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Introduction: Literature examining the sleep and affect association is vast, but fewer studies have examined the reverse of this relationship. Importantly, positive affective experiences have the potential to promote healthier sleep. The aim of the present analysis is to examine the association between affect and sleep across the adult lifespan in a sample of community-dwelling adults. Specifically, affect is characterized by the positivity ratio, the proportion of positive affect to negative affect an individual reports.

Methods: The current study is an archival analysis of middle-aged and older adults (n = 1,255; M = 54.52), who participated in the Midlife in the United States-II (MIDUS-II) study. The positivity ratio was derived from the MIDUS-II Positive and Negative Affect Scale. Global sleep quality scores (GSS) were derived from the Pittsburgh Sleep Quality Index. Both scales were completed by mail.

Results: Hierarchical regression was used to examine the association between affect and sleep. Gender, race, and age were entered into the model as covariates. In step one, covariates accounted for 2.2% of the variance in GSS, F(3, 801) = 6.05, p < .001. In step 2, the addition of the positivity ratio significantly improved the model, explaining an additional 7.2% of variance in GSS, F(4, 800) = 20.80, p < .001.

Conclusion: Overall, the positivity ratio predicted variance in global sleep quality above and beyond gender, race, and age. Specifically, higher positivity ratios (i.e., higher amounts of positive affect in relation to negative affect) were associated with better sleep quality across the adult lifespan. These findings suggest that it may be worthwhile to further examine the role of affect in sleep outcomes, particularly across age groups and in community-dwelling adults. Future research may examine ways to enhance positive affective experiences as possible preventive and/or protective mechanisms against poorer sleep.

0989
SLEEP AMONG LONG-TERM CARE RESIDENTS IN CHINA: A REVIEW OF LITERATURE
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Introduction: The use of long-term care (LTC) service has boomed in China in recent years. As sleep is an integral component of health promotion in older adults, the purpose of this study was to review the status of sleep research in LTC residents in China and provide insights for future research.
Methods: Systematic searches were conducted on MEDLINE, EMBASE, Wan Fang, and China National Knowledge Infrastructure (CNKI) using the following keywords (in English and Chinese) individually and in multiple combinations: (sleep/insomnia/sleepiness) AND (nursing home/long-term care facilities/assisted living facilities/institutionalized) OR (elders/older adults/elderly/Seniors) AND (China/Chinese). Studies were included if they: 1) reported sleep quality, factors associated with sleep, or effects of sleep-promoting interventions in long-term care residents in China; 2) were conducted in the Mainland China, Taiwan, and Hong Kong; 3) written in English or Chinese, and 4) published from January 2000 to June 2015. Reference lists of original and review articles were examined to identify additional published studies.

Results: Sixteen studies met inclusion criteria. Sleep quality was measured by three subjective measures across the 16 studies; 12 of which used the Pittsburgh Sleep Quality Index. No objective sleep measures were used. Nine of the 16 studies were cross-sectional studies reporting that demographics, comorbidities, depression, and lifestyle were associated with sleep quality in Chinese LTC residents. Seven of the 16 studies utilized exercise, traditional Chinese medicine, light therapy, and multi-component interventions to improve sleep quality. Overall, these interventions improved residents’ nocturnal sleep duration and subjectively measured sleep quality.

Conclusion: Sleep has not been well studied in LTC residents in China. More sleep research with rigorous designs and both objective and subjective sleep measures are needed for future studies.

0990 AFTERNOON NAPPING AND COGNITIVE FUNCTION IN CHINESE OLDER ADULTS: A LONGITUDINAL FOLLOW-UP
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Introduction: Cognitive impairment is a significant concern for older adults. Daytime napping is a common habit of Chinese elders. Sleep characteristics have been linked to cognitive function, however, associations between daytime napping and cognition in elders remain unclear. This study aimed to examine the longitudinal associations between self-reported afternoon napping at baseline and cognitive function after two-years of follow-up in Chinese older adults.

Methods: A total of 3,577 individuals 65 years and older from the China Health and Retirement Longitudinal Study in 2011 (baseline) and 2013 (follow-up) were included. Self-reported measures at baseline included duration of afternoon napping and nighttime sleep, demographics, comorbidities, health habits, and daily activities. Based on napping length, subjects were categorized as non-nappers (0 minutes), regular nappers (1-90 minutes) and extended-nappers (> 90 minutes). Cognition was assessed at both baseline and follow-up, using an overall interview-based measure of mental capacity, episodic memory, and visuospatial abilities.

Results: Afternoon napping was reported in 57.7% of participants at baseline, with a mean (SD) napping duration of 63 (40) minutes. Cognitive function at the two-year follow-up (unadjusted) was significantly associated with baseline napping (p < 0.001), with regular nappers showing better overall cognition after 2 years compared to non-nappers (p < .0001) or extended nappers (p < 0.001). After controlling for baseline cognition, age, gender, education, BMI, depression, comorbid medical conditions, mobility, social activities, and nighttime sleep duration, cognition was significantly better in regular napper (p < .0001) and non-napper groups (p = 0.003) compared to extended napping.

Conclusion: In Chinese older adults, we found a longitudinal association between extended napping at baseline and worse cognition after 2 years. Results suggest that regular napping of 1-90 minutes may have cognitive benefits within an elderly population, when compared to none or extended napping. Future studies should examine ways to support good sleep practices as a method of preserving cognition.

Support (If Any): MML/NIH-T32HL07713

0991 USING MACHINE LEARNING TO EXPLORE SUBJECTIVE SLEEP QUALITY IN MIDDLE AND LATE ADULTHOOD
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Introduction: There are age-dependent changes that predispose older individuals to poorer sleep, including increased fragmentation, wakefulness, and an increase in the prevalence of diagnosed sleep disorders. Despite this, several studies have suggested that older individuals rate their sleep quality similar to or better than that of younger cohorts. We explored the relationship between objective sleep characteristics (standard polysomnography and power spectral variables) in predicting subjective sleep quality in a large sample of US-dwelling men and women using machine learning methods. We further explored how the relationship between objective and subjective sleep quality changed with age.

Methods: We used cross-sectional analyses of men and women (N = 5,318), ages 39-90 (M ± SD = 63.2 ± 11.2 years), participating in the Sleep Heart Health Study who completed a single night of at-home polysomnography and rated the prior night’s sleep quality (Sleep Depth and Restfulness) on 1-5 Likert-type scales the next morning. Polysomnography staging, EEG power spectral analysis, demographics and clinical characteristics were all entered into predictive multivariable models. Two machine learning methods, lasso penalized regression and random forests, were used to model subjective sleep quality.

Results: After confirming age was one of the most important predictors across models, participants were stratified into age quartiles (39-55, 56-63, 64-72, 73-90 years). Greater objective sleep efficiency, greater total sleep time, and reduced wake after sleep onset were each associated with reports of higher sleep quality. The top quartile reported the highest sleep quality even as objective sleep deteriorated. Though R² estimates remained low, models explained sequentially more of the variance (from 3% in the lowest quartile to 14% in the highest), suggesting objective correlates have stronger relationships to subjective sleep quality with age. Partial dependence plots of the relationship between sleep efficiency (SE, the most consistently important predictive variable), and sleep quality indicated that sensitivity decreased with age, such that older individuals would rate their sleep better given the same level of SE.

Conclusion: This is the largest study to explore subjective and objective characteristics of sleep quality using novel machine learning algorithms. Subjective sleep quality appears to improve with age even as objective sleep deteriorates. Polysomnography-based staging or EEG spectral power contribute little to explaining subjective sleep quality.

Support (If Any): This study was supported by the following: HL086862 and HL075078 (SHHS) and HL114473 (NSRR); VA Sierra Pacific Mental Illness Research Education and Clinical Center (JMZ); Lucille Packard Foundation for Children’s Health, ULITR001085, Stanford Child Health Research Institute (KAK).
0992
COMPARING SLEEP DURATIONS AMONG US RETIREES AND NON-RETIREES: ANALYSIS OF THE NATIONAL HEALTH INTERVIEW SURVEY

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Introduction: Older age is generally characterized by increased risk for chronic conditions, such as obesity, dyslipidemia, diabetes, and hypertension, and significant changes in sleep patterns. It is unclear whether sleep duration (short or long sleep) contributes to chronic conditions differentially contrasting retirees (≥ 65 years) and non-retirees (18-65 years).

Methods: The study utilized data from the 2004-2013 National Health Interview Survey. NHIS applies a stratified multistage sample survey of the resident civilian non-institutionalized US population. Respondents provided sociodemographic and physician-diagnosed chronic conditions. We defined an unhealthy cohort as a subset of the retired population who reported at least one of four chronic conditions: obesity, dyslipidemia, diabetes, and hypertension. The healthy cohort included individuals who reported none of these conditions. Data was analyzed using SPSS 20.

Results: Of the sample, 56.4% of the retirees were female and 81.7% were white. Among non-retirees, 52.0% were female and 76.5% were white. Non-retirees and retirees had an average sleep duration of 7.08 and 7.49, respectively (p < .01). Adjusted logistic regression analysis indicated that overall retirees were less likely to report short sleep (<7hrs) [OR = .92, 95%CI = .89-.95, p<8hrs] [OR = 1.89, 95%CI = 1.80-1.98, p < .01] compared to non-retirees. Healthy retirees had a 41% greater odds of reporting long sleep, but were no more or less likely to report short sleep, compared to non-retirees. Unhealthy retirees had a two-fold greater odds of reporting long sleep, but 5% lower odds of reporting short sleep, relative to non-retirees.

Conclusion: Retirees had a higher mean sleep duration and were characterized by significantly greater odds of long sleep compared to non-retirees regardless of health status. Although retirees overall were more likely to report long sleep, those with 1 or more chronic health conditions had greater odds of reporting long sleep duration compared to healthy retirees.

Support (If Any): R01MD007716, U54NS081765, R01HL78566, and R01HL095799.

0993
SLEEP DISORDERED BREATHING AND RISK FOR WHITE MATTER HYPERINTENSITIES ON THE ELDERLY

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Introduction: White Matter Hyperintensities (WMHs) have been associated with depressive symptoms, reduced cognitive function, and the development of stroke in late-life. Sleep Disordered Breathing (SDB) is very prevalent in the elderly and it may be a potential cause of cognitive decline and dementia. Several studies have shown an association between SDB and stroke. Despite this, the relationship between SDB and WMHs remains inconclusive as some studies have found an association between central apnea and WMHs while others have not. The purpose of this study was to provide more evidence on this topic and determine whether SDB increases the risk of developing WMHs.

Methods: 86 community dwelling cognitively normal (CDR = 0) elderly (Age 68.9 ± 8.21), Gender (61.6% Female), non-depressed were evaluated using home monitoring for SDB. SDB was evaluated based on the Apnea Hypopnea Index with hypopneas restricted to respiratory events associated with 4% desaturation (AHI4%) as well as AHIhall which was defined as the sum of all apneas and all hypopneas irrespective of O2 Sat. In addition, participants underwent an MRI with structural T1 and T2 FLAIR images. WMH volumes were generated using FireVoxel, a semi-automatic integrated imaging data processing software. Periventricular and subcortical WMHs were defined by their proximity to the lateral ventricles. Two scorers edited the volumes to correct for misclassifications and the kappa statistic was used to test interrater reliability (ICC = .98, p < .001).

Results: SDB was mildly associated with subcortical WMH volume (AHIhall r = .282, p < 0.05) (AHI4% r = .036, p < 0.05) even after adjusting for age and BMI.

Conclusion: Although our preliminary results provide support for an association between SDB and WMHs, these findings should be interpreted with caution considering the conflicting literature. In contrast to previous studies, our population was younger, non-demented, and we used semi-automatic measures of WMHs instead of visual scoring.

Support (If Any): R01HL118624, 3R01HL118624-02S1 and K24HL109156

0994
ARE RURAL OLDER ADULTS USING POTENTIALLY INAPPROPRIATE MEDICATIONS TO TREAT SLEEP DISTURBANCES?

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Introduction: Older adults experience disturbed sleep because of age related changes, comorbid disease and/or pharmacologic management. Older adults may treat their sleep disturbances by taking prescribed medications or over-the-counter (OTC) sleep aids. Their goal may be to improve sleep but several medications are used off-label and have the potential for increased risk of negative effects. The purpose of this study is to describe subjective reports of sleep quality and identify potentially inappropriate medications (PIMS) used to treat sleep disturbances in rural community-dwelling older adults.

Methods: Using an exploratory and descriptive study design, participants (N = 139, age ≥ 65) from the rural Midwest completed subjective sleep disturbance (PROMIS SF-8A) and sleep quality (PSQI) questionnaires. Each participant had an in-person red-bag medication review of prescribed, OTC medications and supplements. Descriptive statistical analyses were performed on questionnaires and medications classified and categorized using 2012 Beers Criteria.

Results: The PROMIS mean score of 47 showed that participants reported sleep better than the population norm of 50 in the past 7 days. PSQI scores in 98% of participants were ≥ 5, indicating disturbed sleep in the past month and 28% took medications ≥ 1 a week for sleep. Of the medications, 12% of participants took first generation antihistamines (94% OTC); 9% short acting benzodiazepines, 3% non-benzodiazepine receptor agonists; 2% mirtazapine and 1% melatonin. Of note, 56% of participants had trouble sleeping ≥ 1 a week due to pain. Of the sample, 16% took non-steroidal anti-inflammatory drugs (NSAIDS) and of those, 68% were OTC.

Conclusion: The majority of rural community-dwelling older adults reported poor sleep quality and more than ¼ used prescribed and OTC PIMS. Patients and health provider collaboration may address the underlying cause of sleep disturbances, re-evaluation of current management, and promote safe alternatives for treatment.

Support (If Any): Jonas Center for Nursing and Veterans Healthcare.
0995
AGE- AND GENDER-SPECIFIC ASSOCIATIONS BETWEEN INSOMNIA AND FALLS IN OLDER PUERTO RICANS
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Introduction: Geriatric falls are notably high in the U.S., contributing to morbidity and mortality, loss of independence, emergency visits and hospitalizations, and early admission to long-term care. Insomnia has been linked to falls in older Whites. However, the age- and gender-specific associations between insomnia and falls in community-dwelling older Puerto Rican adults have never been examined.

Methods: Cross-sectional data was collected with 954 Puerto Ricans, aged 46-79 y, in Boston, Massachusetts. In-person interviews were conducted to collect information on sociodemographics and lifestyles, mental status, medication use, comorbidities, sleep duration, insomnia symptoms, and falls and fractures. Blood and urine samples, and bone density measures were collected to assess C-reactive protein, serum interleukin-6, urinary cortisol, and bone mineral density.

Results: Multivariate robust Poisson regressions suggested that Puerto Rican adults with insomnia had a 32% increased likelihood of having falls (PR = 1.32, p < 0.05), after adjustment for multiple covariates. Age and gender modified the effect of insomnia on risk of falls. Insomnia was significantly associated with higher risk of falls in adults of 60 y or older (PR = 1.43, p < 0.05), and in women (PR = 1.36, p < 0.05), but not in adults younger than 60 years or in men. Insomnia was not associated with recurrent falls or fractures.

Conclusion: Insomnia was associated with falls among Puerto Rican adults, aged 60 y and older and among women, independently of sociodemographic and lifestyle factors, mental status, medication use, other sleep variables, comorbidities, and biological measures. Age and gender need to be taken into account when considering treatment of insomnia in preventing geriatric falls. Well-designed evidence-based interventions to treat insomnia and improve sleep quality may reduce the risk of falls in this population.

Support (If Any): The Boston Puerto Rican Health Study was supported by National Institute of Health [P01 AG023394, P50 HL105185, and R01 AG027087].

0996
DURATION AND TIMING OF HABITUAL LIGHT EXPOSURE IS RELATED TO SLEEP OUTCOMES IN COMMUNITY-DWELLING OLDER ADULTS
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Introduction: Despite its role as the primary input for the circadian system, an understanding of how passive environmental light exposure patterns (such as those habitually experienced in the home environment) relate to circadian regulation and sleep is still developing. Age-related physiological and behavioural changes may mean that light exposure is particularly relevant for healthy sleep-wake behaviour in older adults. However, there is limited assessment of habitual light exposure in this group. This study examined relationships between daily light exposure and sleep-wake behaviour in Australian older adults.

Methods: Nineteen community-dwelling participants aged 65 years or older (M = 73.37, 10 Female) underwent wrist-based monitoring of activity and light exposure for 14 days. Duration and timing of daily light exposure was calculated for a range of illuminance (lux) thresholds. The relationships between light exposure and sleep outcomes were calculated using bivariate correlations.

Results: Longer daily light exposure durations above 250 lux were significantly related to increased sleep efficiency (r = .57 p = .010, CI = .16, .82), reduced night-to-night variability in both sleep efficiency (r = -.58 p = .010, CI = -.82, -.17) and duration (r = -.46 p = .046, CI = -.76, .01), as well as a greater relative amplitude of the rest-activity rhythm (r = .69 p = .001, CI = .34, .87). Later timing of light exposure above 1000 lux was significantly related to longer sleep duration (r = .58 p = .010, CI = .16, .82) and greater relative amplitude of the rest-activity rhythm (r = .46 p = .047, CI = .01, .76).

Conclusion: These results show that there are significant relationships between habitual environmental light exposure and sleep-wake behaviour in older adults. Consideration of home light environments could play a role in supporting healthy sleep, and therefore healthy ageing and sustained community participation. Future research should further document patterns of habitual light exposure in this population and examine the unique contribution of light to sleep-wake outcomes.

Support (If Any): Project funding was provided by the Wesley Research Institute.
XI. Sex Difference, Gender and Sleep

0997
OSA AND PSYCHIATRIC SYMPTOMS IN A NATIONAL SAMPLE OF WOMEN VETERANS
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Introduction: Obstructive sleep apnea (OSA) is pervasive in the adult population and leads to worse quality of life and poor health outcomes. OSA among veterans is especially concerning as it may be exacerbated by unique psychological burdens. However, little is known about OSA among women veterans, who represent a fast-growing population whose mental health burdens outweigh those of male veterans. We evaluated rates of OSA risk and characterized the associations between OSA and psychiatric symptoms of PTSD, depression and anxiety in a large national cohort of women veterans.

Methods: OSA symptoms were assessed within a postal survey sent to 4000 subjects from a national random sample of women veterans. The survey included items to assess demographics, OSA risk (4-item STOP [snoring, tiredness, observed apneas, blood pressure]), prior diagnosis and treatment of OSA, post-traumatic stress disorder (PTSD) symptoms (4-item PC-PTSD), and depression/anxiety symptoms (PHQ-4). A STOP score ≥ 2 was considered high OSA risk. Differences in symptoms between OSA risk groups were evaluated with t-tests.

Results: In total, 1559 women completed the survey (response rate = 39%) with mean age 52 (15 SD) years, 41% married, 41% employed for wages, and 38% indicating a nonwhite race/ethnicity. Among responders, 49% were high risk for OSA, and 13% reported a prior diagnosis of OSA. Women with high OSA risk had more PTSD, depression and anxiety symptoms (p’s < .001). Women previously diagnosed with OSA also had more PTSD, depression and anxiety symptoms (p’s < .04).

Conclusion: While many women veterans were high risk for OSA, few were previously diagnosed. OSA risk and prior diagnosis were both associated with more symptoms of PTSD, depression and anxiety. Further studies are warranted to evaluate if treatment of OSA can improve psychiatric symptoms in women veterans, as improved screening and diagnosis of OSA could be a vital part of optimizing mental health services.

Support (If Any): VA QUERI RRP 12-189

0998
THE RELATIONSHIP BETWEEN SLEEP DURATION AND ALCOHOL DRINKING PATTERNS AMONG BLACK AND WHITE MEN AND WOMEN IN THE UNITED STATES
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Introduction: Racial/ethnic minorities experience poorer health than whites, and differences in alcohol consumption and sleep health may contribute to these disparities. We hypothesized that black men and women who consume alcohol would have more extreme sleep duration than their white counterparts.

Methods: Using a nationally representative sample of 314,134 adults in the National Health Interview Survey (2004-2014), we applied the direct adjustment method to estimate age-standardized prevalence of sleep duration by alcohol consumption (never, former, moderate, heavy) among black and white men and women, standardizing to the 2010 U.S. Census population. Adjusting for socioeconomic status and other potential confounders using Poisson regression models with robust variance, we estimated race- and sex-specific prevalence ratios for each sleep duration category (≤ 6, 7, 8, ≥ 9 hours) compared to remaining categories within alcohol-drinking patterns. Interactions between race and alcohol consumption were tested by level of sleep duration for men and women separately.

Results: Compared to lifetime abstainers, more moderate drinkers reported ≤ 6 hours of sleep among black (40.8% vs 29.1%; P < 0.01) and white (26.4% vs 23.3%; P < 0.01) men as well as black women (39.0% vs 31.9%; P < 0.01). While there was no difference among black men and white men (7.0% vs 11.1%; P < 0.01) and women (7.6% vs 10.3%; P < 0.01) who reported moderate drinking had a lower prevalence of ≥ 9 hours of sleep compared to never drinkers. White men reporting heavy drinking had a 15% (PR = 1.15 [1.07, 1.24]) higher prevalence of ≤ 6 hours of sleep compared to never drinkers and black men had a 29% (PR = 1.29 [1.12, 1.47]) higher prevalence. The same pattern was observed among black and white participants who con-
sumed alcohol in moderation. Black men (PR = 1.44 [1.08, 1.93]) and white women (PR = 1.22 [1.07, 1.38]) who were heavy drinkers were more likely to report ≥ 9 hours of sleep. Race significantly modified the relationship between alcohol and sleep (except men reporting 8 and women ≥ 9 hours) with blacks generally reporting more extreme sleep duration.

Conclusion: Sleep duration varied substantially by alcohol drinking pattern, and significant racial/ethnic and sex differences exist. Men who reported moderate or heavy drinking were more likely to be short sleepers. Long sleep was more common among heavy drinkers, but only in black men and white women. Further research is needed to identify and address the factors that contribute to these findings.

Support (If Any): Dr. Jackson was supported by the Harvard Catalyst Clinical and Translational Science Center (grant U11 TR001102-07).

1000

SLEEP APNEA AND TESTOSTERONE: GENDER EFFECT IN A POPULATION-BASED STUDY

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Introduction: The relationship between serum testosterone levels and obstructive sleep apnea (OSA) has been intensively studied in men, showing a consistent inverse correlation. On the other hand, this issue has been only addressed in women diagnosed with polycystic ovary syndrome. In these patients, it is possible to observe higher testosterone levels associated with increased prevalence of OSA. Our aim was to investigate the interaction effects between gender and OSA on the serum testosterone levels in a population sample.

Methods: This was a cross-sectional study with a 3-stage cluster sampling design based on the EPISONO cohort performed in São Paulo, Brazil. A total of 1,042 participants were invited to answer sleep questionnaires, underwent anthropometric measures and a full-night polysomnography for OSA diagnosis. On the following morning, all volunteers had their blood collected for free and total testosterone measurement.

Results: Our data showed a significant interaction effect between OSA and gender on testosterone levels. After control for age, body mass index, social class, and use of medication, it was observed that men with OSA had lower levels of both free and total testosterone compared to non-OSA group. However, women with OSA presented higher levels of free and total testosterone compared to non-OSA women. Only in men, the changes in testosterone levels were related to disease severity (apnea-hypopnea and desaturation indexes).

Conclusion: This is the first population-based study to address the relationship between testosterone and OSA in both genders. The distinct role of testosterone related to sleep breathing disorder has opposite patterns in men and women.

Support (If Any): NIH grants #R01 NR05345 and T32 NR007088.

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SLEEP IN WOMEN UNDERGOING IN VITRO FERTILIZATION (IVF): A PILOT STUDY

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Introduction: Sleep disturbances are thought to be frequent in patients undergoing IVF; however, studies are minimal and none have used objective methods. Our goal was to longitudinally assess sleep duration and disturbances in women undergoing IVF.

Methods: After IRB approval, women planning to undergo IVF were recruited from the Center for Reproductive Medicine. Actigraphy (Actiwatch 2, Philips Respironics, Bend, OR) and questionnaire batteries (PSQI, ISI, ESS, STOP, perceived stress scale [PSS], and concerns of women undergoing assisted reproductive technology [CART]) were performed prior to and throughout IVF. Mixed models were used to assess change over time of repeated measures. Linear regression modeling with stepwise selection was used to predict oocytes retrieved (OR).

Results: Twenty-four IVF cycles were observed. Total sleep time (TST) less than 7 hours was present in 46%, 57%, 69%, and 42% of baseline, stimulation, post-oocyte retrieval, and post-embryo transfer recordings. ESS greater than 10 was noted in 24%, 33%, and 36% of cycles during baseline, stimulation, and post-embryo transfer. TST (F = 2.95, p = 0.04) and ESS (F = 4.36, p = 0.02) were the only sleep metrics in which a significant main effect of time was found. TST (baseline) and PSS (stimulation) were the only sleep/psychometric variables with a significant or near significant relationship with OR (p = 0.16 and p = 0.05). Stepwise selection drew from potential clinical confounders, TST, PSS, and sleep/psychometric co-variates that could confound the relationship of baseline TST with OR. The final model included...
anti-mullerian hormone, day 3 follicle stimulating hormone, and TST and explained 40% of the variance in OR (adjusted R squared = 0.40, p = 0.03). The expected number of OR increased by 1.5 for every hour increase in TST (p = .09).

Conclusion: Short TST and excessive daytime sleepiness are common during IVF and change over the cycle. TST has a linear relationship with oocytes retrieved but did not reach statistical significance in this small, pilot study.

Support (If Any): This project was supported by the Gene and Tubie Gilmore Fund for Sleep Research and the National Center for Advancing Translational Sciences of the National Institutes of Health under Award Number UL1TR000433.

1003 PATTERNING OF DAILY SLEEP VARIABILITY IN NEW MOTHERS BY EMPLOYMENT STATUS AND INFANT FEEDING METHOD
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Introduction: Demographic and postpartum environmental characteristics, like employment status and infant feeding method, have been increasingly highlighted as predictors and moderators of postpartum maternal sleep. The purpose of the current study was to pattern maternal sleep behavior by employment status [Employed Outside the Home (EOH) vs. Stay at Home (SAH)] and infant feeding method [Breastfeeding (BF) vs. Formula Feeding (FF)] across seven continuous days of wrist-actigraphy and online sleep diary collection in a sample of first-time mothers.

Methods: Seven days of continuous wrist-actigraphy and online subjective sleep diaries were collected from 53 first-time mothers who were 3-6 months postpartum (M Age = 29.37; 95% white; 80% BF; 61% EOH). Frequency and duration of self-reported daytime naps (DN) were corroborated and scored with actigraphy. Sleep interval start hours (SISH), Time in Bed (TIB), and Total Sleep Time (TST) were coded and calculated with actigraphy for nighttime sleep periods (NSP) and DN.

Results: In an ongoing data analysis, mixed-linear models showed that BF mothers had significantly shorter NSP-TST than FF mothers [F(1,293) = 4.92, p = 0.0324], but equivalent frequencies and durations of DN. Overall DN durations did not differ significantly by employment, however, EOH mothers napped more frequently on weekend days than SAH mothers [F(1,142) = 5.93, p = .016]. Although NSP-TST did not differ significantly by employment status, NSP-TIB was significantly shorter for EOH mothers than SAH mothers [F(1,298) = 5.76, p = .017] and SISH was a significant covariate of this relationship.

Conclusion: Although sleep durations (both DN and NSP) in our sample were generally similar across employment status and infant feeding method, there appeared to be larger differences in the distribution of sleep (i.e., the timing and frequency of sleep intervals) across the week of data collection. Further analyses in this study will explore the patterning of sleep timing and sleep interval distribution by employment status and infant feeding method and examine how sleep duration over the previous 24, 48 and 72 hours predicts the duration, timing and distribution of future sleep intervals for these groups. Results may provide more comprehensive information about the roles of demographic and environmental characteristics in postpartum sleep and potentially better inform sleep-related expectations for new mothers in the postpartum.

Support (If Any): KU Behavioral Sciences General Research Fund

1004 LIGHT EXPOSURE CHANGES AND SLEEP DISTURBANCE IN WOMEN ACROSS THE PERINATAL PERIOD
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Introduction: The circadian rhythm of dim light melatonin onset does not remain stable across the perinatal period in expectant/new mothers. Although timing and quantity of light is an important regulator of circadian rhythms and sleep behavior, little research has focused on perinatal light exposure patterns. This study explored methods of quantifying daily light exposure, and examined changes in light patterns from 3rd trimester of pregnancy to 16 weeks postpartum.

Methods: We measured sleep and continuous light levels in 47 expectant/new mothers with a previous history of major depression. Participants wore actigraphs for 1-week intervals at four time points (33 weeks gestation and postpartum weeks 2, 6, and 16). Sleep measures, including sleep onset and sleep offset, were estimated using using Action-W software (AMI). Three light measures (maximum lux, mean lux, and percent time with lux > 20) were derived for three intervals relative to sleep - the two hours prior to sleep onset, sleep onset to sleep offset, and the two hours following sleep offset - and averaged across each week. Light measures were compared across time points using ANOVAs and post-hoc tests (Bonferroni).

Results: The light measure “percent time with lux > 20” (P > 20lux) was normally distributed and we therefore elected to use this measure for the present analyses. Compared with the postpartum weeks, P > 20lux was higher at 3rd trimester both during the two hours before sleep onset (Mean ± SD: 3rdT = 14.5 ± 14.1%; 2 wks = 8.2 ± 7.0%; 6 wks = 7.2 ± 6.6%; 16 wks = 8.2 ± 9.2%; F(3, 163) = 5.14, p = .002) and the two hours after waking (Mean ± SD: 3rdT = 42.0 ± 18.9%; 2 wks = 32.9 ± 17.2%; 6 wks = 33.1 ± 19.4%; 16 wks = 29.5 ± 20.9%; F(3, 163) = 3.47, p = .018). P > 20lux during the sleep period tended to be higher at two weeks postpartum (Mean ± SD: 3rdT = 1.2 ± 2.4%; 2 wks = 2.6 ± 3.4%; 6 wks = 1.4 ± 2.0%; 16 wks = 1.3 ± 2.8%; F(3, 163) = 2.52, p = .060), but this was not statistically significant.

Conclusion: Compared with postnatal time periods, women in their third trimester receive greater light exposure in the two hours preceding and following the sleep period. This light is likely from indoor sources. Future analyses will assess light levels across the entire day and examine how changes in light exposure are related to sleep behavior and mood in the perinatal period.

Support (If Any): This study was supported by K23MH086689 from NIMH to KMS and by a Brown AMS Summer Assistantship awarded to SB.

1005 PREGNANT SLEEP: WHAT CHANGES?
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Introduction: Research and anecdotal evidence suggests that sleep undergoes significant changes during pregnancy. The aim of the current project was to synthesize literature on sleep in pregnancy and assess magnitude of change.

Methods: The literature was searched using the terms “pregnancy”, “Pittsburgh Sleep Quality Index” (PSQI), and “Polysomnography”. Relevant articles were selected and data entered into random effects meta-analyses.

Results: A total of 372 articles were identified and 33 were included in the final analyses. Results indicated that the average PSQI score changed significantly from 5.06 to 5.81 and 6.91 in the first, second,
XI. Sex Difference, Gender and Sleep

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WOMEN WITH POSTPARTUM WEIGHT RETENTION HAVE DELAYED SLEEP TIMING AND DECREASED SLEEP EFFICIENCY IN THE PERINATAL PERIOD

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Introduction: Significant weight gain in the perinatal period is associated with increased risk of overweight/obesity among women of childbearing age, higher incidence of chronic diseases later in life, and disadvantages to exposed offspring. Shorter self-reported postpartum sleep duration is associated with greater postpartum weight retention (PPWR), but we are aware of no study that has examined associations between PPWR and sleep during pregnancy or has measured sleep patterns objectively.

Methods: Perinatal women with a history of major depression or bipolar disorder (but not in a mood episode at enrollment) had sleep onset, sleep offset, total sleep time, and sleep efficiency estimated with one week of wrist actigraphy at 33 weeks gestation and at 2, 6, and 16 weeks postpartum. Self-reported pre-pregnancy weight was obtained during the 33 week assessment with the question ‘What was your approximate weight one year ago?’. At 2 and 16 weeks postpartum, we measured weight to the nearest 0.1 lb using a digital scale. Data were available from 19 women (age ± SD = 29.7 ± 4.8 years). We divided participants into PPWR+ and PPWR− groups, with PPWR+ defined as > 5 kg weight retention from pre-pregnancy to 16 weeks postpartum. We used t-tests to compare sleep measures between groups.

Results: Across the whole sample, weights (mean ± SD) were 73.2 ± 20.4 kg at pre-pregnancy, 79.0 ± 19.4 kg at 2 week postpartum, and 77.7 ± 21.1 kg at 16 weeks postpartum. At 16 weeks postpartum, 33% of the women (n = 6) had gained > 5 kg and were classified as PPWR+. Average pre-pregnancy weights did not differ between groups (PPWR+ = 75.8 ± 18.1 kg and PPWR− = 72.0 ± 220 kg, t = -0.36, df = 17, p = ns). Women with PPWR had later sleep offset times at 33 weeks gestation and 16 weeks postpartum (33 wks: PPWR+= 8:31 ± 84 min; PPWR−= 7:20 ± 54 min; t = -2.21, df = 17, p < .05; 16 wks: PPWR+= 8:19 ± 120 min; PPWR−= 6:52 ± 59 min; t = -2.13, df = 17, p < .05). Moreover, the PPWR+ group had lower sleep efficiencies at 33 wks gestation (PPWR+ = 72.6 ± 16.4%, PPWR−= 85.8 ± 4.4%; t = 2.79, p < .05) and 2 and 16 wks postpartum (2 weeks: PPWR+ = 65.0 ± 5%; PPWR−= 72.0 ± 7.2%; t = -2.13, df = 17, p < .05; 16 weeks: PPWR+ = 78.8 ± 4.8%; PPWR−= 85.3 ± 6.8%; t = -2.11, df = 17, p = .05.)

Conclusion: PPWR was associated with later sleep offset and decreased sleep efficiency during pregnancy and the postpartum period in our small, heterogeneous sample. Possible mechanisms include circadian misalignment and presence of an undiagnosed sleep disorder. Sleep disturbance may be a modifiable risk factor for PPWR.

Support (If Any): MH086689 (KMS)

1007

EFFECTS OF YOGA AND AEROBIC EXERCISE ON ACTIGRAPHIC SLEEP PARAMETERS IN MENOPAUSAL WOMEN WITH HOT FLASHES: FINDINGS FROM THE THE Menopause STRATEGIES: FINDING LASTING ANSWERS FOR SYMPTOMS AND HEALTH (MSFLASH) RESEARCH GROUP

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Introduction: Yoga and exercise are often recommended for improving sleep in women experiencing the menopausal transition and post-menopause, but efficacy data remain inconclusive. The MsFLASH network conducted a randomized controlled trial (N = 355) comparing 12 weeks of yoga, aerobic exercise, and usual activity. Results indicated that both yoga and exercise interventions resulted in small improvements in sleep quality (PSQI) and insomnia severity (ISI). This secondary analysis examined effects of the three interventions on actigraphic assessments of sleep.

Methods: The analysis included 186 MsFLASH participants who were in the late menopausal transition or post-menopausal and aged 40-62 years with hot flashes. Mean and coefficient of variation (CV, higher values indicate greater night-to-night variability) of change in actigraph sleep measures (7 nights) from each intervention group were compared to the usual activity group using linear regression models.

Results: Mean baseline values of the primary sleep measures were total sleep time minutes (yoga, 400.6; aerobic exercise, 412.3; usual activity, 408.8); wake after sleep onset (WASO) minutes (yoga, 40.8; aerobic exercise, 43.1; usual activity, 42.4), and CV for WASO (yoga, 40.4%; aerobic exercise, 54.5%; usual activity, 55.7%); CV for number of long awakenings > 5 minutes (yoga, 75.8; aerobic exercise, 84.2; usual activity, 83.5). Changes in actigraphic sleep outcomes and variability from baseline to Week 11-12 were small, and none differed between groups.

Conclusion: This study adds to the scant literature on effects of yoga and aerobic exercise interventions on objective sleep measures in women with hot flashes during the menopause transition and post-menopause. Although small effects on self-reported sleep were previously reported, the interventions had no significant effects on mean or...
variability values on objective measures of total sleep time or nighttime wakefulness. Future research should explore effects of other approaches, such as CBT-I, for improving subjective and objective measures of sleep quality in this population.

Support (If Any): Study funded by the National Institutes of Health as a cooperative agreement issued by the National Institute on Aging, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Center for Complementary and Alternative Medicine, Office of Research on Women’s Health, and grants U01AG032656, U01AG032659, U01AG032669, U01AG032682, U01AG032699, and U01AG032700 from the National Institute on Aging. At Indiana University, the project was partly funded by the Indiana Clinical and Translational Sciences Institute, grant UL1RR02571 from the National Institutes of Health, National Center for Research Resources, and Clinical and Translational Sciences Award.

1008
SLEEP-RELATED DYSFUNCTION IN PREGNANT WOMEN: VALIDATION OF THE CHINESE VERSION OF THE FUNCTIONAL OUTCOMES OF SLEEP QUESTIONNAIRE-10
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Introduction: The purpose of this study was to evaluate the psychometric properties of a Chinese version of the Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10) in pregnant women.

Methods: A total of 228 first-trimester pregnant women participated in the study which was conducted in an outpatient obstetric clinic at a medical center in Taipei Taiwan.

Results: The Chinese version of the FOSQ-10 showed satisfactory internal consistency (Cronbach’s alpha = 0.85), adequate corrected item-total correlations ranging from 0.40-0.67, and acceptable test-retest reliability over the 7 days (intraclass correlation coefficient = 0.73). Construct validity was supported by exploratory factor analysis showing a one-factor structure with item loading between 0.49 and 0.77. Significant associations of the Chinese version of the FOSQ-10 with Pittsburgh Sleep Quality Index parameters supported adequate criterion-related and convergent validity. Significant differences in the Chinese version of the FOSQ-10 total scores were found between women with clinically significant daytime sleepiness and those without, suggesting adequate discriminant validity. No floor or ceiling effects were observed for the Chinese version of the FOSQ-10 total scores.

Conclusion: The Chinese version of the FOSQ-10 is a reliable and valid instrument to evaluate functional status and identify important impacts of sleep-related impairment in women during pregnancy. This instrument holds great promise as a useful, feasible, and applicable tool for obstetric populations, but needs to be further tested in a broader population of pregnant women, such as women with high risk pregnancies and those with sleep disorders.

Support (If Any): National Science Council, Taiwan, NSC 101-2314-B-002-049 - MY3

1009
COMPARING SUBJECTIVE AND OBJECTIVE SLEEP ASSESSMENTS
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Introduction: Multiple publications have documented that subjective sleep disturbances are more common in women and in older people despite similar objective sleep metrics. We wanted to better understand the relationships between subjective and objective sleep metrics in healthy people and extended previous analyses (O’Donnell, 2009) using data collected from baseline 24-h days and forced desynchrony (FD) studies with 20-h, 28-h, or 42.85-h T-cycles and either 1:2 (Habitual) or 1:3 sleep:wake (Chronic Sleep Restriction) ratios to examine the effects of prior wake duration, current sleep duration, chronic sleep restriction, circadian phase, gender, and age on these relationships.

Methods: Eighty-nine young (18-45 years: 29 women) and 24 older participants (> 45 years: 10 women) were included in this analysis. Polysomnographically obtained objective metrics included sleep latency (to stage 1), number of awakenings, and total sleep duration. Subjective ratings of sleep latency, number of awakenings and total sleep duration were obtained after each sleep episode with a Post Sleep Questionnaire. Mixed-effects models were used to study the relationship between subjective and objective sleep metrics adjusting for T-cycle, sleep:wake ratio, circadian phase at the beginning of the sleep episode, gender and age group.

Results: Under FD, subjective and objective sleep metrics of latency, number of awakenings and total sleep duration were significantly positively associated (all p < 0.001). The associations between subjective and objective metrics of sleep latency and total sleep duration differed by age group (both p < 0.05). Under baseline conditions, only the association between subjective and objective sleep latency was significant (p = 0.007). All associations differed by T-cycle which includes both length of prior wake and of current sleep episode.

Conclusion: Several subjective and objective sleep metrics were significantly associated under baseline and non-24-h schedule. There were no gender differences in these associations. When exposed to a range of sleep conditions including circadian misalignment and sleep restriction, subjects were able to rate their sleep more accurately. Future investigations are needed to identify other reasons for the documented age and gender differences in sleep complaints.

Support (If Any): NIH P01AG009975 (EBK, WW, HL, JFD, CAC), RC2HL101340, R01HL114088, R01GM105015, K24HL105664 (EBK), NSBRI HFP02802 (EBK, WW) and the Harvard Catalyst (WW) and grants supporting original studies (AFOSR 05NL123, NIA U01AG12642, NIH M01RR02635, NASA NAS9-19435, AFOSR F49620-95-1-0388, NASA NCC9-58, NSBRI NAG5-3952, NHFI R01HL52992, NIH M01 RR02635, NIH R01HL081761, F66-EUCLOCK, NIH T32HL7901, NIH K02HD045459, NSBRI HFP01604, AFOSR F9550-06-0080/OSNL132, R01 HL080978).
1010
COMPARISON OF THE EPWORTH SLEEPINESS SCALE BY GENDER AS A PREDICTOR OF SLEEP DISORDERED BREATHING
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Introduction: Sleep disordered breathing (SDB) has a negative impact on quality of life and increases cardiovascular risk. The majority of women with SDB remain undiagnosed. The Epworth Sleepiness Scale (ESS) is a validated marker for daytime sleepiness that is commonly used to screen for SDB. We compared ESS scores in men and women and evaluated subsequent polysomnography (PSG) results to determine if the ESS was predictive of SDB in both.

Methods: Consecutive male and female adult patients who completed ESS assessment and subsequently underwent attended in-lab PSG at Mayo Clinic between January 2013 and January 2015 were identified. ESS scores > 10 were classified as presence of sleepiness. Apnea-hypopnea index (AHI) ≥ 5 was classified as presence of SDB, with increasing values representing greater severity.

Results: Of 6593 total subjects with a valid ESS score and timely subsequent PSG, 42% were females. Mean age of females: 56.2 (SD +/-15.2); males: 58.5 (SD +/-15.1). Mean body mass index in females was 34.0 (SD +/-9.0); males 32.3 (SD +/-6.6). Mean ESS was 9.5 in both females and males (SD +/-5.4 F, 5.3 M). SDB was present in 83.6% of males and in 68.3% of females. Mean AHI in males was 25.9 (SD +/-26.7); females 16.1 (SD +/-22.4) (p < 0.0001). Each unit increase in ESS score in males was associated with a 0.51 unit increase in AHI (p = 0.0001); there was only a 0.16 unit associated increase in AHI in women (p = 0.04) (effect ratio 3-fold greater in men). PSG showed that females had improved sleep efficiency, less breathing-related arousals, and less hypoxemia (p < 0.0001) than males.

Conclusion: Our findings suggest that the ESS is less predictive of the presence and severity of SDB in women than men. Clinicians may wish to utilize different screening tools for SDB in female patients.

1011
CHARACTERIZATION OF PERCEIVED HOT FLASHES DURING SLEEP AND THEIR RELATIONSHIP WITH SLEEP QUALITY IN WOMEN APPROACHING MENOPAUSE
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Introduction: Hot flashes refer to periods of sweating and a sensation of heat and are a major complaint that impacts quality of life and sleep in peri- and post-menopausal women. While the perception of diurnal hot flashes is well characterized, less is known about the perception of nocturnal hot flashes. We investigated the occurrence, physical sensation, emotional and behavioral consequences of self-reported nocturnal hot flashes, and analyzed their role in the perception of sleep quality after accounting for mood, anxiety, and stress.

Methods: Forty women (age: 46-62 years) had 1-5 laboratory-based recordings for a total of 105 nights, from which 219 hot flashes were recalled and characterized upon awakening. Multiple regression analyses were used to explain the variance in perceived amount of wake after sleep onset (WASO) and sleep quality, using frequency of hot flashes (one or more), mood, stress, and anxiety as factors.

Results: Hot flashes were classified as warm (55.7%), feverish (39.7%) or intense (4.6%) heat and were mostly recalled from the second half of the night (61.6%) and perceived as affecting the entire body (62.2%). Most hot flashes lasted < 5min (51.6%); 39.3% of them lasted 5-10min. Women perceived them as bothersome (49.8%), annoying (41.6%), irritating (34.7%), and unexpected (24.7%), and often accompanied by physical sensations (perspiration, 68.5% and dry mouth, 28.8%). Uncovering blankets (88.6%) was the most frequent behavioral intervention. The multiple regression model was significant for the amount of self-report WASO (F4,80 = 3.45, p < 0.012, R2 = .174) with hot flash frequency being the only significant predictor (Beta = 0.328, p < 0.02).

Conclusion: Nocturnal hot flashes are perceived as bothersome by women approaching menopause. Hot flashes are largely implicated in perceived wakefulness even after accounting for psychological factors that could impact sleep, such as mood, stress and anxiety.

Support (If Any): This study was supported by the HL088088 grants (FCB)

1012
COMPARISON FOR THE DEVELOPMENT OF OBSTRUCTIVE SLEEP APNEA BETWEEN MEN AND WOMEN LESS THAN AGE 45 IN A BARIATRIC POPULATION ESTIMATED BY THE APNEA HYPOPNEA INDEX AND ASSOCIATED FACTORS
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Introduction: Hormonal differences may account for the sex difference in OSA prevalence. Hormone level changes may modify the risk of OSA. Previous studies have addressed the effect of female hormonal changes on OSA. These studies focus on menopause suggesting that higher levels of secretory hormones appear inversely related to the incidence of OSA. In addition the studies have elucidated that peripheral adipose tissue may protect women from developing Sleep Apnea whereas central obesity has a strong male predominance and contributes to the higher prevalence of OSA in men. In this study we used a population of candidates from a bariatric clinic to demonstrate women are at minimal risk to the development of OSA than men despite having risk factors.

Methods: Retrospective study comparing: Women under the age of 45 considered for bariatric surgery and had polysomnography vs. Men under the age of 45 who also had a nocturnal polysomnogram. We compared means and standard deviations for each group and correlated age and BMI with AHI in both men and women.

Results: Mean AHI women = 39 (13.2 sd), men = 48 (22.1) (p < 0.08); Mean Age women = 27 (14.9), men = 27 (5.7); Mean BMI women = 55 (11.0), men = 58 (7.3) (p < 0.05). The slope of the regression line of BMI by AHI in women = -0.04, in men = 0.4.

Conclusion: Young women when matched for age with men have a lower AHI and higher BMI in these populations. This observation is consistent with some protective effect by gender in upper airway stability.

Support (If Any): Acknowledgements: Sleep Health Solutions, Ohio Louis B Stokes Veterans Hospital Medical Service, Ohio University Hospitals of Cleveland, Ohio

1013
SLEEP AND WEIGHT IN MIDLIFE WOMEN: THE ROLE OF COPING BEHAVIOR
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Introduction: Poor sleep is a well-known risk factor for elevated body mass index (BMI). Women in midlife are a particularly vulnerable population with high rates of sleep problems and elevated BMI. Though the relation between sleep and weight is clear, less is known concerning factors that connect sleep to BMI. Research has indicated...
that individuals with poor sleep use maladaptive coping mechanisms, leading to elevated BMI, however no study has explored this relationship in midlife women. The current study explores whether coping strategies (stress eating, problem-focused coping) mediate the relationship between sleep and BMI.

**Methods:** The study is an archival analysis of data from the Midlife in the United States-II study (MIDUS-II), Project 1. The sample consisted of 1120 women between the ages of 40 - 60 (M = 49.91, SD = 5.94). Measures include BMI, a self-report questionnaire measuring current sleep (duration, nighttime awakenings, daytime alertness), and the COPE Inventory.

**Results:** After controlling for selected covariates, stress eating was a significant mediator between alertness and BMI (95% CI [.17, .46]; Sobel test: z-score = 4.44, p < .001), and nighttime awakenings and BMI (95% CI [.02,. .28]; Sobel test: z-score = 1.98, p = .046). Problem-focused coping was a significant mediator between alertness and BMI (95% CI [.07,. .25]; Sobel test: z-score = 3.35, p < .001), and nighttime awakenings and BMI (95% CI (.04, .19]; Sobel test: z-score = 2.92, p = .003). Stress eating and problem-focused coping did not significantly mediate the association between sleep duration and BMI (p > .05).

**Conclusion:** Results indicate that coping behavior mediates the sleep/BMI relationship in midlife women. Stress eating appears to underlie the association between worse sleep and higher BMI. Conversely, problem-focused coping served as link between better sleep and lower BMI. Results highlight that sleep and coping strategies have important implications for health in midlife women. Further research is needed to explore the complexities and implications of this relationship.

**1014 OBJECTIVE AND SUBJECTIVE SLEEP MEASURES AND PSYCHOSOCIAL CORRELATES OF SUBJECTIVE SLEEP QUALITY BY SEX IN THE JACKSON HEART STUDY**

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**Introduction:** Self-reported “sleep quality” often is analyzed in epidemiologic studies. However, the basis for variation in sleep quality is not fully understood. Using data from Jackson Heart Study Sleep Ancillary Study, we (1) quantified the extent to which subjective sleep quality is related to sleep disorders, sleep characteristics and psychosocial factors; and (2) examined the associations by sex in 626 African Americans.

**Methods:** Between 2012 and 2015, participants underwent in-home sleep apnea testing and 1-week actigraphy which provided measurements of sleep duration, efficiency, fragmentation, and latency. Epworth sleepiness score, restless legs syndrome (RLS) symptoms, as well as physician diagnosis of insomnia, sleep apnea, and RLS were self-reported. Psychosocial factors included depressive symptoms (Center for Epidemiologic Studies Depression Scale), and anxiety (State-Trait Anxiety Inventory). Sleep quality was measured on a 5-point scale ranging from very sound or restful to very restless sleep. We fit linear regression models to determine the extent to which sleep measures and psychosocial factors were related to self-reported sleep quality adjusted for demographics and socioeconomic status.

**Results:** The sample was 67.5% women, with a mean age of 63 years, and 58.8% reported an average or poor sleep quality. Women had a longer sleep duration, a lower Epworth score, less fragmented sleep but reported more depressive symptoms than men (P < 0.01). Sleep measures and psychosocial factors were weakly correlated with sleep quality (-0.10 to 0.24), with the strongest correlations observed be-
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1016 SLEEP DISORDERS IN ACTIVE DUTY FEMALES
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Introduction: Service-related illnesses are prevalent in military personnel and awareness of sleep disorders within this population has increased over the last decade. However, there is limited data regarding sleep disorders in female military personnel. The purpose of this study is to assess sleep diagnoses in female military personnel with sleep disturbances.

Methods: We conducted a retrospective review of female military personnel undergoing sleep medicine evaluation. Demographic and polysomnographic data as well as medical records were reviewed by a board-certified sleep medicine physician. Comorbid diseases of interest include posttraumatic stress disorder, anxiety, depression, and chronic pain were also recorded.

Results: One hundred and one patients were included within our cohort. The average age was 33.9 ± 9.0 years. The average BMI was 27.3 ± 4.5 (65% above normal weight), with an average Epworth Sleepiness Scale score of 12.9 ± 5.2 (70.3% with increased daytime sleepiness), and Insomnia Severity Index score of 17.6 ± 5.7. Participants reported 6.4 ± 2.1 hours of sleep/night during weekdays and 7.9 ± 2.8 hours/night during weekends. Within our cohort, 96% were diagnosed with a clinically significant sleep disorder. The most common primary sleep diagnoses included OSA only (14.9%), insomnia only (36.6%), and comorbid insomnia/OA (CIO, 34.7%). Of the approximately 50% of the cohort diagnosed with OSA, the average AHI was 16.1 ± 17.3/hr.

Conclusion: Sleep disorders were pervasive in our cohort of female military personnel. Specifically, insomnia was diagnosed in the majority of our patients (71.3%). Additionally, OSA was diagnosed in 49.6% of our population of active duty female military personnel, which is as high as previous reports of male service members. This is in contrast to civilian females who traditionally have had OSA at rates markedly lower than their male counterparts. These findings suggest that improved screening and assessment for sleep disorders in female military personnel is required.

1017 LIVING ARRANGEMENT AS A PREDICTOR OF WORSE SLEEP-RELATED DAYTIME CONSEQUENCES IN FEMALE CAREGIVERS
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Introduction: Evidence related to whether living arrangement plays a role in sleep and sleep-related daytime impairments among caregivers is limited. Previous studies found that caregivers’ emotional burdens differed depending on living arrangement; caregivers living apart from care recipients were more likely to report worry or stress, while caregivers living with their care recipients reported being overwhelmed. We hypothesized living arrangements of caregivers and their care recipients influence sleep difficulties and sleep-related daytime impairments among care providers.

Methods: This study involved secondary analysis of data from a large postal survey screener for an ongoing randomized controlled trial of insomnia treatment among female veterans. Dependent variables included insomnia (yes/no) defined by the DSM-5 diagnostic criteria, items from the Insomnia Severity Index, and total sleep time (TST) and sleep efficiency (SE) using items from the Pittsburgh Sleep Quality Index as well as % of sleep-related daytime consequence symptoms endorsed (11 total items including fatigue, less motivation, trouble paying attention) based on ICS-D insomnia criteria. Living arrangement (i.e., caregivers co-residing, caregivers living apart, noncaregivers), and health and demographics were entered as predictors in regression models.

Results: Of 822 respondents, 129 (16%) self-identified as caregivers, 73 of whom co-resided with and 54 lived apart from care recipients. Living arrangement was not a significant predictor of reported TST, SE or ISI items; however, it did predict more sleep-related daytime impairments, above and beyond health and demographics (model: p < 0.001, adjusted R2 = 0.45). Caregivers living apart had an average of 9% more daytime impairments than those co-residing (CI 0.55-17.92, p = 0.04) and an average of 7% more than noncaregivers (CI 0.33-13.97, p = 0.04).

Conclusion: Poor sleep impacts daytime functioning among caregivers, particularly for those living apart from their care recipients. Further studies are needed to examine whether this may be associated with differences in caregiving experiences or distress.

Support (If Any): HSR&D IIR 13-058-2 (Martin), Geriatric Research, Education, and Clinical Center, VA Greater Los Angeles Healthcare System

1018 NEIGHBORHOOD SOCIAL FRAGMENTATION ASSOCIATIONS WITH OBJECTIVE SLEEP AMONG WOMEN
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Introduction: Poor sleep among adults is an area of increasing concern in the United States and around the world. Sleep is a key regulatory process that is associated with individual health and well-being, making it imperative to identify factors that contribute to poor sleep. Research examining social determinants of health indicates that neighborhood can influence individual health, however little is known about how neighborhood characteristics influence adult sleep. This study examined neighborhood social fragmentation as a predictor of objective women’s sleep outcomes using a multilevel model.

Methods: Participants were 181 women (Mage = 37.9 years) from a representative community sample. The sample was ethnically diverse (65% EA, 32% AA, 3% Other) and ranged in socioeconomic status (66% ≥ poverty line). Women wore a Motionlogger Octagonal Basic actigraph (Ambulatory Monitoring Inc.) for seven nights and sleep parameters were derived using the established Cole-Kripke scoring algorithm. Neighborhood social fragmentation was assessed with a composite of indicators of low neighborhood cohesion, including proportion of residents living in the same house for < 5 years, proportion of vacant homes, and proportion of owner occupied homes (reverse scored). Social fragmentation indicators were obtained from the U.S. 2012 American Community Survey.

Results: Neighborhood social fragmentation was associated with shorter sleep duration (β = -7.20, p < .001), decreased activity during sleep (β = -2.81, p < .001) and greater sleep efficiency (β = 1.10, p < .05). Analyses controlled for race, age, income-to-needs, medication use, season of sleep, cohabitation with a partner, and shift work.

Conclusion: Findings indicate that greater social fragmentation has complex associations with women’s sleep where reduced sleep activity and improved efficiency may compensate for shorter sleep duration. Future studies should explicate pathways between these complex sleep characteristics and mental health, as well as examine longitudinal effects of neighborhood factors.
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1020

WOMEN WITH PRIMARY OSA HAVE A HIGHER PREVALENCE OF DEPRESSION/ANXIETY VRS MEN WHO HAVE A HIGHER DEGREE OF CORONARY ARTERY DISEASE

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Introduction: Obstructive Sleep Apnea (OSA) affects a majority of the population and is associated with hypertension, obesity, diabetes, and an increased risk of heart attack and stroke. The overall objective of this study is to conduct a 2 year review and analysis of over 1000 patients in other to evaluate the comorbid conditions associated with the primary diagnosis of obstructive sleep apnea.

Methods: We identified and diagnosed patients with OSA using polysomnography and determined the prevalence of comorbid conditions at initial diagnosis and/or after CPAP treatment.

Results: Approximately 2-3 new patients are diagnosed with OSA daily. Majority of the newly diagnosed OSA patients present with co-morbid pathology. In most women over 40 years of age the primary diagnosis of OSA is associated with an endocrine condition, depression and anxiety. In majority of men within that same age group, coronary artery disease (CAD) is the prevalent comorbid condition associated with the primary diagnosis of OSA.

Conclusion: OSA is associated with endocrine and mood disorder conditions in women compared to CAD in men. However, both women and men present with the comorbid condition of hypertension and hyperlipidemia. Ongoing analysis are focused on possible factors that may cause this predisposition in women compared to men, and evaluate a possible link to the development of OSA.

Support (If Any): NIH R01-HL093246 to MES

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GENDER DIFFERENCES IN REM SLEEP BEHAVIOR DISORDER

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Introduction: Some studies investigated gender differences in rapid eye movement sleep behavior disorder (RBD). RBD shows a strong male prevalence with approximately 80% of patients being male (Olson et al., 2000; Schenck et al., 1993). Moreover, a later age of RBD onset has been reported in female patients. Olson et al. (Olson et al., 2000) found that male prevalence is preserved in RBD associated with Parkinson's disease (PD) and dementia (AD), but not in Multiple System Atrophy (MSA), but other authors reported a similar gender ratio in RBD associated with neurological disorders (Comella et al., 1998).

Methods: 320 consecutive RBD patients have been included in our study. A comparison between male and female patients have been performed for demographic data, sleep and neuropsychological findings.

Results: In our RBD sample, 261 (82%) were male and 59 (18%) were female. Idiopathic RBD (IRBD) was found in 77% (203/261) of the males and 61% (36/59) of the females. No significant gender difference for age onset was found. In the sub-sample of RBD associated with neurodegenerative diseases, 46 were males (32 PD, 3 MSA, 4 Dementia Lewy body (DLB) and 7 AD) and 20 were females (10 PD, 6 MSA, 3 DLB and 1 AD). Concerning PSG findings, female patients showed longer sleep latency (p = 0.01) and REM latency (p = 0.0002) than males. Other sleep data were similar in both groups. Concerning the neuropsychological findings, females obtained higher scores in phonemic fluency (p < 0.05) than males, while males had higher scores in memory for prose (p < 0.01).

Conclusion: In our RBD sample we found a marked prevalence of male prevalence, that resulted less pronounced in the subsample of “secondary” RBD. Few significant gender differences in PSG and neuropsychological findings have been found in our sample. Follow-up studies on gender differences in RBD should be conducted.

Support (If Any): NIH R01MD007716, R01HL78566, U54NS081765, NIH R01-HL093246 to MES
XII. Instrumentation and Methodology

1022 CORRELATES OF SUBJECTIVE SLEEP QUALITY IN OLDER MEN AND WOMEN: A MACHINE LEARNING ANALYSIS

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Introduction: Ratings of subjective sleep quality are frequently collected in sleep research. It is unclear, however, how well polysomnographic measures of sleep correlate with subjective reports of prior-night sleep quality in elderly men and women. We sought to determine the objective correlates of subjective sleep quality in older adults using more recently developed machine learning algorithms that are suitable for selecting and ranking important variables.

Methods: Community-dwelling older men (n = 1024) and women (n = 459), a subset of those participating in the Osteoporotic Fractures in Men study and the Study of Osteoporotic Fractures study, respectively, completed a single night of at-home polysomnographic recording of sleep followed by a set of morning questions concerning the prior night’s sleep quality. Questionnaires concerning demographics and psychological characteristics were also collected prior to the overnight recording and entered into multivariable models. Two machine learning algorithms, lasso penalized regression and random forests, determined variable selection and the ordering of variable importance separately for men and women.

Results: Thirty-eight sleep, demographic and clinical correlates of sleep quality were considered. Together, these multivariable models explained only 11-17% of the variance in predicting subjective sleep quality. Objective sleep efficiency emerged as the strongest predictor of subjective sleep quality across all models, and across both sexes. Greater total sleep time and sleep stage transitions were also significant objective correlates of subjective sleep quality. The amount of slow wave sleep obtained was not determined to be an important predictor.

Conclusion: Overall, the commonly obtained measures of polysomnographically-defined sleep contributed little to subjective ratings of prior-night sleep quality. Though they explained relatively little of the variance, sleep efficiency, total sleep time and sleep stage transitions were among the most important objective predictors.

Support (If Any): These studies were supported by the following: R01 HL071194, R01 HL070848, R01 HL070847, R01 HL070842, R01 HL070841, R01 HL070837, R01 HL070838, and R01 HL070839 (MrOS); R01 AG005407, R01 AR35582, R01 AR35583, R01 AR35584, R01 AG005394, R01 AG027574, and R01 AG027576 (SOF); VA Sierra Pacific Mental Illness Research Education and Clinical Center (JMZ); Lucille Packard Foundation for Children’s Health, UL1 TR001085, Child Health Research Institute of Stanford University (KAK).

B. Clinical Sleep Science

1023 ASSOCIATIONS BETWEEN THE BUILT ENVIRONMENT AND SLEEP: THE MULTI-ETHNIC STUDY OF ATHEROSCLEROSIS (MESA)

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Introduction: Researchers have demonstrated that adverse neighborhoods physical and social characteristics are associated with sleep disturbances. However, the effect of neighborhood built environments, which may disturb sleep through noise or pollution, is understudied. We analyzed cross-sectional data from the Multi-Ethnic Study of Atherosclerosis (MESA), to determine the association between the built environment and objective measures of sleep duration and efficiency.

Methods: A racially/ethnically diverse population of men and women (N = 1,889) aged 54-93 in the MESA Sleep Cohort underwent 1-week actigraphy between 2010 and 2013. Measures of sleep duration and efficiency were averaged over all days. Walkability was assessed using Street Smart Walk Score® (www.walkscore.com), as well as three specific built environment features that reflect walkability (social engagement destination density, street intersection density, population density). We fit a series of linear multi-level models, clustered by census tract as a proxy for neighborhood to assess the association between built environment indicators and sleep outcomes.

Results: The sample was 53.8% female, with a mean age of 68.6 years. Mean sleep duration was 6.5+1.3 hours and the average sleep efficiency was 89.9%. One standard deviation higher Walk Score® was associated with a shorter average sleep duration of 8.19 minutes (95% confidence interval (CI): 4.12, 12.26) and lower sleep efficiency 0.16 (0.01, 0.33). For sleep duration, the association persisted after adjustment for demographics, individual and neighborhood socioeconomic status, and co-morbidities. However, for sleep efficiency, the association was attenuated and no longer statistically significant in fully adjusted models. Results were generally consistent across walkability components, except that social engagement destination density was not associated with sleep efficiency. Population density had the strongest negative association with average sleep duration of -6.01 minutes (-10.08, -2.05), and intersection density had the strongest negative influence on sleep efficiency -0.15 (-0.32, 0.02).

Conclusion: Sleep duration may decline with higher neighborhood walkability (including more social engagement destinations, intersections and population density). Further understanding how health behaviors are influenced by the social and physical environmental may enhance public health efforts to promote healthy lifestyle behaviors.

Support (If Any): R01HL110068-04SI and R01HL098433

1024 INFLUENCE OF SEASON ON ACTIGRAPHIC SLEEP INDICES IN A POPULATION-BASED SAMPLE

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Introduction: Although seasonal changes in sleep have been demonstrated in the general population, the majority of these studies have used self-report measures of seasonality and sleep. Using a population-based sample in the Midwestern United States (43°N), the current cross-sectional analyses examined whether season influenced actigraphic sleep indices, considering relevant covariates.

Methods: 418 participants (60% female; mean age = 57; SD = 11) in the Midlife in the United States (MIDUS) Biomarker project completed
one week of wrist-worn actigraphy, and the Center of Epidemiological Studies-Depression scale in winter, spring, summer, or fall. Sleep period onset time (SonT), sleep period offset time (SoffT), sleep period duration, total sleep time (TST), sleep onset latency (SOL), and wake after sleep onset (WASO) were derived from Actiware software.

Results: Controlling for sex, depressive symptoms, the interaction of sex and depressive symptoms, age, race, education, smoking status, exercise, and body mass index, analysis of covariance revealed significant seasonal main effects for sleep period duration ($F(3,394) = 3.6, p = 0.01$), TST ($F(3,394) = 3.1, p = 0.03$), and WASO ($F(3,394) = 4.9, p = 0.002$). Seasonal effects were found at a trend level for SOL ($F(3,394) = 2.4; p = 0.07$) and variability of SoffT ($F(3,394) = 2.7; p = 0.05$). More specifically, individuals in winter demonstrated a longer sleep period duration with greater WASO and variability of SoffT, whereas those in summer revealed the shortest sleep period duration and TST with greater SOL and variability in SoffT. Those in fall indicated longer sleep period duration and the longest TST with little fragmentation, and individuals in spring showed consolidated sleep and less variability in SoffT.

Conclusion: Even when considering relevant co-variates, seasonal influences on actigraphic sleep were revealed in this Midwestern population-based sample. Sleep disturbance was most present in winter and summer, and sleep consolidation was most present in fall and spring; however, the type of sleep disturbance and consolidation varied.

Support (If Any): The MIDUS I study (Midlife in the U.S.) was supported by the John D. and Catherine T. MacArthur Foundation Research Network on Successful Midlife Development. The MIDUS II research was supported by a grant from the National Institute on Aging (P01-AG021066) to conduct a longitudinal follow-up of the MIDUS I investigation. The research was further supported by the following grants: 1UL1RR025011 from the Clinical and Translational Science Award (CTSA) program of the National Center for Research Resources, National Institutes of Health.

1025 DEVELOPMENT AND INITIAL VALIDATION OF THE ASSESSMENT OF SLEEP ENVIRONMENT: A NOVEL INVENTORY FOR DESCRIBING AND QUANTIFYING THE IMPACT OF ENVIRONMENTAL FACTORS ON SLEEP

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Introduction: The physical environment plays a role in sleep continuity and architecture. The present study evaluates a new questionnaire and its relationship with sleep quality, insomnia, and sleepiness.

Methods: The Assessment of Sleep Environment (ASE) was developed as part of the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study, a community-based study of $N = 1007$ adults aged 22-60. Items were developed based on available evidence of environmental factors that impinge on sleep. Questions assess the degree to which individuals agree or disagree with statements that sleep is disturbed because the sleep environment is too light, dark, noisy, quiet, warm, cool, humid, unsafe, has an unpleasant smell, or has an uncomfortable sleeping surface due to problems with the pillow, being too firm or too soft, or some other problem. Reliability was assessed with Cronbach’s alpha and split-half correlation. Convergent validity was assessed by examining age-adjusted item and total score relationships to insomnia (Insomnia Severity Index [ISI]), sleepiness (Epworth Sleepiness Scale [ESS]), and sleep quality (Pittsburgh Sleep Quality Index [PSQI]).

Results: Internal consistency was high (alpha = 0.9), as was split-half reliability ($r = 0.8$). ASE total score was associated with ISI ($B = 0.1, p < 0.0005$) and PSQI ($B = 0.1, p < 0.0005$) scores. Item relationships are only reported for “Strongly Agree” or “Agree” vs “Disagree” or “Strongly Disagree” for space. Dark was associated with ISI ($B = 1.13, p = 0.048$), ESS ($B = 1.09, p = 0.010$), and PSQI ($B = 1.29, p = 0.001$). Noise was associated with ISI ($B = 0.96, p = 0.017$) and PSQI ($B = 0.62, p = 0.017$). Quiet was associated with ESS ($B = 0.93, p = 0.014$) and PSQI ($B = 1.02, p = 0.002$). Warmth was associated with ISI ($B = 1.34, p = 0.001$) and PSQI ($B = 1.11, p < 0.0005$). Cold was associated with ISI ($B = 0.83, p = 0.041$), ESS ($B = 0.73, p = 0.015$), and PSQI ($B = 0.72, p = 0.007$). Humidity was associated with ISI ($B = 1.55, p < 0.0005$), ESS ($B = 0.77, p = 0.009$), and PSQI ($B = 1.01, p < 0.0005$). Uncomfortable pillow was associated with ISI ($B = 1.57, p < 0.0005$) and PSQI ($B = 0.86, p = 0.001$). Firmness was associated with ISI ($B = 1.44, p = 0.001$) and PSQI ($B = 0.85, p = 0.002$). Softness was associated with ISI ($B = 1.80, p < 0.0005$), ESS ($B = 0.88, p = 0.008$), and PSQI ($B = 0.91, p = 0.002$). Other sleeping surface issues were associated with ISI ($B = 1.94, p < 0.0005$) and PSQI ($B = 1.12, p < 0.0005$). Feeling unsafe was associated with ISI ($B = 2.30, p < 0.0005$), ESS ($B = 0.98, p = 0.004$), and PSQI ($B = 1.61, p < 0.0005$).

Conclusion: The ASE is a promising new instrument in the assessment of the sleep environment.

1026 WIRELESS MICROSENSOR TO SCREEN FOR OBSTRUCTIVE SLEEP APNEA: PRELIMINARY FINDINGS

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Introduction: Obstructive sleep apnea (OSA) is the most prevalent sleep-related breathing disorder and is associated with impaired daytime functioning and adverse health outcomes. Despite the health burden of OSA, as many as 80% of cases remain unidentified, prompting calls for improved methods for OSA identification. We evaluated the preliminary efficacy and usability of a wireless wearable microsensor developed by Zansors®, LLC to accurately detect obstructive apnea events in patients undergoing clinical screening for OSA.

Methods: Zansors® wireless microsensor is a 1.5 x 2.5 x 0.2 inch device measuring sound and movement during sleep. To evaluate its performance against in-laboratory polysomnography, we recruited 52 adults (29 women, 48.5 ± 13.7 years of age, 23% minority, 33.8 ± 8.5 BMI) from the University of Michigan Sleep Disorders Center who were undergoing in-laboratory evaluation for a sleep-related breathing disorder. Exclusion criteria included medical conditions affecting PSG assessments or interfering with sensor application. Zansors® microsensor was affixed to the neck and the device was worn during the diagnostic PSG. In the morning, subjects completed a questionnaire on device usability and received $50 compensation. We computed sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

Results: Using the current version of our analytic algorithm for determining apneic events and an optimized noise threshold, we found sensitivity of 75%, specificity of 71.4%, PPV of 69.2% and NPV of 77%. The device fell off during the night in 10% of patients and was reattached. In the morning, 86% of subjects rated the device from neutral to very comfortable, with 50% rating the device as “very comfortable.”

Conclusion: The Zansors® microsensor device demonstrated acceptable performance metrics and patient usability outcomes. Future work will focus on bioengineering improvements, improving analytics, hypopnea algorithm development, and comparison against home sleep apnea testing.

Support (If Any): NIH R41 MD008845 (Arnedt/Dasgpaga)
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IMPACT OF MANUAL EDITING OF SLEEP RECORDING TIME FOR HOME SLEEP APNEA TESTS
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Introduction: Type 3 Home Sleep Apnea Tests (HSATs) may underestimate the apnea-hypopnea index (AHI) due to overestimation of total sleep time (TST). We hypothesized that manual editing of the total recording time would reduce misclassification of TST, and result in an AHI that more closely approximated values generated by full polysomnography.

Methods: Thirty 15-channel polysomnography studies (AHI range 0 to 30 events/hr) previously scored using AASM criteria (gold standard) were rescoring in random order by two blinded polysomnologists after data from EEG, EOG and EMG were masked. In Method 1, periods of probable wakefulness were removed from analysis. Method 2 identified TST as the entire recording time without manual editing. Paired t-tests were used to compare the TST and AHI between these methods. Sensitivity and specificity of each method were calculated for gold standard AHI cutoffs of ≥ 5 and ≥ 15.

Results: The mean (SD) AHI using polysomnography, method 1, and method 2 was 12.5 (8.2), 10.8 (7.0), and 9.1 (6.1) events/hr, respectively. The corresponding TST was 366.0 (70.1), 447.1 (59.0), and 542 (61.9) min, respectively. Compared to polysomnography, both alternative methods overestimated the TST (method 1: mean difference [SD] 81.1 [56.1] min, method 2: 176.0 [89.7] min) adjusted p < 0.001) and underestimated the AHI (method 1: mean difference [SD] -1.6 [3.3], method 2: -3.3 [3.9]; adjusted p < 0.001). The sensitivity was 100% and 91.3% for method 1, and 70.0% and 40.0% for method 2 for identifying abnormal studies using AHI cutoffs of ≥ 5 and ≥ 15, respectively. The specificity was 100% for both methods using both cutoffs.

Conclusion: Sleep studies scored without EEG channels and without manual editing of total recording time overestimates the TST and underestimates the AHI. Manual editing of monitoring time reduces the overestimation of TST and improves the sensitivity for identifying studies with abnormal AHI, especially for moderate or more severe sleep apnea.

1028
COMPARABILITY OF UNATTENDED TYPE 3 HOME SLEEP TESTING (HST) WITH POLYSOMNOGRAPHY (PSG) FOR IDENTIFYING PATIENTS WITH MODERATE-SEVERE OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS)
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Introduction: There is little evidence-based guidance for third party payers regarding suitable testing for CPAP authorization. While many allow or require HST for OSAS documentation, others including some Medicaid programs, stipulate PSG testing. We assessed the comparability of HST and PSG for 85 Medicaid beneficiaries at high OSAS risk tested by both HST and PSG between 1/1/2014 and 10/31/2015. Our hypothesis was that HST would be comparable to PSG for identifying moderate-severe OSAS.

Methods: Autoscored HST (NOXturnal T3) tracings were independently edited by two sleep medicine physicians and a group of trainees using standard (4% desaturation) and alternative (3% desaturation) AASM hypopnea criteria. Inter-editor variability was measured by paired t-tests. PSGs were manually scored by experts using standard AASM criteria. Agreement of HST (REI) and PSG (AHI) was assessed using Bland-Altman plots. HST sensitivity and specificity for OSAS were calculated from 2x2 contingency tables for REI thresholds of ≥ 15, ≥ 20, ≥ 25, ≥ 30 and ≥ 40.

Results: Patient characteristics: Age 48.2 +/- 11.7; Male 50%; Hispanic 54%, Black 4%; BMI 40 +/- 10.1; Epworth 12.4 +/- 6.2. Test quality: 2% HSTs vs 1% PSGs inadequate; 21% HST vs 4% PSG marginal (p < 0.001). PSG diagnoses: moderate-severe OSAS 42 (53%), mild-moderate OSAS 16(20%), no OSAS 14(18%), other or non-diagnostic 3(8%). Inter-editor variability was negligible between sleep medicine experts (p = 0.11), but significant between trainees and experts (p < 0.001). Bland-Altman plots showed dispersion of REI-PSG averages < 20/hr with bias toward higher REIs, but alignment for ≥ 20/hr. Optimal sensitivity/specificity occurred with 4% hypopnea criteria and REI OSAS thresholds ≥ 20-30/hr with positive predictive values of 83%, 87% and 91% for thresholds of ≥ 20/hr, ≥ 25/hr, and ≥ 30/hr respectively.

Conclusion: HST was comparable to PSG for diagnosing moderate-severe OSAS when AASM standard scoring criteria and REI thresholds ≥ 20-30/hr were used. Consistency and correlation with PSG are likely influenced by reader expertise. PSG may be indicated for patients with REI values less than the OSAS diagnostic threshold to detect mild-moderate OSAS.

1029
ASSESSMENT OF SLEEPINESS: ARE THESE SCALES USEFUL?
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Introduction: The assessment of excessive wake time sleepiness [WTS] is essential in the practice of Sleep Medicine. The identification of symptomatic patients is mostly based on subjective scales. The Epworth Sleepiness Scale [ESS] being the instrument most widely used around the world. While the scale has been validated using a variety of clinical and non-clinical populations, few studies have compared the scale to concurrent clinical assessment of WTS. The practicality of concurrent use of subjective scales and face to face clinical assessment was evaluated.

Methods: Patients attending a Sleep Medicine clinic were evaluated by a single clinician. Patients completed the ESS and the Time of Day Sleepiness Scale [ToDSS] prior to the consultation. Each patient was defined as sleepy or not sleepy using accepted clinical guidelines [ > 10 on the ESS and any elevation above > 3, > 7 or > 10 on the morning [M], afternoon [A] and evening [E] sub-scales of the ToDSS]. At the time of the initial consultation [and based on the clinical assessment], the clinician identified the patient as sleepy or non-sleepy.

Results: A convenience sample of 46 patients [20 females, 26 males] were evaluated [ age 60 +/- 14, BMI 29.9 +/- 6.8]. The average score on the ESS was 9.0 +/- 5.5 and the scores on the ToDSS were 3.3 +/- 3.8 [M], 6.6 +/- 4.8 [A] and 7.6 +/- 5.7 [E]. The clinician identified 50% of the cohort as being sleepy. On the ESS, 23 patients [50%] were identified as sleepy; on the ToDSS 25 [54%]. The probability of testing positive on the subjective scales was 78% and 83% for the ESS and ToDSS respectively.

Conclusion: While both the ESS and the ToDSS provided an acceptable sensitivity in the identification of WTS, the subjective scales mis-identified 10% of the cohort with a false negative assessment of subjective sleepiness.
IS THE EPWORTH SLEEPINESS SCALE VALID IN COMMERCIAL DRIVERS?

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Introduction: In order to facilitate certification, professional drivers/commercial drivers may underreport sleepiness on the Epworth Sleepiness Scale (ESS), a validated measure of subjective sleepiness. Therefore, in a prospective study of consecutive patients presenting to our center, we compared the ESS in patients who were commercial drivers to those patients who were not commercial drivers. In observations leading to this study, several commercial drivers reported ESS scores of 0-1.

Methods: After IRB approval, 33 patients consented for this prospective study consisting of 12 commercial drivers and 21 non-commercial patient drivers.

Results: The groups had similar ages: commercial drivers (53±13.0), non-commercial (51±9.8 years). They also had similar BMIs: commercial drivers (36.7, s.d. 7.3), non-commercial (35.9, s.d. 10.1 kg/m2). The difference between the apnea hypopnea index (AHI) of commercial drivers (36.1, s.d. 27.5) and non-commercial (19.9, s.d. 27.8) drivers was not significant. As hypothesized, the ESS from commercial drivers was lower compared to non-commercial drivers (9.2, s.d. 5.8 versus 13.5, s.d. 5.2; \( p = 0.039 \)). Despite pre-study findings, no commercial driver had an ESS score of zero or one.

Conclusion: Among sleep center patients, commercial drivers reported lower ESS scores than non-commercial drivers. Strengths of this study include its prospective design and groups of similar age. The mean BMIs were also similar. Limitations include a small sample size from a single sleep center. Commercial drivers might self-select this occupation due to ability to remain alert, other studies have not shown this to be the case. Commercial drivers with sleep apnea may underreport sleepiness. This study adds to the literature indicating limitations of the validity and thus usefulness of the ESS in commercial drivers. We conclude that the ESS should be used cautiously especially in commercial drivers.

REFINEMENT OF THE BRFSS SLEEP QUESTIONS

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Introduction: The Behavioral Risk Factor Surveillance System (BRFSS) sleep questions are used to screen for sleep disorders and lack of sleep opportunity in the population. In a recent study to validate the questions, two of the five questions were found in need of refinement. The current valid questions are: 1) On average, how many hours of sleep do you get in a 24-hour period, and 2) During the past 30 days, for about how many days did you find yourself unintentionally falling asleep during the day, and 3) During the past 30 days for about how many days have you felt you did not get enough rest or sleep The questions requiring refinement are 1) During the past 30 days, have you ever nodded off or fallen asleep, even just for a brief moment, while driving? and 2) Do you snore.

Methods: A qualitative design using structured interviews of 30 patients with and without sleep disorders and 15 sleep experts was used to understand: 1) the current evidence on sleep related screening questions, 2) questions commonly used by sleep experts to screen for sleep problems, and 3) study participants contextual meanings of and their feelings and beliefs about sufficient and restful sleep, then their feel-ings and meanings of not feeling rested. Results of interviews were used to confirm reliability of or make recommendations for refinement of current questions.

Results: Refinement of the wording of two of the BRFSS questions was developed. Recommended wording is 1) Has anyone ever told you that you snore or have you ever woken yourself up snoring? and 2) During the past month have you ever felt the urge to sleep, lost focus on what you are doing, or found it difficult to concentrate while driving or doing a hazardous task?

Conclusion: Changes as well as standard scoring for combinations of the questions is recommended.

THE CHARLOTTE ATTITUDES TOWARDS SLEEP SCALE: A NEW PSYCHOMETRIC TOOL

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Introduction: Health behavior change theories suggest that attitudes can be salient predictors of behavior change and health outcomes. Research has shown associations between attitudes, sleep hygiene, and sleep characteristics, yet a validated measurement tool for this psychological construct is lacking. The aim of the present study was to design and pilot a valid and reliable survey for measuring attitudes towards sleep.

Methods: A series of four studies was conducted. In Study 1, measurement specifications were established, an initial item pool was generated, and item review/content validation was conducted by subject matter experts. In Study 2, the revised pool of items was piloted in a local (N = 165) and national (N = 155) sample of college students. Item endorsement rates and variability were examined, and factor analysis confirmed the underlying factor structure. Item discrimination and internal consistency were examined, as well as the items’ sensitivity to social desirability. In Study 3, the revised item pool was piloted in a new sample (N = 168) for test-retest reliability. Study 4 (N = 218) was a final validation study to estimate predictive validity.

Results: The present study yielded a 10-item, two-factor sleep attitude scale normed for college students. The items were independent of social desirability (rs ranged .002-.22) and yielded sufficient test-retest reliability (r = .76). Internal consistency estimates for the total scale (α = .75), Benefits subscale (α = .80), and Time Commitment subscale (α = .77) were reasonable. The scale yielded predictive validity; above and beyond the influence of sleep disorders and medication, the scale accounted for 18% and 15% of the variance in sleep duration and quality, respectively.

Conclusion: The Charlotte Attitudes Towards Sleep (CATS) Scale is a newly developed, psychometrically-sound measurement tool for sleep attitudes. This scale may be useful in future research examining psychological predictors of sleep outcomes.

TRANSCUTANEOUS CARBON DIOXIDE MONITORING DURING POLYSOMNOGRAPHY

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Introduction: Transcutaneous carbon dioxide (tcCO2) monitoring has not routinely been conducted during polysomnography. Historically tcCO2 monitoring has correlated well with end tidal CO2 monitoring and arterial blood gases. Our center started routine tcCO2 monitoring during polysomnography in January, 2015 for patients with a body...
mass index (BMI) greater than 40 or if indicated for another reason, such as obesity hypoventilation syndrome and PAP titration.

Methods: After IRB approval, a retrospective review was done for all patients at the Sleep Disorder Center at the Mayo Clinic in Arizona to identify patients that had undergone tcCO2 monitoring during their sleep study from January, 2015 through November, 2015. Demographics, BMI and tcCO2 levels were collected. Basic descriptive statistics were used to analyze the data.

Results: 161 patients (52% male) underwent tcCO2 monitoring. Average age was 59 (± 15) years and BMI was 40 (± 9). Average AHI was 21 (range 0-152). Highest tcCO2 levels averaged 45 (± 12) mmHg.

Conclusion: tcCO2 monitoring during polysomnography may help identify sleep-related hyperventilation. Once these patients are identified, their high CO2 levels may influence management in terms of selecting the optimal type of positive airway pressure. Further study is needed in regards to the reliability and value of tcCO2 monitoring during sleep.

1034
PHASE-AMPLITUDE INTERACTIONS BETWEEN HEART RATE VARIABILITY AND SLEEP EEG
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Introduction: The existence of complex heart-brain neural interaction has prompted researchers to examine the relationship between heart rate variability (HRV), a non-invasive measure of cardiac autonomic activity, and electroencephalography (EEG), including during sleep. In this study, we applied comodulogram analysis to investigate the phase-amplitude coupling of HRV and sleep EEG in wake, slow wave sleep (SWS), and rapid eye movement (REM). The comodulogram queried whether the amplitude of a faster oscillation (EEG) is modulated by the phase of a slower oscillation (HRV).

Methods: We recorded a daytime nap in healthy subjects. Both EEG (F4 channel) and HRV signals were resampled to 32 Hz, and for each frequency pair, the signals were filtered separately. HRV frequencies ranged from 0.04-0.5 Hz (0.01 Hz increments) and EEG frequencies from 0.25-15.75 Hz (0.5 Hz increments). Modulation index (MI) was empirically determined for each frequency pair. The MI was calculated creating a comodulogram (Cox et al. 2014). We compared frequency pairs across wake, SWS, and REM using paired t-tests controlling for multiple comparisons.

Results: Compared to wake, SWS showed significant (p < 0.05) phase-amplitude coupling in two clusters: 1) EEG Delta (0.25-3.25 Hz) and high frequency HRV (0.4-0.5 Hz), and 2) EEG Spindles (14.75-15.75 Hz) and low frequency HRV (0.1-0.2 Hz). REM showed significant phase-amplitude coupling in three clusters: 1) EEG Delta (0.75-3.25 Hz) and low frequency HRV (0.04-0.16 Hz) (the maximum phase-amplitude coupling), 2) EEG Delta (0.25-2.25 Hz) and high frequency HRV (0.3-0.5 Hz), and 3) EEG Spindles (13.75-15.25 Hz) and HRV (0.04-0.25 Hz).

Conclusion: Nesting behavior of EEG rhythms in low-frequency and high-frequency HRV during SWS and REM suggest an interaction between the autonomic and central nervous systems. Further investigation is needed to understand the functional impact between ANS and CNS interactions during sleep and wake.

Support (If Any): This study was funded by NIA R01AG046646

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CLASSIFICATION OF SLEEP STAGES USING CONVOLUTIONAL NEURAL NETWORKS
Stephansen JB, Olsen AW, Sørensen HB, Jennum P, Watson NF, Mignot E

Introduction: In the field of sleep medicine polysomnograms (PSGs), are central for the assessment of most sleep related disorders. One aspect of this assessment is sleep staging, in which sleep is divided into a number of categories depending on brain activity, eye movements and muscle tone amongst other things. Sleep staging has traditionally been done manually through visual inspection by trained technicians, but this is time consuming and has the disadvantage of being subjective.

Methods: In this project, a class of models that has become the state of the art in the field of computer vision, convolutional neural networks, was coupled with an auto-correlation representation of PSG data and applied to the problem of discriminating stages of sleep. A model, based on a subset of over 15 thousand PSGs from the Stanford Sleep Cohort (SSC) and the Wisconsin Sleep Cohort (WSC), was constructed and evaluated on a separate test data-set, which included a different subset of the SSC and the WSC as well as data from the American Academy of Sleep Medicine (AASM).

Results: Results, comparing the manual scoring by 5234 technicians from the AASM Inter-Scorer Reliability program, with the model estimate on 200 epochs, showed a 96% model estimate accuracy versus an 89% accuracy for the technicians. The golden standard was assessed as the majority vote of the technicians. Data from the SSC and WSC showed a similarly high accuracy.

Conclusion: The results indicate that, not only does the demonstrated model give a deterministic estimate which outperforms the manual scoring, it also provides the relative probabilities of each stage of sleep, enabling a probabilistic rather than an absolute assessment of stages of sleep. This may lead to the future development of new sleep PSG assessments.

1036
CLASSIFICATION OF SLEEP EPOCHS BASED ON RECURRENCE ANALYSIS OF THE EEG
Fridt C, McCarty D, Kim P, Marino A

Introduction: Recurrence analysis (RA) is a method of measuring lawfulness (non-randomness) in the electrical activity of the brain (EEG). Applied to the sleep-EEG, RA quantifies sleep depth (increased lawfulness) and sleep fragmentation (frequency of abrupt changes in sleep depth). By hypothesis, RA permits objective identification of distinct sleep-EEG states based on algorithmically determined values of depth and fragmentation.

Methods: From de-identified PSGs (N = 50, randomly-selected) of clinically normal subjects (National Sleep Research Resource (NSRR), two RA markers for depth (r,d) and two for fragmentation (Ar,Ad) were computed for each 30-sec epoch in the sleep-EEG (C3) of each subject. The distribution of each marker was algorithmically divided into four Levels (1→4, low→high), and the Levels were used to classify each sleep-EEG epoch into one of the maximum number of empirically determined distinct sleep-EEG states.
Results: Respective epoch-to-epoch marker ranges (r,d,Ar,Ad) for a typical subject were: 7-25%, 50-90%, 2-62 events/hr, 2-80 events/hr. From an analysis of the average values of sleep depth, four statistically distinct sleep-EEG states were identified. At the level of individual subjects, assignment of each sleep-EEG epoch to a sleep-EEG state was determined based on the grouping of the respective RA-marker Levels as follows: (1,1,4,4)→W; (2,2,3,3)→R; (3,3,2,2)→L; (4,4,1,1)→D. The resulting hypnograms closely resembled but were not identical to those from conventional sleep staging by the NSRR investigators (percent agreement): W↔WASO (84%); R↔REM (81%); L↔N1/N2 (90%); D↔N3 (95%).

Conclusion: From a home-recorded nocturnal single-derivation EEG, RA algorithmically identified four distinct brain electrical states, one of which was statistically identical to wake (vigilant EEG). The four RA markers for depth and fragmentation can be combined statistically with the four brain-state classification to create a 16-dimensional biomarker function from the sleep-EEG that may be useful as a low-cost method for identifying specific biopathologies.

1037 DO SELECTIVE SEROTONIN REUPTAKE INHIBITORS INFLUENCE EYE MOVEMENT LATENCY TIMES?
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Introduction: Eye movement initial deflection to initial peak time interval (hereafter termed eye movement latency time or EMLT) is an integral part of scoring sleep stages. EMLTs that are less than 500 milliseconds are termed rapid, while those that are greater than this value are considered slow. The presence of each in combination with other scoring parameters are key to determining sleep stage. Selective serotonin reuptake inhibitors (SSRIs) are reported to decrease rapid eye movement (REM) sleep and increase the number of eye movements during non-REM sleep, particularly Non-REM Stage 2 sleep. Our study looks at whether or not the mean latency times of those eye movements changes during all states with SSRI usage.

Methods: 14 males and 18 female patients ages 18 to 75 were selected from the University of North Carolina Chapel Hill Sleep Disorders Center polysomnography database. Of these patients, 7 males and 9 females reported taking an SSRI during the time of the study. A maximum number of 20 eye movement latency times were sampled from each stage of sleep throughout the night to generate individual and group averages.

Results: Eye movements were more often present in N2 sleep in the SSRI vs the Non-SSRI group (Fisher’s Exact test, p = 0.46). Eye movements were absent in N3 in most cases in both groups. The EMLST in both groups (Non-SSRI, SSRI) was shorter for eye movements in Wake (278ms,319ms) and REM (280ms, 279ms) versus in N1 (1040ms, 1180ms) and N2 (1180ms, 895ms). EMLTs did not differ between groups in any sleep stage based on student t-test comparisons (p = .356, .583, .714, .153). EMLT data distributions were also evaluated for presence of multi-modal peaks that could distinguish eye movement patterns between groups.

Conclusion: The mean eye movement latency time does not appear to vary as a function of SSRI use across wake and stages N1,N2 and REM sleep. Our study does support the observation that SSRIs increase the presence of eye movements, especially N2 sleep.
1040 ACTIGRAPHY VALIDATION: PRELIMINAR ANALYSIS
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Introduction: The actigraph is a device with an accelerometer, microprocessor and internal memory, which is capable of detecting and storing motion signals. Specific algorithms allow to analyze the data and provide information about the patient’s activity while using the equipment. From these estimates, the amount of registered activity is related to sleep patterns (low activity) and wakefulness (high activity). The aim of this study is to validate an actigraph in relation to polysomnography results in a population of patients under investigation for obstructive sleep apnea.

Methods: Population: adults with suspected of sleep apnea from a specialized sleep medicine clinic. Actigraph: devices from Condor Instruments Company, ActTrust®, São Paulo, SP, Brazil, were used. This device resembles a wristwatch and have a 3-axis accelerometer, light sensor, temperature sensor and an event button. The apparatus weighs 38 grams, has dimensions of 47 mm x 31 mm x 12 mm, with a storage capacity of 2 MB of memory, 12 bit resolution and 25 Hz sampling rate. Polysomnography: the parameters of the American Academy of Sleep Medicine for collection and analysis of biological variables related to sleep were used. Procedure: the equipment was placed in the early evening in the non-dominant arm and removed at the end of polysomnography examination. Actigraphy and polysomnography were simultaneously collected during sleep laboratory admissions. Analysis: epochs of 30 seconds from ActTrust and polysomnography were compared. Sensitivity, specificity, positive predictive value, negative predictive value and agreement were assessed. The algorithm used was the Cole-Kripke in PIM method (proportional integration mode).

Results: Forty-three patients were enrolled and a total of 37287 epochs were analyzed. Overall, sensitivity (83.28%), specificity (69.29%) and accuracy (89.24%) were high.

Conclusion: The present preliminary analyzes conclude that ActTrust with the current algorithms has a good sensibility, accuracy and specificity for a population suspect of sleep apnea.
Correlations between PCs and daytime symptoms were examined. Using logistic regression, the associations of the PC with history of diabetes and cardiac conditions were examined.

**Results:** The sample included a total of 172 HF patients [65.3% male (M (SD) age = 60.3 ±16.1 years)]. Seven clusters explained 64.1% of the total variation in 22 sleep variables. Sleep measures were classified into three clusters separately for PSG, ACT, and PSQI. The apnea cluster included the respiratory disturbance (RDI) and arousal indices (AI) and percent of stages NREM 1 and NREM 3. The other sleep variables comprised three clusters. Only the cluster representing self-reported sleep disturbance (PSQI) was associated with symptoms and physical function (p < .001). The PSG cluster, but not the other clusters, was associated with history of diabetes (p = .050), peripheral vascular disease (p = .034), and history of angioplasty (p = .048). The apnea cluster explained history of ischemic heart disease (p = .029) after controlling for demographic characteristics.

**Conclusion:** Although sleep measurements are often redundant, only subjective sleep measures explained symptoms and self-reported physical function. PSG, but not ACT or PSQI, were associated with diabetes and cardiac problems.

### 1043

**SLEEP ENDOSCOPY - DOES IT JUSTIFY THE EFFORT AND COST?**

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**Introduction:** Introduction: Accurate assessment of obstruction sites and severity in sleep apnea is essential to surgical planning. Drug induced sleep endoscopy (DISE) is thought to be more accurate than awake clinical evaluation methods as it most closely approximates natural sleep. However, performing DISE adds to the cost and requires additional resources and time. Objective: 1. Characterise pattern of upper airway obstruction in sleep apnea in both awake clinical examination and drug induced sleep states. 2. Determine correlation between DISE findings and awake clinical examination findings.

**Methods:** Methods: Prospective study. Patients with OSA diagnosed on PSG for which surgical intervention is considered are recruited and assessed awake using Muller’s manoeuvre and End Expiratory Retroglossal Area (EERGA), followed by DISE (at BIS 70-80) using the VOTE classification.

**Results:** Results: 33 patients were recruited over a 1 year duration. Correlation between the different sites on awake examination and DISE were as follows EERGA and DISE tongue base collapse- 82%; Muller’s tongue base collapse and DISE tongue base collapse- 48%; Muller’s velopharynx (VP) collapse and DISE Velum anterior posterior (AP) collapse- 30%; Muller’s lateral pharyngeal wall (LPW) collapse and DISE Velum lateral collapse- 39%

**Conclusion:** Discussion & Conclusion: The best correlation was found between EERGA and DISE tongue base collapse. Muller’s manoeuvre tends to underestimate tongue base collapse. On the contrary, it tends to over-estimate the degree of collapse at the level of velopharynx compared to DISE. Accurate identification of the levels, patterns and degrees of obstruction play an important role in the selection of appropriate surgical procedures as this will likely influence surgical outcomes. This study suggests that awake evaluation methods are by and large unreliable and DISE should be the standard of care in the preoperative workup of a surgical patient.

### 1044

**TIME-OF-DAY EFFECTS ON RESPONSES TO CLINICAL HEALTH MEASURES**

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**Introduction:** Although it has been shown that the sensitivity of physiological systems is increased in the morning compared to the evening, possible time-of-day effects on psychological inventories are less certain. It is also unclear how possible diurnal variations in clinical health measures relate to diurnal fluctuations in biomarkers known to relate to mood and well-being (IL-1β, IL-6, and cortisol). We sought to address these uncertainties by testing our measures in a morning and an evening group of participants.

**Methods:** 45 participants were randomly assigned to either a morning (8:00-10:00 a.m) or an evening (8:00-10:00 p.m.) testing condition. Participants completed questionnaires including the Profile of Mood States, the World Health Organization Quality of Life BREF (WHOQOL), the Morningness-Eveningness Questionnaire, the State-Trait Anxiety Inventory, the Center for Epidemiological Studies Depression Scale, the Insomnia Severity Index, the Perceived Stress Scale, and the Pittsburgh Sleep Quality Inventory. Additionally, participants provided saliva samples for the quantification of IL-1β, IL-6, and cortisol.

**Results:** ANOVAs comparing the groups showed that, consistent with previous reports, cortisol was significantly higher in the a.m. (F = 17.96, p < 0.01). Unlike previous studies, we did not observe a diurnal variation in either IL-1β or IL-6. We also showed increased quality of life reports in the evening compared to the morning on three domains: WHOQLD2 (F = 7.78, p < 0.01), WHOQLD3 (F = 7.06, p < 0.01), WHOQLD4 (F = 9.39, p < 0.01). In agreement, we further showed increased depressive symptomatology (F = 6.63, p = 0.01) and perceived stress (F = 6.38, p = 0.02) in the a.m. compared to p.m. group.

**Conclusion:** We found that certain clinical health measures exhibit diurnal sensitivity, with participants generally expressing greater distress in the morning. These findings are in line with existing research suggesting heightened physiological reactivity in the morning. The current results suggest that this relationship may extend to the field of psychological assessment.

**Support (If Any):** This study was funded through a Department of Education Grant (Number P120A140012) awarded to Jaime L. Tartar

### 1045

**EVALUATION OF EFFECTS OF HIGH REBOUND MATTRESS TOPPERS ON ATHLETIC PERFORMANCE IN YOUTH (2ND REPORT)**

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**Introduction:** Use of airweave (a high rebound [HR] mattress with a structure that facilitates breathability) induces effective heat loss (i.e., a larger decline in core body temperature) and enhances deep sleep compared to low rebound [LR], pressure-absorbing mattress toppers during the initial phase of nocturnal sleep in healthy males (Sleep, 2013 & 2014). Sufficient, restorative sleep is essential to maximize athletic performance of advanced athletes (Mahl et al., 2005). We therefore examined if sleeping on airweave toppers will improve sleep and athletic performance of young athletes. Preliminary results indicated that sleeping with HR tended to improve athletic performance, namely 40-meter sprint, long jump, and star drill (Sleep, 2015).

**Methods:** The study was conducted in 23 healthy male athletes (who provided signed informed consent) at IMG sport academy (Bradenton, FL).
FL), with a randomized six weeks cross-over design with or without HR-toppers on regular beds equipped in their dormitory. Subjects from various programs without any sleep disorders, circadian rhythm disorders or allergic rhinitis were selected. Half of athletes started by 6 weeks of the HR session followed by 6 weeks of “no topper” session, while the order of the sessions were reversed for the other half. The athletic performance and subjective sleep quality and performance were evaluated twice a week during last two weeks of each session. The following measures were evaluated: objective athletic performance (40-meter sprint, long jump, star drill); subjective self-rating (1 to10) at practice (SSRP) and games (SSRG); subjective sleep evaluations (Epworth sleepiness scale [ESS], visual analogue scales of sleep [VAS-S], performance [VAS-P], and mood [VAS-M]); objective sleep and psychomotor performance (actigraph and a standardized psychomotor vigilance test [PVT]).

**Results:** There were no significant differences in the subjective sleep, performance, and mood, subjective athletic self-ratings, as well as objective psychomotor performance between with vs without HR-topper. We observed statistically significant improvements with the star drill (32.85 ± 0.70 sec, p-value = 0.0386). Subjects tended to perform better with the 40m sprint and long jump with the HR-topper, although the difference was not significant.

**Conclusion:** Our studies show that sleeping with HR possibly improved athletic performance in youth athletes. It is possible that restorative sleep with HR may have contributed to better athletic performances in these subjects, although we could not observe any significant differences in sleep evaluations applied in the study.

**Support (If Any):** The study was supported by airweave, inc.

### 1046 PATTERN OF DAILY MOTOR ACTIVITY PREDICTS CHANGES IN SLEEP, COGNITION, AND MORTALITY IN OLDER MEN

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**Introduction:** There has been a growing interest in the area of “wearable tech” and its relationship to physical and psychiatric health. A common element of many of these devices is an accelerometer that can yield information on activity levels; the utility of such data in predicting changes in health is, however, relatively unexplored.

**Methods:** Data from 2,976 older (76.4 ± 5.5 yrs), community-dwelling men were collected. At baseline, daily activity (4-7 days of actigraphy, Sleepwatch-O) was measured. The daily pattern of activity was quantified using functional principal component analysis (fPCA), a shape-invariant analytic technique. Sleep (polysomnography) and cognitive function (Modified Mini-Mental State exam/3MS, Trails B) data were collected at baseline and 6.5-8 years later. Mortality follow-up was 6.5 years later. Mortality follow-up was 8 years. Baseline activity patterns and their association with changes in cognition, sleep, and mortality were assessed with models adjusted for education, socioeconomic status, self-rated health, age, mental status, race, anxiety, depression, daytime sleepiness, and history of sleep disruption.

**Results:** High fPCA1 values (elevated daily activity) at baseline were associated with a worsening of sleep efficiency (p < 0.05) and more wake after sleep onset (p < 0.05) at follow-up. Low fPCA1 values at baseline were associated with worse Trails B scores (p < 0.001) 6.5 years later. Low fPCA2 values at baseline (earlier wake and bed time) were associated with larger declines (worse) in 3MS scores (p < 0.05) 6.5 years later. Those in quartile 1 (Q1) of fPCA1 had over a 1.6-fold higher risk of all-cause mortality [HR = 1.64 (1.34-2.00)] compared with men in Q4 (p-trend < 0.0001). Men in Q4 of fPCA4 (late afternoon peak in activity) had over a 1.4-fold higher risk of all-cause mortality [HR = 1.46 (1.21-1.77)] compared with men in Q1 (p-trend = 0.0001). Men in Q4 of fPCA3 (longer duration of daytime activity with a bimodal activity pattern) had over a 1.4-fold higher risk of all-cause mortality [HR = 1.42 (1.02-1.98)] compared with men in Q1 (p-trend = 0.0078).

**Conclusion:** Actigraphy-derived patterns of daily activity are associated with changes in clinically-relevant outcome measures, including mortality. It will be important to establish whether consumer devices can yield similar data quality.

**Support (If Any):** NIH grants U01 AG027810, U01 AG042124, U01 AG042139, U01 AG042140, U01 AG042143, U01 AG042145, U01 AG042168, U01 AR066160, U1L TR000128, R01 HL071194, R01 HL070848, R01 HL070847, R01 HL070842, R01 HL070841, R01 HL070837, R01 HL070838, and R01 HL070839. This analysis project was supported by the VA Sierra Pacific Mental Illness Research, Education, and Clinical Center.

**1047 AN AGILE METHOD TO ANALYZE AND IMPACT SLEEP PATIENT BEHAVIOR ON A PATIENT-CENTERED SLEEP MEDICINE PORTAL**

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**Introduction:** Development of a sleep patient educational portal is one component of the Sustainable Methods, Algorithms, and Research Tools for Delivering Optimal Care Study (SMART DOCS) designed to provide patients better access to information about their medical care. Agile methods were used to rapidly and repeatedly assess patient portal utilization and the impact of personalized communications on behavior.

**Methods:** A rich, refined methodology for collecting and analyzing patient behavior in a visual manner provides insight into how sleep patients use a patient portal. For example: when and how often patients log in, what sequence of pages patients visit, and what documents patients access. Patient demographic factors (age, education, ethnicity, etc.) and biometric factors (diagnosis, severity, body mass index, etc.) filter utilization data to provide insight into effective use of the portal relative to specific needs. Customized patient emails were sent on a regular basis to guide patients to specific educational documents selected based on their sleep disorders, and personalized reports from clinic visits.

**Results:** Patient portal utilization was analyzed for a subset of 157 patients for a period of one year. On average, patients viewed 6.68 web pages 14.75 times, which includes viewing 5.53 sleep educational documents 11.26 times and 1.54 personalized patient reports 4.61 times. There was a 5.04% increase in educational document views and 41.89% increase in personalized report views when comparing patient portal usage within 10 days of a customized email message to days without recent email communications.

**Conclusion:** Data visualization techniques and targeted patient communications used in a rapid and repeated agile fashion appears to encourage increased engagement of sleep patients in a patient-centered portal. We hypothesize that increased patient portal utilization will be associated with improved patient satisfaction and more effective healthcare at a lower cost.

**Support (If Any):** SMART DOCS is funded through a Patient-Centered Outcomes Research Institute (PCORI) Award (CE-12-11-4137).
THE MULTITAPER SPECTROGRAM: A HIGH-RESOLUTION, OPTIMIZED METHOD FOR DYNAMIC SPECTRAL ANALYSIS, WHICH FACILITATES THE CHARACTERIZATION OF SPECTRAL MOTIFS PRESENT IN THE SLEEP ELECTROENCEPHALOGRAM, CLINICAL PHENOTYPING, AND MICROEVENT ANALYSIS

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Introduction: Sleep is a dynamic process, thus, methods for characterizing continuous changes in the sleep electroencephalogram (EEG) are needed. Although time-frequency analysis is ideal for this purpose, previous studies have been limited by use of statistically inefficient estimators, which produce noisy, inaccurate results that are difficult to interpret. We therefore propose the multitaper spectrogram (MTS), optimized to reduce bias and variance, as a tool to analyze time-varying spectra. In this study, we show that the MTS produces an information-rich representation of neural dynamics during sleep in a way that the hypnogram cannot, while still preserving features required for clinical sleep staging.

Methods: We recorded 64-channel EEG from ten (5 women, 5 men) healthy (AHI < 5, RDI < 15, BMI < 30) right-handed subjects (19-32 years) for two nights in the Massachusetts General Hospital (MGH) Sleep Laboratory, and selected clinical polysomnograms (PSG) from the MGH clinical database. Using custom software, we scored 16 clinical sleep records (8 control, 8 from patients with apnea or limb movement disorders) using the MTS alone. MTS-derived estimates of total sleep time were used to calculate clinical respiratory measures.

Results: The MTS revealed the dynamic spectral motifs of traditional sleep stages and transitions, providing a single, full-night visualization with resolution sufficient to clearly distinguish individual microevents. The MTS also revealed broadband EEG activity following apnea events. Spectral scoring showed no significant difference from the clinically scored epochs of Wake, REM, and NREM (Cohen’s Kappa = .71), as well from clinical estimates of AHI and RDI (p < .003 Wilcoxon ranked sign test).

Conclusion: By adapting efficient spectral estimation methods like the MTS for sleep EEG analysis, we provide a much clearer picture of sleep EEG dynamics, leading to a better understanding of the underlying neural activity. This approach will facilitate discovery of links between PSG EEG and the underlying neural substrates of clinically important phenotypes.

Support (If Any): This work was supported by VA and by NINDS R21 NS093000 (R.E.B.), NIMH R01 MH039683 & NHLBI HL095491, and NIH New Innovator Award DP2-OD006454 (P.L.P.)

THE IMPACT OF SIGNAL ARTIFACTS ON EEG DATA AND THE EFFECTIVENESS OF AUTOMATED ARTIFACT-REJECTION ALGORITHMS

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Introduction: Electroecephalography (EEG) recordings during sleep are often contaminated by ocular and muscle artifacts, affecting subsequent data analyses. However, to date, the effects of these artifacts on spectral power across different sleep states have not been quantified. Consequently, the effectiveness of automated artifact-rejection algorithms in minimizing these effects is unknown.

Methods: We obtained standard 10-channel sleep EEG recordings from five subjects and visually scored them for all types of artifacts. To quantify the impact of ocular and muscle artifacts, we compared EEG powers from two groups of data samples devoid of all but ocular artifacts (group I) or muscle artifacts (group II) against EEG powers computed from artifact-free data (based on visual rejection). Then, to quantify the effectiveness of automated algorithms, we applied two previously published algorithms for ocular (Doman’s algorithm) and muscle (Brunner’s algorithm) artifact rejection and compared the post-artifact-rejection powers to the artifact-free powers. We repeated this analysis across different frequency bands and sleep states.

Results: During both rapid eye movement (REM) and non-REM sleep, muscle artifacts (group II) contaminated no more than 5% of the EEG data across all channels, but substantially corrupted the delta, beta, and gamma powers by up to 87%, 209%, and 598%, respectively. While ocular artifacts (group I) were absent in non-REM sleep, they affected up to 15% of the frontal and temporal EEG channels during REM sleep, primarily corrupting the delta powers by up to 48%. For both REM and non-REM sleep, the Doman’s and Brunner’s algorithms restored the powers to within 10% of the artifact-free powers for the majority of EEG channels and frequency bands.

Conclusion: Although artifacts affect a small fraction of EEG data (<15%), they can significantly affect the EEG powers (by up to 600%). The Doman’s and Brunner’s automated artifact-rejection algorithms are very effective in minimizing corruption in EEG activity bands.

Support (If Any): Disclaimer: The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Army or of the U.S. Department of Defense. This abstract has been approved for public release with unlimited distribution.

AN INFORMATICS METHOD TO CLASSIFY AND ANALYZE PRESCRIPTION AND NON-PRESCRIPTION MEDICATIONS FOR SLEEP-RELATED CLINICAL TRIALS

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Introduction: Documenting medication use by patients enrolled in sleep medicine clinical trials is important, but is complicated by...
XII. Instrumentation and Methodology

Conclusion: Preliminary findings from this ongoing study provide evidence that movement of the thigh measured by a single triaxial accelerometer may be used to distinguish components of sleep-wake behavior. A thigh worn device provides some advantages compared to traditional wrist actigraphy used in sleep research because it allows investigators to also measure daytime behaviors (e.g., physical activity, sedentary behavior) that are known to influence human health. Training the algorithm on a larger, more diverse data set may yield a robust method to improve estimates of all components of wake and sleep behaviors.

1052
DISTINGUISHING INSOMNIA FROM NON-INSOMNIA WITH ACTIGRAPH AND SLEEP DIARY PARAMETERS: A QUANTITATIVE APPROACH
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Introduction: Insomnia treatment studies suggest self-reported sleep diaries predict insomnia abatement better than actigraphy in young adults, perhaps due to sleep state misperception or poor actigraphy specificity. Actigraphy has been validated as a diagnostic tool for insomnia in the general adult population, but not yet for young adults. Thus, we compared the ability of sleep diary and actigraphy parameters to predict insomnia diagnosis in young adults. We hypothesized sleep diary sleep onset latency (SOL), wake after sleep onset (WASO), and terminal wakefulness (TWAK) would best discriminate between groups because they capture perceived wake periods.

Methods: We collected one week of sleep diary and actigraphy data from college students with clinical interview-confirmed insomnia (n = 69) or normal sleep (n = 81). Actigraphy data was analyzed with 30-second epochs, low wake threshold, and sleep onset/offset settings of 20 epochs. Pairwise comparisons were made between groups for the following parameters: time in bed, total sleep time (TST), SOL, number of awakenings (NWAK), WASO, sleep efficiency (SE), and TWAK. Receiver operator characteristic curves (ROCC) were calculated to determine the best predictors of insomnia status.

Results: Pairwise comparisons of sleep diary parameters indicated that individuals with insomnia demonstrated greater SOL (Cohen’s d = 1.03), WASO (d = 0.84), TWAK (d = 0.45), NWAK (d = 0.38), and lesser TST (d = 0.82) and SE (d = 1.28) than normal sleepers (all ps < .05). Actigraphy comparisons revealed no differences (all ps > .125). ROC area under the curve (AUC) analysis revealed greatest prediction of insomnia status by sleep diary SOL (AUC = 0.86), SE (AUC = 0.87), and a weighted combination of both (AUC = 0.88).

Conclusion: Sleep diary parameters (particularly SE and SOL) can successfully discriminate insomnia status among college students. However, actigraphy fails to find differences between these groups.

Support (If Any): NIH grant AI085558 NIAID (DJT, KK)
1053
ACTOGRAPHY BASED SLEEP ESTIMATION IN CHILDREN AND ADULTS: A COMPARISON TO POLYSOMNOGRAPHY USING TWO SCORING ALGORITHMS
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Introduction: Actigraphy is increasingly used to provide objective measurements of sleep. Nonetheless, there are limited data that directly assess agreement with polysomnography (PSG) and evaluate alternative scoring algorithms. We assessed the accuracy of sleep-wake-estimation of the ActiGraph GT3X+ using two algorithms contrasting wrist placement to PSG.

Methods: We asked 9 adults and 10 children, aged 10 to 14 years, to wear the actigraph on the wrist over a single night concurrent with in-home full PSG. Total sleep time (TST) and wake after sleep onset (WASO) were independently estimated from actigraphy and PSG. The Cole-Kripke (C-K) algorithm and the Sadeh (S) algorithm were compared in all individuals. Agreement between PSG and GT3X+ was estimated using intra-class correlation coefficients (ICC) and paired t-tests.

Results: Compared to average TST by PSG (435.6 ± 36.9 min), actigraphy TST (C-K) was 447.2 ± 39.4 min (p = 0.53) and TST (S) was 419.2 ± 47.8 min (p = 0.43) in adults. In children, the corresponding average TST was 495.7 ± 56.7 min, 479.6 ± 52.1 min and 448.3 ± 53.8 min, respectively (p = NS). TST measured using the Cole-Kripke algorithm strongly agreed with PSG in children (ICC = 0.88) and adults (ICC = 0.80). The ICC for TST between PSG and actigraphy (S) was slightly lower (ICC = 0.77 in children and ICC = 0.64 in adults). We found poor agreement between actigraphy and PSG WASO (C-K: ICC = 0.00 in children and ICC = 0.10 in adults; S: ICC = 0.01 in children and ICC = 0.00 in adults).

Conclusion: The GT3X+ wrist actigraph provides good estimates of TST but not WASO both in children and adults with a trend toward stronger agreement using the Cole-Kripke algorithm.

Support (If Any): Max Kade Postdoctoral Research Exchange Grant, Max Kade Foundation, NY; Year 4 Within-Center Developmental Award, National Cancer Institute Centers for Transdisciplinary Research on Energetics and Cancer (TREC) (U54CA155626).

1054
LONGITUDINAL ANALYSIS OF SLEEP DURATION USING ACTIGRAHY AND SLEEP DIARY: STABILITY AND AGREEMENT OVER 8-11 MONTHS
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Introduction: Prospective sleep evaluation using a sleep diary and actigraphy are optimal for in-home data collection over time. Unlike polysomnography (PSG), these measures can be used to assess typical sleep habits over more than just a few nights. However, not much is known about the longitudinal reliability of these measures over months as typical use of these measures spans 1-2 weeks. Therefore, there exists a need to examine the stability and agreement of these measures over time.

Methods: Actigraphy and sleep diary data from community-dwelling individuals, ages 25-50, were obtained (n = 20). Sixteen participants were adherent to the study protocol for ≥ 70% of nights across the 1-year time period. Data were examined relative to the temporal consistency of both sleep measures, as well as fluctuations in subjective-objective disagreement.

Results: Mean sleep duration across all participants was 480.33 minutes (SD = 80.35) for sleep diary and 436.46 minutes (SD = 74.76) for actigraphy. Mean days recorded was 276.38 days (range 228-326). Bland-Altman plots revealed good agreement between sleep diary and actigraphy, with a systematic over-reporting of sleep duration in sleep diary (mean difference -42.26 minutes, SD = 65.41). Stability over time was high. When sleep duration from the first 30 days was subtracted from the 30 days of month 8 (to examine consistency across subjects), the mean difference was -1.81 mins for actigraphy and -7.32 mins for diary. Subjective-objective discrepancies were also consistent overall, with a mean of 5.31 fewer minutes of discrepancy at 8 months versus the first 30 days. Further analyses are forthcoming, including signal processing approaches.

Conclusion: Longitudinal agreement of actigraphy and prospective sleep diary measures of total sleep time was highly stable over 8-11 months. The discrepancy between subjective and objective measures remained stable over time. Results suggest that shorter duration assessments (<2-4 weeks) may be sufficient for characterizing typical sleep habits across multiple months.

Support (If Any): Dr. Grandner is supported by K23HL110216. Dr. Perlis is supported by R01AG041783.

1055
A NOVEL METHODOLOGY FOR DETECTING DROWSY DRIVER BASED ON TEMPORAL CHANGES IN HEART RATE VARIABILITY AND BLINKING DURATION
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Introduction: Excessive sleepiness in drivers is a strong risk of traffic accidents. Recently, a compact, three-dimensional analysis of visual information of a face photographed using an infrared CCD camera system has been designed to monitor driver. Heart rate variability is a non-invasive and reliable tool to quantify the autonomic activity in the sympathetic and parasympathetic modulation in humans. We developed a driving support system based on heart rate variability and blinking measurement.

Methods: Twelve young healthy adults were enrolled. Standard polysomnography (PSG) was performed while subjects were in a relaxed sitting position on the driver’s seat of a simulated automobile. The laboratory environment was dark and quiet during testing, and smoking, caffeinated beverages and physical/mental activities were prohibited during the 30 minutes prior to the PSG study. The heart rate variability was assessed with the spectral analysis of RR intervals of the electrocardiogram on PSG. Low-frequency (LF, 0.04-0.15 Hz) and high-frequency (HF, 0.15-0.40 Hz) power were calculated by integrating the power spectral density in defined frequency bands. An eyelid movement tracking system (Anti Sleep, Smart Eye, Göteborg, Sweden) comprising an infrared CCD camera with a single lens and image processing function was used to obtain facial information, such as head position, gaze direction, and eyelid closure in the driving
1056
SLEEP-WAKE ALGORITHM FOR HOLTER MONITORING

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Introduction: There was a suggestion for an automated algorithm for determining periods of sleep and wakefulness according to thorax acceleration and designed for devices with long-term monitoring of the cardiovascular system.

Methods: Simultaneous recording of polysomnography (Natus Embla N7000) and holter monitoring (Kardiotekhnika KT -07-AD-3/12R) with accelerometer in reference electrode placed at thorax during night evaluation of sleep in 14 healthy and 9 patients with obstructive sleep apnea (OSA).

Results: Algorithm allows us to classify periods of record for “Sleep” and “Wake” with accuracy 77.6% and 83.7% in healthy subjects and 70.5% in the OSA patients. Overall sensitivity was 78%, with 86.1% in healthy subjects and 68.9% in OSA patients. Specificity was 80% in healthy subjects, 62.7% in OSA patients and overall 72.1%

Conclusion: Algorithm shows good accuracy in subjects without sleep disorders and may be acceptable in OSA patients. The application of this algorithm in Holter monitoring systems in routine practice will improve the quality of cardiovascular diseases diagnostics for more accurate evaluation of sleep characteristics and also identify sleep disorders.

Support (If Any): Russian Federation President Grant MK.7812.2015-7

1057
UTILITY OF A CONSUMER WEARABLE SLEEP MONITOR FOR SELF-QUANTIFICATION OF SLEEP DURATION


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Introduction: Wearable actigraph technologies are popular in consumer markets for promoting and tracking multiple health behaviors, including sleep. Like clinical actigraphs, these devices use information about movement measured by an accelerometer to estimate parameters of sleep (e.g., duration, timing). The purpose of this study was to assess the performance of the commercially available Misfit Shine (MS) to estimate sleep timing (start and end of sleep) and total sleep duration.

Methods: 10 healthy men and 4 healthy women age 19 thru 37 years (mean 29 ± 10) wore a MS for 4 days and nights and were asked to complete a self-reported (SR) sleep diary daily. Nights when users forgot to report their sleep were eliminated from the analysis. MS sleep timing and duration were compared to self-reported (SR) timing and duration form a sleep diary.

Results: After data cleaning, 50 user nights were recorded. Mean absolute minute difference between MS and SR was 8.7 ± 7.7 and 9.0 ± 10.4 for start and end of sleep time, respectively. For total sleep duration, mean relative absolute difference between MS and SR was 3.5% ± 2.5% and regression analysis revealed a Pearson correlation of 0.97 between the two methods.

Conclusion: These data suggest the MS can be used as an alternative to self-report. The automatic sleep detection algorithm combined with the usability, wearability and relative cost efficiency of consumer devices make them an attractive option compared to self-report and the more expensive clinical actigraphs.
METHODS: Three-hundred and sixty-nine apps were initially identified (n = 272 from the Google play store; n = 97 from iTunes) using the term “sleep” in September 2015. The final sample consisted of 35 apps that met the following inclusion criteria: 1) Stand-alone functionality; 2) Sleep tracker or monitor apps ranked by 100+ users; and 3) Sleep Alarm apps ranked by 1000+ users. Only 5 (14%) of the apps included were paid apps. A coding instrument was developed to assess the presence of 19 theoretical constructs in the following four categories: 1) knowledge; 2) cognitive strategies, 3) behavior strategies, 4) emotion-focused strategies, and 5) therapeutic interventions. Two graduate students downloaded and coded 17 apps to evaluate content and reach consensus with coding procedures (IRR = .993). A “1” was assigned if a construct was present in the app and “0” if it was not. Mean scores were calculated across all apps, and comparisons were made between total scores and app ratings using R.

RESULTS: The mean behavior construct scores (BCS) across all apps was 34% (range, 5% to 84%). Behavioral constructs for realistic goal setting (85.7%), time management (77.1%), and self-monitoring (65.7%) were most common. iOS apps (33%) had higher BCS compared to android apps (28%), and a positive association was observed between BCS and user ratings, but neither was found to be statistically significant (p > 0.05).

CONCLUSION: While the overall behavior construct scores were low, an opportunity exists to develop or modify existing apps to support sustainable sleep hygiene practices.

Support (If Any): This work was supported by research funds from the Department of Kinesiology and Community Health at the University of Illinois-Urbana Champaign and the NHLBI Behavioral and Sleep Medicine Program to Increase Diversity among Individuals Engaged in Health-Related Research.

1060 WATCHPAT IS ACCURATE IN THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA IN THE PRESENCE OF ATRIAL FIBRILLATION

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Introduction: The WatchPAT is a Home Sleep Testing (HST) device shown in numerous studies to accurately diagnose sleep-disordered breathing (SDB). It is based on Peripheral Arterial Tone (PAT), pulse rate, oxygen saturation, actigraphy and an optional combined Snoring and Body Position (SBP) probe (composing microphone and 3D accelerometer) placed below the sternal notch. Though identifying SDB, WP200U does not separate central sleep apnea (CSA) from Obstructive Sleep Apnea (OSA). PAT signal usptoke variations that are associated with intra-thoracic pressure changes coupled with respiratory movements derived from the SBP enhanced the WP200U algorithms to enable CSA-OSA differentiation and were validated in CHF patients.

Methods: Thirty two (32) SDB suspected CHF patients (27 males), age 71 ± 9.1 years, BMI 31 ± 4.7 underwent simultaneous in-lab sleep study with polysomnography (PSG) and WP200U (Itamar-Medical, Caesarea, Israel), in 6 sleep centers. PSG scoring was performed by experienced PSG technologists blind to the automatic WP200U data. Results: Average Total Sleep Times (TST) by WP200U and PSG were 06:10 ± 01:12 and 05:59 ± 01:11 respectively. Using a threshold of AHI ≥ 15 the sensitivity, specificity and agreement of WP200U for diagnosing OSA vs. PSG were 0.89, 0.86 and 0.88 respectively and for CSA were 0.83, 0.85 and 0.84 respectively. ROC analysis demonstrated AUC (Area Under the Curve) of 0.89 and 0.93 for OSA and CSA respectively. Pearson correlations, for OSA AHI and CSA AHI, between WP200U and PSG were 0.79, p < 0.001 and 0.92, p < 0.001 respectively. The correlation between CSA derived Cheyne Stokes Breathing percent time and PSG was 0.94, p < 0.001.

Conclusion: These findings support our hypothesis that WatchPAT can accurately detect SDB events in patients with AF, and that AF should not be an exclusion criterion for using this device.

Support (If Any): The study was supported by a non-restrictive grant from Itamar Medical.

1061 WATCH-PAT 200 IS ACCURATE IN THE DIAGNOSIS OF CENTRAL AND OBSTRUCTIVE SLEEP APNEA IN CHF PATIENTS

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Introduction: Watch-PAT (WP200U) is a Home Sleep Testing (HST) device shown in numerous studies to accurately diagnose sleep disordered breathing. It is based on Peripheral Arterial Tone (PAT), pulse rate, oxygen saturation, actigraphy and an optional combined Snoring and Body Position (SBP) probe (composing microphone and 3D accelerometer) placed below the sternal notch. Though identifying SDB, WP200U does not separate central sleep apnea (CSA) from Obstructive Sleep Apnea (OSA). PAT signal usptoke variations that are associated with intra-thoracic pressure changes coupled with respiratory movements derived from the SBP enhanced the WP200U algorithms to enable CSA-OSA differentiation and were validated in CHF patients.

Methods: Thirty two (32) SDB suspected CHF patients (27 males), age 71 ± 9.1 years, BMI 31 ± 4.7 underwent simultaneous in-lab sleep study with polysomnography (PSG) and WP200U (Itamar-Medical, Caesarea, Israel), in 6 sleep centers. PSG scoring was performed by experienced PSG technologists blind to the automatic WP200U data. Results: Average Total Sleep Times (TST) by WP200U and PSG were 06:10 ± 01:12 and 05:59 ± 01:11 respectively. Using a threshold of AHI ≥ 15 the sensitivity, specificity and agreement of WP200U for diagnosing OSA vs. PSG were 0.89, 0.86 and 0.88 respectively and for CSA were 0.83, 0.85 and 0.84 respectively. ROC analysis demonstrated AUC (Area Under the Curve) of 0.89 and 0.93 for OSA and CSA respectively. Pearson correlations, for OSA AHI and CSA AHI, between WP200U and PSG were 0.79, p < 0.001 and 0.92, p < 0.001 respectively. The correlation between CSA derived Cheyne Stokes Breathing percent time and PSG was 0.94, p < 0.001.

Conclusion: These findings support our hypothesis that WatchPAT can accurately detect SDB events in patients with AF, and that AF should not be an exclusion criterion for using this device.

Support (If Any): The study was supported by a non-restrictive grant from Itamar Medical.
1062
NON-INFERIORITY BETWEEN THE OVERALL AND REM-RELATED APNEA-HYPOPNEA INDEXES OBTAINED BY POLYSOMNOGRAPHY AND A FOREHEAD WORN, AUTO-SCORED SYSTEM

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Introduction: The capability to evaluate both sleep structure and sleep disordered breathing (SDB) using a self-applied device worn for multiple nights in the home may benefit researchers in the evaluation of metabolic syndrome, hypertension, diabetes and obesity. This is the first report on the accuracy of a device with such capabilities.

Methods: With IRB approval, 60 patients completed laboratory polysomnography (PSG) while simultaneously wearing a device designed to stage sleep and detect SDB. Seventy-five percent of the studies had sleep times > 3 hrs. The AASM scoring criteria were manually applied by a single technician to the PSG records, with hypopneas based on a 4% oxyhemoglobin desaturation. The Sleep Profiler PSG2 (Advanced brain Monitoring, Carlsbad, CA) acquires EEG, EOG and EMG from three frontopolar sites to stage sleep, airflow with a nasal cannula and pressure transducer, in addition to head movement/position, snoring, and pulse from the forehead, wireless finger oximetry, and thorax and abdomen effort by respiratory induced plethysmography. Auto-staging of the device recordings was derived using a combination of ratios of the power spectral density characteristics, and auto-detection of cortical and micro-arousals, sleep spindles, and oculomotor activity. The airflow signal was used to automate the differentiation of apneas from hypopneas. For this study, the SpO2 signal obtained by PSG was used for the auto-staged calculation of the apnea-hypopnea index (AHI). The REM AHI agreement was applied to records with REM time > 10 min (n = 40).

Results: For the overall AHI, the correlation between the two measures was 0.98 with a Bland-Altman bias of 0.0+/-6.0 events/hr. Applying clinical cutoffs of > = 5, 10, 15 events/hr, sensitivities were 1.00, 0.94, 1.00, specificities were 0.85, 0.96, 0.97, positive predictive values were 0.93, 0.97, 0.96, negative predictive values were 1.00, 0.93, 1.00, positive likelihood ratios were 6.7, 26.3, 33.0, negative likelihood ratios were 0.00, 0.06, 0.00, respectively. For the REM AHI, the correlation between the two measures was 0.95 with a Bland-Altman bias of 2.8+/-7.1 events/hr. Applying clinical cutoffs of > = 5, 10, 15 events/hr, sensitivities were 0.84, 0.93, 0.73, specificities were 0.90, 0.96, 0.96, positive predictive values were 0.89, 0.93, 0.92, negative predictive values were 0.86, 0.96, 0.86, positive likelihood ratios were 8.84, 23.3, 18.3, and negative likelihood ratios were 0.17, 0.07, 0.28, respectively.

Conclusion: During concurrent acquisition, the system with autoscoring does not appear to be inferior to PSG with manual scoring in the assessment of overall and REM-related SDB.
using oronasal masks were randomized and split into either a model
development or validation group. As the name indicates, predictive
models were then created in each model development group and the
accuracy of the models were then tested in the model validation groups.

Results: The correlation between our new oronasal model and labora-
tory determined optimal CPAP was significant, sign = 0.99, p < 0.001. Our
oral formula was also significantly related to laboratory determined
optimal CPAP, sign = 0.35, p < 0.001. The oronasal model created in our
study significantly outperformed the original CPAP predictive model
developed by Hoffstein, z = -0.16, p < 0.90. The best predictors for the oral
mask group were: AHI, lowest SaO2, and neck size. Whereas the best
predictors in the oronasal group were: AHI and lowest SaO2.

Conclusion: Our data show that a predictive model of CPAP that takes
into account mask style can significantly improve the formula’s accu-

1065
THE UTILITY OF THE PITTSBURG SLEEP QUALITY
INDEX IN U.S. MILITARY PERSONNEL
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Introduction: Sleep disturbances are endemic in military personnel.
In the RAND report, Sleep in the Military, 48.6% of participants
had a Pittsburgh Sleep Quality Index (PSQI) > 5 consistent with poor
sleep and indicative of a significant sleep disorder. However, the PSQI
has not been validated in military populations. An appropriate cut-off
could differentiate military personnel with clinical sleep disorders ver-
sus those with sleep disturbances resulting from restricted sleep sched-
ules resulting from duty requirements.

Methods: Observational study of military personnel (N = 179, 33.3 ± 7.9
years) undergoing sleep medicine evaluation. Sleep disorder diagnosed
independently of PSQI after clinical evaluation and polysomnogram.
Participants were classified in the control group (no disorder, or hav-
ing insufficient sleep or primary snoring), and the sleep disorder group
(insomnia or obstructive sleep apnea).

Results: The average total sleep time was 6.7 ± 1.2 hours with an average
PSQI score was 12.0 ± 4.1. Approximately 93% of the participants
had a PSQI score > 5. Participants with a significant sleep disorder had
a PSQI score 12.3 ± 4.0 versus a PSQI score 10.7 ± 4.3 in those without
(p = 0.055). Sleep onset latency and total sleep time did not differ be-
tween groups (p > 0.70), whereas sleep efficiency was 89.6% ± 9.5% in
the sleep disorder group and 92.5% ± 5.5% in those without (p = 0.079).

Conclusion: Almost the entire sample in our study was identified as
poor sleepers using the current PSQI cut-off. In military personnel a
PSQI score > 5 is not necessarily indicative of a significant sleep dis-
order. Studies assessing the utility of PSQI in military populations are
required to determine an appropriate cut-off score to differentiate good
versus poor sleepers. This could lead to an improved clinical referral
process, differentiating military personnel who would benefit from a
formal sleep evaluation versus those who may respond to education
regarding appropriate sleep practices.

1066
GENERAL ESTIMATING EQUATIONS AS AN ANALYTICAL
APPROACH INTERPRETING SLEEP DIARIES’ DATA OF A
3-MONTH RANDOMIZED TRIAL WITH ZOLPIDEM
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Introduction: Considering large amounts of data collected and lost
with sleep diaries in clinical trials, in some cases the main subjective
outcome, we find critical the use of statistical approaches that deal with
variable distribution and missing values. We sought to describe sleep
diaries analysis with the use of Generalized Estimating Equation.

Methods: In a 3-month and double-dummy trial with five on-site visits,
patients were randomized into the Oral group (n = 33), to receive oral
zolpidem 10 mg for bedtime and sublingual placebo both for bedtime
and ‘as-needed’; or the Sublingual group (n = 34), to receive sublin-
gual zolpidem 5 mg both for bedtime and ‘as-needed’, and oral placebo
for bedtime. Patients underwent medical evaluation and fulfilled dia-
aries during all course of treatment. Equation modelling included sleep
quality (poor or good) as dependent variable, using Poisson distribu-
tion. Predictors were treatment group, middle-of-the-night-awakening,
and use of rescue tablets as factors and age, total sleep time, total time
in bed, and bedtime as covariates.

Results: Of 67 randomized patients (48 ± 10 years), 46 (69%) com-
pleted 92 ± 5 days of treatment. Sixty-six patients fulfilled 4,765
diaries, included in analysis (≈20% are missing due to dropouts or
incompleteness). Good sleep, middle-of-the-night-awakening, and
‘as-needed’ tablets were reported in 62%, 45% and 11% of diaries, res-
pectively. Mean total sleep time, total time in bed, and bedtime were
5.9 ± 1.5h, 7.7 ± 1.6h, and 23.3 ± 1.2h. Overall, good sleep was more
frequent in the Sublingual group, especially in nights without middle-
of-the-night-awakenings (RR: 1.15; 95/CI: 1.02-1.30; p = 0.03). The
use of ‘as-needed’ medication predicted good sleep in the Sublingual
group, while it predicted bad sleep in the Oral group (0.72; 0.63-0.82;

Support (If Any): Associação Fundo Incentivo a Pesquisa-AFIP, EMS
Pharmaceutical Company
1067
USING BIG DATA TO DETERMINE THE SOCIAL AND ENVIRONMENTAL DETERMINANTS OF SLEEP DURATION IN THE US POPULATION: APPLICATION OF A MACHINE-LEARNING APPROACH TO DATA FROM APPROXIMATELY 700,000 AMERICANS

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Introduction: Despite many epidemiologic studies, the complex, non-linear relationships between sleep duration and social-environmental determinants have not been sufficiently modeled.

Methods: Stochastic Gradient Boosted Modeling (GBM) was employed, using N = 354,394 from the 2013 CDC Behavioral Risk Factor Surveillance System (BRFSS) as a training sample and N = 341,342 from the 2014 BRFSS as a validation sample. Sleep duration was assessed using the item: “On average, how many hours of sleep do you get in a 24-hour period?” Predictors included: age, sex, race/ethnicity, income, education, employment, marital status, household size, health insurance, sedentary behavior, smoking, depression, body mass index (BMI), alcoholic drinks/day, overall mental health, overall physical health, and census region. GBM is a machine-learning technique for nonlinear modeling of correlated predictors that benefits from large datasets.

Results: The GBM model explained 7.1% of the variance of sleep duration in the 2013 data, attenuated by only 1.4% in the 2014 data. This outperformed a linear regression model, which explained 2.3% less. All of the predictors were influential in predicting sleep duration, with relative influences (in order) of 13.7% (mental health), 12.8% (employment), 11.5% (age), 9.8% (BMI), 8.9% (census region), 8.2% (income), 6.8% (race/ethnicity), 5.2% (education), 4.9% (physical health), 4.3% (marital status), 3.9% (alcohol), 3.4% (household size), 3.0% (smoking), 1.2% depression, 1.0% (sex), 0.8% (exercise), and 0.7% (insurance). Briefly, days of both poor mental and physical health and household size showed robust negative associations. Employed, Multiracial/Other, Asian, divorced, depressed, male, and active individuals had the least amounts of sleep. There were non-linear, U-shaped relationships between sleep and age, education, and income. Sleep duration was lowest in the mid-Atlantic region.

Conclusion: Sleep duration is related to many factors, though these relationships are complex and often non-linear. This approach was able to uncover patterns and explain additional variance otherwise missed by traditional linear models.

1068
ROLE OF CONSUMER WEARABLE SLEEP MONITORING TECHNOLOGY IN GLOBAL EPIDEMIOLOGIC INVESTIGATIONS

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Introduction: Historically epidemiologic data about global sleep patterns has largely been gathered through surveys, such as the National Sleep Foundation (NSF) Bedroom Poll of 2013, in which 250 participants in each of six countries were interviewed about their sleep habits. Recently there has been a proliferation of wearable consumer devices, including the Misfit physical activity and sleep monitors, which are sold in more than thirty countries, their mobile applications have been translated into more than fifteen languages, and their performance has been compared to polysomnography, actigraphy, and sleep journals. The purpose of this study was to compare the results of aggregate data collected by consumer wearables with data from large scale surveillance research.

Methods: De-identified data from consumer physical activity and sleep monitors were gathered from approximately 35,000 nights of sleep from individuals in the six countries where sleep data had been collected by the NSF poll (Canada, Germany, Japan, Mexico, the United Kingdom, and the United States).

Results: Mean difference, and mean absolute difference, between the consumer devices and NSF average weekday nightly sleep duration, for the six countries was 0.55% and 4.2%, respectively. Important trends observed in the NSF poll were confirmed by the consumer device data, including, for example, that average nightly sleep duration in Japan was significantly shorter than that in Germany (with a difference of 39 minutes in the NSF data, 50 minutes in the consumer device data).

Conclusion: These data suggest that consumer wearable devices offer promising tools for monitoring of global sleep trends, allowing the objective measurement of global sleep trends at a scale never before possible.
1070 EXAMINING THE RELATIONSHIP BETWEEN INSOMNIA SEVERITY AND DEPRESSION SYMPTOMS, CONSIDERING THE ROLE OF SOCIAL CONNECTEDNESS

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Introduction: There is growing evidence suggesting relationships between depression and insomnia symptoms, yet scant evidence indicating directionality of those relationships or potential mediators. Evidence also suggests that social connectedness is a vital, protective factor for depression. Social connectedness may hold promise for helping sleep scientists better understand relationships between disrupted sleep and depression symptomology.

Methods: The current study drew on social network analysis, an under-explored approach in sleep medicine, and survey methods to examine social connections, insomnia severity, and depression symptoms. Participants (n = 38) were 44.7% female, with an average age of 56.7 years; 86.8% of the participants self-identified as black. Bivariate correlations and logistic regression were performed to examine relationships between social connectedness, insomnia severity, and depression symptoms.

Results: Of the sample, 71.1% reported insomnia and 23.7% reported depression. Participants provided responses to social network items across kin (m = 2.8 people), non-kin (m = 2.4 people), and formal networks (m = 1.6 people). Case by case agreement was strong between kin network size and depression symptomology (chi square < .05), but not between kin network and insomnia (chi square = .658). The logistic regression in the current study showed individuals with depressive symptoms were 6.75 (95% CI 1.45-31.47, p < 0.05) times more likely to have severe insomnia versus individuals without clinically significant depression symptoms. There was no significant relationship in the regression between network variables and insomnia or depression symptoms.

Conclusion: Our findings are consistent with previous findings and evidence on a strong, positive relationship between depression symptomology and insomnia severity. However, they are not in line with literature suggesting a positive relationship between kin networks and depression symptomology. It is of interest to explore the causal relationship between social connectedness and sleep, and how social networks might serve as a protective (or risk) factor for insomnia, and maybe depression.

Support (If Any): This work was supported by funding from NIH (UL1TR000038).

1071 TAILORED BEHAVIORAL INTERVENTION AMONG BLACKS WITH SLEEP APNEA AND METABOLIC SYNDROME: RESULTS OF THE METSO TRIAL

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Introduction: Poor adherence to evaluation and treatment of obstructive sleep apnea (OSA) is a public health challenge. Despite higher prevalence of OSA, blacks are less likely to adhere to physician-recommended OSA care than are whites.

Methods: Among black patients with metabolic syndrome, we compared, in an RCT, effectiveness of a telephone-delivered culturally and linguistically tailored OSA health messages over 6 months (Intervention) versus standard patient education (Control) in improving adherence to recommended OSA care. We hypothesized that patients randomized to the intervention arm would exhibit greater adherence to OSA consultation, evaluation, and treatment than those in the control arm. We also evaluated the predictive role of baseline sociodemographics, health risks, comorbidity, and psychosocial factors on adherence status using multivariate-adjusted regression analyses.

Results: 380 patients (mean age = 59yrs; 71%, women) were enrolled with 80% retention rate (intervention = 160 and control = 143). Of the sample, 69.4% of patients exposed to the intervention attended initial consultations, compared with 36.7% of patients in the control arm (p < .001); 74.7% versus 66.7% of patients in the intervention and control arms, respectively, completed diagnostic evaluations (p = 0.46), while 86.4% versus 88.9% in the intervention and control arm, respectively, adhered to OSA treatment. Based on adjusted logistic regression, patients in the intervention arm were 3.17 times (95% CI = 1.68-5.99, p < 0.001) more likely to have initial consultations, relative to controls. Treatment self-efficacy was the strongest predictor of OSA adherence (OR = 1.11, 95% CI = 1.03-1.20, p < 0.01). Adjusted models revealed no significant differences between the two arms regarding adherence to OSA evaluation and treatment.

Conclusion: The culturally and linguistically tailored OSA health messages were successful in improving initial consultation for OSA diagnosis. However, once patients were in treatment, there was no difference in OSA adherence rates between the two groups.

Support (If Any): NIMHD (R01MD004113 and R01MD007716)

1072 COMPLIANCE WITH DIAGNOSTIC TESTING AND TREATMENT AMONG PATIENTS WITH SUSPECTED AND ESTABLISHED OBSTRUCTIVE SLEEP APNEA IN THE U.S.

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Introduction: Approximately 12 million patients in the US have obstructive sleep apnea (OSA). Untreated OSA has significant clinical and economic implications and is driven to some degree by patient noncompliance with both diagnostic testing (DT) and treatment. Real-world compliance with OSA DT and positive airway pressure treatment (PAPTx) remains under-studied, limited to controlled observations of small populations. This study measured OSA patients’ compliance with DT and PAPTx initiation, and persistence with PAPTx for 9-months. This is the first cross-sectional study to estimate the baseline DT/PAPTx compliance rates in the commercially-insured population.

Methods: We analyzed the pre-authorization database of a national US sleep management program covering 18.5 million lives for 26 plans from 1/1/2013 to 9/30/2014. Linking these data to insurance claims, non-compliance was defined as approved services (DT and/or PAPTx) with no matching claim within the subsequent 3 months. PAPTx discontinuation rates were analyzed at 3 months intervals for patients with sufficient follow-up duration.

Results: Among 61,430 patients approved for DT, 23.9% did not undergo testing. Of 44,474 tested patients approved for PAPTx, 12.1% failed to initiate treatment. Among 39,075 members who initiated PAPTx, cumulative discontinuation at 3, 6 and 9 months was 13.8%, 34.8% and 46.8% respectively. This study estimates that, of every 1,000 OSA patients approved for sleep testing, 761 patients proceed with diagnostic testing, 659 patients initiate treatment, 577 patients stay treated at 3 months, 436 at 6 months, and merely 356 remained treated at 9 months.

Conclusion: This large-scale study evaluated the relative contribution of failure to comply with DT, failure to initiate PAPTx and failure to persist with PAPTx to untreated OSA. Given the clinical and economic implications of OSA, this study highlights the need for future research to identify factors contributing to patient noncompliance, and interventions to enhance compliance.
implications of untreated OSA, this study supports a multifaceted approach to improving OSA management, and highlights the importance of ongoing efforts identifying patient and provider factors likely to increase compliance.

**1073**
CMS PAP ADHERENCE CRITERIA LIMIT TREATMENT OF MANY MEDICARE BENEFICIARIES

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**Introduction:** Centers for Medicare and Medicaid Services (CMS) reimbursement for PAP devices for obstructive sleep apnea (OSA) treatment is dependent on patients meeting adherence expectations within the first three months on therapy. Adherence is defined as usage of the device for at least 4 hours per night on 70% of nights during a consecutive 30-day period. We hypothesize that adherence patterns may be established beyond this initial period, which may limit the opportunity to treat many patients.

**Methods:** Remote Monitoring of Obstructive Sleep Apnea in Military Veterans is a study to examine the impact of continuous wireless monitoring with targeted interventions to improve adherence to PAP and treatment of obstructive sleep apnea. Treatment and adherence data from PAP devices were monitored via wireless modems for forty-two PAP-naïve veterans in this cohort who have completed one year of nightly monitoring. Their baseline characteristics were as follows: age: 58.5 ± 12.5 (SD); BMI: 33.7 ± 5.7; diagnostic AHI (pre-treatment) 28.1 ± 18.5; AHI on PAP: 4.3 ± 3.3. We examined quarterly, semiannual and annual reports, and the best 30-day adherence report for each quarter.

**Results:** In the first 3 months, 19/42 subjects were adherent and 23/42 subjects were not. Of the 19 adherent subjects, 13 (68.4%) remained adherent and 6 (31.6%) became non-adherent or stopped PAP treatment for the remainder of the year. In the 23 initially non-adherent subjects, 16 (69.6%) stopped PAP treatment and 7 subjects (30.4%) became adherent (using CMS criteria) during the rest of the year. Thus, PAP adherence during the first 3 months was predictive for the rest of the year in only 68.4% of patients. PAP non-adherence during the first 3 months was predictive for further non-adherence in only 69.6% of the cases.

**Conclusion:** CMS adherence criteria affecting PAP coverage are restrictive, and can result in the withholding of therapy in many patients who otherwise might become adherent.

**Support (If Any):** ResMed and Respironics

**1074**
IMPACT OF CPAP ON WORK-RELATED OUTCOMES

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**Introduction:** Obstructive sleep apnea (OSA) reduces work productivity through decreased concentration, excessive daytime sleepiness, and other mechanisms. However, the effect of OSA treatment on work outcomes has not been tested. We aimed to test the impact of continuous positive airway pressure (CPAP) on work-related outcomes.

**Methods:** This prospective cohort study included patients with newly diagnosed OSA who were prescribed CPAP and stratified into users (defined as mean use > 4 hours/night) or non-users (defined as mean use < 0.5 hours/night). Data were collected before CPAP and 12 months later, and included the validated Symptoms of Nocturnal Obstruction & Related Events questionnaire (SNORE-25) and covariates. The SNORE-25 includes Occupational Impact and Work Productivity domains, each scored 0-5 where higher is worse. We tested the difference in these work-related outcomes between CPAP users and non-users using multivariate linear regression, adjusting for potential confounders.

**Results:** The cohort (N = 182) was middle-aged (47+/-12 years) with severe OSA (apnea-hypopnea index 33+/-24 events/hour) and borderline excessive daytime sleepiness (Epworth Sleepiness Scale 10+/-5). At 12 months, CPAP users (mean use 6.5+/-1.3 hours/night, N = 72) were improved compared to non-users (mean use 0.0+/-0.0 hours/night, N = 110) on the Occupational Impact domain (0.29, 95%CI -0.01, 0.59, p = 0.06) and Work Productivity domain (0.47, 95%CI 0.04, 0.90, p = 0.03), after adjusting for age, sex, race, apnea-hypopnea index, and the functional comorbidity index.

**Conclusion:** Successful CPAP use appears to improve work-related outcomes. Further study is warranted to test the effects of OSA treatment on specific aspects of work productivity (eg, presenteeism and absenteeism), work engagement, job satisfaction, and their economic impacts.

**Support (If Any):** R01 HL084139 (Weaver) T32 DC000018 (Weaver)

**1075**
CHARACTERISTICS OF UNANTICIPATED HOSPITAL Admissions AND Readmissions IN CPAP Compliant AND Non-compliant Patients With Obstructive Sleep Apnea

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**Introduction:** Patients with untreated obstructive sleep apnea (OSA) have higher healthcare utilization costs than matched controls. In this study, we aim to improve the understanding of unanticipated hospitalizations in OSA patients by comparing characteristics of unplanned admissions, unplanned 30-day readmissions, and overall length of hospital stay between CPAP compliant and non-compliant patients.

**Methods:** A retrospective cohort study of OSA patients (ICD-9 code 780.57) from a single Veterans Affairs hospital was performed. Patients who were admitted from 2007 to 2015 and had CPAP compliance data from card download within 12 months prior to initial admission were included. Planned procedures were excluded. Compliance was defined as CPAP usage greater or equal to 4 hours per night on at least 70% of nights. Unpaired t-test and adjusted odds ratio were used to compare characteristics between CPAP compliant and non-compliant groups.

**Results:** Out of 2,077 records reviewed, 350 patients (185 compliant and 165 non-compliant) met our inclusion criteria. The compliant and non-compliant groups had an average AHI of 49.75 ± 31.1/h and 46.55 ± 43.4/h, respectively. There were no significant differences between baseline demographics, co-morbidities, and medication compliance between the two groups. The compliant group had a total of 211 unanticipated initial admissions, of which 30.9% were cardiovascular-cause (13 were due to myocardial infarct, 13 due to hypertensive crisis/emergency, 16 due to arrhythmia, 7 due to peripheral vascular disease, and 5 due to acute congestive heart failure). The non-compliant group had a total of 269 unanticipated initial admissions, of which 32.3% were cardiovascular-cause (32 due to myocardial infarct, 25 due to arrhythmia, 13 due to congestive heart failure, 11 due to peripheral vascular disease, and 4 due to hypertensive crisis/emergency). Thirty-day readmission rate was higher in the non-compliant group for both all-cause readmissions (adjusted OR of 4.05, 95% CI = 2.33-7.03, p = 0.001) and cardiac-cause readmissions (adjusted OR of 2.99, 95% CI = 1.43-6.23, p = 0.004). Mean length of stay for the non-compliant group was 4.62 ± 1.2 days compared to 4.22 ± 1.6 days in the compliant group.

**Conclusion:** CPAP non-compliance is associated with increased unanticipated hospital admissions, 30-day readmissions, and length of...
stay. Non-compliant patients also have a higher risk of cardiovascular-related readmissions. Cardiovascular-related admissions account for a high proportion of unplanned admissions in both groups.

1076
CPAP ADHERENCE IN AN EHR-INTEGRATED VIRTUAL CARE PATHWAY FOR SLEEP APEA
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Introduction: During sustained therapy for sleep apnea, CPAP has a track record of suboptimal adherence and high abandonment rates. This report examines 6-month CPAP adherence in a in a health care system employing wireless data transfer incorporated with EHR-integration and structured virtual care.

Methods: Over a 2-year period, EHR-integration of wireless transfer of discrete CPAP data was embedded in an end-to-end virtual care pathway for the purpose of optimizing quality and efficiency of care. Ninety percent of patients initiated on CPAP were enrolled by choice or payer coverage into this strategy. The virtual pathway includes coaching for patients not achieving a specified list of 6 subjective and 3 objective benchmarks. All patients identifying CPAP as primary therapy were included in adherence calculations. Patients choosing alternative therapy for management of sleep apnea were not included. Metrics include average AHI on therapy for the first 30 days of use and average measures over the entire 180 days including minutes of use and % of patient using CPAP = 4 hours.

Results: 2,240 sequentially-enrolled patients (63% male) had a median age of 51 years (range 6-91) and an average BMI of 36.3 +/- 8.1. The average use of CPAP at 180 days was 303.1 +/- 140.6 minutes and monthly population average for 30-day compliance (> = 4 hours for 70% of nights) ranged between 61% and 75% during 2 years of population monitoring. Baseline AHI was 40.6 +/-32.1 (N = 1,485), and dropped to 3.4 +/- 3.7 (N = 1,818) in the first 30 days of use.

Conclusion: EHR integration employing wireless transfer of CPAP data and incorporated within a structured virtual care pathway is associated with effective management and high adherence at 6 months.

Support (If Any): University of Minnesota Health

1077
CPAP UTILIZATION DEVELOPMENT FROM DIRECTED LEARNING, EDUCATION AND SUPERVISION (CUDDLES) STUDY
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Introduction: A significant portion of patients diagnosed with OSA do not comply with PAP treatment. Compliance has been defined as using PAP for 4 hours per night, and Medicare has chosen 70% patient compliance as a goal for PAP coverage. The primary objective was to determine whether a simple, novel email educational intervention would improve compliance.

Methods: CUDDLES was a randomized, prospective PAP compliance study designed to examine the effect of an email-based intervention on PAP compliance. Bi-weekly emails focusing on encouragement and PAP education were sent for the first 3 months of PAP use. The following variables were examined in terms of control/intervention groups: average daily PAP use, percentage of days PAP was used, and whether the patient met certain benchmarks for average usage time and frequency.

Results: The analysis included valid data from 229 patients. 121 were randomly assigned to the intervention group, and 108 were assigned to be controls. Overall compliance was defined by meeting both benchmarks of ≥ 4 hours PAP use per night and ≥ 70% of nights with PAP use. 44.5% of all patients were compliant, with control cohort compliance at 36.1% and intervention cohort compliance at 52.1% (chi square = 5.881, p = .015). Mean hours of PAP use were intervention at 5.53 and control at 5.27 (sig. 2 tailed: .193). Mean percentages of days using more than 4 hours of PAP were intervention - 54.207% and control - 46.140% (sig. 2-tailed: .134)

Conclusion: Patients who participated in the simple, novel email intervention had higher compliance with PAP use. Given that the trend in percentage of days of PAP use was more significant than that of average PAP usage time, it is likely that significance lies with increasing the number of days used, and not the actual time per day.

1078
EFFICACY OF INPATIENT DIAGNOSIS OF SLEEP DISORDERED BREATHING AND BARRIERS TO OUTPATIENT FOLLOW-UP
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Introduction: The empiric diagnosis and treatment of sleep disordered breathing (SDB) among hospitalized patients is limited despite prevalence rates approaching 80% in whom suspicion is high enough for polysomnography (PSG) referral. Inpatient sleep screens (HST) could hasten SDB diagnosis however high comorbidities and unstable health states are considered HST contraindications. The role and reliability of HST among inpatients remains unknown. We reviewed our inpatient sleep screen program for prevalence of SDB, device failure and outpatient sleep care.

Methods: Inpatients ≥ 18 years-old who underwent HST type III sleep screens (ARES device) from 2009 to 2015 were included for analysis. Prevalence of SDB (AHI ≥ 5), device failures, referral diagnosis (ICD-9 codes) and frequency of scheduled outpatient PSG were evaluated. Pearson correlation was analyzed for sleep screen vs. PSG AHI. Frequency of outpatient PSG completion and reasons for follow-up failure were evaluated.

Results: 749 inpatients met inclusion criteria, 36 (4.8%) were study failures. AHI ≥ 5 was reported in 510 HST’s (71%). Mean HST AHI was 20 events/hr (20.8 ± 21.1). Referring diagnosis were mainly OSA (73%) and hypoxia (10.3%). Out of 749, 194 (26%) were scheduled for outpatient PSG, 80% of whom had an HST AHI ≥ 5. Among the PSG-scheduled group, 112 (57%) successfully completed a PSG. Significant moderate correlation between PSG and sleep screen AHI was observed (r = 0.51, p < 0.001). Reasons for PSG not done (n = 82) were reported in 90.3%; patient cancelled (n = 45, 54.9%), no show (n = 36, 43.9%), refusal (n = 6, 7.3%), sickness (n = 6, 7.3%), no insurance approval (n = 3, 3.7%), transportation difficulties (n = 2, 2.4%).

Conclusion: Despite multiple medical comorbidities, inpatient type III sleep screening is feasible, reliably predicts SDB and could potentially reduce time to SDB diagnosis and effective treatment, in addition to prioritizing early referral for laboratory-based PSG. However, significant barriers exist for integrating inpatient and outpatient diagnosis, treatment and follow-up.
STOP-BANG DOES NOT PREDICT BRONCHOSCOPY COMPLICATIONS DURING MODERATE CONSCIOUS SEDATION

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Introduction: STOP-Bang ≥ 3 is a known risk factor for adverse outcomes during deep sedation but not conscious-sedation endoscopy. We assessed associations of STOP-Bang score with short-term complications during bronchoscopy under moderate conscious sedation.

Methods: A cohort (n = 77) of consecutive patients (median age 65 (IQR 55-73) with STOP-Bang score ≥ 3 in 43 (56%) and mean BMI 26.0 ± 6.1) undergoing flexible bronchoscopy under moderate conscious sedation at a tertiary medical center were prospectively assessed with the STOP-Bang questionnaire July-November 2015. Participant demographics, body mass index (BMI), procedural medications, and procedural duration were recorded. Participants were assessed for peri-procedural complications based on the respiratory composite score composed of hypoxemia (SpO2 < 85%), bradypnea, and use of mask oxygen, bag mask ventilation, jaw lift/chin tilt, nasal/oral airway, and naloxone. The overall complication composite score additionally includes procedural hypotension or hypertension or an increase in level of care. Logistic regressions were performed adjusting for procedure duration and history of disease (pulmonary, cardiac, renal, and neuromuscular) and baseline use of opioids or benzodiazepines.

Results: In unadjusted or adjusted analyses, there was no association between STOP-Bang score and respiratory (OR = 1.12, p = 0.23 and OR = 1.14, p = 0.23, respectively) or overall complications (OR = 1.12, p = 0.31 and OR = 1.10, p = 0.43, respectively). However, bronchoscopy duration was found to have a significant association with overall complications (OR = 1.01, p = 0.02) in unadjusted analyses which became stronger after multivariable adjustment (OR = 1.01, p = 0.01); procedure length was significantly associated with hypotension, hypertension, and increase in level of care in unadjusted (p = 0.003) and adjusted analyses (p = 0.002). Bronchoscopy length does not have a significant interaction with procedural medications.

Conclusion: This study found no association between STOP-Bang score and peri-procedural bronchoscopy complications. The association between bronchoscopy duration and overall complications was primarily driven by peri-procedural hypotension and hypertension and increases in level of care.

IMPACT OF INTERACTIVE WEB-BASED EDUCATION AND AUTOMATED FEEDBACK PROGRAM ON CPAP ADHERENCE FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Improving continuous positive airway pressure (CPAP) adherence remains challenging. We evaluated the impact of two telemedicine mechanisms on 90-day CPAP usage after initiating therapy: 1) OSA web-based educational program (Emmi Solutions); 2) automated follow-up (U-Sleep; ResMed Corp) providing individualized feedback via text/email/phone based on CPAP usage.

Methods: Study was a 4-arm randomized controlled trial. Patients referred to the Kaiser Permanente Fontana Sleep Center for suspected OSA were enrolled if appropriate for home sleep apnea testing; if indi-

cated, CPAP was ordered with wireless modem. Patients were randomized into: 1) Traditional pathway (usual care); 2) Education pathway (usual care + web education); 3) Auto-Feedback pathway (usual care + Automated follow-up); 4) Both pathway (usual care + web education and automated follow-up). Objective/subjective data were collected at 3 months.

Results: 1,873 patients were enrolled. After accounting for “no-shows”, those without OSA or choosing non-CPAP therapies, 556 were prescribed CPAP. There were no substantial differences in baseline characteristics between groups (demographics, BMI, Epworth Sleepiness Scale, FOSQ10, self-reported sleep times). 90-day compliance (Medicare) was: Traditional 53.5%; Education 60.7%; Auto-Feedback 65.6%; Both 73.2%. Significant differences were seen between each Auto-Feedback group vs Traditional (p < 0.05) but not between Education vs Traditional (p = 0.21). Auto-Feedback (both groups compiled) showed 21% improvement in compliance compared to non-Feedback (compliance rates 70% vs 58%; p < 0.01); no significant difference was seen between Education versus non-Education (66% vs 59%; p = 0.09). Auto-Feedback vs non-Auto-Feedback subgroup analyses: 1) improved compliance was seen in moderate/severe (72% vs 57%; p < 0.01) but not mild OSA (64% vs 59%; p = 0.53); 2) Auto-Feedback also reduced the drop in CPAP use from 1st to 2nd month (7.7% vs 16.0% reduction in “days used”; p = 0.01). Subsequent reduction was similar between groups.

Conclusion: Automated telemonitoring follow-up platform, but not web-education, improved 90-day CPAP compliance; impact was primarily seen in moderate/severe OSA. Clinicaltrials.gov Identifier: NCT02279901

THE IMPACT OF LIVING ENVIRONMENT STABILITY ON POSITIVE AIRWAY PRESSURE ADHERENCE

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Introduction: Poor adherence undermines the effectiveness of positive airway pressure (PAP) therapy for sleep apnea. Disparities exist in PAP adherence by race and neighborhood socioeconomic status (SES), but the etiology of these differences is not understood. This study investigated home environmental factors as potential barriers to PAP adherence and explored if they differed by SES.

Methods: Adult sleep apnea patients who had been prescribed PAP were recruited at clinic visits to complete a short survey addressing living environment stability, bedtime partners, home safety and comfort, and educational attainment. Medical records were abstracted for demographic data, sleep apnea severity, comorbidities, and PAP adherence. Analysis was performed using multivariate linear and logistic regression with testing for effect modification by SES factors.

Results: The patients sampled (n = 119) were diverse, with 41% non-White and 34% uninsured/Medicaid. After adjusting for age, sex, race/ethnicity, insurance, neighborhood of residence, education, marital status, obesity and comorbidities, subjects who changed the location where they slept at least once per month (18%, n = 21) averaged 88 (standard deviation 42) fewer minutes of PAP use per night (p = 0.04) and had 73% lower odds (p = 0.04) of meeting PAP adherence criteria (> 4 hrs/night > 70% of nights). Living environment stability was the only home environment factor surveyed associated with PAP adherence. The association did not differ by SES or demographic factors. Of the SES markers, only education was significantly associated with PAP usage, with high school degree or less associated with 96 (SD 43) fewer minutes of PAP use (p = 0.03) in adjusted models.
Conclusion: Living environment stability, independent of SES, may impact PAP adherence and therefore potentially sleep apnea treatment outcomes. This finding has implications for physician-patient dialogue and inclusion of portability considerations in PAP device selection. Prospective investigation is needed to confirm this finding and inform design of potential interventions.

Support (If Any): University of Washington Medical Student Research Training Program

1082 TAILORED APPROACH TO SLEEP HEALTH EDUCATION (TASHE): A COMMUNITY-ENGAGED, MULTIPLE-STAKEHOLDER-INFORMED PROJECT TO PROMOTE AWARENESS OF SLEEP APNEA AMONG BLACKS

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Introduction: Health intervention is successful when messages are culturally and linguistically tailored to a specific population. The current study utilized a comprehensive approach involving multiple stakeholders to develop tailored health messages to promote awareness of sleep apnea among Blacks.

Methods: We engaged several stakeholders (community-based organizations, patients, and healthcare providers) to develop and implement an online sleep educational intervention. First round of focus groups were conducted with participants (N = 35; 71% Female, 100% Black, average age 45.2 years). Next, community leaders from churches, barbershops, and other organizations (N = 8, 75% Female, 87% Black, average age 48.1 years). Finally, interviews were conducted with healthcare providers (N = 6, 16% Female, 83% White, average age 51.2 years). All data collection was focused on barriers to awareness, diagnosis and treatment of sleep apnea. This paper presents results of the qualitative analysis conducted to inform the design of this community-engaged, linguistically and culturally tailored online sleep education program.

Results: Analysis illuminated key barriers preventing sleep apnea awareness, including 1) low knowledge about the connection between daytime somnolence and associated sleep difficulties, 2) embarrassment about snoring and sleep apnea, and 3) inadequate healthcare access for effective treatments. The educational tool was designed using evidence-based approaches to diagnosis and treatment of sleep apnea, while acknowledging the primary themes identified in the focus groups. The tool was then refined with feedback from stakeholders (community members, sleep medicine doctors, and health communication experts. The TASHE resource included four key components, 1) tailored, population-appropriate reading level, 2) evidence-based tips and suggestions for sleep health and sleep apnea, 3) partnership with community-based organizations, and 4) cultural context.

Conclusion: A conceptual model for tailored interventions in sleep medicine has been developed and implemented based on the principles of community-engaged research to ensure acceptability of tailored health messages and sustainability of the online sleep apnea educational program. The model developed can be used to structure the design and implementation of community-based, tailored sleep education programs that aim to promote sleep health at the population level.

Support (If Any): This work was supported by funding from the NHLBI (R25HL116378).

1083 PERCEIVED EFFECTIVENESS, SELF-EFFICACY, AND SOCIAL SUPPORT FOR ORAL APPLIANCE THERAPY AMONG PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Oral appliances (OA) are increasingly prescribed as therapy for obstructive sleep apnea (OSA). Value-expectancy and other social psychological theories suggest that adherence to oral appliance therapy (OAT) may be influenced by patients’ perceived effectiveness of the therapy, self-efficacy, and availability of social support. We examined these perceptions among older veterans prescribed OAT.

Methods: As part of a larger study of OSA therapy among older veterans, we mailed surveys to patients aged ≥ 65 years who had been prescribed OAT over the prior 36 months at a Veterans Affairs medical center. We examined frequencies for items assessing perceived benefits (e.g., How effective do you believe regular use of your sleep dental appliance is in managing your sleep apnea? self-efficacy (e.g., I am confident I will use my dental sleep appliance regularly even if I do not feel like using it), and social support (e.g., I will get the help I need to use my dental sleep appliance nightly).

Results: Thirty-nine individuals responded (response rate 32%; mean age 74.6 [SD 23.6] years; 100% male). Thirty-one percent of the sample perceived regular use of OAT to be extremely or very effective in managing OSA; 31% strongly or slightly agreed that they felt confident about using OA regularly; 33% strongly or slightly agreed that there are people in their life who will support their use of OA; and 31% strongly or slightly agreed healthcare staff will help them use their OA regularly.

Conclusion: Although OAT is increasingly prescribed for OSA, only about one-third of older veterans perceive it to be an effective treatment, are confident about OA use, or believe they will receive needed support. Future research is needed to better understand veterans’ perceptions so that interventions can be designed to improve OAT adherence.


1084 IMPLEMENTATION OF AASM GUIDELINES FOR OBSTRUCTIVE SLEEP APNEA IN AN URBAN SLEEP MEDICINE GROUP PRACTICE

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Introduction: Obstructive sleep apnea (OSA) increases sleepiness, mortality and morbidity. Recently published AASM guidelines provide a framework to assess and improve OSA management in healthcare systems. The author analyzed baseline adherence to OSA guidelines at a university-based sleep medicine practice.

Methods: Retrospective chart analysis. Index cases were 30 consecutive OSA patients having polysomnography (PSG) at 4 University Hospitals sleep laboratories, 122 patients in total, from October 2014-15. Data included demographics, PSG, positive airway pressure (PAP) usage, sleep clinic visits before the index PSG, and after PAP data.
B. Clinical Sleep Science

1085 OUTCOMES OF A SCREENING PROGRAM FOR OBSTRUCTIVE SLEEP APNEA AT AN ON-SITE CLINIC FOR A LARGE U.S. EMPLOYER

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Introduction: We evaluated an on-site obstructive sleep apnea (OSA) screening program at a large U.S. employer.

Methods: Over 17 months, most patients seen during routine and urgent care visits at an on-site clinic for a large U.S. employer were screened for OSA by a family practice physician.

Results: 100 patients were identified as at risk for OSA based on clinical impression. All patients at risk were offered a sleep medicine evaluation. 63 patients declined this referral. Of these, 57.1% were males, 61.9% had hypertension, 20.6% had diabetes mellitus, and 79.4% had obesity. 37 patients agreed to see a sleep medicine physician. Of these, 10 (38.5%) had mild, 5 (19.2%) had moderate, and 7 (26.9%) had severe OSA. The sleep study was non-diagnostic in 4 (15.4%) patients.

Conclusion: This study demonstrates that primary care providers can identify patients at risk for OSA at on-site workplace clinics. Patients with OSA are approximately twice as likely to have workplace accidents as employees without OSA, making screening for OSA in the workplace important. For those whose sleep studies were available, 85% of patients referred for consultation from this workplace clinic, were diagnosed with OSA. Performing such screenings at on-site clinics for employees may lead to improvements in workplace safety and a secondary reduction in health care costs. Unfortunately in this population, many patients who were felt to be at risk for OSA declined further evaluation. The reason for this is unclear and further research is needed.

1086 DEMOGRAPHICS AND DIAGNOSIS EXPERIENCE OF PEOPLE WITH NARCOLEPSY: FIRST WAVE RESULTS FROM THE NEXUS NARCOLEPSY REGISTRY

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Introduction: The Nexus Narcolepsy Registry is a web-based registry of patient-reported data launched in June 2015. The database contains demographic, diagnosis experience, symptom, treatment, employment and productivity, quality of life and daily functioning data. This report presents the first wave results on narcolepsy diagnosis experience.

Methods: All adults who report ever having been diagnosed with narcolepsy by a physician are eligible, and may enroll via a secure web-based interface. Participants are required to sign an on-line consent indicating that they are ≥ 18 years of age, are willing to respond to the questions over time (every six months), and are willing to share their de-identified data as part of an aggregated dataset. The registry was approved by a central institutional review board (IRB).

Results: As of 11/1/2015, 473 participants had registered and completed the full questionnaire. Participants had a mean age of 40, and had been diagnosed with narcolepsy on average 9 years before enrollment. 87% were female and 96% were white. All regions of the US were well represented. 55% reported being married or living as married, while 28% were single and 16% were separated or divorced. 53% had at least a bachelor’s degree, 57% were employed full or part-time and 66% had commercial health insurance. The mean age of symptom onset was 19 years; mean age at first physician consultation for problems associated with narcolepsy was 27; and mean age at diagnosis was 31, for an average total diagnosis delay of 12 years. 93% reported having been diagnosed with narcolepsy by a neurologist or sleep specialist and 95% reported having had a Multiple Sleep Latency Test (MSLT).

Conclusion: Data from a new and on-going narcolepsy registry suggest that people with narcolepsy on average first experience symptoms in their late teenage years and can go undiagnosed for over a decade.

Support (If Any): This registry was supported by Jazz Pharmaceuticals, Inc.

1087 THE EFFECT OF ONLINE CASE-BASED CONTINUING EDUCATION ON PHYSICIAN KNOWLEDGE AND COMPETENCE FOR THE MANAGEMENT OF NARCOLEPSY COMORBID WITH PSYCHIATRIC ILLNESS

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Introduction: Narcolepsy is a primary disorder of the central nervous system resulting in unexpectedly falling asleep at any time. This condition remains underrecognized and the relationship with psychiatric disorders can make narcolepsy difficult to diagnose. We sought to determine if an online, case-based continuing medical education program could improve the ability of neurologists and psychiatrists to manage narcolepsy comorbid with psychiatric illness.

Methods: The educational impact of the program was assessed using responses from neurologists and psychiatrists who participated in the
educational intervention. The activity presented 2 patient scenarios with 4 knowledge questions and 6 clinical decision questions. Tailored feedback was provided based on potential consequences of each learners' clinical decisions. A paired 2-tailed t-test assessed differences in mean pre-assessment versus post-assessment scores for the knowledge questions. Educational effect size was calculated using Cohen's d and P < .05 was considered significant.

Results: Baseline assessment indicated that neurologists and psychiatrists had a wide range of knowledge and clinical competency regarding the diagnosis and management of narcolepsy comorbid with psychiatric illness (correct responses: 24%-71%, neurologist; 27%-69% psychiatrist). After receiving tailored feedback, clinical competency improved 17%-47% among neurologists (d = 0.56; medium effect size) and 18%-49% among psychiatrists (d = 0.64; medium effect size). There was significant improvement in knowledge among both neurologists (90%; P < 0.05) and psychiatrists (47%; P < 0.05) on the psychiatric disorder most commonly associated with narcolepsy. The educational activity did not change knowledge of mechanisms responsible for type 1 narcolepsy, the sleep disorder most commonly associated with ADHD, and environmental narcolepsy triggers for both groups.

Conclusion: Online scenario-based education that requires clinical decision-making was successful in improving or reinforcing the knowledge and clinical competence of neurologists and psychiatrists regarding the diagnosis and management of narcolepsy comorbid with psychiatric illness. Future education should continue to address the clinical factors involved in the recognition and diagnosis of narcolepsy.

Support (If Any): The educational intervention and outcomes measurement were funded through an independent educational grant from Jazz Pharmaceuticals.

1089
FUNCTIONING, PRODUCTIVITY AND HEALTH-RELATED QUALITY OF LIFE (HRQOL) IN PEOPLE WITH NARCOLEPSY: FIRST WAVE RESULTS FROM THE NEXUS NARCOLEPSY REGISTRY

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Introduction: The Nexus Narcolepsy Registry is a web-based registry of patient-reported data launched in June 2015 and contains demographic, diagnosis experience, symptom, treatment, employment, productivity, and HRQoL data. This report presents first wave results on functioning, productivity and QoL.

Methods: The registry was approved by a central institutional review board (IRB). All adults who report ever having been diagnosed with narcolepsy by a physician are eligible, may enroll via a secure web-based interface, and are required to sign an on-line consent form. As part of the full questionnaire, participants complete the Functional Outcomes of Sleep Questionnaire 10 item version (FOSQ-10), the Work Productivity and Activity Impairment Questionnaire: Specific Health Problem v2.0 (WPAI-SHP), and the RAND 36-Item Health Survey (SF-36).

Results: As of 11/1/2015, 473 participants had registered and completed the full questionnaire. 70% reported currently taking medication(s) for narcolepsy. The mean Epworth Sleepiness Scale (ESS) score at registration was 15.5, with 38.9% currently experiencing excessive daytime sleepiness (EDS) without cataplexy and 57.5% reporting cataplexy. The mean FOSQ-10 score was 10.9, with the highest optimal score on the scale being 20. Of the 29% who were unemployed, two-thirds attributed leaving their job to narcolepsy. Those working for pay reported missing an average of 7.7 hours of work in the past week and an average 47.8% productivity impairment while at work due to narcolepsy ("presenteeism"). The entire sample reported an average 63.4% impairment in regular daily activities other than work. Mean QoL scores, based on the RAND SF-36 were 40.1 for the Physical Component Summary score and 37.6 for the Mental Component Summary score, compared to a mean population-based norm of 50 on each (standard deviation 10).

Conclusion: In a new narcolepsy registry, participants report substantial impact on functioning, productivity and QoL related to their condition.

Support (If Any): This registry was supported by Jazz Pharmaceuticals, Inc.

1089
USE AND UTILITY OF THE SWISS NARCOLEPSY SCALE (SNS): RESULTS FROM A CLINICIAN SURVEY

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Introduction: The Swiss Narcolepsy Scale (SNS) is a 5-question (3 on excessive daytime sleepiness, 2 on cataplexy) patient-response questionnaire designed to enhance physician screening for narcolepsy type 1 (with cataplexy) in clinical practice.

Methods: Online market research surveys were conducted among physicians (sleep specialists, pulmonologists, PCPs, neurologists, psychiatrists) at two time points, April-May 2015 (group one; N = 202) and Oct-Nov 2015 (group two; N = 200), to monitor change in SNS awareness, use, and perception; 48 physicians participated in both surveys. Inclusion criteria included spending ≥ 75% of time in patient care, and treating ≥ 30 sleep disorder patients/month and ≥ 2 narcolepsy patients/month. Survey questions covered knowledge and use of the SNS and how it impacts clinical diagnosis.

Results: Physicians averaged 15.5 years in clinical practice with ≥ 95% of their time seeing patients. Overall awareness of the SNS was 22% (group one) and 34% (group two). Among physicians who were aware of the SNS and took both surveys, SNS use was 15% (group one) and 27% (group two). Physicians who use the SNS reported 60% of patients screened led to a narcolepsy diagnosis (29% for narcolepsy type 1 with cataplexy). The percentage of physicians who consider using the SNS was high in both groups one and two (86% and 94%). More than half of group two users of the SNS confirm its reliability (51%) and rated its value for screening narcolepsy type 1 with cataplexy (60%) as “agree/ strongly agree”.

Conclusion: While awareness and use of the SNS has increased, it still remains low. However, clinicians who have used this screening tool reported high utility for identification of patients who should be evaluated for narcolepsy. The SNS is specifically designed for narcolepsy type 1 with cataplexy and may help facilitate its diagnosis and recognition.

Support (If Any): This market research was conducted by Jazz Pharmaceuticals.
B. Clinical Sleep Science

1090
A QUALITATIVE STUDY ON THE MULTIDISCIPLINARY TRAINING IN SLEEP MEDICINE FELLOWSHIPS IN THE UNITED STATES
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Introduction: Little is known about the number of physicians from each sleep medicine sub-specialty involved in the training of sleep medicine fellows. It is also unknown if training programs with multidisciplinary faculty provide more comprehensive training as opposed to sleep training by a single specialty. The current study will use qualitative methods to explore the current state of training in sleep medicine fellowship programs in the United States

Methods: To assess the participation of various specialties in the training of sleep medicine trainees, we first researched the Accreditation Council for Graduate Medical Education (ACGME) database and individual sleep medicine fellowship program websites. Second we interviewed fellowship directors and graduated sleep fellows. To understand current training and identify gaps, we used semi-structured interviews to explore their perceptions of the multidisciplinary representation in sleep medicine fellowship training until thematic saturation was achieved.

Results: Of the 83 fellowship programs listed on the ACGME website, 76 programs had individual websites. The program director’s specialties were identified: 42 were pulmonologists, 22 neurologists, 5 internists, 4 psychiatrists, and 3 pediatricians. The faculty sub-specialties across programs included: pulmonary 51.3% neurology 21.1%, psychiatry 6.6%, Internal Medicine 6.3%, pediatric pulmonary 3.6%, Otolaryngology 2.7%, psychology 2.4%, and other specialties 6.1%. 54% of the programs had 1-2 specialties represented while 46% of the programs had ≥ 3 specialties represented. Qualitative interviews up to date have shown a consensus that multidisciplinary participation in sleep fellowship training is beneficial.

Conclusion: Fellowship directors and fellows recognize the importance of multidisciplinary teams in the education of sleep medicine, but currently many specialties are under-represented. Efforts must be implemented to provide a multidisciplinary education in our current sleep fellowship training programs.

1091
LSUHSC-SHREVEPORT NEUROLOGY RESIDENT SLEEP PROJECT
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Introduction: This pilot study aims to determine sleep schedules among LSUHSC-Shreveport neurology residents using a two-day sleep log, correlating sleep with sense of well-being and education satisfaction.

Methods: PGY2 and 3 residents take “24+6” hour calls, every 3+days, with 2-6 calls per month. To minimize interference with the normal education process, we designed a simple survey to distribute during weekly Grand Rounds to obtain information on resident sleep during the preceding two days, call status and PGY level. Well-being and education satisfaction were assessed using a visual analog scale. After IRB review, the surveys were distributed to residents during Grand Rounds for six consecutive weeks. All forms were anonymous and viewed only by a nonclinical staff for analysis.

Results: 37 surveys were included in the analysis. Residents slept 1-5 hours on-call, 7-12 hours post-call, and 3-9 hours when non-call. Sleep was significantly correlated to resident well-being (WB) (r = 0.451; p < 0.01) and education satisfaction (ES) (r = 0.409; p < 0.05) when the amount of sleep two nights before the survey was used for analysis. Means ± SD were 6.8/10 (WB); 7.2/10 (ES) in residents reporting 1-3, 5-8, & 9-12 hours sleep, respectively. Overall mean resident well-being was 6.1/10, and mean education satisfaction was 6.8/10. PGY2s had lower sense of well-being, but higher education satisfaction.

Conclusion: Our study revealed a correlation between sleep and well-being. In a post-study feedback session with residents, potential sleep issues were identified and interventions formulated to improve residency experience. Our survey may be applied to other programs. Because considerable variation exists in residency experience across specialties, programs may find it helpful to obtain baseline resident sleep information as this may be associated with sense of well-being and satisfaction with education or other aspects of training.

XIII. Health Care Services, Research and Education

1092
HOW SLEEP DISORDER AFFECTS EDUCATIONAL ACHIEVEMENT IN STUDENT GROUPS
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Introduction: This research has shown the important of sleep on student’s educational achievements. The aim of this study was to determine the rate of sleep effect on educational achievement in student groups and probable difference of sleep disorder between two genders.

Methods: 120 (cases) students in three grades (third and fifth in primary school and second in junior high schools) were selected in clinic. All 120 students (both genders) participated in the sleep study. In order to analyze the social skill and family preferences, forms were given out to the students. Among the students a group accepted to perform the method completely, some did the assignment fairly, while the rest refused it.

Results: Results showed meaningful differences in sleep behavior of student groups in terms of their educational achievements.

Conclusion: The highest educational achievement was observed in the accepted group, while the least was observed in the rejected. Results also showed meaningful differences (p < 0.05), between the gender’s sleep disorder for their educational achievements.

1093
SLEEP QUALITY AND ITS ASSOCIATION WITH COGNITIVE DIFFICULTIES AMONG RESIDENT PHYSICIANS IN PUNJAB, PAKISTAN
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Introduction: Extended work hours during medical training can lead to poor sleep quality which can impair cognitive performance. Although previous studies have assessed sleep quality among resident physicians, the relationship between sleep quality and cognitive difficulties in Pakistan has not been explored.

Methods: Sleep quality was measured by the Pittsburgh Sleep Quality Index (PSQI) and cognitive difficulties were assessed by the Cognitive Difficulties Scale (CDS) in 268 residents (47% females) in four teaching hospitals of Punjab. The sub-scales of CDS were: attention-
concentration and language (C1), praxis (C2), delayed recall (C3), orientation for persons (C4), temporal orientation (C5) and prospective memory (C6). Data was analyzed using SPSS (V22). Spearman correlation coefficient was determined between variables of PSQI and CDS. P value < 0.05 was considered as significant.

Results: Forty-eight percent of the sample had poor sleep quality: 61.1% of females and 36.6% of males had global PSQI score > 5. All the sub-scales of CDS were significantly correlated with global PSQI score: C1 (r = 0.325), C2 (r = 0.264), C3 (r = 0.173), C4 (r = 0.230), C5 (r = 0.186) and C6 (r = 0.257).

Conclusion: Almost half of the resident physicians, predominantly females, had poor sleep quality associated with difficulties in execution of different cognitive processes. These findings can help establishing guidelines for assuring better sleep quality among residents which in turn might result in better cognitive functioning.

1094 SLEEP IN PREGNANCY: ADDRESSING THE GAP BETWEEN SCIENCE AND PUBLIC PRACTICE

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Introduction: Sleep is a major determinant in a person’s health; however there are times when poor sleep is ‘expected’ and ‘accepted’. This project explores the disconnect between sleep expert recommendations and the general public’s understanding of the importance of sleep during pregnancy and in the first months post-partum. A search of Medline/PubMed quickly reveals the significant body of scientific knowledge regarding the influences of pregnancy on sleep quality as well as the negative consequences that poor sleep quality and sleep disorders can have on mother and infant outcomes. Yet when speaking with new mothers the most common statement is “yes my sleep is terrible, but that is to be expected, right?” This paper discusses the need to translate the vast body of sleep research into the understanding of the general public about the importance of sleep during and after pregnancy.

Methods: A mixed methods approach was used for this project. A systematic review of the literature was used to ask the question: “What role does sleep play in pregnancy and postpartum?” Next, a convenience sample of pregnant and postpartum (within 1 year) women were asked to tell us about their sleep during and/or after the birth and what, if anything they did about it.

Results: Data collection is ongoing. However, preliminary results suggest that there is in fact a significant gap between the recommendations put forward from sleep researchers regarding the importance of quality sleep during and after pregnancy and the general understanding and application of this information in pregnant and recently delivered mothers.

Conclusion: There is no doubt that in today’s society new mothers are getting less sleep after childbirth which is affecting their health. Our goal as health professionals should focus on ways to decrease the prevalence of this problem through different interventions concentrated on mother and baby.

1095 SLEEP QUALITY AND LIFESTYLE IN A BRAZILIAN POPULATION BASED STUDY (ISACAMP 2014/2015)

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Introduction: Sleeping pattern is an important component of individual’s lifestyle and has profound influence in health and wellbeing. The objective was to analyze the association of sleep quality with sleeping characteristics and problems, demographic variables and health related behaviors.

Methods: It is a population-based cross-sectional study, developed with data from the Campinas Health Survey carried out in 2014/2015 (ISACamp 2014/15) in Campinas, SP. In this study we analyzed data from a representative sample of 1997 individuals 20 years old or more. Sleep quality was self-evaluated and analyzed according to age, gender, sleeping related variables (such as complaints about initiating and maintaining sleep and to be quite full of energy at wake up), leisure time physical activity, alcohol consumption and smoking. Prevalence ratios, crude and adjusted for age and gender, were estimated using Poisson regression and the analyses considered the sample design. The analyses were performed with svy commands of STATA 11.0.

Results: In Campinas, 29.5% of the adult population perceived their sleep as excellent/very good, 43.6% as good, 18.8% as regular and 8.4% as poor/very poor. Among those with poor/very poor sleep, 79.2% have complaints about initiating sleep, 81.6% wake up in the middle of the night and have difficult to sleep again, 51.7% report snore, 12.1% witnessed apnea, 40.2 % napping, 24.1% use sleeping pills and 55.2% almost never feel well-disposed after awaking. The prevalence of leisure time physical activities is significantly lower in poor sleepers (RP = 0.49; 95% CI: 0.33-0.73) and the prevalence of smokers significantly higher (RP = 1.55; 95% CI: 1.17-2.06) among them. Alcohol consumption was not associated with sleep quality in the studied population.

Conclusion: Sleep quality self-evaluated is strongly associated to sleep complaints and characteristics. The association observed between sleep quality with leisure time physical activities and with smoking suggest that strategies for improving sleep quality should consider improving other components of life style.

Support (If Any): FAPESP nº 2012/23324-3 and FAPESP nº 2013/19338-1; CNPq for providing productivity scholarships to M. B.

1096 HARNESSING THE PATIENT VOICE IN BIG DATA: ANALYSIS OF SLEEP-RELATED CHACHA DATA

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Introduction: Sleep insufficiency (lack of time asleep) and poor sleep quality are important public health problems impacting over 70 million persons in the US. Sleep problems are known to be highly predictive of negative health outcomes and increase health care costs. The public are increasingly using Internet-based sites and social media to obtain and discuss health information, such as problems with poor sleep, which has led to the existence of large datasets that contain individual searches for topics such as health concerns. Analysis of this organic data allows for a comparison between existing knowledge of sleep problems that emerge from research with the topics searched via the internet by the public. The purpose of this study will be to describe the frequency and nature of sleep-related questions asked by users of ChaCha, a human-guided question/answer platform.

Methods: A retrospective analysis of anonymous user-generated textual queries submitted to the search engine ChaCha between January 2009 and November 2012 was completed. A total of 1.934 billion questions were examined for the present analyses. A set of perl scripts was used to pull questions that match a seed set of 22 keywords. Those questions were clustered into discoverable subtopics through a word adjacency graph model.

Results: Preliminary results indicate there were 7 million sleep related questions after removing invalid questions and users. Two word
phrases, clustering terms, and major topics will be presented. Minimal demographics of users, time and location of question, and visual mapping of terms will also be presented.

Conclusion: Results from this study will provide geographical timing, location, and specific terms people use to seek answers to regarding sleep in a naturalistic setting. The study will also provide insight on how the public asks questions regarding issues and problems around sleep that can generate patient-centered interventions using more focused language.

Support (If Any): Supported by Center for Enhancing Quality of Life in Chronic Illness at the Indiana University School of Nursing

1097 DETERMINANTS OF SLEEP HEALTH DISCUSSIONS BETWEEN PATIENTS AND PROVIDERS

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Introduction: It is unknown how increased awareness about sleep health has affected the frequency of patient-provider sleep health discussions, which was 30% in 1995 according to a National Sleep Foundation study. Patient factors that promote dialogue are also unknown.

Methods: The Sleep and Healthy Activity Diet Environment and Socialization (SHADES) study asked community-dwelling adults (age 22-60; n = 1007) three questions about patient-provider sleep discussions: 1) had they ever told a provider about trouble sleeping (from the National-Health-and-Nutrition-Examination-Survey [NHANES]), 2) had their provider discussed the importance of regular sleep schedules and 3) had their provider discussed the need to get enough sleep (both from the Sleep-Practices-and-Attitudes-Questionnaire [SPAQ]). Regression models explored responses for association with age, sex, education, race/ethnicity, income, shiftwork, smoking, BMI, overall health, depression (PHQ-9), anxiety (GAD-7), insomnia-severity (ISI), snoring, and sleep duration.

Results: Overall, 36% had discussed sleep problems with their provider (NHANES item). Increased odds were predicted (high-low AOR) by moderate-severe insomnia, mild insomnia, and female-sex (AOR = 6.83-1.73); decreased odds were predicted (low-high AOR) by Asian race/ethnicity, age-range 50-60, and age-range 40-49 (AOR = 0.37-0.50). Overall, 32% endorsed the SPAQ item about providers discussing healthy sleep schedules. Moderate-severe insomnia, multiracial/other-race-ethnicity, Black/African-American (B/AA) race/ethnicity, mild insomnia, some college education, and high BMI predicted higher odds of discussions (AOR = 2.04-1.03); income in quintiles 2, 1, & 3 predicted lower odds (AOR = 0.39-0.52). Overall, 38% endorsed the SPAQ item about providers discussing benefits of enough sleep. Moderate-severe insomnia, B/AA/race/ethnicity, female-sex, anxiety disorder, and high BMI predicted higher odds (AOR = 2.17-1.03); income in quintiles 1, 2, & 3, and anxiety disorder predicted lower odds (AOR = 0.50-0.96).

Conclusion: Over the last 20 years, there has been little change in the proportion of individuals discussing sleep health with providers. Moderate-severe insomnia is overwhelmingly associated with higher odds of patient-provider sleep discussions, thus patient complaints may warrant further insomnia disorder screening. Patients who are older, anxious, and socioeconomically disadvantaged may require additional diligence for discussing sleep.

Support (If Any): The Sleep and Healthy Activity Diet Environment and Socialization (SHADES) study was funded by R21ES022931. Dr. Grandner is also supported by K23HL110216. Dr. Perlis is supported by R01AG041783.

1098 QUALITATIVE LEARNING FOLLOWING SLEEP EDUCATION IN A DOCTOR OF NURSING PRACTICE PROGRAM

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Introduction: Despite concerns regarding sleep disorders that threaten public health and related costs, health providers, particularly nurse practitioners, receive little to no training regarding sleep disorders and sleep health promotion. This work describes qualitative outcomes from a brief training session that can be easily incorporated into a doctor of nursing practice (DNP) program.

Methods: Sleep training was re-engineered from a lay health manual for advanced practice nurses enrolled in a university DNP program. Training explored leading sleep disorders (OSA, snoring, insomnia symptoms, short sleep duration, RLS) and sleep hygiene/stimulus control methods presented in PowerPoint format. Qualitative data were derived from a post-training open-ended question regarding area of greatest learning. Statements were transcribed verbatim, coded, and then categorized into themes.

Results: DNP students (N = 51; ~80% women) were from family, adult, women’s health, psychiatric and pediatric specialties. Of the 51 students, 47 (92.2%) provided 66 mentions for the greatest learning question. Three leading themes emerged: 1) Application to clinical practice (32, or 48.5% of mentions), e.g., “Incorporating sleep assessment into my H and P”; 2) Greater knowledge of sleep disorders (25, or 37.9% of mentions), e.g., “Example of sleep study and oximetry was effective”; and 3) Sleep disorders, lifestyle and chronic disease (9, or 13.6% of mentions), e.g., “Learning the relation between sleep and health as well as the association with many diseases...”.

Conclusion: Comments provided by advanced practice DNP students suggest that this evidence-based training module provides information that educates, informs and, importantly, leads them to incorporate sleep assessment and training into practice. Notably, application to clinical practice was the leading theme that emerged. Given their growing ubiquity in clinical care, DNP-prepared nurse practitioners could become leaders in assessing sleep problems and promote healthy sleep across the lifespan, thereby reducing sleep-associated comorbidities and health care costs.

1099 EFFECT OF ABMS RECOGNITION OF SLEEP MEDICINE IN 2007: A COMPARISON OF PRE AND POST 2007 PUBLICATION TRENDS OF SLEEP MEDICINE RELATED ARTICLES IN HIGH IMPACT MEDICAL JOURNALS

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Introduction: Sleep Medicine is a relatively recently recognized specialty of medicine. Depending on the age sub group, the sleep disorder breathing was prevalent in the community as high as 17%. In 2007 the sleep medicine was included as one of the ABMS (American Board of Medical Specialties) specialties. It would be expected that this recognition would generate interest in sleep medicine through publication of the subject in high impact medical journals We compared pre 2007 (year 2004) and post 2007 (year 2014) publication rates of sleep
B. Clinical Sleep Science

Introduction: Sleep disorders are significantly under-diagnosed and under-treated worldwide. Practitioners’ lack of sleep medicine knowledge is a contributing factor to this public health problem. This global gap in sleep medicine knowledge directly affects practitioners’ ability to recognize and treat sleep disorders. To address this problem, Current Topics in Sleep Medicine from the University of Pennsylvania was developed to offer free online asynchronous sleep medicine content available for CME/CNE credit.

Methods: Traditional lectures were adapted to create 11 initial online modules and included topics such as overview of sleep disorders, sleep deprivation & physiology, OSA, & portable studies. Learners enroll via an online portal available at the Penn CME website, where they review CME course requirements, review the content, take a pre and post-test and activity evaluation, and finally claim credit.

Results: From February 2014-February 2015, there were 4993 total enrollments by 1718 unique users across the 11 courses published during the period. 99% of enrollments found these educational activities at least somewhat relevant to practice needs. On a Likert scale of 1 (not at all) to 5 (completely) enrollments reported an overall average of 4.2 for the activities’ ability to enhance corresponding learning objectives. Demographic data of learners shows that participants are comprised of 15% physicians, 2% nurse practitioners, 2% nurses, 1% physician assistants, and 80% other healthcare professionals. Furthermore, 37 countries are represented with 93% of learners from the United States.

Conclusion: Given the dearth of sleep medicine knowledge worldwide and lack of formal learning opportunities, adaptation of current resources to web-based format can enhance access to educational resources. Next steps include reviewing data from a commitment to change instrument to assess how the learning was applied in practice and identify barriers to application. Future directions could include incorporation of principles of instructional design into sleep medicine e-learning materials.

Support (If Any): This educational initiative has been supported with educational grants from Jazz Pharmaceuticals, Merck Inc., and ResMed Corporation.

XIII. Health Care Services, Research and Education

Support (If Any): This educational initiative has been supported with educational grants from Jazz Pharmaceuticals, Merck Inc., and ResMed Corporation.

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SLEEP RELATED FACTORS ASSOCIATED WITH INDUSTRIAL ACCIDENTS AMONG FACTORY WORKERS: THE EFFECT OF SLEEP HYGIENE EDUCATION INTERVENTION
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Introduction: This study was conducted to investigate the association between industrial accidents and sleep-related parameters in factory workers, and to examine the effectiveness of sleep education intervention for improvement of sleep status.

Methods: Eight hundred factory shift workers were included in the study. A baseline survey was conducted using a self-administered questionnaire in December 2013. The questionnaire included items for evaluation of sleep status (containing PSQI and ESS), sleep-related lifestyle habits, and experience of industrial accidents. In January 2014, workers were selected for a sleep education program that included attendance at a lecture and a take-home leaflet containing information on how to improve their sleep habits. All of the workers then participated in a follow-up survey in March 2014 to investigate the effectiveness of the education program. We first analyzed the association between industrial accidents and sleep status at the time of the baseline survey. Then, using data from the follow-up survey, we examined the effectiveness of sleep education by analyzing the differences in the improvement of sleep disorders and sleep habits between the groups who did and did not receive sleep education.

Results: We detected a significant association between the occurrence of industrial accidents and PSQI scores from the baseline survey. With regard to the effectiveness of the sleep hygiene education intervention, the percentage of early risers increased significantly in the intervention group among the participants less than 40 years of age. Among the participants aged 40 years or older, the percentage of those who did not drink an alcoholic beverage before going to sleep increased significantly in the intervention group.

Conclusion: This cross-sectional study detected a significant association between PSQI score and the occurrence of industrial accidents. In specific age groups, the use of sleep hygiene education intervention achieved significant improvements in some lifestyle habits.

Support (If Any): This work was supported by JSPS KAKENHI Grant Number 25460816.

1102
USING SOCIAL MEDIA TO RECRUIT FOR SLEEP RESEARCH STUDIES
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Introduction: Research has entered an era of conducting large national research studies, including PCORI’s National Patient-Centered...
Research Network, NIH’s Precision Medicine Initiative, and the Department of Veteran Affairs Million Veteran Program. A key feature of these efforts is the utilization of Real World Evidence, both in the form of practice and utilization data from the electronic medical record and patient-reported outcomes from patients. One key challenge is the recruitment and enrollment of patients into these large national studies. A social media media approach was utilized to recruit and enroll patients into a website.

Methods: Separate Google Adwords and Facebook campaigns were used to recruit for potential enrollees to our website. Google Analytics was used to track the effectiveness of the two campaigns.

Results: A Google AdWord campaign resulted in 18,493 hits (i.e., clicks on our webpage), and 17,035 sessions (i.e., some time spent on our website). The number of pages viewed per session was 1.27, and it resulted in 90 new participants signing up (0.5%). A Facebook ad and referral campaign resulted in 15,096 sessions, 2.5 pages viewed per session, and resulted in 336 new participants (2.23%).

Conclusion: The Facebook ad and referral campaign was approximately four times more effective in enrolling new participants than the Google Adwords campaign. Both approaches incurred similar costs for the development and deployment of the campaign. The Facebook campaign utilized referrals from one user to another, which likely explained its higher effectiveness. Future research in this area should explore not only how to initially recruit and enroll, but how to engage participants over time.

1103
MYTHS AND UNFOUNDED BELIEFS ABOUT SLEEP: IMPLICATIONS FOR EDUCATION CAMPAIGN

PROMOTING HEALTHFUL SLEEP
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Introduction: Beliefs can persist despite contradicting scientific evidence (termed myths). Myths relating to sleep can impinge upon healthful sleep practices among people and among populations. Identifying beliefs lacking an evidence base can inform future sleep education initiatives seeking to promote healthful sleep.

Methods: We identified myths about sleep and examined their prevalence in closed-ended surveys. Using a convenience sample of participants from the Food and Brand Lab at Cornell University (n = 175), open-ended responses were collected to the prompt “What questions do you have about sleep? List anything that comes to mind.” Responses were content-analyzed, then joined with a list of results from Internet searches with the terms “Sleep” and “Myth” to generate a set of myth statements. Next, with a larger sample (n = 65; 60%, male; average age = 38yrs; 48%, white) from Amazon Mechanical Turk, prevalence of myths was ascertained by asking participants to mark “True,” “Not true,” or “I’m not sure” to the myth statements.

Results: A “myth” is defined in the current research as a belief held by 30% or more of the sample despite contradicting scientific evidence. From the list of nine myths identified in the open-ended survey and Internet search, the most prevalent myths included 1) “The human body can adapt to needing less than 8 hours of sleep” (69% reported this to be true), 2) “You can make up for lost sleep by sleeping in on weekends” (74% reported this to be true), and 3) “A good sleeper is able to fall asleep in five minutes or less” (46% reported this to be true).

Conclusion: Myths are problematic beliefs for uptake of health behaviors. Sleep myths identified in this study may inform interventions designed to change maladaptive cognition and to promote healthful sleep in the population.

Support (If Any): This work was supported by funding from NIMHD (R01MD007716).

1104
SLEEP CLASS: A SHARED MEDICAL APPOINTMENT TO EDUCATE PATIENTS AND IMPROVE DIAGNOSTIC EFFICIENCY

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Introduction: Veterans who present with sleep disturbance symptoms at STVHCS enter the Sleep Medicine carepath through Sleep Class, a 90-minute educational class and shared medical appointment. Patients are provided information in a group setting regarding common sleep problems, including insomnia and sleep apnea, as well as treatment options. Participants complete a detailed diagnostic questionnaire. AASM-Boarded sleep physicians review each patient’s medical history and questionnaire and formulate an individualized plan for diagnosis and treatment. Assessment options are organized in a diagnostic cascade, including actigraphy, home sleep testing, and attended in-lab polysomnography. Treatment options include follow up in CPAP clinic, sleep clinic, and cognitive behavioral treatment for insomnia (CBT-I).

Methods: Patients completed an anonymous survey following Sleep Class reporting information on their history, symptoms [measured by Insomnia Severity Index (ISI)], and perceptions of the class.

Results: The 216 respondents were mostly male (86.3%), ages 23-89. Patients endorsed high severity of sleep-related impairment as measured by the ISI (79.6% moderately severe to severe insomnia). Patients were stratified into 3 groups: 54.2% no prior sleep-related treatment/assessment, 8.4% prior assessment but no treatment, 37.4% prior assessment and treatment. Veterans reported learning information from this class (76.5% agree or strongly agree) that will likely help improve sleep quality (70.6% agree or strongly agree), regardless of prior assessment/treatment status (all p > 0.07). 87.2% agreed or strongly agreed that they were provided information and guidance on the next step in assessment/treatment of their condition, and 95.7% said that they are likely or very likely to follow up on the recommendations made by the sleep professionals at the time of the class, with 94.3% feeling confident or very confident in their ability to do so.

Conclusion: A large group shared medical appointment format can combine sleep education with diagnostic assessment and optimize the carepath for evaluation and treatment.

1105
PROMOTING SLEEP MEDICINE PROFICIENCY AMONG PRIMARY CARE PROVIDERS: A TELEMEDICINE APPROACH

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Introduction: Many primary care providers practice in regions with limited access to sleep medicine specialists. Given the prevalence of sleep disorders, these providers regularly evaluate and manage sleep complaints. Using video-teleconferencing technology, this Specialty Care Access Network -Extension of Community Healthcare Outcomes (SCAN-ECHO) project provided education (didactic and case review...
to non-specialty U.S. Department of Veterans Affairs’ (VA) Veterans Health Administration (VHA) providers on management of common sleep disorders.

**Methods:** We invited multidisciplinary providers to attend ten one hour sessions on sleep topics including insomnia and sleep apnea. We emailed invitations to participants from pre-existing SCAN-ECHO and VHA integrative medicine training. An online 30-day follow-up evaluation assessed self-reported changes in practice and comfort in specific content areas. We performed a descriptive analysis examining learner demographics and 30-day evaluation responses.

**Results:** A total of 39 learners attended at least one session. The majority of learners practiced in urban settings (74%). Most learners (67%) worked in primary care. Nurse practitioners comprised the majority of learners (26%), followed by registered nurses (21%) and physicians (15%). Fourteen learners (38.5%) completed the 30-day evaluation. More than fifty percent of respondents reported practice change in all nine assessed content areas, with the highest percentage in “patient education about sleep disorders” (79%). The majority of respondents reported improved comfort level in all seven assessed content areas, with the highest percentages in “assessment of sleep complaints,” “sleep apnea evaluation” and “non-pharmacologic management of insomnia” (71% in each area).

**Conclusion:** SCAN-ECHO participants report practice change and an increased level of comfort in sleep medicine content areas addressed in the program. Future evaluation is needed to determine whether this educational method results in objective changes in clinical practice and improved patient access to specialty sleep care.

**Support (If Any):** This material is the result of work supported by resources from the VA Puget Sound Health Care System (Seattle, Washington) and the VA Portland Health Care System (Portland, Oregon). Funding support was provided by the VA Office of Patient Care Services, Specialty Care Services program office and the VA Office of Rural Health. The views expressed here are those of the authors and do not reflect the position or policy of the U.S. Department of Veterans Affairs.

1106

**PREDICTORS OF CHANGE IN A HOSPITAL-BASED EMPLOYEE SLEEP WELLNESS PROGRAM**

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**Introduction:** Poor sleep is associated with a number of deficits in health and well-being, and healthcare providers’ sleep problems have been associated with increased risk to patients and detriments to care. These risks may be mitigated by improving employee sleep, but research on the development, implementation, and outcomes of such programs is limited. Therefore, the purpose of this study was to examine possible factors associated with outcomes on an email-based employee sleep wellness program (The Sleep Smart Program).

**Methods:** Sleep Smart was an eight-week module-based sleep intervention conducted at a large Children’s Hospital through email and online surveys. Participants (n = 847) completed the Insomnia Severity Index (ISI) during both the first and last week of the program, as well as a program evaluation. Analysis utilized linear regression to evaluate whether engagement variables predicted change on the ISI, while ANOVA analysis compared change in scores across initial motivation groups.

**Results:** Overall, each engagement variable (coded 0|1) significantly predicted change in ISI after completion of Sleep Smart (perceived level of effort, β = - .788, se = .276, p = .004; perceived sleep improvement, β = - 1.064, se = .425, p = .013; and initial motivation, β = -1.346, se = .326, p < .001). Change scores between the motivation variables was significant, F(3,714) = 7.13, p < .001. ISI scores improved more when participants were motivated to address their sleep problems (M = -2.779, SD = 4.093) rather than to learn about their sleep (M = -1.843, SD = 3.428), because the program seemed interesting (M = -1.183, SD = 3.719), or to earn wellness points (M = -1.183, SD = 3.245).

**Conclusion:** Results indicate successful outcomes may be partially dependent on perceived engagement with the program and initial motivation to participate. Individuals who initially participated in Sleep Smart to address sleep concerns exhibited greater improvement in scores than those participating for other reasons. Further, effort and perceived improvement appeared associated with positive outcomes. The importance of addressing these factors in development and implementation will be discussed.

1107

**SPECIFIC AREAS OF PRIMARY CARE INTEREST IN SLEEP MEDICINE [CHAPTER DOWNLOAD DATA]**

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**Introduction:** A majority of clinical sleep medicine is provided in the primary care setting. Currently the role of primary care practitioners in the providing of Sleep Medicine services is expanding based on technical and payment considerations. For the Sleep Medicine field, it is becoming increasingly important to assess the particular areas of primary care interest despite the absence of actual data.

**Methods:** The 2nd edition of Primary Sleep Medicine, a sleep medicine text designed and marketed for the primary care physician, was published in 2014. This text includes 31 chapters authored by sleep experts on a wide spectrum of topics. An increasing percentage of this text is being purchased electronically with 4.46% of the electronically purchased chapters purchased as specific chapter downloads. This publisher provided data as to the number of specifically purchased chapter downloads is utilized to indicate areas of primary care interest/ disinterest in sleep medicine topics.

**Results:** Mean #/chapter specific downloads (11.9); std. dev. (9.3). Key: (# /chapter). Areas of highest interest (> 2 std. dev.): Cognitive Behavioral Therapy (CBT) (46); Pharmacologic Treatment of Insomnia (31); Polysomnography (28). (> 1 std. dev.): Circadian disturbance (20). Areas of lowest interest (> 2 std. dev.): Excessive Daytime Sleepiness (EDS) (0); Sleep in Women (1); Sleep and the Esophagus (1); RLS/PLMD (4); The Future of Sleep Medicine (6); Sleep in apnea (6); Central Sleep Apnea (6); Complex Apnea (6); Apnea & Cardiovascular disease (6); Obesity & Obstructive Sleep Apnea (6); Sleep Disorder Breathing in children (7).

**Conclusion:** This real world data as to the actual areas of primary care interest in sleep medicine indicates that the highest areas of primary care interest in Sleep Medicine are in the treatment of insomnia (CBT and medications) with lowest areas of interest: EDS, more complicated apnea presentations, and sleep in specific populations. This data could be utilized in developing future primary care oriented sleep medicine training literature and teaching programs.

**Support (If Any):** Data provided by Springer
MEDICATIONS, ALERTNESS AND SAFETY: A MATTER OF RISK PERCEPTION AND COMMUNICATION BETWEEN PHARMACISTS AND PATIENTS
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Introduction: A core role of the pharmacist is to ensure safe and effective medication use. A number of therapeutic classes can adversely affect alertness which poses safety concerns for the patient when undertaking activities requiring psychomotor vigilance (e.g., driving). Such therapeutic classes can be broadly referred to as Alertness Impairing Medications (AIMs). Standard labelling and counselling protocols have a longstanding history of use in the profession for the provision of AIMs. However, little is known about how pharmacists perceive and/or assign medication-related risks, communicate risk related messages or indeed the impact of current practice in this area on patient safety.

Methods: In-depth semi-structured interviews explored pharmacists’ perceptions of medication-related risks, current medication provision and the feasibility of new practice tools. Interviews were digitally recorded, transcribed verbatim and analysed using ‘Framework Analysis’ to identify emergent themes. In addition, a psychometric risk assessment tool was used to measure pharmacists’ perceptions of the benefits, risks, harms and level of consumer awareness of medication-related risks across seven common psychotropic drug classes.

Results: Synthesis of the qualitative data set of 30 pharmacist interviews revealed three key themes: ‘Safety and Consequences of Alertness Impairing Medications’, ‘Factors that Influence Risk Communication’ and ‘Refining Risk Communication’. Pharmacists were generally aware of the therapeutic classes associated with medication-related risks but were concerned about patients’ level of understanding. While the current reliance on labelling was deemed adequate, pharmacists also highlighted workflow limitations and the need to bring patients’ attention to this resource during the clinical interaction to maximize impact. Concerns were also voiced about inter-individual differences, which could make the precise assignment of risk difficult. Most pharmacists were receptive to the possibility of new risk-assignment clinical tools. Further, the psychometric risk assessment tool also suggests that pharmacists perceived the benefits of AIMs to outweigh their risks and harms with the exception of Hypnotics.

Conclusion: Medication-related risk communication is a complex phenomenon that is largely dictated by patients’ prior experiences and the pharmacists’ practice environment. Extending pharmacists’ clinical knowledge in this therapeutic area and refining clinical resources are key steps towards optimizing safe medication use in patients.

IMPLEMENTING BEHAVIORAL INSOMNIA TREATMENTS: A QUALITATIVE STUDY WITH VETERANS
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Introduction: To increase the viability of integrating behavioral insomnia treatments into primary care settings, it is critical to understand the barriers and facilitators that will impact the success and/or failure of implementing such treatments. While several factors are already known (e.g., insufficient trained providers, lack of knowledge about treatments), many are yet to be identified or not well enough understood to incorporate into implementation efforts.

Methods: A semi-structured, audio-recorded, interview was completed with Veterans with an insomnia complaint. The interview was guided by the Consolidated Framework for Implementation Research (CFIR) to identify key factors in the five CFIR domains that may impact the implementation and integration of behavioral insomnia treatments into primary care. The five CFIR domains were: intervention characteristics, inner settings, outer settings, individuals involved, and the implementation process. In addition to the interview, self-report measures were completed, including: Insomnia Severity Index (ISI), Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), Quick Inventory for Depressive Symptomatology (QIDS), and the PTSD Checklist for DSM-5 (PCL-5). Interviews were transcribed for coding—identifying common themes, concepts, and repeated ideas.

Results: Three male and one female Veteran were interviewed (M age = 63.25, SD = 6.45). Insomnia severity was moderate to severe (M
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ISI = 21, SD = 2.31) and dysfunctional beliefs and attitudes about sleep were moderate (DBAS = 5.36, SD = 1.59); depressive and PTSD symptoms were minimal. The broad themes that emerged were: insomnia problem/complaint; treatment characteristics; delivery of treatment; patient characteristics; and comorbid problems.

**Conclusion:** Preliminary findings identified common themes expressed by each Veteran related to the diagnosis and treatment of insomnia. Future interviews would benefit by asking more detailed questions related to expectations for care, ideal care, as well as comparing and contrasting of models of care that would best meet the needs of Veterans with insomnia. The use of focus groups may help to improve Veteran dialogue and identify additional factors.

**Support (If Any):** Funding for this project was provided by the VISN 4 Mental Illness Research, Education and Clinical Center, VA Pittsburgh Healthcare System. The content is solely the responsibility of the authors and does not represent the views of the Department of Veterans Affairs or the United States Government.

**1111 PATIENT ACCEPTABILITY OF BEHAVIORAL SLEEP MEDICINE REFERRALS IN AN ACADEMIC MEDICAL CENTER**

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**Introduction:** Despite the widespread prevalence of disorders, such as insomnia, which can benefit from behavioral sleep medicine intervention, many academic medical centers struggle to develop appropriate referrals and utilization for this clinical service. One reason for decreased utilization of behavioral sleep medicine may be the barrier of referring patients from traditional sleep medicine or primary care settings to more behaviorally oriented specialists or settings where many clinicians practice in the absence of integrated care. This study aims to provide data on the referral patterns in a large academic medical center for behavioral sleep medicine and the subsequent patient acceptability and follow-up of these referrals.

**Methods:** Data was aggregated on all new behavioral sleep medicine referrals in a large academic medical center’s outpatient psychiatry clinic with a certified behavioral sleep medicine psychologist. In a calendar year, 109 new referrals were originated. Data collection is ongoing and anticipated to result in a doubling of the sample size within 6 months.

**Results:** The majority of the referrals originated from sleep medicine physicians accounting for 76.3% of the total. Primary care contributed to 8% of the referrals, Psychiatry, Neurology, and Pulmonary contributed to 2.7% of the referrals each. 1.8% of the referrals were from another source, while 7.3% were of unknown origin. The most frequent referral reason listed as ‘insomnia’ at 87.3%, while OSA and CPAP desensitization was the next most frequent at 3.6%. Of referred patients, 45.9% accepted the referral, demonstrated by scheduling an appointment with the behavioral sleep medicine psychologist upon phone contact. The average length between referral and appointment time was 42 days.

**Conclusion:** The results indicate that sleep medicine physicians are almost exclusively utilizing behavioral sleep medicine expertise compared to other specialties, despite data to suggest many of the conditions which could benefit from intervention, such as insomnia, are routinely encountered in other departments such as primary care. There is a need for increased education and awareness of behavioral sleep medicine benefits and access for departments outside of sleep medicine in academic medical centers. Further study is indicated on moderators which may determine what contributes to patient acceptability of behavioral sleep medicine referrals, given that less than half of the patients in this study accepted the referral.

**1112 TARGETED BEHAVIORAL INTERVENTIONS IMPROVE DISTURBED SLEEP**


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**Introduction:** Sleep is an established risk factor for cardiovascular disease (CVD). CVD prevention programs are an ideal setting to assess patients for disturbed sleep. For our CVD prevention program, we report the frequency of disturbed sleep and improvement of important outcomes.

**Methods:** At baseline, patients completed validated questionnaires: Berlin Questionnaire for sleep apnea, Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and Stanford Fatigue Scale. After CVD risk assessment by a nurse practitioner, patients attended a healthy lifestyle workshop with didactics on healthy sleep practices, experiential stress reduction, and food demonstration. All patients received personalized lifestyle prescriptions. Patients with abnormal sleep surveys received customized sleep recommendations. Over 12 months, patients were coached on diet, exercise, and stress management. Validated surveys were repeated at graduation. Means and standard deviations provide descriptive statistics. Two sample t-tests measure statistical significance for changes from baseline to graduation.

**Results:** Of 455 consecutive program completers, 59% women, there were 61% white, 31% black, 4% Hispanic, 2% Asian, 2% other. Fiftyone patients (11%) entered the program with previously diagnosed sleep apnea. Screening for sleep apnea was positive in 217 more patients (48%) consequently referred for polysomnography. Of the remaining 187 patients (41%), 58% had poor sleep quality (mean PSQI 7.8 ± 2.8, normal sleeper < 5 points), mean sleep duration 6.6 ± 1.2 hours, ESS 7.3 ± 4.4, and fatigue score 3.4 ± 2.2. Of patients with poor sleep quality (68%), PSQI improved 2.2 points, p < 0.001; 54% improved sleep duration 30 minutes, p = 0.007; 71% improved ESS 3 points, p < 0.001, and 58% improved fatigue 1.2 points, p < 0.001.

**Conclusion:** Our CVD prevention program provides an opportune mechanism to identify sleep disturbances. Nearly 2/3 of our population screens positive for sleep apnea and a majority of the remainder experience poor sleep quality and duration. Targeted interventions for improved sleep are effective and support CVD risk modification.

**Support (If Any):** Funding for this project comes from the Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, Maryland.

**1113 COMPARISON OF TWO CONCEPTUALLY DIFFERENT METHODS FOR TREATING PTSD AND INSOMNIA AMONG CANADIAN MILITARY VETERANS: CBTI VS. MBSR**

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**Introduction:** Insomnia is prevalent in veterans with Post-traumatic Stress Disorder (PTSD), has a significant impact on mental health, and contributes to maintain symptoms of PTSD when left untreated. This pilot study compared two conceptually different methods to treat insomnia among veterans with PTSD: CBT for insomnia (CBTi) versus Mindfulness Based Stress Reduction (MBSR), in order to determine whether MBSR is as effective as CBTi in improving insomnia, PTSD,
anxiety and depressive symptoms in veterans with comorbid PTSD/insomnia.

Methods: Twenty-six (4 female) veterans participated in either a CBTi (n = 19) or MBRS (n = 7) group. All participants were diagnosed with PTSD and insomnia (ISI ≥ 14). Participants completed weekly sleep logs and pre and post-group symptom measures (i.e., PCL-M, PSQI, BAI, BDI-II). Actigraphy data were also collected.

Results: Across both groups, participants reported decreases in symptoms of insomnia (p = .05), anxiety (p = .02), re-experiencing (p = .04) and arousal (p = .01) from baseline to post-group. Between-group differences were non-significant, suggesting that symptoms improved following both treatments. Actigraphy data revealed a trend toward improved post-group sleep efficiency (from 77.8 to 82.2%) and sleep time (from 6.8 to 7.3 hours), although these improvements did not reach statistical significance. Six-month follow-up data are being collected to assess whether subjective symptom improvements endure over time.

Conclusion: This pilot study compared the effectiveness of CBTi vs. MBRS in a sample of Canadian military veterans with comorbid PTSD and insomnia. Improvements were observed in sleep quality and symptoms of PTSD, depression and anxiety in both groups. While CBTi directly targets symptoms of insomnia, MBRS does not directly target insomnia or psychological symptoms. We hypothesize that MBRS decreases physiological hyperarousal, commonly observed in veterans with PTSD, which in turn decreases symptoms. A larger sample and specific measures of arousal are needed to better understand this phenomenon.

1114
THE USE OF A VIRTUAL AGENT TO DIAGNOSING MAJOR DEPRESSIVE DISORDERS IN A SLEEP CLINIC
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Introduction: Major depressive disorder (MDD) is the most frequent psychiatric disorder in patient with sleep disorders. However, MDD is still largely under diagnosed, possibly owing to the duration of clinical interviews necessary to diagnose mood disorders. Embodied conversational agents (ECA) are software-driven virtual humans able to sustain a clinical interview. They could therefore help physicians to screen major chronic diseases like MDD. The aim of this study is to test the validity and acceptability of an ECA to diagnosing MDD in patients with sleep disorders.

Methods: Outpatients were recruited at the Sleep Clinic of Bordeaux University Hospital from November 2014 to June 2015 in a consecutive sample design. Patients have to meet in a random order a psychiatrist and the ECA software. Each conducts a medical interview to diagnosing MDD. They have also to complete the Acceptability E-scale (AES) (to quantify the acceptability of the ECA) and the Beck Depression Inventory BDI II (to quantify depressive symptoms). Validity (sensitivity and specificity) of the ECA diagnostic was compared to the psychiatrist diagnostic considered as the gold standard.

Results: 179 outpatients were recruited (57.5% of females, mean age = 46.5 ± 12.9 years, mean educational level = 13.3 ± 3.0 years, mean BDI-II score = 10.7 ± 9.3). 35 (19.5%) patients were diagnosed with MMD by the psychiatrist. The specificity was high (96%) for the whole sample and sensitivity reached 73% for severe depressive symptoms (BDI II > 28). The acceptability score was high (25.4 ± 4.6 on a scale of 0-30).

Conclusion: Prevalence of MDD in patients with sleep disorder is high. A systematic clinical interview to screen for a diagnostic of comorbid MDD is necessary in sleep clinic. The present study shows that ECA could be very helpful to help sleep doctor in busy clinical practice.

Support (If Any): This project was supported by the grant ANR PHE-NOVIRT (EQUIPEX).

1115
PREDICTORS OF TALKING TO A DOCTOR ABOUT SLEEP PROBLEMS AMONG OLDER VETERANS WITH INSOMNIA
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Introduction: Insomnia, a prevalent condition among older veterans, is a treatable condition. Patient-doctor communication regarding a patient’s insomnia symptoms is one of the first steps in the diagnostic and treatment pathway. The present study examined the proportion of patients, and the factors associated with, reporting talking to a doctor about sleep problems.

Methods: We mailed a questionnaire designed to identify chronic insomnia disorder (based on ICSD-2 criteria) to all patients aged ≥ 60 who had received care at our VA medical center within the prior 18-months. We performed logistic regression analysis in the subset of respondents with insomnia to assess the odds of reporting talking to a doctor about sleep problems, with predictor variables of age, health status (single item self-rated health from Short Form [SF]-36), race, gender, number of daytime insomnia-related symptoms, and duration of sleep problems (> 12 months or 3-12 months).

Results: 4637 veterans responded (response rate of 53.6%), of whom 2444 (52.9%) met criteria for chronic insomnia disorder. 1362 (55.7%) of those with insomnia reported having talked to a doctor about sleep problems. Duration of sleep problems > 12 months (OR 2.09, p < 0.001) and larger number of daytime insomnia-related symptoms (OR 1.14, p < 0.001) were significantly associated with a greater likelihood of reporting talking to a doctor about sleep problems.

Conclusion: Nearly half of older veterans with insomnia did not report talking to a doctor about their sleep problems. The number of daytime symptoms and longer duration of insomnia predicted talking to a doctor about sleep problems, while health status and demographic variables did not. Future research is needed to understand factors that would increase patient engagement with providers about sleep difficulties.

Support (If Any): Veterans Administration Health Services Research and Development Merit Review (IIR 08-295-1), Greater Los Angeles Geriatric Research Education and Clinical Center (GRECC).

1116
INSOMNIA AND HEALTH CARE USE: A NATIONALLY REPRESENTATIVE STUDY
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Introduction: Insomnia is common and associated with comorbidities and poor health outcomes that increase health services utilization. However, national patterns and predictors of health service utilization by adults with insomnia in the United States have not been comprehensively described. Therefore, our aim was to examine relationships between insomnia and health service utilization in a nationally representative sample of adults in the United States.

Methods: We analyzed data from participants ages 18-65+ (n = 33,855) in the 2012 National Health Interview Survey, the principal source of data on the health of the United States population. Participants with
insomnia were identified by self-report of regularly having “insomnia” or “trouble sleeping” during the past year. Participants also reported on health service use in the past year. We used multivariate logistic regression models, controlling for sociodemographics (e.g., age, sex, race/ethnicity, income), and health conditions (e.g., heart disease, chronic pain, mental health disorders, respiratory disease, and diabetes) to test associations between insomnia and three types of health services use: emergency department visits, office-based healthcare visits, and home healthcare visits.

**Results:** Insomnia was reported by 19.2% of participants during the preceding year. Compared to participants without insomnia, those with insomnia had higher rates of ED visits (32.1% vs 16.4%), office-based visits (75.7% vs 59.1%), and home health care visits (4.5% vs 1.8%). After controlling for covariates, adults with insomnia had greater odds of ED visits (OR = 1.48; 95% CI: 1.34-1.63) office visits (OR = 1.25; 95% CI: 1.13-1.37), and home health visits (OR = 1.32; 95% CI: 1.07-1.63) than adults without insomnia.

**Conclusion:** In a nationally representative sample of adults, insomnia symptoms were associated with increased health services utilization. Studies describing the national economic burden associated with insomnia are urgently needed to further support the need for resources directed toward this costly and burdensome health problem.

**Support (If Any):** CBG was supported by National Institutes of Health Ruth L. Kirschstein National Research Service Award Institutional Research Training Grant T32GM086270 (PI: TMP).
C. Case Reports

1117
RAPID-EYE-MOVEMENT SLEEP-PREDOMINANT CENTRAL SLEEP APNEA RELIEVED BY POSITIVE AIRWAY PRESSURE
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Introduction: CSA almost exclusively occurs during NREM sleep. A patient under our care presented with prominent episodes of CSA occurring only during REM sleep, which resolved with sufficient positive airway pressure (PAP). We offer possible neuro-physiological explanation for this case.

Report of Case: An obese 45 year old female presented with snoring, daytime sleepiness and witnessed apneas. Polysomnography demonstrated severe OSA and CSA, worse in REM sleep. AHI 35 and CSA Index 8.5 were noted. Frank central apneic events were seen only in REM sleep. There was no evidence of Cheyne-Stokes respirations. Her only prescription medication was Lisinopril 10 mg. She then underwent a CPAP titration which showed that 12 cm of water resolved her OSA and CSA. This case is unique due to (1) the occurrence of CSA during REM and (2) the observation that sufficient PAP that eliminated the REM predominant CSA. REM normally suppresses physiologic apneas. Hence, two components are needed to produce the sleep-disordered breathing observed in our patient: (1) the emergence of the apneic threshold during REM and (2) a reduction in PaCO2 beneath the apneic threshold. The first component could result from a central disease process. This patient refused MRI, which would likely uncover any neuropathology. The second component could result from a high loop gain (LG). Intermittent hypoaxia associated with OSA can result in a high LG due to long-term facilitation of respiratory controller neurons. Alternatively, systolic heart failure or pulmonary arterial hypertension could also cause elevated LG, but our patient had no evidence of these diseases.

Conclusion: This case represents a rare finding in which CSA occurs during REM and is reversed by PAP. The mechanism remains uncertain, but LG dependent modulation of central respiratory drive which is relieved by sufficient PAP is possible.

1118
PATIENT-VENTILATOR ASYNCHRONY DUE TO AUTO-TRIGGERING BY CARDIAC OSCILLATIONS
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Introduction: Non-invasive ventilation is commonly used for hypercapnic respiratory failure, obstructive sleep apnea and sleep hypoventilation. Poor patient-ventilator interaction can lead to unsuccessful treatment. We report an unusual case of patient-ventilator asynchrony due to auto-triggering secondary to cardiac oscillations during polysomnographic sleep study.

Report of Case: A 54 year old gentleman with a previous bilateral lung transplant for idiopathic pulmonary fibrosis was referred to the sleep disorder center for a sleep study to evaluate bilevel ventilation that was started empirically for hypoventilation. Reviewing his sleep history indicated that there was no daytime hypersomnolence or witnessed apnea. Epworth Sleepiness Scale score was 8. The diagnostic part of his split night polysomnography revealed normal sleep efficiency and AHI was normal at 0.3 events per hour. \( O_2 \) saturation fell to 86% on room air. He was then started on Bilevel Positive Airway Pressure Spontaneous/ Timed (BPAP-ST) for sleep hypoventilation. The patient was generly controlled on the ventilator, with \( O_2 \) saturation of 94% on room air and a transcuateous CO\(_2\) of 48 mmHg. The patient however was noted at times to have a very rapid respiratory rate due to auto-triggering of the Respironics Ventilator from flow fluctuations related to cardiac oscillations. This phenomenon subsequently led to low tidal volumes of 200 ml and hypoventilation. Therefore he was treated with a Resmed Ventilator in order to allow manipulation of the trigger sensitivity. Repeated sleep study on a Resmed Ventilator with trigger sensitivity set to low demonstrated improved patient-ventilator synchrony.

Conclusion: Auto-triggering caused by cardiogenic oscillations has been described in flow-triggered ventilators, and can cause ineffective ventilation. Such asynchrony may compromise ventilation and affect sleep quality leading to daytime hypersomnolence. This phenomenon can be managed effectively by decreasing the sensitivity of the ventilator trigger. Recognizing this phenomenon by the sleep physician may prevent adverse outcomes.

1119
AN UNUSUAL TREATMENT OF RESTLESS LEG SYNDROME
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Introduction: Restless Leg Syndrome (RLS) is a sensorimotor disorder characterized by the urge to move or restlessness that is provoked by rest. The cause remains unknown although studies have supported deficiency of brain iron that might influence dopamine function. We present a case of RLS that responded to non-classical dopaminergic therapy.

Report of Case: A 28 year old male with history of attention-deficit/ hyperactivity disorder (ADHD) and mood disorder presented with the complaints of a creepy-crawly sensation in his legs associated with an urge or move around to relieve this uncomfortable sensation. This occurred mainly upon lying down before going to sleep and had been present since his teen years. It also occurred on prolonged periods of rest while on airplanes and buses. These uncomfortable sensations were relieved if he took a small dose of dextroamphetamine/amphetamine that was prescribed for ADHD, or masturbated at the onset of symptoms. A diagnosis of RLS was made. Ferritin level was normal at 102 ng/ml, and he was started on Ropinirole, a dopamine agonist, 0.25mg one and a half hours before bedtime. He had significant improvement in symptoms at follow-up.

Conclusion: Improvement in symptoms of RLS with masturbation and Amphetamine/Dextroamphetamine may be secondary to increased dopamine levels in the brain that masturbation and sympathomimetics are known to cause. It is also possible that RLS in this patient was a manifestation of underlying ADHD.

1120
SEVERE AORTIC AND MITRAL STENOSIS LEADING TO CHEYNE-STOKES BREATHING-CENTRAL SLEEP
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Introduction: Cheyne-Stokes Breathing-Central Sleep apnea (CSB-CSA) is seen most commonly in congestive heart failure, particularly systolic heart failure. We present a case of CSB-CSA secondary to
severe aortic and mitral stenosis and mild mitral regurgitation with complete resolution following valve replacement.

**Report of Case:** A 57 year old female with a history of hypertension, arthritis, mitral valve regurgitation, moderate mitral valve stenosis and severe aortic stenosis with a valve area of 0.8 cm² presented to our sleep center with the chief complaint of loud snoring, witnessed apneas, and episodes of choking and gasping for air for a few years which had become worse over the past year. She underwent a polysomnography (PSG) with a split night protocol on March 6, 2015. Apnea-hypopnea index 49.7 with a respiratory disturbance index of 54.2 on the baseline portion of the study. Events were a combination of obstructive, central, and mixed events. Central events had a Cheyne-Stokes pattern. CPAP titration eliminated the obstructive events, but the central events persisted despite increasing CPAP pressure. She was subsequently placed on an ASV machine which was successful in eliminating both obstructive and central events. She underwent aortic and mitral valve replacements on June 17, 2015. A repeat polysomnography was performed on September 3, 2015 which showed only obstructive events and no central events. ASV settings were changed to BiPAP for obstructive sleep apnea.

**Conclusion:** There have been a few case reports on CSA in patients with severe aortic stenosis that improved with surgery. Our case is interesting in that she had both aortic and mitral valve disease which we hypothesized contributed low cardiac output with increased circulation time leading to CSB-CSA which resolved with both valve replacements.

### 1121

**TREATING ENURESIS AND OSA WITH CPAP: A CASE SERIES**

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**Introduction:** While the association between enuresis and obstructive sleep apnea (OSA) in children has been widely reported with several large population based studies, enuresis in adults with sleep-disordered breathing remains the subject of case reports. Here we describe four adult patients with OSA and enuresis with both conditions cured by CPAP.

**Report of Case:** There were two males and two females with an average age of 47. All were obese (average BMI 39.5) and three had severe OSA. One had onset of enuresis during childhood, which briefly resolved after tonsillectomy. Another developed enuresis after his untreated OSA worsened from mild to severe. In a third patient with a remote history of multiple strokes, enuresis began after her diagnosis of mild OSA. She was trialed on oxybutynin without effect. The fourth noted onset of enuresis coinciding with CPAP machine malfunction; investigations for other causes of enuresis such as diabetes and prostate disease were negative. All four patients had complete resolution of enuresis with PAP therapy.

**Conclusion:** Although previous reports only describe enuresis in adults with severe OSA, we have found that it can occur even in mild disease. Given the long-term health risks of untreated OSA as well as the potential to cure enuresis with PAP therapy, all adults with enuresis should be screened for OSA. Large population based studies are needed to ascertain the prevalence of enuresis among adults with sleep-disordered breathing as well as better understand the effect of all OSA treatments on enuresis.

### 1122

**CYCLING FEEDING PUMP MIMICKING PERIODIC LEG MOVEMENTS: AN EDUCATIONAL CASE REPORT**

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**Introduction:** Patient-related electrical artifacts can potentially mimic periodic leg movements (PLM) during polysomnography (PSG) recordings and cause clinical confusion. We present an interesting educational case of a feeding pump causing such an artifact.

**Report of Case:** A three-year-old girl with severe developmental delay, intractable seizures, and gastrostomy tube feeding, was referred for a full night video-electroencephalogram (EEG) and PSG study because of frequent oxygen desaturations at home while asleep with concerns for nocturnal seizures and/or sleep-related respiratory events. Her video-EEG showed generalized slowing of the background activity with burst suppression pattern without clinical seizures. Her PSG showed severe sleep apnea without significant hypoxemia nor hypoventilation. Her left and right surface electromyogram (EMG) derivations of the tibialis anterior muscle showed an abnormal electrical activity that was always bilateral, and occurred every 60 seconds with a constant duration of 7 seconds. In addition, the electrical interference was also apparent in some other PSG (chin EMG/cheek belt signals) and EEG montage channels (T3-T5/T5-O1/Cz-Pz).

**Conclusion:** The electrical pattern was an artifact related to On/Off (7s/53s) durations of a cycling feeding pump that was placed in the patient’s bed close to her gastrostomy tube. Although the duration and frequency of occurrence of the artifact were in the accepted range for the duration (0.5-10s) and frequency of occurrence or inter-leg movement interval (IMI: 5-90s) of PLM, these values were too constant to be truly physiological. Moreover, PLM exhibit an intra-individual variability in duration and IMI that is even more pronounced in children than in adults. Sleep clinicians and technologists should be aware of devices like cycling feeding pumps that can generate electrical artifacts mimicking periodic leg movements.

### 1123

**RESTLESS LEG SYNDROME/WILLIS EKBM DISEASE IN A PATIENT WITH C282Y/H63D NEGATIVE HEMOCROMATOSIS**

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**Report of Case:** Approximately one in 200 persons of northern European ancestry have hemochromatosis, of which approximately 90% are attributable to inheritance of two common mutations of the hemochromatosis-associated HFE gene on chromosome 6. We report the case of a 45 year old Caucasian man seen in the Clinical Center for Sleep and Breathing Disorders and diagnosed with restless leg syndrome (Willis Ekboi Disease). He endorsed the common criteria of hypnic kicking, an urge to move his legs at night, and relief of symptoms with moving his legs. He was found by our routine testing for RLS/WED to have a serum ferritin level of 525 ng/ml (normal 30-400). The serum iron level was 69 mcg/dl (normal 59-158), and the transferrin saturation was 43% (normal 20 to 50%). He was negative for the two most common genes for hereditary hemochromatosis C282Y and H63D. A repeat ferritin level was 579 ng/dl. He had taken over the counter multivitamins with iron in the past as treatment for self-diagnosed RES/WED. A brief
course of these over the counter medications had led to symptoms of dysgeusia and fatigue, common symptoms of hemochromatosis, and he had stopped these supplements prior to his initial visit at CCSBD. Our review indicates that restless legs syndrome may be common in patients with hemochromatosis and may be the presenting symptom. The prevalence of RLS/WED in patients with hemochromatosis is unclear as these patients are treated with phlebotomy to goal of a ferritin level of less than 50 mcg/l. This complicates assessments of diagnosed patients as their ferritin levels are iatrogenically decreased. This supports routine iron studies prior to initiation of any iron therapy for RLS/ WED. The true prevalence of RLS/WED in this population demands further study.

1124
OSA AND SICKLE CELL TRAIT: NOT RISK-FREE WHEN FLY-BY-NIGHT
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Introduction: Pediatric patients with sickle cell disease (SCD) have a substantial incidence (10%-41%) of obstructive sleep apnea (OSA). Adenotonsilar hypertrophy, secondary to lymphoid hyperplasia, and reduced upper airway reflex measured by genioglossal muscle activity have been implicated as possible factors. Compared to OSA only, patient with SCD and OSA have worse nocturnal oxygen desaturationi (both desaturation time and nadir SpO2). Untreated OSA has been also linked to cases of cerebrovascular accidents in patients with SCD.ii Data on the prevalence and outcome of OSA in adults with SCD are lacking. We present a case of splenic infarction likely precipitated by OSA at moderate altitude in an adult patient with previously unknown sickle cell trait (SCT).

Report of Case: A 43 year old African-American soldier with severe OSA treated with CPAP, developed severe LUQ pain after a transatlantic flight from Germany for 10 hours (highest pressure altitude of approx. 6500 ft) during which he had several alcoholic beverages and slept several hours without CPAP. His past medical history was pertinent for hypertension and unappreciated SCT. He was admitted to the hospital and was found to have a splenic infarct. Sickle hemoglobin was 38%. His sickle cell crisis was likely secondary to hypoxemia, precipitated by both altitude and obstructive sleep apnea. One day earlier he had flown on military aircraft from Afghanistan without symptoms; he had also previously flown many lengthy flights without difficulty, usually awake or with very short naps (military flights prohibit alcohol).

Conclusion: This case highlights the susceptibility of patients with SCT and untreated OSA to hypoxic episodes which can precipitate sickle cell crisis. We suggest aggressive counseling and treatment of OSA in patients with SCT, especially among populations with a significant prevalence such as those of African ethnicity, in conjunction with reduced Oxygen environments.

1125
TREATMENT OF NON-REM PARASOMNIA WITH MELATONIN
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Introduction: Non-REM parasomnia is a sub-category of sleep disorders that frequently manifest as sleepwalking, night terrors and confusional arousals. It is thought to involve the disinhibition of “basic drive states” such as feeding, sex and aggression that are otherwise inhibited by the prefrontal cortex and can manifest as sleep related eating disorder, and abnormal sexual behaviors (Sexsomnia). Benzodiazepines are best documented and traditionally used for treatment. We describe a case of a 21 year-old-male successfully treated with Melatonin.

Report of Case: A 21 year-old-male was evaluated for one episode when he was awakened by his brother who was hitting him because the patient was fondling him in his sleep. The patient was unaware of this behavior. In addition, there was evidence of other behaviors during sleep, consistent with Non-REM parasomnia episodes, occurring about twice a week. The patient described finding dishes in the living room, texting in his sleep and signs of getting up to urinate at night of which he had no recollection. The patient declined treatment with Clonazepam due to a family history of substance abuse and associated death. He was started on Melatonin 5 mg at night. On the six-week follow-up, patient reported only one episode suggesting sleepwalking, when he found his phone in a different place in the morning.

Conclusion: The literature confirms Clonazepam to be effective in alleviating problematic behaviors of Non-REM parasomnias. However, with the exception of hypnosis, there has been no alternative treatment of Non-REM parasomnias described. Melatonin is currently used as a treatment for REM behavior disorder, but not Non-REM parasomnias. One pediatric case report has suggested that melatonin therapy may be helpful for children with sleepwalking. Our case demonstrates that Melatonin can be used in adults with Non-REM parasomnia, when the treatment with benzodiazepines is not an option.

1126
SUDDEN-ONSET RESTLESS LEG SYMPTOMS SECONDARY TO MULTIFOCAL BRAINSTEM AND UPPER SPINAL CORD LESIONS
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Introduction: Restless legs syndrome (RLS) is frequently secondary to common medical conditions including anemia, renal failure, and pregnancy. Here we report a case of restless legs symptoms occurring in the course of a multifocal central nervous system (CNS) process in the brainstem and upper spinal cord.

Report of Case: A 37 year old female with a history of anxiety, attention deficit disorder and allergic rhinitis noticed acute onset of an urge to move her legs. Within a few days, the patient gradually developed paresthesia circumferentially around her waist that extended to her toes, along with muscle weakness. She subsequently developed urinary retention and was evaluated in the Emergency Department. Magnetic Resonance Imaging demonstrated multifocal lesions in the brainstem and upper spinal cord with a peripheral (leptomeningeal) pattern with enhancement, and corresponding T2 and FLAIR signal abnormality which was suspicious for a demyelinating or inflammatory process. Further workup that included bloodwork, lumbar puncture and PET scan was unremarkable. She was started on steroid infusions on a monthly basis for 6 months. The steroid course improved her muscle weakness and paresthesia, and repeat MRI demonstrated resolution of neurological lesions; however, she continued to complain of leg restlessness that was worse at night. She was subsequently evaluated in the sleep clinic and had an unrewarding physical exam including non-focal neurological evaluation. Overnight polysomnography demonstrated frequent limb movements with PLMS Index of 67/hour. On follow up, she reported gradual (though incomplete) resolution of symptoms, and elected conservative management.

Conclusions: This case highlights the fact that restless legs symptoms can result from lesions in the CNS, particularly in the spinal cord. However, the clinical course of such symptoms does not necessarily coincide with neuroimaging findings.
1127
SPONTANEOUS PNEUMOTHORACES AND SURGICAL TREATMENT IN OBSTRUCTIVE SLEEP APNEA
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Introduction: Spontaneous pneumothoraces is a relatively rare condition believed to be secondary to pulmonary blebs which are prone to rupture with abrupt changes in intrathoracic pressure. Resultant pneumothorax may result in shortness of breath, chest pain and rarely, acute respiratory failure.

Report of Case: EB is a 34 year old male with a history of three spontaneous pneumothoraces during the previous 10 years which required chest tube placements, pleureseosis, lobectomies and blebeotomy. A recent chest CT scan revealed additional blebs on the right lung and a normal left lung. The patient presented to the Sleep Disorders Clinic with history of loud snoring, snort arousals and frequent night-time awakenings. He reported associated non-refreshing sleep, morning headaches and excessive daytime sleepiness. Past medical history was significant for hypertension and diabetes. On physical examination, his BMI was 39 with a neck circumference of 17 inches. He had an elongated uvula, Friedman tongue position 2, 2+ tonsils, deviated nasal septum and turbinate hypertrophy. Muller’s maneuver revealed significant collapse at the soft palate and supraglottis (with a posteriorly positioned epiglottis) without significant base of tongue collapse. Diagnostic polysomnography revealed an AHI of 40.4 and oxygen saturation nadir of 82%. In the interim he was followed by the pulmonary service, who advised against CPAP therapy given his recurrent, spontaneous pneumothoraces and persistent blebs on CT. The patient subsequently underwent UP3 with tinsellectomy, hyoid suspension, nasal septoplasty and turbinate reduction bilaterally. Post-operatively, the patient reported of subjective improvements sleep quality and daytime sleepiness as well as resolution of snoring and morning headaches. A post-operative polysomnogram has been scheduled.

Conclusion: There are many causes of CPAP intolerance, but few true medical contraindications. Recurrent spontaneous pneumothoraces in the presence of persistent pulmonary blebs is one such contraindication to CPAP therapy and surgical treatment of obstructive sleep apnea may be of benefit.

1128
NEW ONSET SLEEP PARALYSIS IN A 13 YEAR OLD GIRL WITH MILDLY ELEVATED SERUM LEVELS OF OXCARBAZEPINE THAT PROMPTLY SUBSIDED WITH DOSE REDUCTION
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Report of Case: Oxcarbazepine is an anticholinergic anticonvulsant drug used primarily in the treatment of epilepsy. Subjective clinical evidence shows that oxcarbazepine induces drowsiness in patients with epilepsy. There have been no prior reports of recurrent sleep paralysis secondary to oxcarbazepine. We report the case of a 13 year old Hispanic girl with five episodes of sleep paralysis while taking high dose oxcarbazepine. She had a history of a left frontal cystic lesion, resected at age one year, with resultant localization-related epilepsy. Although she had a history of about one seizure per year on oxcarbazepine, she experienced an increased number of nocturnal seizures in the last year. An EEG at that time showed frequent interictal left frontal spikes and slow/sharp waves that were activated in sleep. The dose of oxcarbazepine was increased to 34 mg/kg/day with subsequent control of seizures. At this dose she experienced recurrent episodes of early morning awakenings with inability to move her limbs and the feeling of paralysis. These episodes were about 30 seconds in duration. Serum oxcarbazepine levels at that time were elevated at 39 mcg/ml (normal 3-35 mcg/ml). The dose of oxcarbazepine was reduced with complete resolution of sleep paralysis episodes. A subsequent serum oxcarbazepine level was 27 mcg/ml. Oxcarbazepine has been reported to be useful for the management of rapid eye movement behavior disorder (RBD) and insomnia. The pharmacodynamics of oxcarbazepine use in insomnia may be more than simple sedation. The pharmacodynamics for RBD remain unclear. The observed effect in our patient suggests that oxcarbazepine may interact in an agonist fashion with the descending paralytic tracts that cause paralysis in REM sleep. Further studies for efficacy of oxcarbazepine in RBD are warranted.

1129
CHEYNE-STOKES RESPIRATION-CENTRAL SLEEP APNEA IN CONGESTIVE HEART FAILURE RESISTANT TO CPAP THERAPY SUCCESSFULLY TREATED WITH BIPAP THERAPY
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Introduction: Cheyne-Stokes respiration-Central Sleep Apnea (CSR-CSA) is a condition commonly encountered in patients with congestive heart failure (CHF) and is associated with increased risk of mortality. We present a case of CSR-CSA which was resistant to treatment with continuous positive airway pressure (CPAP) but was successfully treated with bilevel positive airway pressure (BiPAP).

Report of Case: An 81 year old male with medical history of systolic congestive heart failure, syncope with subsequent pacemaker placement, atrial fibrillation, and coronary artery disease status post three vessel bypass graft surgery was referred to sleep medicine for observed episodes of sleep apnea with oxygen desaturation. Polysomnography demonstrated severe central sleep apnea (CSA) with apnea-hypopnea index (AHI) of 38. The respiratory pattern was consistent with Cheyne-Stokes Respirations (CSR). The central apneas demonstrated oxygen nadir of 56%, oxygen saturations between events were generally in the 90% range. CPAP was attempted with pressures between 4-17 cm H2O, but central apneas persisted including episodes with Cheyne-Stokes pattern. Due to the ineffectiveness of CPAP in controlling central sleep apneas, BiPAP (in spontaneous mode) was attempted. At pressures of 17/13 cm H2O through 20/13 cm H2O hypopneas persisted in a pattern consistent with Cheyne-Stokes Variant (CSV). At pressures of 21/13 cm H2O through 22/14 cm H2O respirations were more even and oxygen saturations generally remained in the 90% range in NREM sleep. At the pressure of 21/13 the mean saturation was 96% with a residual AHI of 6.5 (NREM AHI of 4). An echocardiogram 27 days after the polysomnogram revealed a left ventricular ejection fraction (LVEF) of 30%.

Conclusion: The use of BiPAP in this patient to treat CSR-CSA proved to be efficacious when CPAP was inadequate. This treatment option may be considered in similar patients, but further research into efficacy and safety of BiPAP in CSR-CSA is warranted.

1130
SLEEP DISORDERED BREATHING IN CHILDREN WITH PRIMARY MITOCHONDRIAL DISORDERS
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Introduction: Primary Mitochondrial Disorders (MD) are heritable spontaneous inborn errors of metabolism in which conversion of sub-
**Introduction:**

The diagnosis of narcolepsy is challenging. It requires a broad differential diagnosis, including sleep-related disorders such as obstructive sleep apnea, central sleep apnea, and periodic limb movements during sleep. Narcolepsy is characterized by excessive daytime sleepiness, cataplexy, hypnagogic hallucinations, and sleep paralysis. It is an underdiagnosed and undertreated condition.

**Case Report:**

A 50-year-old African American male with hypertension presented with a 6-month history of excessive daytime sleepiness, cataplexy, and sleep paralysis. Physical examination revealed mild facial weakness and a recent history of a transient ischemic attack.

**Sleep Study:**

Polysomnography revealed an AHI of 25 events per hour, with 93% of events being Central Sleep Apneas (CSA). The patient had a nadir of 73% oxygen saturation during sleep. MRI brain studies showed mild leukoencephalopathy.

**Conclusion:**

The patient was diagnosed with narcolepsy and obstructive sleep apnea. Treatment included vasoconstrictor nasal sprays, a CPAP machine, and a VNS implant. The patient's symptoms improved significantly with these interventions.

**References:**


Mallampati class 4 oropharynx, mildly enlarged nasal turbinates, and recurrent intermittent pharyngeal spasm consistent with coincidental VNS activations. Direct endoscopic visualization of airway showed intermittent upper airway obstruction occurring during VNS activations at the level of the laryngopharynx. Polysomnography with the VNS turned “off” revealed an AHI of 89.8/hour, which was optimally controlled (residual AHI of 0/hour) with CPAP 10 cm. Polysomnography with VNS turned “on” revealed a lower AHI of 17.1/hour. However, even with higher CPAP pressure of 14 cm sleep apnea remained uncontrolled with a residual AHI of 13.5/hour. No cardiac abnormalities or periodic limb movements were noted on either study. REM sleep constituted 27.8% and 17.1% of total sleep time, with the VNS off and on, respectively. Spontaneous arousal indices were 3.6/hour and 21.7/hour, respectively.

Conclusion: CPAP therapy that controls SDB at baseline may be suboptimal during VNS activations. VNS activations in this patient resulted in a decrease in REM sleep proportion as well as in increased arousals. Recognition of sleep apnea before and after VNS implantation is important as VNS activations may change sleep apnea characteristics and response to CPAP therapy.

1134
INCIDENTAL IDENTIFICATION OF ELECTROGRAPHIC STATUS EPILEPTICUS OF SLEEP (ESES) DURING POLYSOMNOGRAPHY
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Introduction: Electrographic status epilepticus of sleep (ESES) is a rare condition occurring primarily in childhood with a suggested prevalence of 0.2% to 0.5% of childhood epilepsies. ESES is electrographically characterized by nearly continuous subclinical spike-wave discharges during non-REM sleep. Clinical manifestations consist of variable and incompletely characterized neurocognitive symptoms typically consisting of developmental regression or language impairment.

Report of Cases: Two pediatric patients and one young adult patient with known epilepsy but no specific clinical suspicion for ESES underwent polysomnography for assessment of unrefreshing sleep, for evaluation of clinical sleep-related seizures, and for evaluation of abnormal sleep-related movements, respectively. The two pediatric studies were performed with 18-lead electroencephalography (EEG) due to a history of frequent clinical seizures and the adult study was performed using a dedicated parasomnia montage. All three polysomnograms demonstrated subclinical, near-continuous spike wave discharges during non-REM sleep consistent with ESES. One pediatric study additionally demonstrated minimally excessive non-obstructive hypopneas, whereas the other studies did not demonstrate sleep-disordered breathing. No clinical seizures were observed during any of the studies. None of these patients exhibited symptoms typical for ESES such as acquired language disturbance or cognitive decline, and ESES had never been detected during standard daytime EEG studies previously performed for these patients. The incidental identification of ESES during polysomnography led to further neurological investigation in all three cases and trials of ESES-specific seizure treatment in two.

Conclusion: These findings suggest that individuals with clinically evident epilepsy may have concurrent ESES in the absence of obvious symptoms and that polysomnography or nocturnal video EEG monitoring may represent a more effective and clinically pertinent tool for the identification of these cases than standard daytime EEG studies.

1135
CHILDHOOD BRAIN TUMOR RESULTING IN SECONDARY NARCOLEPSY
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Introduction: Pediatric brain tumors account for nearly 20% of all childhood cancers. Prognosis is good with greater than 70% survival rate due to advances in treatment, but can result in sequela. Secondary narcolepsy should be considered in any individual with a history of brain pathology so proper treatment can be initiated in timely fashion.

Report of Case: 21 year old male presents with a complaint of excessive daytime sleepiness. His mother states he unintentionally falls asleep while at school, driving, in concerts, and at other inappropriate times. He sleeps between 8:30 pm and 4:30 am and reports good quality sleep. He takes two one hour long naps during the day that are refreshing. He denies snoring or symptoms of restless leg syndrome. Past medical history is significant for neurofibromatosis type 1, with bilateral optic nerve and chiasmal gliomas that required tumor debulking and ventriculoperitoneal shunt placement at 5 years of age. He was recently diagnosed with panhypopituitarism requiring hormone replacement therapy. He was also hospitalized nine months prior for multiple blackout spells and seizure-like activity and diagnosed with psychogenic non-epileptic seizures. These episodes, exacerbated by stress, would last a few minutes and were accompanied by loss of muscle tone. Work up included an electroencephalogram, tilt-table test, and brain MRI that were normal.

Conclusion: Physical and neurological exam were unremarkable. Polysomnogram was performed with a total sleep time of 434 minutes, apnea-hypopnea index of 0.3 events per hour, and REM latency of 1.5 minutes. Multiple sleep latency test revealed a mean sleep latency of 4 minutes and 12 seconds and sleep-onset REM of 2 minutes. He was diagnosed with secondary narcolepsy with cataplexy and started on stimulant medication with good response. All patients with a history of damage to the hypothalamus and increased daytime sleepiness should be screened for secondary narcolepsy.

1136
NARCOLEPSY AND IMPAIRED FECUNDITY: AN AUTOIMMUNE RELATION?
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Introduction: Sleep quality plays an integral role in one’s health and contributes to long-term cardiovascular and psychiatric disturbances. Little is known about the relationship of disregulated sleep and fecundity. Changes in menstruation and fertility can be partly attributed to autoimmune causes. Recent studies have suggested an autoimmune mediated process linked to narcolepsy causing a loss of orexin neurons.

Report of Case: We present a case of a 33 y/o female with a history of depression, anemia and menstrual irregularities with excessive daytime sleepiness, sleep paralysis and vivid dreams since age 15. Her Epworth sleepiness scale (ESS) was 15. The overnight PSG was normal, AHI 2.5, followed by an MSLT with sleep latency 5.2 minutes and SOREM in 2 of 5 naps. She was diagnosed with narcolepsy without cataplexy. Her narcolepsy symptoms were controlled with naps, caffeine and low dose modafinil due to side effects of other stimulants. For her challenges with conception and irregular cycles with intermenstrual bleeding, she started charting with the Creighton model for Fertility Care. After low dose naltrexone was added for the autoimmune aspect of impaired fecundity, her cycle improved with less intermenstrual bleeding and remarkably reported, “My friends have never seen me so
wide awake.” She went on to quickly achieve a successful pregnancy. However when she moved out of state and did not have access to low dose naltrexone, she subsequently had a series of miscarriages.

**Conclusion:** Both narcolepsy and impaired fecundity can have an autoimmune etiology. Ensuring proper treatment of sleep disorders is expected to enhance a woman’s quality of life and influence her health. Having a heightened awareness for the coexistence of these disorders could be of value. Low dose naltrexone may be a cost effective and safe treatment of both.

1137  
**NASAL TRUMPET FOR TREATMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME**  
Bansal R, Senders C, Nandalike K  
University of California, Davis, CA

**Introduction:** Obstructive sleep apnea syndrome (OSAS) is frequently seen in children with cerebral palsy (CP) and management is often complex. We present a case of a child with CP and severe OSAS treated successfully with use of a nasal trumpet.

**Report of Case:** 13 year old girl with CP, multiple congenital anomalies and global developmental delay presented to sleep clinic for management of OSAS. History was significant for cleft palate repair at age one, at which time she was diagnosed with OSAS, and was recommended to use a nasal trumpet. Her OSAS symptoms progressed and she underwent an adenotonsillectomy and uvulopalatopharyngoplasty at age four. There was improvement in symptoms initially, followed by subsequent worsening and she resumed use of the nasal trumpet. After seeing her in our clinic, we obtained a split night polysomnogram with and without the trumpet. Baseline apnea-hypopnea index (AHI) was 81.7 events/hour and minimum oxygen saturation of 68%, and with the trumpet the AHI was 1.5 events/hour and minimum oxygen saturation of 89% (Figure 1-A). Nasal endoscopy without the trumpet showed crowding and redundant pharyngeal tissue (Figure 1-B). Nasal endoscopy with the trumpet showed the tip of the trumpet just above the epiglottis (Figure 1-C). Patient continues to tolerate nasal trumpet well, and mother is not keen on pursuing other treatment options, such as continuous positive airway pressure (CPAP) therapy or upper airways surgeries.

**Conclusion:** Although the mainstay of therapy for OSAS in is usually adenotonsillectomy, residual OSAS post operatively is more common in children with CP. Other management options such as CPAP and other upper airway surgeries pose significant challenges. Given the low complication rate and ease in use, nasal trumpet, could be considered as a long term treatment in select patients with OSAS who fail or are not candidates of other treatment options.

1138  
**COGNITIVE BEHAVIOR THERAPY FOR RESIDUAL SLEEPINESS IN A CPAP-TREATED OSA PATIENT: A CASE STUDY**  
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**Introduction:** Residual sleepiness with CPAP treatment in OSA patients has become a treatment issue over the past decade. Previous studies on this issue have focused more on physiological aspects of this phenomenon, and rarely addressed possible psychological and behavioral contributing factors. The current study reports a case whose residual sleepiness is associated with cognitive and behavioral factors and responded well to psychological and behavioral intervention.

**Report of Case:** Mr. Lin was a 31-year-old patient with mild OSA (AHI = 5.3) and was treated with CPAP. He was referred for psychological intervention by his primary care physician due to an irregular sleep/wake pattern and in an anxiety state. Mr. Lin complained a lack of energy even after using CPAP (ESS score = 15) and light sleep around 4 am with the CPAP on. The evaluation found that he had a delayed sleep pattern during weekend in addition to irregular sleep/wake schedule. To manage Mr. Lin’s complaint, the therapists introduced sleep restriction in order to increase sleep efficiency and to regulate his sleep pattern. Mr. Lin was also found to be preoccupied with possible detrimental effect of sleep apnea. He also expressed great concern on his experience of unrefreshed napping that he attributed to his sleep apnea. The therapists confronted him by reviewing his PSG report with him and introduced a relaxation training to reduce his anxiety. After four sessions of psychotherapy, Mr. Lin kept a regular sleep schedule, and showed improvement in both sleep efficiency and subjective sleepiness (ESS score = 15 to 7). He also changed his belief and no longer attribute poor napping to his sleep apnea.

**Conclusion:** Residual sleepiness of the CPAP-treated OSA patients may be associated with poor sleep hygiene practices and excessive focus on sleep related issue in some cases. Cognitive behavior therapy could be a treatment of choice for these patients.

1139  
**A CASE OF NARCOLEPSY FOLLOWING HPV VACCINATION**  
Dhokarh R, Ismail K  
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**Introduction:** The development of narcolepsy involves both genetic and environmental factors including the role of some infections and vaccinations. In the past few years an association between the AS03 adjuvanted H1N1 vaccine and development of narcolepsy has been found. We present an interesting case of narcolepsy in a boy following HPV vaccination.

**Report of Case:** A 16-year-old boy presented to the sleep clinic for evaluation of hypersomnia. This was sudden in onset and started after he received the second dose of the HPV vaccine. He had excessive daytime sleepiness with an Epworth score of 24. He had multiple sleep attacks during the day, naps were slightly refreshing and he was sleeping more than 15 hours in a 24-hour period. He had no hallucinations or REM behavior disorders. He did have one episode of sleep paralysis. He also developed abnormal right-sided limb movements followed by weakness. These were also associated with facial drooping on the same side. These episodes were triggered by emotions such as excitement or anger and lasted about 10-15 seconds and at times occurred in clusters. He underwent a brain MRI and EEG, which were both negative for any pathology. These episodes could represent an atypical presentation of cataplexy. He underwent an in-lab sleep study followed by an MSLT. The sleep study ruled out sleep apnea as a cause of hypersomnia. The MSLT was consistent with a diagnosis of narcolepsy with a mean sleep latency of 0.6 seconds and five out of five naps with sleep-onset REM periods.

**Conclusion:** The sudden onset of symptoms and temporal association following the HPV vaccine in this case suggests the possibility of an association. Epidemiologic studies are needed to further explore this.
1140
SEVERELY ABNORMAL SLEEP DISORDERED BREATHING AFTER RESOLUTION OF PAROXYSMAL COUGH IN A 6-WEEK-OLD FULL TERM INFANT WITH PERTUSSIS
Gillett ES, Davidson Ward SL
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Introduction: Pertussis is a vaccine-preventable bacterial respiratory infection transmitted by airborne exposure or direct contact with secretions. Unvaccinated infants are particularly vulnerable to pertussis and often require PICU admission. Disease progression may be atypical, including truncated catarrhal stage and severe paroxysmal stage with apnea and bradycardia but without the classic “whooping” cough. Sometimes apnea is the only symptom. Complications may include pneumonia, pulmonary hypertension, respiratory failure, seizures, encephalopathy, and death. Resolution of oxyhemoglobin desaturations, as monitored by continuous pulse oximetry, is one common discharge criterion. However, the accuracy of pulse oximetry is dependent on sampling rate, and little is known regarding the severity of sleep disordered breathing and sleep-related hypoxemia in infants convalescing from pertussis.

Report of Case: A full term, 3-week-old infant girl presented with coughing associated with perioral cyanosis and post-tussive emesis. Azithromycin was started by her pediatrician just prior to admission. Pertussis PCR from nasopharyngeal aspirate was positive. High flow nasal cannula was required for 4 days. Chest X-ray showed increased interstitial markings and mild hyperinflation. Capillary blood gases showed mild, improving respiratory acidosis. Once weaned to room air, she exhibited persistent intermittent oxyhemoglobin desaturations not associated with cough. Brain MRI was normal. Extended daytime nap polysomnography was completed on hospital day 21. Severe sleep disordered breathing and sleep-related hypoxemia were seen. Central apnea index was 10 events/hour. Obstructive apnea hypopnea index was 60 events/hour. Baseline SpO2 was in the low to mid-90s, but the lowest recorded SpO2 was 54% and the infant spent 27.4% of sleep time with SpO2 < 90%. There was no hypoventilation.

Conclusion: Infants with pertussis may exhibit severe sleep disordered breathing with severe intermittent hypoxemia during the convalescent stage of illness. Standard bedside pulse oximetry may significantly underestimate the severity of sleep-related hypoxemia in these children.

1141
A MULTIDISCIPLINARY APPROACH TO THE MANAGEMENT OF HYPNOTIC DEPENDENCE IN AN ELDERLY PATIENT
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Introduction: Hypnotic dependence is an issue that is increasingly prevalent in the elderly population and frequently plagues sleep medicine patients and practitioners. Although they have proven clinically useful in well-selected patients and scenarios, hypnotics can be exceedingly difficult medications to discontinue when they are found to no longer provide clinical benefit in patients who have developed dependence. The case presented here demonstrates successful weaning of zolpidem via a multidisciplinary approach.

Report of Case: A 71 year-old male with a past medical history significant for memory difficulties, alcohol dependence, depression, suspected transient ischemic attack, and severe obstructive sleep apnea presented to the sleep disorders center complaining of CPAP intolerance secondary to mask claustrophobia. He was referred for CPAP desensitization in the behavioral sleep medicine clinic. Despite making progress in that clinic using conventional methods, the patient obtained a prescription for zolpidem 10 milligrams from his primary care physician. He used the medication to decrease his sleep onset latency while wearing his CPAP mask. Over the next two years, the coordinated effort of the patient’s primary care, sleep medicine, and behavioral sleep medicine teams eventually culminated in the successful weaning and discontinuation of the hypnotic medication. Clinical follow-up, CPAP device data download and repetition study were obtained to optimize the pressure setting. Sleep diaries, prescribed sleep restriction, and frequent cognitive therapy were pursued to address the patient’s perceptions and behaviors pertaining to sleep. At the present time, the patient’s obstructive sleep apnea is effectively treated with CPAP, to which the patient is compliant without the use of hypnotics.

Conclusion: The present case illustrates the successful discontinuation of a hypnotic medication in an elderly patient with obstructive sleep apnea, depression, and a history of alcohol dependence by way of collaboration amongst sleep medicine and behavioral sleep medicine teams.

1142
POSTERIOR REVERSIBLE ENCEPHALOPATHY AS A MANIFESTATION OF ADULT ONSET CONGENITAL CENTRAL HYPOVENTILATION SYNDROME
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Introduction: Congenital central hypoventilation syndrome (CCHS) is a rare syndrome of autonomic dysfunction due to a mutation in the PHOX2B gene. Clinical consequences of apnea or severe hypoventilation can be prevented by adequate ventilatory support.

Report of Case: A 27-year-old female was admitted with a 3-week history of lower extremity edema, fatigue, and hypoxia. She was found to be severely hypercapnic with a PCO2 of 180 mmHg. She became unresponsive and required intubation. Subsequently, she became alert and was extubated to continuous Bi-level 16/6 cm H2O. A baseline polysomnogram revealed an AHI 21.9, Central apnea index 7.4, Oxygen nadir 55%, and transcutaneous CO2 63 mm Hg). Transthoracic echo and right heart catheterization confirmed pulmonary hypertension (PASP 39mmHg). Her clinical presentation was consistent with late-onset CCHS. She was subsequently discharged home with nocturnal Bi-level therapy. The morning after discharge, she was confused and required readmission. Her hospital course was complicated by status epilepticus, breakthrough seizures, confusion, visual field deficits, visual hallucinations, and elevated blood pressure. A brain MRI revealed brain cerebral edema in the occipital left posterior parietal and frontoparietal regions. Lumbar puncture showed elevated protein. Her clinical presentation was believed to be the result of posterior reversible encephalopathy caused by a combination of high blood pressures and hypercapnea. During this hospitalization, she was also successfully treated with Trilogy 100, mode PC/AVAPS, VT 400 mL, rate 12, IPAP max 25 min 10, EPAP 16. A subsequent brain MRI showed improvement in cerebral edema. Genetic testing showed a PHOX2B mutation (genotype 20/25).

Conclusion: CCHS is a rare genetic condition that typically present in infancy. It is caused by a change in the PHOX2B gene on chromosome 4, which plays an important role in the formation and development of nerve cells. Nocturnal or continuous ventilatory support is typically required.
1143
PERIODIC LIMB MOVEMENT DISORDER (PLMD) ASSOCIATED WITH HIV: A CASE REPORT
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Introduction: Human Immunodeficiency Virus (HIV) and the anti-retroviral medications used to treat it have been implicated in the pathogenesis of neuropathy and other neurological disorders. PLMD is considered to be a rare disorder and its exact prevalence is unknown, but periodic leg movements are frequently observed during polysomnography. PLMD has been associated with a higher frequency of mood disorders, parasomnias and attention deficits. We present a patient with HIV and periodic limb movement disorder (PLMD) which has not been previously reported in literature.

Report of Case: A 61 year old male with HIV, Diabetes Mellitus Type II, neuropathy, COPD, depression, stroke, and seizure disorder presented with complaints of worsening fatigue and non-restorative sleep of two years duration. He was on retro-viral therapy with Truvada and Norvir. Polysomnogram was ordered for suspicion of obstructive sleep apnea, but did not reveal sleep disordered breathing. Frequent periodic leg movements in sleep were noted without a circadian component. The periodic limb movement index was significantly elevated at 93.6. PLMD was suspected and possible etiologies considered included HIV and retro-viral therapy. Treatment with gabapentin was initiated at 300 milligrams nightly and the patient reported a resultant decrease in onset to sleep latency, a decrease in the frequency of nocturnal arousals, an increase in sleep quality and resolution of daytime sleepiness.

Conclusion: The present case illustrates the possibility of an association between HIV and/or anti-retroviral medications and PLMD. PLM of sleep during polysomnography should not be dismissed and must be interpreted clinically, especially in a subset of at risk patients, or those who have neurological dysfunction in the absence of sleep disordered breathing.

1144
CATATHRENIA IN CHILDHOOD
Trivedi S
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Introduction: Catathrenia is included in Sleep Related Breathing Disorders section in ICSD-3 for its usual occurrence in REM sleep. It is thought to be rare, and more common in men. A girl with onset of catathrenia in infancy is reported herein.

Report of Case: A 13-year old girl with underlying history of attention deficit hyperactivity disorder (ADHD) presented with several episodes of groaning noises during sleep since infancy. She was unaware of those noises, but it was causing significant concern to her parents and disruption of their sleep. The groaning occurred every night along with restless sleep, but was unassociated with snoring, stridor, breathing pauses, dreaming, parasomnias, or ancillary symptoms of narcolepsy or cataplexy. Upon awakening, there was no headache, but she did not feel rested and complained of dry mouth. She was described as grumpy, and ill tempered by her mother without excessive daytime sleepiness. There was no family history of similar disorder; father had OSA. Craniofacial and oropharyngeal examination were normal. Polysomnography revealed mild obstructive sleep apnea with AHI 2/hr (pediatric normal reference range < 1/hr). Groaning started 3 hours after falling asleep, lasting 2-14 seconds. Fourteen episodes were recorded in REM and one in stage N2 sleep, all episodes occurred in supine position except one on left side. Half of these were followed by bruxism, arousal, and change in position. These were associated with mild tachycardia and normal oxygen saturation. Sleep efficiency and architecture were normal. The serum ferritin level was low at 28 mcg/L.

Conclusion: We report a patient with ADHD, sleep-disordered breathing, catathrenia, and sleep-related bruxism. The overall clinical picture agrees with previously obtained associations of catathrenia with sleep-disordered breathing, and REM sleep. Additionally, an association with bruxism was observed. The onset of catathrenia in infancy period suggests a neurodevelopmental disturbance in causation of this disorder.

1145
PHASIC REM RELATED SINUS ARREST: A CASE REPORT
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Introduction: Surges in autonomic activity are characteristic of REM. The decrease in sympathetic activity in phasic REM is hypothesized to potentiate cardiac dysrhythmias.

Report of Case: 39 y/o man with history of RLS, PTSD, depression and insomnia presents to the sleep disorders clinic with unrefreshing sleep, daytime fatigue and uncontrolled restless legs. His ESS was 9/24 and he fulfilled 4 RLS diagnostic criteria. He was recently evaluated by cardiology after an episode of chest tightness. The cardiac work-up was negative and no medications were prescribed. Physical examination was significant for a BMI of 27.6, Mallampati IV, neck size 17 and normal vital signs. The PSG revealed a normal AHI but the high number of snoring arousals prompted the sleep technologist to initiate CPAP titration. His snoring and arousals decreased significantly with CPAP therapy. His resting heart rate was 65-75bpm. At 3 am, the patient started developing episodes of bradycardia to the low 30’s with 18 episodes of sinus arrest, lasting 2.5-7 seconds during phasic REM. There were no respiratory disturbances and hypoxemia associated with these events. No evidence of brady-arrhythmias during NREM. The patient was referred back to his cardiologist for further evaluation.

Conclusion: Historically seen in healthy, asymptomatic individuals, there are only a few cases of REM related sinus arrests reported in the literature over the last 30 years. REM sleep related heart blocks have been linked as a possible cause of sudden cardiac death. Pacemaker implantation has been suggested in the management of REM related sinus arrest although the ACC/AHA guidelines only recommend pacemakers for asystole greater than 3 seconds or any escape rate less than 40bpm in awake, symptom-free patients with high grade AV block. No specific guidelines have been developed for REM sleep related sinus arrests, which warrants further studies.

1146
SUCCESSFUL USE OF AUTO-TITRATING NOCTURNAL NONINVASIVE VENTILATION IN ADVANCED RESTRICTIVE LUNG DISEASE
Dreddla BK, Avalon N, Potter CA, Kaplan J
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Introduction: Survival is prolonged in individuals with restrictive lung disease who receive nocturnal assisted ventilation. These patients are prone to REM sleep-associated hypoventilation and desaturation. We describe the use of a new auto-titration pressure support device (AVAPS-AE) in a patient with advanced restrictive lung disease who also had a history of obstructive sleep apnea.

Report of Case: A 21 year-old female presented with a six-month history of dyspnea upon exertion and morning headache. Her past medical history included congenital myopathy and chronic hypercapnic
respiratory failure since age 8. Previous surgical history included tonsillectomy, adenoidectomy, maxillofacial surgery (mandible and palate) and kyphoscoliosis requiring repair with multiple revisions. Previous sleep studies had suggested the presence of both central and obstructive sleep apnea. She complained of excessive daytime somnolence, insomnia and severe morning headaches. Spirometry confirmed a severe restrictive process with a forced vital capacity of 22% of predicted. Arterial blood gases on room air showed a respiratory acidosis with partial compensation (pH 7.34, PaCO2 60.3, PaO2 78). Polysomnography on room air revealed REM associated desaturation (minimum REM was 67% and mean REM was 76%) due to hypoventilation and partial upper airway collapse. Oxygen supplementation at 2L/min marked respiratory instability with periods of hypoventilation alternating with frequent respiratory effort-related arousals were noted. A therapeutic trial of average volume assured pressure support (AVAPS) was ineffective. During REM sleep, she showed continuous desaturations. She was then switched to a full-face mask and started on a trial of the AVAPS-AE. Her breathing stabilized and she achieved continuous sleep without REM-associated hypoventilation, desaturation or arousals. Her morning headache and daytime hypersomnolence resolved. **Conclusion:** This case demonstrates the effectiveness of AVAPS-AE in managing REM-associated hypoventilation in a patient with severe restrictive lung disease who also had a component of pharyngeal flow limitation.

### 1147

**NOCTURNAL LEG CRAMPS AND DAYTIME HYPERSONOMIA FOLLOWING ANTHRAX VACCINE**

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**Introduction:** Anthrax is an acute infectious disease caused by the spore-forming gram-positive rod Bacillus anthracis. Due to the threat of biological terrorism, all U.S. military personnel are mandated to receive vaccination against this agent. We present a case of a veteran male with painful nocturnal leg cramps with hypersomnia following anthrax vaccine.

**Report of Case:** 28 year old male with a body mass index of 34.1 presented to our veteran affairs sleep clinic with severe painful nocturnal leg cramps, myalgias and daytime hypersomnia since receiving anthrax vaccine three years ago. He denied any of these symptoms prior to vaccination. He was not taking any medications including statins. He reported no history of trauma and denied symptoms of restless legs syndrome. Laboratory investigations revealed consistently elevated creatinine phosphokinase ranging from 1700 to 2200 and elevated aldolase level of 11.2. Rheumatology workup, electromyography and muscle biopsies were all negative. Polysomnogram showed an apnea-hypopnea index of 7 events per hour and nadir oxygen saturation of 91%. In addition, periodic limb movements (PLMs) were noted with an index of 32, with arousal index of 0.7. Following day multiple sleep latency testing showed mean sleep latency of 6.8 minutes with no sleep onset rapid eye movement periods (SOREMPs). Patient had a trial of gabapentin, pregabalin, tramadol and hydrocodone with tramadol being the most effective in improvement of his myalgias and painful nocturnal leg cramps. Patient was also started on AutoPAP therapy for his mild OSA.

**Discussion:** Known adverse effects following anthrax vaccine include fever, chills, myalgia, arthralgia, and nausea. However, chronic adverse effects are extremely rare. In our patient, development of PLMs and leg cramps appear to be related to his prior anthrax vaccination. To our knowledge, this is the first report of an association between PLMs and nocturnal leg cramps following anthrax vaccine.

### 1148

**OBSTRUCTIVE SLEEP APNEA DUE TO A VAGAL NERVE STIMULATOR IN A PEDIATRIC PATIENT**

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**Introduction:** Vagal Nerve Stimulators (VNS) have been used for the treatment of refractory epilepsy since receiving FDA approval in 1997 and have been shown to achieve a greater than 50% reduction in seizure frequency rate in most patients. VNS, however, are known to cause respiratory complications including decreases in airflow and oxygen saturation during sleep. While this is mostly of a mild to moderate degree and in adult populations, it has only rarely been seen to be severe and in pediatric patients as in our case.

**Report of Case:** A 10-year-old Caucasian male with autism, a history of tonsillectomy and adenoidectomy and intractable epilepsy status post a right temporal lobectomy was evaluated in the Sleep clinic for the presence of snoring and sleep disordered breathing. The patient was noted to have a vagal nerve stimulator since 2010 for control of refractory seizures. He was reported to have worsening symptoms including witnessed apneas. An in-laboratory polysomnogram was performed and showed severe obstructive sleep apnea (OSA) with apnea and hypopnea events at regular intervals similar to the stimulus frequency settings of the VNS. The reported apnea hypopnea index was 21.2 with a majority of events being hypopneas. The parameters of the patient’s VNS were adjusted with improvement.

**Conclusion:** The etiology of OSA is important to determine the appropriate management, especially in patients with VNS. While the pathophysiology of worsening OSA due to VNS has not been clearly elucidated, it may be related to recurring vocal cord adduction, peripheral effects on upper airway musculature, and central effects on upper airway patency and respiratory pattern. Treatment in such cases involves the following options: changing of VNS parameters, discontinuation of the VNS if tolerated by the patient, and the use of continuous positive airway pressure therapy (CPAP).

### 1149

**CASE REPORT OF FALL AND EVENTUAL DEATH AFTER OVERNIGHT POLYSOMNOGRAPHY: ROOT CAUSE ANALYSIS AND IMPROVING SAFETY FOR SLEEP DISORDERS PATIENTS**

Hope CR, Richert AC

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**Introduction:** Proposed changes to the AASM standards for accreditation will require that sleep disorders centers define, document, and analyze all significant adverse events that occur to our patient population. These changes may seem unnecessary given the seemingly benign nature of overnight polysomnography. The following case report details an academic sleep disorders center’s experience with such an adverse event.

**Report of Case:** A 66 year old woman with hypertension and morbid obesity was referred for outpatient polysomnography secondary to snoring and daytime sleepiness recognized during university-based hospitalization for hypertensive urgency. Split-night polysomnography performed 44 days after discharge lasted 7.6 hours, recorded 5 hours of sleep, and revealed moderate OSA (AHI of 15.1). CPAP was initiated and successfully titrated to 8 cm H2O. Post-study patient
questionnaires documented “good” sleep quality during the study and feeling “rested” prior to leaving the center. Unfortunately while leaving the sleep disorders center after testing, she tripped over a curb in the parking lot, fell, and fractured her distal radii bilaterally. Twelve days after falling she underwent left open reduction and internal fixation. Two days thereafter, she developed acute shortness of breath secondary to a saddle pulmonary embolus and died. Root cause analysis revealed that multiple factors likely contributed to the adverse event including technician training, staffing issues, and patient characteristics. An improvement plan is being developed to address these issues and to help reduce the risk of further similar events.

**Conclusion:** Using root cause analysis and other tools to improve patient safety may help mitigate the risk of serious adverse events even in the relatively low-risk environment of laboratory-based sleep testing.
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