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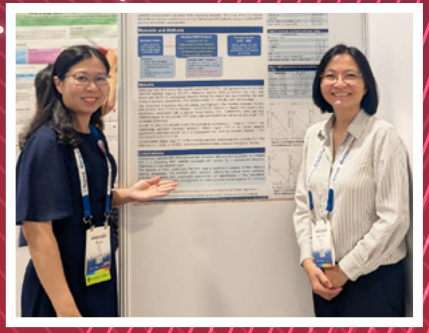
ABSTRACTS



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Aging and Developmental Issues

Sleep EEG-Based Brain Age Index as a Biomarker of Cognitive Function

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Introduction: Sleep quality and architecture are known to influence cognitive processing, and growing evidence links sleep disruption to neurodegenerative diseases and cognitive decline. Our group recently introduced the brain age index (BAI), a novel biomarker derived from sleep EEG, which has shown associations with cortical thinning. This study examines whether the sleep EEG-based BAI can serve as an indicator of brain health, specifically by evaluating its association with cognitive function
Materials and methods: We retrospectively analyzed polysomnography (PSG) data from 128 individuals (89 with obstructive sleep apnea [OSA], 39 healthy sleepers) who also completed neuropsychological assessments. Sleep EEG data were transformed into scalograms and input into a 3D deep learning model to predict brain age. BAI was calculated as the difference between predicted and chronological age. We performed correlation and mediation analyses to evaluate the role of BAI in linking sleep features and cognitive outcomes.
Results: BAI showed negative correlation with attention and executive function in both overall subjects and the OSA subgroup. Mediation analysis revealed that BAI significantly mediated the relationship between sleep EEG microstructure and attention/executive function, as well as between sleep macrostructure (N3%, sleep efficiency) and attention/executive function.
Conclusions: This study demonstrated that sleep EEG based-BAI could be a promising biomarker for assessing cognitive impairment in patients with sleep disorders. Furthermore, BAI may serve as a mediator in the relationship between sleep and cognitive function, offering novel insights into the pathophysiology of neurodegenerative diseases.

Basic Research

Shared genetic architecture between sleep apnea related sleep traits and cardiometabolic diseases

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Introduction: Sleep apnea related sleep traits show high comorbidities with cardiometabolic diseases (CMDs). Although genetic relationships between them have been widely reported, it is still unknown whether a small number of loci or the whole genome would be responsible for the overall genetic association. Genome-wide association studies (GWAS) have identified single nucleotide polymorphisms (SNPs) associated with either sleep apnea or cardiometabolic diseases. These findings provide a foundation for subsequent analysis of pleiotropic SNPs exhibiting cross-traits associations, which might aid in the understanding of potential shared genetic architectures underlying these comorbid conditions. The purpose of this study was to find shared genomic regions, genes, and pathways between sleep apnea and associated sleep traits (insomnia, sleepiness and snoring) and seven cardiometabolic diseases (atrial fibrillation, coronary artery disease, heart failure, hypertension, stroke, type 2 diabetes and venous thromboembolism).
Materials and methods: Using GWAS summary statistics from publicly available data sources, we calculated genetic correlation between two traits using linkage disequilibrium (LD) score regression (LDSC) and high-definition likelihood (HDL) analysis. Furthermore, PLACO, a pleiotropic analysis under a composite null hypothesis, was used to identify genetic variants that influence risk of two traits. And

causal variants were identified by FM-summary, a Bayesian fine-mapping method. Colocalized association signals between trait pairs or among multiple traits were determined by the R packages coloc or HyprColoc. ANNOVAR program were used to identify nearest genes of causal variants and MAGMA was used to detect potential pleiotropic genes. Phenotype enrichment analysis and over-representation enrichment analysis were performed to characterize the phenotype and pathway specificity of these pleiotropic genes. Two-sample and multivariable mendelian randomization (MR) were used to identify causal associations between these traits and potential factors mediating causal relationships.
Results: Among 28 trait pairs between four sleep traits and seven cardiometabolic traits, 23 showed significant genetic connections. Pleiotropic analysis identified 720 (678 unique) pleiotropic causal SNPs in 23 trait pairs, with 92 (85 unique) colocalized loci. 73 nearest genes of colocalized loci were annotated with ANNOVAR program and gene-based analysis verified 48 of them. Shared genes were highly enriched in aging, live/biliary system, muscle and endocrine/exocrine gland phenotypes. Furthermore, pathway enrichment analysis highlighted biological pathways including Cushing syndrome, an endocrine and metabolic disease characterized by too much cortisol in the body, and signal transduction like cAMP, Rap1 and cGMP-PKG signaling pathway. Vertical pleiotropy was further demonstrated across 14 trait pairs using MR analysis. Adjusting triglyceride, total cholesterol and glycemic traits, genetically predicted snoring was associated with higher risk of atrial fibrillation and heart failure. And genetically predicted sleep apnea was independently related with heart failure and type 2 diabetes, after adjusting blood pressure. Particularly, some pleiotropic loci were identified to be shared among multiple traits, such as 3q27.1 (*ECE2*), 4p12 (*GNPDA2*) and 17q21.31 (*ACBD4*).
Conclusions: This study not only supported the observed comorbidity of sleep apnea related sleep traits and CMDs, but also indicated shared genetic determinants underlying these trait pairs, might facilitating treatment and management of comorbid sleep apnea and CMDs.

Temporal effects of chronic intermittent hypoxia on genioglossus electromyography and ultrastructure in a rat OSA model

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Introduction: This study established a chronic intermittent hypoxia (CIH) rat model simulating obstructive sleep apnea (OSA) to evaluate the temporal impact of CIH on genioglossus (GG) electromyography (EMG), mitochondrial morphology, and neuromuscular junction (NMJ) integrity.
Materials and methods: Forty healthy male Sprague-Dawley rats (7-week-old) were randomized into three groups: normal control (NC, n=10), CIH (4-week hypoxia, n=15), and prolonged CIH (8-week hypoxia, n=15). CIH groups underwent daily 8-hour cycles of alternating hypoxia (90s at 7% O_2) and normoxia (90s at 21% O_2). Serial measurements of GG-EMG activity were performed at baseline and weekly intervals, complemented by repetitive nerve stimulation (RNS) assessments during weeks 4-8. Histopathological evaluation through H&E staining and transmission electron microscopy (TEM) quantified myofibrillar architecture and subcellular organelle integrity.
Results: In the CIH group, the GG-EMG showed a gradually increasing trend from the first week of CIH to the end of the fourth week ($P < 0.05$). And the multiple comparisons of GG-EMG between the groups during 1-4 weeks of CIH were statistically significant ($P < 0.05$). Meanwhile, the GG-EMG in most CIH prolonged groups showed a decreasing trend around 6 weeks of CIH.At 4 weeks of CIH, 15% of the rats showed decreased RNS high-frequency (20Hz) stimulation, and with the extension of hypoxia time, up to 8 weeks of CIH, 60% of the rats showed decreased RNS high-frequency stimulation($P < 0.05$).Compared with the NC group, the CIH group had disordered arrangement of GG fibers, irregular and swollen fibers. TEM showed that the damage of GG muscle fibers and mitochondria was not obvious two weeks before CIH, and the damage of GG mitochondria was earlier than that of GG muscle fibers. With the prolongation of CIH exposure, the damage of GG muscle fibers and mitochondria was further aggravated.
Conclusions: CIH induces time-dependent GG neuromuscular dysfunction:Early compensatory EMG enhancement (≤4 weeks) transitions to decompensation (≥6 weeks).Mitochondrial vulnerability manifests earlier than myofibril damage.Progressive NMJ impairment correlates with RNS-detected

abnormalities.These findings highlight critical phases of hypoxic adaptation in OSA-related upper airway dysfunction.

Beyond Sleep Duration: The Critical Role of Sleep Stages in Cardiovascular Disease Risk: Insights from two community-based cohort study

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Introduction:
While most studies have focused on conventional self-reported measures such as sleep duration and quality, emerging evidence highlights the physiological and clinical heterogeneity of sleep architecture. This study comprehensively investigated the linear and nonlinear associations between four polysomnography-derived sleep stages (N1, N2, N3/N4, REM) and long-term CVD incidence in two large independent cohort studies, focusing on effect modification by habitual sleep duration and obstructive sleep apnea (OSA) status, as well as the mediating pathways exploration.
Materials and methods: We recruited 5,804 middle-aged and elderly individuals from the Sleep Heart Health Study (SHHS) and 1,416 individuals from the Wisconsin Sleep Cohort (WSC). Sleep stages were assessed objectively using in-home polysomnography. Multivariable Cox regression models were employed to calculate hazard ratio (HR) for CVD, coronary heart disease (CHD), and stroke, adjusting for demographics and other sleep metrics. Subgroup analyses stratified by habitual sleep duration and OSA status were conducted. Mediation analysis was used to quantify the mediating effect of six modifiable cardiometabolic biomarkers.
Results: A total of 4,042 participants from SHHS and 600 participants from WSC were included in the analysis, with a mean follow-up of 11.0 (SD=2.7) and 8.8 (SD=2.6) years, respectively. During the follow-up time, 695 and 60 CVD cases occurred in SHHS and WSC. After adjustment for potential confounders, each standard deviation (SD) increase in N2% was associated with a 17% increase in CVD risk (adjust hazard ratio (AHR)=1.17, 95% CI: 1.08–1.27), while each SD increase in REM% was associated with an 11% reduction in CVD risk (AHR=0.89, 95% CI: 0.83–0.96). Sleep duration shows a significant modification effect for REM% (P for interaction=0.008), while OSA status shows a significant modification effect for N2%, N3/4%, and REM% (All for interaction<0.05). Restricted cubic spline curves indicate U-shaped associations of N3/4% with CVDs (P for non-linearity<0.001). Mediation analysis shows BMI and SBP are the main mediators, accounting for 13.1% and 5.5% for N2% and 13.9% and 7.4% for REM% sleep.
Conclusions: Our study demonstrates that a higher proportion of N2 sleep and a lower proportion of REM sleep are associated with increased CVD risk, especially in individuals with short habitual sleep duration and non-OSA populations. The BMI reduction and SBP control for CVD prevention may warrant prioritization, targeting the adverse effects of unfavorable sleep stage proportion.

The Impact of Obstructive Sleep Apnea on the Temporal Coupling of NREM Sleep Oscillations in Schizophrenia

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Introduction: Dysfunctional connectivity between and within brain regions is a proposed mechanism underlying schizophrenia. Electroencephalographic (EEG) abnormalities during Non-Rapid Eye Movement (NREM) sleep such as reduced and dysmorphic sleep spindles and slow oscillations (SO) have been described in schizophrenia. The temporal coupling between these oscillations is thought to

reflect the coordination and integrity of the thalamocortical circuitry and has been associated with functions of memory with uncoupling being associated with aspects of ageing and cognitive decline. We investigated 1) whether a reduction in the temporal relationship between SO and spindles are observed in the schizophrenia group reflecting thalamocortical dysfunction. Individuals with schizophrenia are often given obesogenic medication, increasing the likelihood of developing obstructive sleep apnea (OSA). We further explored 2) whether this oscillatory coupling would be further impaired in those with OSA and 3) the association of coupling with cognitive performance.
Materials and methods: We measured high-density EEG overnight polysomnography in two groups 1) people with schizophrenia (n=31) and 2) without schizophrenia (n=31) across a range of OSA severity, defined by the Apnea Hypopnea Index (AHI), matched for age and sex. Participants completed a cognitive test battery before and after sleep. Sleep spindles and SO events were automatically detected using previously reported algorithms across 256 High-density EEG. The mean phase angles (phase preference), the resultant vector length (coupling strength) and coupling density of each co-occurring event between SO and sleep spindles were measured. To reduce bias of phase angle concentration, participants with >10 events were included in the analyses. General linear models were used to test the association between coupling metrics and the effects of group and AHI and the interaction between the two and the association of cognition in the form of a procedural memory task (finger tapping) with the main effect of the coupling strength, group and AHI.
Results: We observed group differences in the schizophrenia group showing reduced coupling density compared to controls (b -0.06, p<0.01) this was not further impaired if they had comorbid OSA (b 0.00 p=0.65). Across both groups, we did not see a difference in coupling strength (resultant vector length) (Group x AHI b = 0.00 p=0.82). No significant differences were observed in overnight improvement on the procedural memory motor task and AHI (b -0.11 p=0.31) . Worse task performance was observed in the schizophrenia group (b=-22.37, p=0.01) but not significant if these patients had OSA (p=0.05)
Conclusions: Our results show that the coupling of SO and sleep spindles in schizophrenia may be preserved and is not impacted by the presence of OSA. The schizophrenia group show additional activation in the centroparietal regions which may possibly reflect a compensatory mechanism. This interpretation might suggest that recruitment of function with adjacent areas could be due to local network dysfunction in the frontal brain regions in schizophrenia. Future work will aim to understand the effects on these dynamics following CPAP treatment in schizophrenia and explore the potential of SO-spindle coupling reflecting functional connectivity and its interaction with other brain regions

LncRNA NONMMUT009018 drives tumorigenesis and progression by modulating the miR-8100/Col1a2/Thbs1 axis under intermittent hypoxia

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Introduction: This study aims to investigate the mechanism by which LncRNA NONMMUT009018 /miR-8100/Col1a2/Thbs1 in promoting tumor proliferation,invasion,metastasis mediated by obstructive sleep apnea hypopnea syndrome (OSAHS)-related intermittent hypoxia (IH).To provide a theoretical foundation and potential therapeutic targets for the clinical prevention and treatment of OSAHS-associated tumors.
Materials and methods: Affymetrix Clariom D microarray and bioinformatics analysis， RIP, and dual-luciferase reporter assays were used to confirm binding interactions within the ceRNA network.DMOG was used to stabilize HIF-1α expression in tumor cells,and C57BL/6J mouse tumor-bearing models were subjected to IH mimicking OSAHS for 28 days in vivo, Lentiviral and mimic transfection techniques were applied to modulate LncRNA NONMMUT009018 and miR-8100 expression in LLC and B16F10 melanoma cells, influencing downstream target genes *Col1a2* and *Thbs1*. CCK-8, transwell chamber, scratch wound healing assays,in vivo imaging, tumor weight/volume measurements, HE staining, RT-qPCR, and western blot were conducted to explore the role of the LncRNA NONMMUT009018/miR-8100*/Col1a2/Thbs1* regulatory axis in tumor growth, invasion and metastasis.
Results: Compared to the normoxic group, IH significantly upregulated the expression of LncRNA NONMMUT009018, *Col1a2*, and *Thbs1* in tumor tissues (P< 0.05), while miR-8100 expression was markedly downregulated (P<0.01). RIP,MS2/AGO2-RIP and dual-luciferase reporter assays

demonstrated direct binding of HIF-1α to LncRNA NONMMUT009018, LncRNA NONMMUT009018 to miR-8100,and miR-8100 to *Col1a2* and *Thbs1*. Knockdown of LncRNA NONMMUT009018 and overexpression of miR-8100 significantly reduced *Col1a2* and *Thbs1* mRNA expression by RT-qPCR(P< 0.01) . CCK-8 assays,transwell invasion and migration assays, scratch wound healing experiment,and EMT-related marker proteins E-cadherin,N-cadherin and MMP9 revealed that knockdown of LncRNA NONMMUT009018 or overexpression of miR-8100 can significantly inhibit HIF-1α-mediated proliferation, invasion and metastasis of LLC and B16F10 tumor cells. However,overexpressing LncRNA NONMMUT009018 or inhibitoring miR-8100 restored proliferation, invasion, migration of tumor cells. Similar phenotypic characteristics were found in IH-mediated tumor tissues.
Conclusions: This study established the LncRNA NONMMUT009018/miR-8100/*Col1a2/Thbs1* ceRNA network driving IH-associated tumor progression. HIF-1α activation upregulated LncRNA NONMMUT009018, which sponged miR-8100 to derepress *Col1a2/Thbs1*, promoting tumor proliferation, invasion, migration, and EMT. Targeting this axis may offer novel strategies for OSAHS-related cancer prevention and therapy.
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The Impact of Early Morning Training on Subjective and Objective Sleep Indices Among Male Collegiate Rowers in Japan

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Introduction: Sleep deprivation is a well-known factor that can impair cognitive, physical, and technical aspects of athletic performance. Despite increasing awareness, many athletes-especially those with early morning training schedules-are unable to secure sufficient and high-quality sleep. Although sleep patterns in athletes have been studied, little research exists on Japanese collegiate rowing athletes. Moreover, few studies have combined both subjective and objective methods to assess sleep. This study aimed to clarify the sleep characteristics and lifestyle habits of male collegiate rowing athletes in Japan, focusing on the impact of early morning training on sleep.
Materials and methods: This study included 11 male collegiate rowers from University A, observed over 7 consecutive days in June 2025. Participant characteristics were as follows: height 172.8 ± 5.1 cm, age 20.3 ± 0.9 years, weight 71.0 ± 4.3 kg, and BMI 23.8 ± 0.9. Collected data included demographic factors (e.g., caffeine and alcohol consumption, nap habits), subjective sleep quality using the Japanese version Pittsburgh Sleep Quality Index (PSQI-J) and sleep diaries, objective sleep data from wrist-worn actigraphy, dietary records, and training schedules.
Results: During the 7-day observation period, participants had morning training starting at 5:00 a.m. on three weekdays, 6:30 a.m. on two weekend days, and two weekdays without morning training. 63.6% of athletes were classified as having poor subjective sleep quality (5.5＜PSQI-J score; mean PSQI-J = 6.9 ± 2.6).
Actigraphy data showed that Total Sleep Time (TST) was significantly shorter on nights before weekday morning training compared to nights before weekdays without morning training and nights before weekend (p＜0.01). Furthermore, bedtime on nights before weekday morning training was more than two hours earlier than that on nights before weekday without morning training.
One-way ANOVA revealed significant differences across training categories in some objective sleep indices. TST and total minutes in bed on nights before weekday morning training were significantly shorter than those on nights before weekdays without morning training (p＜0.01) and on weekend nights (p < 0.01). The number of awakenings was also significantly smaller on nights before weekday morning training than that on nights before weekend training (p=0.014). Subjective TST from sleep diaries showed similar results: significantly shorter on nights before weekday morning training than on the other nights (p ＜0.01). TST was significantly shorter in objective data than in subjective sleep diary data (p< 0.001,

0.013, and < 0.001 for weekday with morning practice, weekday without morning practice, and weekend, respectively).. On the other hand, subjective sleep latency was significantly longer (p=0.003), and sleep efficiency was significantly higher (p=0.017) than those in objective measures respectively.
Conclusions: This study found that early morning training reduced TST and caused earlier bedtime among Japanese male collegiate rowers. Many athletes reported poor subjective sleep quality and discrepancies were observed between subjective and objective sleep assessments. These findings highlight the importance of using both types of measures when evaluating sleep and suggest that training schedules should be reviewed to support adequate sleep and recovery.

A cross-sectional observational study on sleep parameters in Indian males and females

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Introduction: Nearly all living organisms spend a fraction of their lives in a reversible, unconscious, coma-like state. It is still unclear why exactly organisms sleep but it is related to health and well-being. Disturbed sleep has negative effects on mental and physical health. Sleep has gender difference as well. The aim of the present study was to understand and compare sleep pattern of adult Indian males and females.
Materials and methods: A cross-sectional observational study was conducted on 301 participants presenting to a tertiary care centre in India. Participants were bystanders of patients representing the community and were not suffering from any known medical or psychiatric disorder. The participants were assessed on their socio-demographics, sleep profile and substance use profile with the help of Piitsburgh Sleep Quality Index (PSQI), Sleep -50, Epworth Sleepiness Scale (ESS), sleep Hygeine and The Alcohol Smoking and Substance involvement screening test (ASSIST).
Results: 187 males and 114 females participated in the study. Nearly half of the sample was married and nearly 60% of the sample were employed. Most of the sample belong to urban locality and middle socio-economic status. Only five percent of the sample reported lifetime use of tobacco and three percent reported current tobacco use. No participant reported use of any other substance. There was no difference in socio-demographics in males and females except for employment status as most of the females in our study were housewives. The mean age of the total sample was 31.2 (10.2) years. The mean subjective sleep latency and total sleep time of the sample were 30 (15,60) minutes and 417.3 (70.7) minutes. Near about 30 percent of the sample has PSQI>5. Females reported more sleep disturbance (n=37,33%) than males (n=53,28.8%) in terms of total PSQI score>5, however it was not statistically significant. The median PSQI score of the sample was 4(2,6). The median sleep latency was found to be same for males and females (30(15,60) minutes vs30 (15,30) minutes). The median ESS scores for males was 3.5 (0,7) and for females was 4 (1,9). The mean total sleep latency for males and females was 417.2 (73.7) minutes and 418.4 (67.1) minutes respectively. Most of the patients had normal day time sleepiness (n=268,89%). Only three percent of the participants (n=8) reported moderate to severe day time sleepiness. No significant difference was observed between subjective sleep latency, subjective total sleep time, total PSQI scores and total ESS scores between male and female participants. A significant negative correlation was observed between marital status and sleep latency in males but not in females. A significant positive correlation was observed between total ESS scores and type of employment in males but not in females.
Conclusions: The general adult population in India has a sleep of around seven hours. Females had more sleep disturbance than males although difference was not statistically significant. Married males had earlier onset of sleep.

Effects of Combined Chronic Intermittent Hypoxia and Hypercapnia Exposure on Blood Pressure, Systemic Inflammation, and Oxidative Stress Levels in Rats

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Introduction: Chronic Intermittent Hypoxia (CIH), the most characteristic pathophysiological feature of obstructive sleep apnea (OSA), has been extensively documented in animal studies to induce multiple OSA-associated adverse outcomes. Intermittent hypercapnia, another hallmark pathophysiological trait of OSA, however, has rarely been incorporated into OSA animal modeling paradigms. The purpose of this study is to investigate the effects of combined chronic intermittent hypoxia with hypercapnia (CIHHC) exposure on blood pressure, systemic inflammation, and oxidative stress (OS) levels in Sprague-Dawley (SD) rats, compared to chronic intermittent hypoxia (CIH) alone and chronic intermittent hypercapnia (CIHC) alone.
Materials and methods: Forty 6-week-old male SD rats were randomly divided into four groups (n=10 per group) and exposed for 8 hours daily to specific oxygen (O_2) or carbon dioxide (CO_2) partial pressure conditions: (1) Control group (O_2: 21%, CO_2: 0.3%); (2) CIH group (O_2 cycled every 60 seconds between 5% and 21%, CO_2: 0.3%); (3) CIHC group (O_2: 21%, CO_2 cycled every 60 seconds between 0.3% and 5%); and (4) CIHHC group (O_2 cycled between 5% and 21%, CO_2 cycled between 0.3% and 5% every 60 seconds). Tail artery systolic blood pressure (SBP) was measured pre- and post-30-day exposure. Post-exposure peripheral serum samples were collected to quantify levels of inflammatory biomarkers [tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6)] and OS markers [superoxide dismutase (SOD), malondialdehyde (MDA)].
Results: No significant differences in pre-exposure SBP (pre-SBP) were observed among the four groups. While post-exposure SBP (post-SBP) differed significantly (P=0.002), with the order CIH > CIHC > CIHHC > Control. Post-SBP increased significantly in all experimental groups but not the control group compared to their respective pre-SBP (all $p<0.05$). Post-exposure serum levels of TNF-α, IL-6, SOD, and MDA also differed significantly among groups (all $P<0.05$). TNF-α, IL-6, and MDA levels followed the order CIH > CIHC > CIHHC > Control, while SOD levels ranked Control > CIHHC > CIHC > CIH.
Conclusions: Both CIH and CIHC exposure significantly elevated blood pressure, systemic inflammation, and OS levels in rats. However, combined CIHHC exposure induced significantly milder effects compared to CIH or CIHC alone, suggesting that intermittent hypercapnia concurrent with CIH may exert a protective or ameliorative influence on these pathological processes.

BTBD9 Controls Sleep via Ubiquitination of IMPDH2 and Adenosine Modulation in the Basal Forebrain

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Introduction: BTBD9 has been established as a critical sleep-regulating gene, whose genetic variants are associated with human insomnia and restless legs syndrome (RLS), while its loss-of-function leads to disrupted sleep architecture in both mice and Drosophila. However, its precise molecular mechanisms remain elusive.
Materials and methods: We employed an integrated multidisciplinary approach: 1) AAV-mediated Cre/loxP system with stereotaxic injection for basal forebrain (BF)-specific genetic manipulation; 2) Long-term sleep monitoring and deprivation experiments using synchronized electroencephalography/electromyography (EEG/EMG) recordings; 3) Quantitative proteomics, ubiquitinomics, and bioinformatic prediction to identify key substrates; 4) Structural analysis, in vitro ubiquitination assays, and site-directed mutagenesis to validate molecular interactions; 5) Fiber photometry and tissue metabolome for neurotransmitter dynamics assessment; 6) AAV-delivered competitive interfering peptides for in vivo functional rescue experiments.
Results: We discovered that BF-specific *Btbd9* knockout induces a previously-unexpected pro-sleep phenotype mediated by elevated adenosine levels. IMPDH2, the rate-limiting enzyme in *de novo* GTP biosynthesis, was identified as an evolutionarily conserved ubiquitination substrate of BTBD9, with lysine 195 (K195) being the critical modification site. BTBD9-mediated ubiquitination disrupts GTP-dependent

feedback inhibition of IMPDH2, altering its enzymatic activity. Both pharmacological inhibition of IMPDH2 with MPA and conditional knockout in BF neurons recapitulated the sleep-promoting effects, increasing NREM sleep duration and slow-wave activity (SWA)—key markers of sleep pressure. Crucially, targeted disruption of the BTBD9-IMPDH2 interaction via AAV-delivered interfering peptides not only prolonged NREM sleep but also confirmed the druggability of this pathway.
Conclusions: Our study unveils the novel BTBD9-IMPDH2-adenosine axis in sleep regulation and proposes targeting this interaction as a promising therapeutic strategy for sleep disorders. These findings provide groundbreaking insights into the molecular pathogenesis of sleep disturbances.

Behavior, Cognition and Dreaming

Exacerbated Negative Impact on Sleep, Mood, Cognition and Daytime Functions in Comorbid Frequent Nightmares and Insomnia

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Introduction: Insomnia often co-occurs with frequent nightmares. While previous studies have examined the independent effects of insomnia and nightmares, few studies have investigated the impact of the comorbidity of these conditions. This study aims to determine whether frequent nightmares exacerbate impairments in sleep, mood, cognition, and daytime functioning in individuals experiencing insomnia, compared to those with insomnia alone.
Materials and methods: This is a cross-sectional study recruited adults aged 18 to 70 with insomnia symptoms (Insomnia severity index, ISI≥10) in Hong Kong. Participants completed online questionnaires on sleep and mood, clinical interviews (The Structural Clinical Interview for DSM-5 Disorders, SCID-V) for psychiatric diagnoses, and mobile cognitive tests assessing attention (The Psychomotor Vigilance Test, PVT), risk-taking propensity (Balloon Analogue Risk Task, BART), inhibition control (Go/No-go Task) and working memory (N-back Task). Frequent nightmares were defined as occurring more than once a week over the past three months (Nightmare Frequency Questionnaire). Individuals with post-traumatic disorder (PTSD, identified by SCID-V) were excluded. Group comparisons (insomnia with vs without nightmares) were analysed using Pearson's chi-square test and Wilcoxon rank-sum test. Associations between frequent nightmares and outcomes were further examined using linear and logistic regression.
Results: A total of 230 participants (median age 43 years; 75.7% female) with complete clinical interview, questionnaire, and cognitive task data were included. Individuals with comorbid frequent nightmares (N=53, median age 37 years; 77% female) exhibited greater insomnia severity, pre-sleep arousal, mood disturbances, suicidal ideation, somatic symptoms, and less satisfaction with surrounding environment compared to those with insomnia alone. After adjusting for covariates (age, gender, income, psychiatric diagnoses and insomnia severity), frequent nightmares remained significantly associated with higher depressive severity ($\beta = 1.55$, $p < .05$), rumination ($\beta = 4.16$, $p < .05$), suicidal ideation (OR = 2.34, $p < .05$), attention deficits (longer PVT reaction time: $\beta = 55.63$, $p < .01$; higher Go/No-go omission rate: $\beta = 4.86$, $p < .05$), and somatic symptoms ($\beta = 1.72$, $p < .01$). Adjusting further for depressive and anxiety symptoms, frequent nightmares still demonstrated significant associations with greater pre-sleep cognitive arousal ($\beta = 1.84$, $p < .05$), reflective rumination ($\beta = 0.86$, $p < .05$), attention deficits (longer reaction time in PVT: $\beta = 55.05$, $p < .01$; higher omission rate in Go/No-go Task: $\beta = 5.50$, $p < .01$), and somatic symptoms ($\beta = 1.44$, $p < .05$).
Conclusions: Frequent nightmares comorbid with insomnia exacerbated pre-sleep arousal, reflective rumination, attention impairment, and somatic symptoms beyond the impact of insomnia alone, independent of insomnia severity and mood disturbances. These findings suggest that intervention targeting both nightmares and insomnia should be incorporated into management of comorbid insomnia and nightmares.

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Sleep Surprises Questionnaire: Using Expectancy Violations from Naturalistic Behavioural Experiments to Enhance Sleep-Wake State Curiosity

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Introduction: Surprises, triggered by expectancy violations, drive new learning, reshape expectations, prompt adaptive behaviours, and generate evolving perceptions, creating further curiosity in a cycle of resilience. Surprises abound in sleep and waking, arising from naturally-occurring behavioural experiments and challenging our assumptions about sleep-wake states, next- day alertness and energy. The Sleep Surprises Questionnaire (SSQ) captures these expectancy violations in non-insomnia and (potentially) insomnia populations, promoting trust in sleep self-regulation, and gathering evidence that promotes curiosity about sleep-wake states. This oral presentation will explore how the SSQ's design and scoring illuminate surprise-driven learning, encouraging behaviours that enhance perception of sleep robustness with implications for preventive sleep health strategies.
Materials and methods: The SSQ, comprising 22 items across naturalistic behavioural experiments (eg, sleeping after an evening coffee or cinema screening), sleep-wake discrepancies (eg nearby sounds incorporated into dreams, time distortions), and next-day functioning (eg surprising alertness after broken sleep), uses a unified response scale:
N/A (never experienced), not surprised (0), mildly surprised (1), quite surprised (2), or very surprised (3). Scores sum across items (max 66, N/A excluded) with categories: little surprise (0–22), some surprise noted (23–44), very attentive to sleep surprises (45–66).
Objective is to establish SSQ norms (eg score distributions for 22 items (max 66), categories: 0–22, 23–44, 45–66), validate against ISI (insomnia severity) and DBAS-16 (dysfunctional beliefs), and assess content validity. Sourcing a population of non-insomnia adults (eg general population or students, N≈300 for normative study, N ≥ 100 for EFA, and N ≥ 50 for test-retest, stratified by age, gender). Will include a subset with mild insomnia (eg ISI 8–14) for comparison. Rationale is to gauge if SSQ scores reflect openness to surprise and correlate inversely with ISI and DBAS-16 scores. Will recruit participants using convenience sampling (eg universities, online platforms) or random sampling for representativeness, and obtain informed consent & ethics approval. Initially exclude clinical population (ISI ≥ 15) until second stage of research.
Results: Preliminary findings for 3 participants with mild insomnia (eg Sunday night sleep concerns) score low on both ISI (<15, or Subthreshold insomnia) and SSQ (eg SSQ: 6-10/66, "little surprise"), but individual high-surprise items (eg surprise at alertness after poor sleep) suggest intervention pathways. The preliminary data indicate higher openness & attentiveness to surprises inversely correlates with insomnia severity, offering a streamlined tool to foster adaptive sleep perceptions.
Conclusions: Even in a non-insomnia demographic, negative sleep predictions fuel sleep "safety-seeking" behaviours which reinforce beliefs about sleep fragility, while increased tolerance of the inherent uncertainty of sleep-wake state discrepancies drives optimistic predictions and nonfearful behaviours. Preliminary findings suggest naturalistic behavioural experiments have the potential to raise expectancy violations, reflected in SSQ scores which inversely correlate with insomnia severity & rigidly dysfunctional beliefs about sleep. Surprises disconfirm perceptions of fragile sleep and build confidence in sleep self-regulation. By quantifying surprise, the SSQ supports CBT-I behavioural experiments, creating learning opportunities to explore sleep-wake perceptions with growing curiosity.
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Personality, cognitive performance and perceived workload in young adults with unmanaged sleep disorders after 20 hours of extended wake

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Introduction: There are inter-individual differences in the effects of extended wake on cognitive performance, including a potentially modifying influence of personality trait dimensions. Greater extraversion has previously been associated with poorer psychomotor vigilance performance during extended wake in young adults with healthy sleep.
Performance may also be worsened in individuals with sleep disorders. Up to 20% of young adults have sleep disorders that require clinical investigation and up to 80% of these disorders are undiagnosed. Yet, young adults with sleep disorders are poorly represented in existing studies of extended wake. The aim of this study was to determine associations between sleep disorders, cognitive performance and perceived mental workload after extended wake in young adults, and explore whether personality dimensions modify any observed associations.
Materials and methods: Data from 24 young adults aged 18 – 32 years (Mean(SD) = 25.0(3.9), 42% female) were included. Participants first competed a Structured Clinical Interview (SCISD) and NEO Personality Inventory (NEO-PI-R) with a trained psychologist. All participants included in analyses met diagnostic criteria for insomnia (n=14) or delayed sleep wake phase disorder (DSWPD; n=10) according to DSM-5-TR criteria but had no prior diagnosis or treatment for a sleep disorder at baseline. Participants underwent a diagnostic polysomnography with sleep onset and offset times aligned with their habitual bedtime before commencing extended wake. The psychomotor vigilance task (PVT) was performed at 2 hours and 20 hours after wake. Reciprocal reaction time (RTT; 1/ mean reaction time) and number of lapses in attention were used to determine changes in performance and were the primary performance outcomes. The NASA Task Load Index (NASA-TLX) assessed subjective workload immediately after each PVT (performance, effort, frustration, and mental, physical, and temporal demand) on a 0-100 scale. Data were analysed in R Studio, using a combination of linear regression and mixed effects regression in the *lmer* package.
Results: We observed the anticipated effect of extended wake on PVT metrics, with reduced RRT (reflecting poorer performance, 3.02(0.56) *v* 2.22(0.77), $p<0.001$), and increased PVT lapses (3(7) *v* 15(13), $p<0.001$). All indicators of subjective mental workload on the NASA-TLX were elevated at 20hours wake compared to 2hours (all $p<0.05$), with the exception of temporal demand (p=0.42).
Time by personality dimension interactions on PVT performance were not significant (all $p>.05$), suggesting cognitive performance was not modified by personality dimensions. However, extraversion modified the association between extended wake and mental workload, where higher extraversion was associated with higher perceived temporal demand (B=1.04, 95%CI = 0.41, 1.68, $p=.002$), poorer perceived performance (B=0.79, 95%CI=0.08, 1.49, $p=.031$), and greater frustration (B=0.96, 95%CI=0.09, 1.83, $p=.033$).
Conclusions: Extraversion may modify the perceptions of performance and mental workload more broadly in young adults with sleep disorders. Unlike healthy sleepers, extraversion in young adults with sleep disorders modified the association between 20h of extended wake and subjective performance, but not objective performance. Personality-task mismatch on monotonous tasks may be an issue for extroverts who are entering healthcare professions, who may feel greater frustration and perceive poorer performance when sleep deprived.
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Factors and Issues Affecting Sleep Quality in Elderly Hong Kong Residents: A Cross-Sectional Survey, 2024-2025

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Introduction: Sleep is a vital component of health and well-being. Older adults in high living density living environments may experience disproportionately higher levels of sleep disturbances, reducing the quality of sleep. This study investigates the factors associated with poor sleep quality among Hong Kong adults aged 65 and older, with the aim of identifying modifiable targets for evidence-based interventions.
Materials and methods: Between December 2024 to April 2025, a cross-sectional random telephone survey was conducted on community-dwelling older adults (n=723). The Pittsburgh Sleep Quality Index (PSQI) was used to assess overall sleep quality, alongside questions regarding the sleep environment, substance use, and pre-sleep cognitive activity. Multiple linear regression models, adjusted for age, gender, education, and income, were applied to identify predictors of PSQI scores.
Results: Among the older age participants (59.9% female), respondents reported an average of 29 minutes to fall asleep, resulting in a mean total sleep duration of 6.45 hours/night (SD= 1.34). Of the sample, 24.9% reported less than 6 hours of sleep/night. Significant sleep impairments were observed, with 71.1% reporting difficulty initiating sleep and 93.1% struggling with sleep maintenance. Regression analysis identified three key predictors of PSQI scores: nocturia (β=0.988, p<0.001), pre-sleep cognitive arousal (β=3.223, p=0.001), and trends indicating that substance use, specifically smoking (β= 0.258, p=0.26) , was associated with reduced sleep efficiency. Breathing difficulties, loud cough/snoring, feeling cold/ hot, bad dreams and pain were not significantly associated with PSQI scores.
Conclusions: This study highlights the complex interplay of physiological, psychological, and behavioral factors contributing to sleep deficits among older adults in Hong Kong. Addressing these determinants could alleviate the healthcare burden associated with geriatric sleep disorders and enhance the quality of life for this vulnerable population.
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Napping and cognition in older adults-context matters: reasons for napping, nap timing, and overall sleep health

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Introduction: While midday napping in younger persons benefits cognition, napping in older persons tends to be associated with poorer cognitive outcomes, leading to the view that napping may be 'symptom' of age-related degradation in sleep neurobiology. However, whether naps are maladaptive or productive for older adults may depend on the reason behind the nap and must be understood in the context of overall sleep health as these may underlie negative associations. To rule this out, we examined associations between napping and cognition in a group of older adults with relatively good sleep health (7-10h average TIB, having no trouble falling asleep and/or staying asleep for ³ 5 nights/week, no sleep disorders).
Materials and methods: Older adult healthy sleepers (n = 393) aged between 67-80 years (mean age: 73.8 years, SD: 2.7 years) completed neurocognitive testing and questionnaires probing nap behaviour. Nap frequency (no naps, 1-2 naps/week, 3-6 naps/week, daily naps), nap duration (£ 30 mins, 31-60 mins, > 60 mins), nap timing (morning, afternoon, evening), nap intention (unintentional, intentional) and reasons for napping (slept poorly the night before, felt tired, boredom, habit) were assessed. Linear regression models were used to determine the effects of nap characteristics on cognitive domains (global cognition, speed of processing, executive function, attention, language, verbal, visual, and visual-spatial memory). Models adjusted for age, gender, years of education, smoking, high blood pressure, diabetes, and history of cardiovascular events and organ disease.
Results: Napping to counter tiredness was associated with better verbal memory (B = 2.47, CI_{95} = 0.29-4.66) and language (B = 2.08, CI_{95} = 0.07-4.09) compared to napping because one slept poorly the night before. Napping in the afternoon was associated with better visuospatial memory compared to napping in the morning (B = -5.77, CI_{95} = -10.55--0.99). Napping daily was also associated with better verbal

memory (B = 0.58, CI_{95}= 0.00-1.17) and language (B = 0.64, CI_{95} = 0.10-1.17) compared to not napping at all, but with relatively small effects.
Conclusions: In older adults with 'intact' sleep health, napping in the afternoon in response to tiredness cues is associated with better memory performance. Our findings suggest that whether or not napping is a 'symptom' or a 'strategy' for better daytime function may depend on its use patterns and the overall sleep health of an older person.

Correlation between iron deposition and cognitive function in OSA patients of different severity levels based on quantitative susceptibility mapping

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Introduction: Excessive cerebral iron deposition has been implicated in cognitive dysfunction across various neurological disorders. This study investigates severity-dependent patterns of cerebral iron accumulation in OSA using quantitative susceptibility mapping (QSM) and examines their potential role in mediating cognitive impairment.
Materials and methods: The study cohort comprised 139 OSA patients stratified by severity (68 mild-moderate [OSA-M: apnea-hypopnea index (AHI) 5-30 events/hour]; 71 severe [OSA-S: AHI>30]) and 48 healthy controls (HC). All participants underwent polysomnography, neurocognitive assessment using the Montreal Cognitive Assessment (MoCA), and 3T MRI with multi-echo gradient echo sequences for QSM analysis. Whole-brain voxel-wise comparisons was conducted to characterize iron deposition patterns. Correlation analysis and mediation models evaluated associations between OSA severity, regional iron content, and cognitive performance.
Results: As the severity of OSA patients increases, iron content increased in the left central anterior gyrus, left medial superior frontal gyrus, right central anterior gyrus, right medial superior frontal gyrus, right putamen, and middle cingulate gyrus increases; while it decreased in the left superior temporal gyrus, left superior frontal gyrus, right parietal sulcus, and middle right frontal lobe. Critically, higher iron levels in the left precentral gyrus and right putamen negatively correlated with cognitive deficits (MoCA), particularly in visuospatial function ($P < 0.05$), whereas lower iron in the left superior temporal gyrus and right parietal sulcus correlated with poorer cognition ($P < 0.05$). Mediation effect analysis demonstrated that iron deposition in the right putamen partially mediated the relationship between AHI, BMI, N3 stage proportion,Pulse oxygen<90% and cognitive function,especially the visuospatial abilities.
Conclusions: Our findings suggest that cerebral iron overload may contribute to cognitive dysfunction in OSA patients across severity levels, with chronic intermittent hypoxia-induced iron metabolism dysregulation serving as a potential neuropathological mechanism.
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Chronobiology/Circadian Disorders

Light at Night Exacerbates Depression Risk via Circadian Disruption and Hippocampal Per1 Dysregulation: Translational Evidence from a Large-scale Prospective Cohort and Animal Study

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Introduction: In the modern era of pervasive artificial lighting, approximately 80% of the global population is exposed to light at night (LAN), posing significant public health challenges. While cross-sectional evidence suggests a link between LAN and mood disorders, the causal effects and mechanisms remain poorly understood. This study integrates human cohort data with controlled animal experiments to elucidate the behavioral and neurobiological pathways linking LAN exposure to depression pathogenesis.
Materials and methods: We analyzed 75,636 UK Biobank participants with objectively measured LAN exposure via wearable devices. Incident depression cases were ascertained through linked electronic health records (hospitalizations, primary care visits) and mortality registries. Cox proportional hazard models, adjusted for potential confounders, were used to assess associations. To further confirm the causal effects of LAN on depression onset, ICR mice (n=50/group, 10-week-old) were randomized to: control group (12h 200 lux light/12h dark) or LAN group (12h 200 lux light/12h 5 lux dim light). Spontaneous locomotor activity was monitored using Clocklab. Depression-like behaviors were evaluated via sucrose preference test (SPT) and forced swim test (FST). Brain serotonin (5-hydroxytryptamine, 5-HT) and brain-derived neurotrophic factor (BDNF) levels were measured by ELISA. Hippocampal circadian genes were analyzed through multi-timepoint transcriptome sequencing, with rhythmicity evaluated using CircadiOmics. Key genes were further validated by Real-Time Quantitative Polymerase Chain Reaction (RT-qPCR).
Results: Compared to participants with low LAN exposure (median: ~ 1 lux), those with higher exposure exhibited significantly higher adjusted hazards for depression (HR=1.24, 95% CI: 1.12-1.35), demonstrating a dose-response relationship (P for trend < 0.01). Animal experiments demonstrated that, compared to the control group, LAN group exhibited significantly increased depression-like behaviors, such as decreased sugar preference and increased immobility time (all $P < 0.05$). In addition, locomotor rhythms monitoring revealed that LAN exposure reduced wheel-running activity, nocturnal activity levels, and rhythm amplitude (all $P < 0.05$). Correlation analysis revealed that disruptions in rest-activity rhythms were significantly associated with these depressive-like behaviors (all $P < 0.05$). ELISA analysis demonstrated decreased levels of both 5-HT and BDNF in the LAN group (all $P < 0.05$), with 5-HT levels showing positive correlations with activity amplitude ($P = 0.04$) and nighttime activity ($P = 0.01$). Moreover, transcriptome and RT-qPCR analysis further identified LAN exposure disrupted the expressions of hippocampal circadian genes particularly *Period 1* (*Per1*) in mice.
Conclusions: Integrating epidemiological and experimental evidence, we propose that LAN exposure may contribute to depression risk through circadian disruption, with hippocampal Per1 alterations and monoaminergic dysfunction emerging as plausible mechanistic links. This translational framework warrants further validation in targeted human interventions.
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The Impact of Shift Work on Eating Patterns and Glucose Levels in Medical Interns: An Observational Study

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Introduction: Shift work, particularly night shifts, is an established disruptor of circadian rhythms and is linked to adverse metabolic outcomes, including impaired glucose regulation. Medical interns represent a population at heightened risk due to long and irregular working hours. Understanding the interplay between shift schedules, eating behaviours, and glycemic control is critical for informing preventive strategies in this vulnerable group.

Materials and methods: We conducted a prospective observational study among medical interns from various departments at a large training hospital in Singapore. Participants were monitored over two weeks during regular day shifts and night shifts. Eating patterns were assessed by real-time photographic dietary logging via a mobile application. Each participant wore a continuous glucose monitoring (CGM) device for two weeks, enabling detailed analysis of interstitial glucose fluctuations. Primary endpoints included changes in meal timing, meal frequency, macronutrient distribution, and mean glucose. Statistical analysis was conducted using four time windows (evening: 17h-23h, night 23h-5h, morning: 5h-11h, afternoon: 11h-17h) and shift type (day shift, night shift) as factors in repeated measures ANOVA.
Results: A total of 61 interns (mean age 24.6 ± 1.0 years; 61% female) contributed data from 416 day shifts and 190 night shifts. Night shifts were associated with a significant shift in meal timing. While overall meal frequency was not different (2.4 ± 0.8 meals/day shift vs 2.6 ± 1.1 meals/night shift), fewer meals were taken in the evening preceding a night shift (0.74 ± 0.5) compared to a dayshift (0.96 ± 0.4 meals, $p = 0.02$), and more meals were taken during the night (0.47 ± 0.5 meals/night shift vs. 0.05 ± 0.1 meals/day shift, $p < 0.001$) and morning period (0.69 ± 0.4 meals/night shift vs. 0.55 ± 0.4 meals/day shift, $p = 0.043$). Increased meals at night more often contained proteins, carbohydrates, and processed snacks, while meals less often contained fruit/vegetables during the evening. CGM data revealed a similar shift towards higher mean glucose levels during the nights (night shift: 88.3 ± 1.4 mg/dL vs. day shift: 82.8 ± 1.2 mg/dL, $p < 0.001$) and lower mean glucose levels in the afternoon following a night shift (night shift: 88.5 ± 1.6 mg/dL vs. day shift: 97.5 ± 1.2 mg/dL, $p < 0.001$).
Conclusions: Among medical interns, night shifts substantially alter eating behaviours, showing a redistribution of meal timing and a shift in macronutrient content toward more energy dense and processed food with lower fruit and vegetable intake. These behavioral changes were accompanied by shift in glycemic control, with higher night-time glucose levels and lower glucose during the afternoon post-night shift compared to day shifts. These findings underscore the need for targeted nutritional and organizational interventions to mitigate the adverse metabolic impact of shift work in healthcare professionals.
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Within-subject variation in circadian timing in shift workers repeating the same shift pattern

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Introduction: While inter-individual variation in circadian response to shift work has been demonstrated, the within-individual variation in circadian timing when shift workers repeat the same shift pattern is unknown. Light is a key factor influencing individual circadian timing. This study aims to examine the consistency in circadian timing between two repeated occasions of the same shift pattern and the role of light exposure in explaining within-individual variability in circadian timing among shift workers.
Materials and methods: In an ongoing study, shift workers (*n*=25, age 39.12±11.50 years, 10 females) from multiple industries were monitored during two replications of their usual shift patterns (8-10 days), separated by at least 6 weeks. Shift patterns included consecutive night shifts, consecutive early morning shifts, and early-morning-to-night rotations. Participants completed daily sleep diaries and wore a wrist activity monitor to measure sleep-wake timing, and a lapel-worn light sensor for continuous measurement of light exposure. Circadian phase was assessed at the end of each shift pattern via 6-sulphatoxymelatonin (aMT6s) acrophase (peak) in urine. A light consistency index (LCI) was calculated as the percentage of time for which light was above or below a threshold of 70[TS1] melanopic lux at

corresponding parts of the work roster, to examine the consistency of light exposure patterns between the two occasions of the same shift pattern. The difference in average light exposure between the two occasions in the phase-advance (90-degree bin after acrophase) and phase-delay zones (90-degree bin before acrophase) of the circadian phase response curve to light was calculated.

Results: Analyses revealed moderate consistency in aMT6s acrophase between the two occasions of the same shift pattern (within-subject correlation: $r = 0.59$, $p < .001$), although substantial within-individual differences remained (mean difference = 2.38 ± 1.56 h; range = 0.14–5.46 h). Consistency in circadian timing was significantly associated with a higher light consistency index prior to circadian assessment (β = –0.09, $p = .02$, $R^2 = .22$). Aligning LCI to individual acrophase improved its ability to predict differences in acrophase (β = -0.08, $p = .0003$, $R^2 = .45$). Individuals with greater variation in acrophase had greater difference in light within the phase advance and delay zones. Linear regression revealed within-individual variation in acrophase was associated with differences in average light level in the advance (β = 1.99, $p = .02$) and delay (β = 3.75, $p = .00002$) zones between the two occasions ($R^2 = .56$).

Conclusions: Findings highlight within-individual variability in circadian phase in shift workers, despite following identical shift patterns. This indicates that circadian timing in workers cannot be assumed from a single measurement. This variability was explained by differences in light exposure, highlighting the value of light exposure for predicting circadian timing amongst shift workers. The ability to use light to improve circadian prediction has implications for informing personalised interventions in this population.

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Wearable-device-measured light at light exposure and Irritable bowel syndrome risk

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Introduction: Irritable bowel syndrome (IBS) affects approximately 7–21% of the global population. Circadian rhythm disruption (CRD) is increasingly recognized as a contributing factor in gastrointestinal disorders. Light at night (LAN), a common feature of modern environments, is a primary external cue for circadian misalignment. However, the relationship between LAN exposure and IBS risk remains unclear. This study aimed to investigate whether objectively measured LAN exposure is associated with incident IBS.
Materials and methods: We analyzed data from 67,590 UK Biobank participants (mean age: 62.7 years; 59.2% female), excluding baseline shift workers. LAN exposure was measured via wrist-worn accelerometers. IBS cases were identified through linked health records. Cox proportional hazards models were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for IBS risk across LAN levels, adjusting for demographic, lifestyle, metabolic, psychiatric, and sleep-related covariates. Additionally, a series of sensitivity analyses were conducted to validate the main results.
Results: Over a median follow-up of 7.0 years (466,674 person-years), 820 incident IBS cases were recorded. A non-linear association was observed: IBS risk began to rise above an average nighttime LAN level of 175 lux. Participants exposed to >175 lux had a higher risk of IBS (HR = 1.35; 95% CI: 1.05–1.73) compared to those with lower exposure. Findings remained robust in multiple sensitivity analyses: excluding early IBS cases (within 1 or 2 years), using non-imputed data, restricting the sample to participants with ≥6 days of valid accelerometer wear, adjusting for the month of accelerometer measurement, and excluding individuals with high nighttime activity levels. All results remained significant ($P < 0.05$), confirming the robustness of the association.

Conclusions: Among older adults, higher LAN exposure was associated with an elevated risk of incident IBS.. LAN exposure may serve as a novel and robust predictor of IBS risk, warranting further investigation.
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Sleep variability, eveningness and depression in adolescents: a case-control study

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Introduction: Adolescence is characterized by a circadian shift towards eveningness and changes in sleep pattern. This period is also often associated with an increased incidence of psychopathology, such as depression. Greater intraindividual sleep variability has been linked to both eveningness and depression. However, limited research has explored the interplay between eveningness and depression in relation to sleep variability in youth. The present case-control study aimed to investigate sleep variability in adolescents with eveningness and/or depression, as well as to explore the correlates of sleep variability.
Materials and methods: Four groups of adolescents aged 12-20 years were recruited: eveningness and depression group (ED), eveningness only group (E), depression only group (D), and healthy controls. Eveningness was defined as a score of ≤ 41 on the Morningness-Eveningness Questionnaire. Depression groups met DSM-5 criteria for major depressive disorder or dysthymia. Participants completed a 7-day sleep dairy with actigraphy monitoring and self-reported questionnaires to assess circadian preference, insomnia symptoms, depressive symptoms, and bedtime procrastination. Subjective and objective sleep variabilities were calculated using root mean squared successive differences from sleep diary and actigraphy data, respectively.
Results: A total of 95 participants (mean age: 17.82 s.d. 1.59 years, 76% female) were included in the analysis (ED: n = 23, E: n = 26, D: n = 25, C: n = 21). Both ED and D groups showed significantly more severe depressive symptoms compared to E and C groups (all ps < .001). ED group showed greater variability in time in bed (vTIB) compared to D group (sleep diary: p = .033; actigraphy: p = .040) and controls (sleep diary: p = .025; actigraphy: p = .013). ED group also showed greater variability in sleep offset (vSOFF) and rise time (vRT) as measured by sleep diary compared to D group (SOFF: p = .009; RT: p = .004) and controls (SOFF: p = .037; RT: p = .012). ED group showed greater variability in sleep offset as measured by actigraphy compared to E group (p = .034), D group (p = .005), and controls (p < .001). E group showed greater variability in time in bed as measured by actigraphy (p = .026) compared to controls. Regression analyses showed that stronger eveningness preference was independently associated with greater sleep variability in TIB, TST, and RT as measured by sleep diary, and TIB as measured by actigraphy (all ps < .05). No other associations were found between sleep variability parameters and insomnia symptoms, depressive symptoms, or bedtime procrastination.
Conclusions: The present study suggested a synergetic effect of eveningness and depression on increasing sleep variability in adolescents. Evening preference was independently associated with greater sleep variability. Future research may consider adopting a longitudinal design to further elucidate the

relationships between sleep variability, chronotype preference and depression and to explore the effects of circadian-focused interventions on reducing sleep variability and depressive symptoms in youth.
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Reward processing and eveningness in adolescents: A case-control study with EEG investigation

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Introduction: Adolescence is often associated with increased evening tendency and the risk of developing mental health problems. Previous research has suggested a close interplay between evening chronotype, which is characterized by an inclination for later bedtime and wake time, and depression, but there has been limited research to investigate the potential mechanism underlying their association. Given that altered reward processing is a key feature of depression, this case-control study examined whether adolescents with an evening preference also exhibit deficits in reward processing.
Materials and methods: Thirty adolescents aged 12–20 (63.33% female) with an evening chronotype (Morningness-Eveningness Questionnaire (MEQ) ≤41) and 30 non-eveningness healthy controls (MEQ ≥42) with matched age and sex were recruited. Participants with a current clinical diagnosis of sleep or psychiatric disorders (except for delayed sleep phase disorder in the eveningness group) or a medical condition that could significantly affect sleep quality were excluded. All participants underwent a clinical interview, followed by completing a battery of self-report questionnaires including Insomnia Severity Index (ISI) for insomnia severity, Beck Depression Inventory-II (BDI-II) for self-reported depressive symptoms, and the subscale of reward responsiveness in Behavioral Inhibition System/Behavioral Activation System (BIS/BAS) scales for the measure of reward responsiveness. The Children's Depression Rating Scale-Revised (CDRS) was used for measuring clinician-rated depressive symptoms. Participants wore an actigraphy for eight consecutive days and completed a Door Guessing Task as a measure of reward sensitivity using an electroencephalogram.

Results: The eveningness group had higher self-reported and clinician-rated depressive symptoms (both Ps < 0.05) but comparable insomnia severity. In terms of sleep measures, the eveningness group showed significantly longer sleep onset latency, later bedtime, rise time, and sleep midpoint as measured by sleep diary. Actigraphy results showed significantly later sleep onset, sleep offset, and sleep midpoint, as well as shorter total sleep time in the eveningness group compared to healthy controls (all Ps < 0.05). Compared to healthy controls, the eveningness group showed significantly lower signal on reward positivity (RewP) overall without significant difference between conditions ($F(1, 51) = 4.35$, $P = .042$), indicating blunted reward processing. On the behavioral level, the eveningness group also showed stronger alterations (switched choices more often) in the trial-by-trial behavioral adjustment analyses ($t(7105.0) = 2.57$, $p = .010$). However, there was no significant interaction between group, cue, and choice adjustments. Healthy participants showed significantly different reaction times (gain > neutral, $t(7065.2) = –2.21$, $P = .027$), this effect was not found in eveningness participants. Reward responsiveness, as measured by BIS/BAS, was not significantly different between groups.

Conclusions: RewP may reflect the neural deficits in reward processing and has been suggested as a potential early biomarker for depression. The findings on blunted response to reward in adolescents with evening preference may be indicative of the risk for depression in eveningness. Longitudinal studies are necessary to establish causality and explore potential interventions targeting circadian factors in the prevention of youth depression.
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Dental

Effects of Oral Appliance Therapy on Sleep Bruxism and Sleep-Respiratory Parameters in Patients with Obstructive Sleep Apnea

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Introduction: This study aimed to investigate the relationship between sleep-related respiratory events and sleep bruxism (SB) in patients with obstructive sleep apnea (OSA) treated with oral appliance (OA) and to clarify the efficacy of OA treatment on SB.
Materials and methods: Twenty-one OSA patients (10 males and 11 females; mean age, 57.8 years±16.0 SD） were sequentially enrolled in this study at Fukuoka University Hospital from October 2020 to May 2025. They underwent overnight polysomnography (PSG), and their masseter muscle activity was simultaneously assessed using a wearable electromyographic device before and after OA treatment. The apnea-hypopnea index (AHI), arousal index (ArI), percutaneous oxygen saturation (SpO_2), and episodes of SB were compared before and after OA treatment. The responding group that improved AHI by more than 50% or reduced it by less than 5 after treatment (n = 10) was compared to the non-responding group with other conditions (n = 11). OSA and SB diagnoses were based on the guidelines and criteria of the AASM.
Results: OA treatment significantly reduced mean AHI from 17.3±7.8 SD to 12.3±10.7 SD ($p = 0.008$), and respiratory events during both REM and NREM sleep. The total episodes of SB, tonic, and mixed episodes also significantly decreased ($p = 0.002$, $p = 0.034$, and $p = 0.002$, respectively). Meanwhile, the ArI and spontaneous arousal index (SAI) during REM sleep significantly increased ($p = 0.008$ and $p = 0.007$, respectively). Additionally, the non-responding group in OA treatment showed a significant reduction in total SB episodes ($p = 0.013$).
Conclusions: This study suggests that SB is a pathological condition associated with multiple factors besides OSA. OA may be effective for both respiratory events and SB. Meanwhile, to understand the mechanism that causes SB and to determine the applicability of OA and maximize its therapeutic effect, further research is needed.

Effects of Home-Based Tongue Exercises on Tongue Strength in Older Adults: Implications for Sleep-Disordered Breathing

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Introduction: Age-related declines in orofacial muscle tone, particularly reductions in tongue strength, contribute to dysphagia and increased upper airway collapsibility during sleep—an important pathophysiological mechanism in obstructive sleep apnea (OSA). Tongue exercises (TEs) utilizing specialized devices have been proposed as effective interventions for improving tongue strength and mitigating OSA severity. However, such devices are often costly, cumbersome, and impractical for routine home use, limiting their accessibility for older adults.
Home-based TEs offer a feasible, low-cost alternative to improve tongue function without specialized

equipment. Despite emerging interest in their use, the most effective home-based TE protocols for enhancing tongue strength in older adults remain insufficiently studied. This study aimed to evaluate the effects of three simple home-based TE protocols on anterior and posterior tongue strength in older adults, with potential implications for the management of sleep-disordered breathing.
Materials and methods: Thirty-six healthy older adults (aged ≥65 years) were randomly assigned to one of three home-based tongue exercise (TE) protocols: **tongue wrap**, **tongue corner**, or **tongue paint**. Participants were instructed to perform each exercise five times per session, three sessions per day, over a four-week period at home. Anterior tongue strength (ATS) and posterior tongue strength (PTS) were assessed using the Iowa Oral Performance Instrument (IOPI) at baseline and after the intervention period. Improvements in both ATS and PTS were recorded and analyzed to evaluate the efficacy of each TE protocol.
Results: All TE groups showed post-training gains in tongue strength. The **tongue paint** group showed statistically significant improvements in both ATS and PTS ($p < 0.05$), with mean gains of 28.70 ± 27.93 and 53.13 ± 89.96 kPa, respectively, corresponding to the greatest relative increase (30.72%). The tongue wrap and tongue corner groups also exhibited improvements (ATS: 12.75 ± 25.05 and 20.74 ± 36.14 kPa; PTS: 18.56 ± 35.53 and 9.04 ± 21.57 kPa, respectively), although changes were not statistically significant.
Conclusions: Home-based TEs, particularly the **tongue paint** protocol, significantly improved both ATS and PTS in older adults. These findings support the effectiveness of targeted, cost-free TEs as a non-invasive strategy to enhance tongue function. Strengthening tongue musculature through such exercises may contribute to improved oropharyngeal stability and potentially reduce the risk of sleep-disordered breathing in the elderly population.
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Excessive Daytime Sleepiness

Assessment of wakefulness in Vietnamese patients with obstructive sleep apnea using a modified Maintenance of Wakefulness Test protocol

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Introduction: Obstructive sleep apnea (OSA) is marked by the recurrent collapse of the upper airway during sleep, causing fragmentation of normal sleep patterns and notable sleepiness during the daytime. The Maintenance of Wakefulness Test (MWT) assesses a patient's ability to stay awake in a dark environment without any external support. With this study, we aimed to evaluate the ability to maintain wakefulness among OSA patients in the Vietnamese population using a modified MWT protocol.
Materials and methods: A cross-sectional study, collecting patients from University Medical Center, Ho Chi Minh City, from November 2022 to August 2024. Adult patients with newly diagnosed, untreated OSA were recruited, excluding those on sleep-affecting medications or those with other conditions affecting alertness. Pilot testing revealed challenges with the standard MWT due to cultural napping habits, leading to protocol adaptation. The modified MWT allowed participants to nap between sessions at their usual times, required waking at least 30 minutes before each session, and subjects were not awakened if sleep occurred during the 40-minute sessions. Signals from the MWT electrodes were recorded continuously

between sessions to measure the sleep latency (SL) of each session and the total sleep time (TST) during the test day.
Results: The study included 63 subjects, median age 48 (IQR 36-58), 79% male, median BMI 27.4 (IQR 25.1-29.8), 84% reported napping habits. Most of participants (71%) had severe OSA (median AHI 44, IQR 26-70). Objective MWT measurements showed average SL of 22 minutes (IQR: 11-30). A clear correlation was observed, with baseline AHI positively correlated with TST and negatively correlated with SL measured by MWT. In MWT, sleeping in session 1 increased the odds of sleeping in session 2 by 3.64 times (95% CI: 1.16, 11.9); greater TST in a preceding session was significantly associated with shorter SL in the subsequent session(s).
Conclusions: Higher TST in a preceding MWT session correlated with higher TST and shorter SL in subsequent session(s), indicating persistent difficulty staying awake, regardless of nap. The modified MWT protocol, tailored for cultural sleep practices, provides feasible and meaningful assessment of wakefulness in Vietnamese patients with OSA, thereby suggesting adaptation the MWT for countries with nap habits.
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Long-Term Clinical and Functional Evolution in Patients with Obstructive Sleep Apnea and Daytime Sleepiness Treated with CPAP: Results from the HYPNOSA Cohort Study

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Introduction: Obstructive Sleep Apnea (OSA) associated with Excessive Daytime Sleepiness (EDS) is a highly prevalent clinical phenotype with significant impact on physical and psychological wellbeing. The HYPNOSA study aims to characterize this phenotype and evaluate the evolution of symptoms, quality of life, and physiological parameters under CPAP therapy. This abstract presents descriptive interim findings at 6, 12, and 24 months of follow-up.

Materials and methods: HYPNOSA is a prospective, multicenter observational study including 616 patients diagnosed with OSA and EDS. Patients were evaluated at baseline and followed at 6, 12, and 24 months. Collected data included demographics, respiratory sleep parameters (AHI, CT90, mean $SatO_2$), ESS, EuroQol-5D, FOSQ, HADS, and CPAP adherence. Analyses were conducted using R v4.4.2.
Results: The population had a mean age of 55.6±11.5 years; 65.6% were male. Baseline sleep study showed severe OSA (mean AHI: 39.5/h), oxygen desaturation ($SatO_2$: 91.4%) and prolonged hypoxic burden (CT90: 21.7%).
Baseline clinical scales revealed a high burden of symptoms:

- **Epworth Sleepiness Scale (ESS):** mean 10.9 (P50: 11), with most reported sleepiness while watching TV (2.06±0.95) and lying down in the morning (2.22±0.98).
- **EuroQol-5D:** moderate limitation in mobility, pain, and daily activities (mean ~1.5), with **anxiety/depression as the most impaired domain**.
- **FOSQ:** mean score of 92.1±24.4, with marked functional impairment; 20 of 30 items scored >3.2 (quite a bit/much), especially in concentration, household chores, and keeping pace with peers. Lowest was general activity (2.69±1.1).
- **HADS:** total score 12.07±7.24, indicating frequent symptoms of anxiety and low mood.

At 6 months, improvements were substantial:

- **ESS:** 7.95±4.61, with reduction in most somnolence items.
- **EuroQol-5D:** improved to 73.5±16.5, pain remained most reported limitation.
- **FOSQ:** increased to 100.07±21.3, 29/30 items >3.4; lowest again was general activity (2.8±1.04).
- **HADS:** reduced to 4.17, indicating low-mild psychological symptoms.
- **IAH:** decreased to 3.2/h; **CT90 fell to 0.5%**; **$SatO_2$ improved to 95%**; average CPAP use: 6.2 h/night.

At 12 months, this trend continued: ESS 7.19; HADS 2.04; FOSQ 101.5; EQ-5D 72.5. At 24 months (in limited data), results remained stable: ESS 6.67, HADS 0.05, FOSQ 109.7, EQ-5D 76.7. CPAP adherence was consistently above 5.3 h/night.
Conclusions: Despite being relatively young and without major comorbidities, patients with OSA and EDS present with significant functional, emotional, and quality-of-life impairment. CPAP treatment leads to rapid and sustained improvement in sleep physiology, daily functioning, and psychological wellbeing. However, some limitations—especially general activity—persist. These findings support the value of long-term follow-up and structured management in this clinical phenotype.

Sleep Health

Associations between thyroid hormone regulation and sleep phenotypes

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Introduction: Our study aims to assess the causal relationships between thyroid hormone regulation (including thyroid stimulating hormone (TSH), free thyroxine (FT4) levels, hypothyroidism, and hyperthyroidism) and sleep traits such as Apnea–Hypopnea Index (AHI)/Respiratory event index (REI), obstructive sleep apnea (OSA), snoring, excessive daytime sleepiness (EDS), insomnia as well as sleep duration.
Materials and methods: We obtained summary statistics from published genome-wide association studies (GWAS) on thyroid hormone regulation and sleep traits. Subsequently, we performed bidirectional Mendelian Randomization (MR) analyses to estimate the causal directions and effects between them.

The inverse variance weighting (IVW) approach was used as the primary method, with multiple methods serving as alternative sensitivity analyses.
Results: We revealed that insomnia has a negative causal influence on TSH levels (β=-0.192, 95%CI = [-0.383, -0.002], *p*=0.048). We also observed that OSA has a positive causal influence on FT4 levels (β=0.098, 95%CI = [0.022,0.175], *p*=0.012). Sleep duration was found to have a negative causal effect on FT4 levels (β=-0.187, 95%CI = [-0.314, -0.060], *p*=0.004). Conversely, TSH levels showed a positive causal impact on OSA (β=0.079, 95%CI = [0.025,0.132], *p*=0.004). Further validation analyses based on heterogeneity and pleiotropy status were consistent with the causal direction of the above initial results.
Conclusions: Our results indicated suggestive causations from insomnia to TSH levels, from OSA and sleep duration to FT4 levels as well as from TSH levels to OSA, providing valuable insights into clinical strategies for regulating thyroid function and preventing sleep problems.

The Impact of Sleep Deprivation on Mental and Physical Functioning Among Medical Students: A Mixed-Methods Study

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Introduction: Current research indicates that sleep deprivation induces significant neurocognitive impairments in healthy adults, including impaired synaptic plasticity, reduced brain volume, disrupted memory consolidation, and decreased alertness. Medical students typically experience shorter sleep duration and irregular sleep pattern, due to high-intensity academic tasks and clinical workload. This study aimed to assess the impact of sleep deprivation on mental and physical functioning as well as the daily life, among the medical students.
Materials and methods: This sequential explanatory mixed-methods study received ethical approval from the Ethics Committee of GPHCM (No. YE2022-266). All participants provided written informed consent prior to the enrolment. Phase 1 was a quantitative survey of medical students aged 18-26 years, interning in Guangzhou with self-reported average sleep duration ≤ 7 hours/night over the past week. Participants completed the Profile of Mood States (POMS), Epworth Sleepiness Scale (ESS), and Psychomotor Vigilance Task (PVT) to assess their emotional states, daytime sleepiness, and cognitive performance (reaction time, vigilance, and sustained attention). Based on the pilot study indicating cognitive impairment (defined as >10 PVT lapses) in 10% of participants, a sample size of 35 was expected. Phase 2 was a semi-structured qualitative interview, recruiting participants from the Phase 1, aiming at supplementing the quantitative findings. Data were analysed using statistics, thematic analysis, and triangulation validation between the quantitative and qualitative results .
Results: Quantitative analyses showed a significant negative correlation between sleep duration and PVT lapses ($p < 0.05$), indicating vigilance declined with reduced sleep duration. While sleep duration correlated negatively with PVT response speed, this relationship was not statistically significant ($p > 0.05$). Sex, body mass index, menstrual period, medical school and caffeinated beverages consumed did not significantly affected the PVT performance, POMS scores, or ESS scores ($p>0.05$ for all). Qualitative data revealed that all interviewees subjectively perceived sleep deprivation as negatively affecting their next-day work and study performance, including cognitive deficits, emotional instability, and uncomfortable physical symptoms. Common manifestations included reduced attention and psychomotor slowing (consistent with PVT results), alongside with impaired short-term memory, fatigue, and headaches, which was beyond the quantitative findings. Subgroup-analysis suggested that participants with mild sleep deprivation (6–6.5 hours/night) experienced appetite suppression and chest tightness, whereas severe deprivation (4–5 hours/night) had complaints about severe fatigue, excessive daytime sleepiness, memory impairment, and hyperarousal.
Conclusions: Even short-term sleep deprivation impairs brain functioning, causes discomfort and disrupts daily life in medical students. These findings underscore the urgent need to develop targeted healthcare interventions for medical students to mitigate these adverse effects, which may include sleep hygiene education, workload adjustments, and psychological support services.

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Sleep Concordance and Discordance in Dyads of Cancer Patients and Bed-Partner Caregivers: A Systematic Review on Patterns, Health Impacts, and Dyadic Interventions

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Introduction: Optimal sleep is composed of adequate sleep duration (seven to eight hours) that is easily initiated (less than 20 min of sleep onset latency [SOL]) and maintained without disruptions (less than 20 min of wake after sleep onset [WASO]). Non-optimal, disturbed sleep has been seen at an alarming high level in cancer patients and caregivers. The context of coping with cancer together as a relational system makes the cancer patient-partner dyads unique in the phenomenon of sleep and sleep disturbance. Therefore, this systematic review aimed to synthesize evidence on sleep concordance and discordance in the dyads of cancer patients and bed-partner caregivers.
Materials and methods: We conducted the systematic review following the JBI Manual for Evidence Synthesis on conducting systematic reviews of effectiveness. Searches were conducted the four medical databases, including PubMed, CINAHL Plus, Web of Science, and EMBASE. Studies were included if they focused on sleep in adult cancer populations, and included the perspectives on dyadic patterns, health impacts, and interventions of sleep among cancer patient-caregiver dyads. A narrative synthesis was conducted based on our three research questions: Dyadic patterns (sleep concordance and discordance), Health impacts (actor and partner effect on physical and psychosocial health), and Dyadic interventions. Meta-analyses were performed to determine the pooled effect of dyadic intervention on sleep outcomes.
Results: A total of 3810 studies imported for screening. Twenty-eight studies were included in the narrative synthesis with19 observational studies and 9 interventional studies. Majority of caregivers reported the relationships with patients as spouses or partners. Observational studies identified significant actor and partner effects between sleep and health outcomes, including physical functioning, anxiety and depression, quality of life, and relationship satisfaction. Mindfulness practices were the most used intervention strategies in dyads. Psychological interventions, including family resilience therapy and acceptance and commitment therapy, have been applied in cancer patient-caregiver dyads. Eight studies reported the effectiveness of dyadic interventions on cancer patients' and caregivers' sleep disturbances. Dyadic interventions yielded a significant effect on decreasing patients' sleep disturbances (SMD=-0.53, 95%CI [-0.91, -0.15]) with a medium level of heterogeneity indicated by I^2=48% as well as a significant effect on decreasing caregivers' sleep disturbances (SMD=-0.52, 95% [-0.84, -0.19]) with a low heterogeneity indicated by I^2=0%.
Conclusions: This review acknowledged the interdependent nature of sleep among cancer patients and caregivers. Our results could have significant implications in sleep management for healthcare professionals working with dyads impacted by cancer, particularly bed-sharing couples.

Comparative Efficacy of Transcutaneous Auricular Vagus Nerve Stimulation (taVNS) versus SSRIs for Sleep Improvement in Depression: An 8-Week Randomized Controlled Trial

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Introduction: Depression is typically accompanied by considerable sleep disorders, which often remain even after treatment. Transcutaneous auricular vagus nerve stimulation (taVNS), a non-invasive neuromodulation therapy, has showed potential in treating depressive symptoms. Some research reveals that taVNS may alter sleep regulation via its effects on the autonomic nervous system and sleep-wake cycle modulation. However, its comparative efficacy with first-line selective serotonin reuptake inhibitors (SSRIs) for improving sleep symptoms in depression remains unclear. This study aims to compare the efficacy of 8 weeks of taVNS treatment with SSRI drug treatment in improving sleep disorders in patients with depression.
Materials and methods: This study included 43 adult patients with depression meeting DSM-5 diagnostic criteria. Participants were randomly assigned to the taVNS group (n=21) or the SSRIs group (n=22) and received 8 weeks of treatment. The taVNS group received 30 minutes of standardized parameter stimulation therapy daily, while the SSRIs group received medication treatment according to clinical guidelines. Sleep outcomes were assessed using the Hamilton Depression Rating Scale (HAMD) sleep subscale at baseline and post-treatment. Baseline characteristics showed no significant differences between groups in HAMD sleep scores ($F=2.302$, $p=0.494$; taVNS group: $M=3.71\pm0.332$; SSRIs group: $M=3.32\pm0.462$). Statistical analyses included paired t-tests for within-group comparisons and Mann-Whitney U tests for between-group differences, with effect sizes calculated using Cohen's d.
Results: Both treatment modalities demonstrated significant improvements in sleep symptoms after 8 weeks of intervention. In the taVNS group, HAMD sleep scores decreased from 3.71 ± 1.52 at baseline to 2.33 ± 1.80 post-treatment ($t(20)=3.15$, $p=0.005$, $d=0.69$), representing a medium effect size improvement. Similarly, the SSRI group showed reduction from 3.32 ± 2.17 to 1.64 ± 1.33 ($t(21)=3.00$, $p=0.007$, $d=0.64$), also demonstrating a medium effect size. Between-group comparisons using Mann-Whitney U tests revealed no statistically significant difference in treatment efficacy ($U=226.5$, $z=-0.112$, $p=0.911$), with comparable mean ranks between groups (taVNS=22.21; SSRIs=21.80). Both treatments were well-tolerated, with no serious adverse events reported in either group.
Conclusions: This study provides evidence that both taVNS and SSRIs are effective in improving sleep disturbances associated with depression, with comparable efficacy after 8 weeks of treatment. These findings position taVNS as a viable non-pharmacological alternative to SSRIs for managing sleep symptoms in depression, particularly for patients who prefer to avoid medication or experience side effects from pharmacotherapy. The comparable efficacy, combined with taVNS's favorable safety profile, supports its consideration in treatment algorithms for depressed patients with prominent sleep disturbances. Future research should investigate longer-term outcomes, optimal treatment parameters for taVNS, and potential differential effects on specific sleep architecture components.

Contemporaneous network analysis of mental health symptoms in middle-aged and elderly patients with OSA

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Introduction: To analyze the mental health status and severity of middle-aged and elderly patients with obstructive sleep apnea (OSA), and to construct a network of mental health symptoms in middle-aged and elderly patients with OSA through network analysis, and to identify the core symptoms.
Materials and methods: A total of 741 patients with OSA who were admitted to the Sleep Medicine department of the People's Hospital of Guangxi Zhuang Autonomous Region from February 2022 to November 2023 were enrolled. The symptomcheck lis1-90 (SCl-90) was used to evaluate the psychological situation of the patients. According to whether the score of each factor of SCL-90 ≥2, it was divided into positive symptom group and negative symptom group of each factor. The

network analysis method was used to construct the psychological symptom network, and the core symptoms were identified through the central index, the bridge strength was analyzed, and the psychological and polysomnography characteristics of the positive and negative groups of bridge symptoms were compared.
Results: The most common psychological symptoms of middle-aged and elderly patients with OSA were other symptoms (60.46%), obsessive-compulsive compulsion (45.48%) and somatization (38.87%), and the results of centrality index analysis showed depression (rs=1.433, rb=1.950, rc=2.024), anxiety (rs=1.109, rb=0.942, rc=0.727) and interpersonal sensitivity (rs=1.006, rb=1.278, rc=0.587) as the core symptom. Depression is the primary bridging symptom, followed by interpersonal sensitivity and anxiety. Patients were grouped according to the presence of positive symptoms of anxiety or depression. It was found that patients with anxiety or depression symptoms had lower AHI (Apnea-Hypopnea Index) but were more prone to daytime somnolence.
Conclusions: Depression, anxiety and interpersonal sensitivity are the core symptoms of psychological symptoms in middle-aged and elderly patients with OSA, which provides new ideas for the clinical diagnosis of this population, determines the key intervention targets for clinical treatment, and provides a theoretical basis for reducing the symptom management burden of middle-aged and elderly OSA patients.

Structural Factors Impeding or Facilitating Freshmen Sleep Habits

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Introduction: Starting college is a time of transition that can be stressful. Developing healthy sleep habits in this period of relative autonomy is important for physical and mental wellbeing. We evaluated freshmen sleep, activity and wellbeing through different phases of the academic calendar using a wearable (Oura Ring) and a proprietary app (Z4IP). A comprehensive understanding of the structural factors that impede or facilitate freshmen sleep as they adapt to college life can inform programs to optimize student life and wellbeing.
Materials and methods: 638 freshmen underwent multi-factor evaluation across a 20-week semester using a combination of objective sleep measurements (Oura Ring), daily subjective reports of sleep and well-being (Z4IP), and periodic time-use diaries (Z4IP). We explored how sleep patterns were affected by the academic calendar, early morning classes, and staying on- versus off-campus.
Results: During instructional weeks, freshmen woke 49.8min earlier on weekdays compared to weekends (t_{629}=24.14, p<.0001), especially when there were early morning classes. However, delaying waketimes after the midterm break (β=5.81, p<.0001), often past the first class, resulted in increased sleep (β=5.56, p<.0001). In contrast, bedtimes were stably late across the semester, with minimal weekday-weekend differences (15.2min). Despite reduced needs for commuting, freshmen staying on-campus obtained less sleep than those staying off-campus (t_{629}=−6.36, p<.0001), even after accounting for naps (t_{629}=−5.26, p<.0001), due mainly to later bedtimes (t_{629}=6.62, p<.0001). Four hours before going to bed, on-campus students spent 60min on social and co-curricular activities, and compositional data analyses indicated that those spending more time on these activities slept later. Additional digital leisure activities showed similar effects for off-campus students.
Conclusions: Freshmen's sleep evolved across the semester as they adapted to college life. By the second half of the semester, more sleep was obtained by waking up later, often past early morning classes. Residential status also affected their sleep habits, and the type of activities that delayed when they went to bed. The mix of predicted and unpredicted findings underscores the utility of our minimally obtrusive, multi-factor, longitudinal behavioural and physiological phenotyping approach.
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Poor sleep behaviour from childhood to adolescence is associated with polycystic ovary syndrome in adolescence: Findings from the Raine Study

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Introduction: Poor sleep behaviour is highly prevalent in females with polycystic ovary syndrome (PCOS), but its relationship with PCOS during childhood and adolescence is unclear. This study compares the longitudinal sleep behaviour trajectories and specific sleep behaviours from childhood to adolescence in those with and without PCOS.
Materials and methods: Caregivers of index participants (Gen2) of the Raine Study completed the Child Behavior Checklist (CBCL) questionnaire at ages 5-, 8-, 10- and 14-years. The CBCL includes six sleep behaviour items, each rated as '0' (not true), '1' (somewhat/sometimes true) or '2' (very/often true), which were summed to generate a composite score. A higher score indicates poorer sleep behaviour. PCOS status was assessed at 14-year using the 2018 adolescent Rotterdam criteria. Sleep behaviour composite scores were analysed longitudinally using generalized estimating equations at each time point and across time from 5-, 8-, 10- to 14-years. Prevalence of each sleep behaviour item from ages 5- to 14-years were also determined.
Results: N=187 participants with fully completed sleep behaviour and PCOS data were included, consisting of 29 (15.5%) diagnosed with PCOS. After adjusting for age of menarche, body mass index percentiles, family income, and symptoms of anxiety/depression, participants with PCOS exhibited poorer sleep behaviour trajectory compared to participants without PCOS that worsened over time from ages 5- to 14-years (mean difference (MD)=0.65, 95% confidence interval (CI)=0.23 to 1.07, p=0.003). Poor sleep behaviour trajectories did not differ significantly between participants with and without PCOS at age 5 (MD=0.09, 95% CI= -0.39 to 0.58, p=0.71), but diverged significantly from age 8 (MD= 0.76, 95% CI=0.14 to 1.37, p=0.016) until age 14 (MD=1.04, 95% CI=0.36 to 1.72, p=0.003). Specifically, compared with participants without PCOS, those with PCOS had a higher prevalence of several poor sleep behaviours during childhood, including trouble sleeping (24.1–69.0% vs. 7.0–43.7% at ages 5, 10, and 14), being overtired without good reason (34.5–79.3% vs. 20.3–53.8% at ages 5, 8, and 14), and sleeping less than most kids (24.1–48.3% vs. 11.4–31.0% at ages 10 and 14). Other sleep problems such as nightmares, talking or walking in sleep, and sleeping more than most kids showed smaller or inconsistent differences between groups.
Conclusions: Our findings suggest that participants with PCOS diagnosed at adolescence have poorer sleep behaviour patterns during childhood compared to participants without PCOS. In children with diagnosed PCOS at adolescence, poor sleep may worsen hormonal imbalances and metabolic issues, potentially increasing insulin resistance and obesity, and further sleep problems in a vicious cycle. Future research should identify and address childhood sleep problems, leading to better interventions and support.
Acknowledgments: Veski Fellowship (LM); NHMRC Centre for Research Excellence in Women's Health in Reproductive Life (grant 1171592); Australian Government Research Training Program Scholarship (NAJ). Core management of the Raine Study funded by The University of Western Australia, Curtin University, The Kids Research Institute Australia, Women and Infants Research Foundation, Edith Cowan University, Murdoch University and The University of Notre Dame Australia. The PCOS sub-study from Gen2 14-year follow-up was funded by NHMRC (Hickey et al, ID 403968).

Unpacking the Discrepancy Between Subjective and Wearable-Measured Sleep: A Neurophysiological Perspective Using fNIRS

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Introduction: Discrepancies between subjective sleep experience and objective sleep metrics are well-documented in both clinical and consumer settings. While consumer sleep trackers like Fitbit provide convenient longitudinal monitoring of sleep structure using accelerometry and PPG, many users report that these data do not align with how they feel upon waking. These mismatches are often attributed to device inaccuracy, yet even gold-standard polysomnography (PSG) explains only a small fraction of the variance in subjective sleep quality. Despite this, little is known about the underlying neural basis of this divergence, particularly in the context of sleep-tracking technologies. This study aims to explore the neurophysiological correlates of subjective versus wearable-derived sleep assessments during the first sleep cycle, and to evaluate whether these reflect distinct patterns of prefrontal cortical activity.
Materials and methods: We conducted an N-of-1 pilot study with a healthy male in his 30s, free from diagnosed sleep or mental health conditions. Prefrontal cortical hemodynamics were recorded during the first 90 minutes of sleep using a 27-channel wearable fNIRS system (Brite 24, Artinis). Concurrently, sleep metrics were obtained from a Fitbit Sense (e.g., TST, WASO, sleep efficiency, light/deep/REM sleep ratios, and Fitbit's sleep score). Subjective sleep quality was self-rated on a 5-point Likert scale each morning. Eight hemodynamic features were derived from fNIRS data (i.e., mean, median, SD, skewness, kurtosis, total power, peak amplitude, peak ratio), and correlations were computed with both subjective ratings and Fitbit metrics.
Results: Subjective sleep ratings were moderately and positively correlated with median ΔO_2Hb and ΔHHb in specific prefrontal cortex (PFC) channels, suggesting that more stable or elevated hemodynamic activity during the first sleep cycle may support better perceived sleep. Negative correlations were observed between subjective ratings and the skewness and kurtosis of ΔO_2Hb, indicating that flatter or more symmetrical signal shapes may align with positive sleep perception. In contrast, Fitbit's sleep score showed strong negative correlations with the mean and standard deviation of ΔO_2Hb and ΔHHb in a different set of PFC channels ($r < -0.70$), implying that higher signal amplitude or variability is linked to poorer device-rated sleep quality. Additional Fitbit metrics demonstrated distinct physiological signatures. Sleep continuity metrics—including sleep efficiency, WASO, wake ratio, and light sleep ratio—were positively associated with hemodynamic activity. Conversely, sleep quantity metrics like total sleep time and deep sleep ratio showed negative associations. REM sleep ratio exhibited weak or inconsistent correlations. Topographical analyses revealed little spatial overlap between channels linked to subjective ratings and those linked to Fitbit metrics.
Conclusions: Subjective and wearable-based sleep assessments appear to reflect different neurophysiological dimensions of early sleep cycle. The commonly observed mismatch is not merely a matter of device error but rather of measurement misalignment. These findings suggest a need to move beyond improving algorithmic accuracy and toward personalized, neuroscience-informed feedback in future sleep tracking technologies.
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Comparing sleep markers in a comparative micro-cohort study for mothers with depressive symptoms and a community cohort

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Introduction: Infant sleep is crucial for early development, with maternal mental health being linked to the infant's sleep patterns. While maternal depression can negatively affect various aspects of parenting, its direct impact on infant sleep remains underexplored.

This study aims to compare reported sleep markers of both infants and mothers from the Women's Emotional Health Service (WEHS) to those from the Sleep Easy Programme (SleEP). The WEHS

supports mothers identified to have pre-and-postnatal depression or other types of emotional distress through the child's first year of life. The SleEP is the first community-based infant sleep screening and early intervention program in Singapore. We report findings from the first nine months of our collaboration (July 2024 to March 2025).

Hypothesis
It is hypothesized that infants of mothers with depressive symptoms will exhibit more frequent night wakings, shorter sleep durations, and disrupted sleep patterns compared to the community group. It is expected that in the former group, there will be a higher referral need to be referred for sleep interventions.

It is also hypothesized that mothers with depressive symptoms will report a shorter sleep duration compared to the community group.
Materials and methods: A 22-item questionnaire adapted from the Brief Infant Sleep Questionaire, was administered on parents of infants for both groups during the enrollment. For the SleEP cohort, the parents completed the form during the infant's well-baby visits at the primary care.

A total of 30 mother-infant dyad from the WEHS group and a community sample comprising of 2185 mother-infant dyad are included in this study for the measured time range. Descriptive analysis is used to describe the study sample. Categorical data are presented as frequencies and percentage.
Results: The key findings support our hypotheses that (1) the percentage of infants referred for interventions is significantly higher at 70.0% for the WEHS cohort compared to the community SleEP cohort (26.5%). Of these, (2) they have more frequent night waking (3.5 times) than the SleEP cohort (2.3 times). Interestingly, the infants from the WEHS cohort sleep an average of nearly 30% more (12 hours) than their SleEP infants (8.4 hours).

The mothers from the WEHS cohort have reduced sleep quantity (5.4 hours) than the SleEP cohort (6.4 hours). There are double the number of mothers from the WEHS cohort (57.1%) who reported a significant lack of confidence than the SleEP cohort (29.7%). 66.7% of the WEHS mothers whose infants needed interventions perceived their sleep to be a moderate or serious problem than 49.1% of the mothers from the SleEP cohort.
Conclusions: Potential mediating factors identified during our related to the WEHS cohort's elevated results are: (1) infants from the WEHS cohort sleep on the same bed and room as their parent(s), (2) there is lack of consistency in bedtime routines (42.9% in WEHS cohort versus 61.2% of the SleEP cohort) for the infants needing interventions.
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Factors and associations related to sleep quality in patients with tinnitus

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Introduction: Tinnitus is a phantom symptom of hearing sounds with an unexplained source. The sound could become more perturbing when sleeping in quiet surroundings at night. Many people with tinnitus suffer from sleep difficulties, and some have psychological distress, such as depression and anxiety. Here, we aim to explore the relationship among the severity of tinnitus, sleep quality, and anxiety/depression.
Materials and methods: This prospective cross-sectional study was conducted at Chakri Naruebodindra Medical Institute (CNMI), a medical school hospital, from May 2023 to March 2025. Patients diagnosed with tinnitus aged over 18 years and lasting more than 3 months were enrolled. Data were collected using

three standardized questionnaires: Tinnitus Handicap Inventory (THI) for tinnitus severity, Pittsburgh Sleep Quality Index (PSQI) for sleep quality, and Hospital Anxiety and Depression Scale (HADS) for symptoms of anxiety and depression. PSQI is divided further into 3 subscores of sleep efficiency, perceived sleep quality, and daily disturbance. Pure tone audiometry was also administered to objectively evaluate hearing in participants. Correlation analyses among the three questionnaire scores were performed by IBM SPSS statistical software.
Results: A total of 115 participants met the inclusion criteria after careful evaluation and completed the questionnaires. Sixty-one (61) of 115 participants were female (53%) with an average age of 59.44 ± 12.60 years. The tinnitus severity across all participants was predominantly classified as mild handicap severity (18-36 points), with a mean total THI score 31.51 ± 21.64 points. The sleep quality assessment using the PSQI in tinnitus patients shows a mean total PSQI score of 7.84 ± 3.77, indicating poor sleepers. Additionally, total THI scores showed a positive correlation with the total score of PSQI (r = 0.19 p value 0.042). The daily disturbance subscale of PSQI exhibited a strong correlation with total THI scores, with correlation coefficients of r = 0.280 (p value 0.002).
In the corner of psychological distress, assessment using the HADS revealed that most participants were within the normal range (76.5% for the anxiety subscale and 82.6% for the depression subscale). However, both the anxiety and depression subscales of HADS showed a positive correlation with tinnitus severity (r = 0.284, p value 0.002).
Conclusions: Patients with tinnitus may have an associated impact on sleep quality. This might lead to daily disturbance, which may worsen tinnitus perception and contribute to emotional distress.
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Prevalence and Psychological Profiles of Comorbid Obstructive Sleep Apnoea and Post-Traumatic Stress Disorder in a UK General Population Sample

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Introduction: Post-Traumatic Stress Disorder (PTSD) impacts 4% of UK and 5.6% of adults worldwide. PTSD is strongly linked to sleep disorders, including Obstructive Sleep Apnoea (OSA). Emerging evidence suggests a bidirectional relationship between OSA and PTSD, with overlapping hyperarousal mechanisms exacerbating both conditions. Evidence also suggests the risk of OSA in people with PTSD may have a differential profile to developing OSA. This study examines the prevalence and psychological profiles of comorbid OSA and PTSD in a UK general population sample.
Materials and methods: Three-hundred-eighteen adults (75.8% female; 29.9% aged 34-44 years) completed validated online questionnaires, including the STOP-BANG (OSA risk), PCL-17 (DSM-5 PTSD symptoms classification), PSAS (pre-sleep arousal), ESS (daytime sleepiness), HADS (depression and anxiety), B-PSQI (sleep quality), and EQ-5D-5L (quality of life). Participants were grouped into OSA-only risk (low, intermediate, and high) and OSA+PTSD categories. Chi-square tests were used to examine associations between group classifications and key demographic or psychological factors.
Results: Prevalence: 87.7% of participants were PTSD-symptomatic. High OSA risk (STOP-BANG ≥5) occurred in 13.3% of PTSD-symptomatic individuals whereas 5.1% non-symptomatic (χ^2=7.899, *P*=0.019).
Demographic profile:
Males predominantly belonged to (OSA+PTSD), particularly in the high-risk OSA and symptomatic PTSD (35.3% of males), (χ^2= 79.80, *P* < 0.001, ES = 0.354). Additionally, 77.8% of high-risk OSA and symptomatic PTSD participants were <45 years vs. 50% >45 in OSA-only (χ^2=79.04, *P* <0.001). Median

BMI was significantly higher in (OSA+PTSD) (36.41 kg/m²) vs. OSA-only (25.71 kg/m²; P <0.001).
Psychological characteristics:
Pre-sleep arousal: Somatic arousal affected 98.1% of (OSA+PTSD) in contrast to 73.3% OSA-only (χ^2=43.989, P <0.001).
Daytime sleepiness: Among those with severe excessive daytime sleepiness, 25.0% were classified in the high-risk OSA symptomatic PTSD, while no participants with this level of sleepiness were in the OSA-only group, ($\chi^2(20) = 37.79$, $P = 0.009$, ES = 0.172).
Psychological Distress: Individuals with both anxiety and depression were predominantly classified in the (OSA+PTSD) (44.5%), while those with no anxiety or depression were more likely to be in the OSA-only group (30.6%), ($\chi^2(15) = 72.98$, $P < 0.001$, ES = 0.277).
Sleep Quality: Poor sleep quality (B-PSQI > 5) was more prevalent in the (OSA+PTSD) group, particularly in the high-risk OSA symptomatic PTSD subgroup (13.1%) and the intermediate- OSA risk symptomatic PTSD subgroup (29.8%),($\chi^2(5) = 15.68$, $P = 0.008$, ES = 0.222).
Quality of Life: "Poor" quality of life was reported exclusively by individuals in the (OSA+PTSD) group (20.0% in both intermediate- and high-risk symptomatic subgroups), while no participants in the OSA-only group reported poor quality of life,($\chi^2(15) = 43.81$, $P < 0.001$, ES =0.314).

Conclusions: Individuals with comorbid OSA and PTSD represent a distinct psychological and health profile, marked by younger age, male predominance, elevated BMI and heightened somatic arousal. They also exhibit greater psychological distress, excessive daytime sleepiness, and significantly poorer quality of life. findings underscore the urgent need for comprehensive screening protocols to go beyond traditional OSA risk factors, particularly in individuals with PTSD. Early identification and integrated treatment approaches targeting both conditions are essential to reduce the cumulative burden of this complex phenotype and improve health outcomes.

Polysomnographic comparison of sleep architecture between patients with disorders of consciousness and healthy controls

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Introduction: Disorders of consciousness (DoC) involve prolonged impairments in awareness and wakefulness. Sleep architecture, particularly the presence of deep and REM sleep, has been suggested as a potential indicator of residual brain function and recovery potential. However, systematic comparisons between DoC patients and healthy individuals using polysomnography (PSG) are limited.
Materials and methods: In the current prospective study, patients diagnosed with DoC (more than one month post-injury) and their age- as well as sex-matched healthy controls were recruited. All DoC patients underwent 24-hour PSG monitoring in a hospital setting, while healthy controls underwent 12-hour standardized PSG in our sleep lab. Key parameters included total sleep time (TST), sleep efficiency, proportions of N1, N2, N3, REM sleep, and the presence of sleep-disordered breathing (SDB), evaluated by the apnea-hypopnea index (AHI).
Results: Five DoC patients (mean age 60.6 ± 13.4 years) and three healthy controls (mean age 54.2 ± 11.2 years) were included in this preliminary analysis. Average sleep efficiency in the DoC group was 67.1%, which was comparable to 68.3% in controls. In the patient group, the average proportions of sleep stages were: N1 at 5.9%, N2 at 13.9%, N3 at 69.5%, and REM at 10.7%, with an AHI of 2.9. In the control group, N1 accounted for an average of 7.8%, N2 for 44.7%, N3 for 31.5%, and REM for 16.0%, with an AHI of 0.9. These preliminary results suggest that DoC patients showed significantly reduced N2 and

REM sleep, while a markedly increased proportion of N3 sleep, and more frequent SDB compared to healthy individuals.
Conclusions: Sleep architecture differs substantially between DoC patients and healthy individuals. PSG-based assessment may provide objective markers of residual brain function and support the development of sleep-informed approaches for consciousness evaluation and neurorehabilitation.
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Sleep Stage Classification over Continuous Positive Airway Pressure Signals with Multi-Period Convolutional Neural Network

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Introduction: Continuous Positive Airway Pressure (CPAP) therapy is the standard treatment for obstructive sleep apnea (OSA), yet its potential for passive sleep monitoring remains underexplored. Polysomnography (PSG), the clinical gold standard for sleep staging, is resource-intensive and impractical for routine home use. To address this gap, we developed a deep learning-based framework that classifies sleep stages using only CPAP signals.
Materials and methods:

We propose the **Multi-Period Convolutional Neural Network (MP-CNN)**, a novel architecture specifically designed to extract temporal features from CPAP-derived respiratory signals. Unlike conventional CNNs that rely on fixed receptive fields, MP-CNN incorporates multiple period-specific convolutional kernels (p=3, p=9, and p=21) to simultaneously capture short- and long-term respiratory dynamics. The model processes 630-second input windows with subject-normalized input features, including **CPAP flow (Cflow), positive airway pressure (PAP), and instantaneous respiratory rate (IRR)**. We augment features by reducing redundancy while preserving temporal information. Specifically, every 25 samples are downsampled to 1 Hz, and four statistical descriptors (mean, standard deviation, maximum, minimum) are computed within each window to capture local dynamics. This multi-period design allows MP-CNN to more effectively uncover the intrinsic relationships between CPAP signals and sleep stages, which may be overlooked by standard CNN architectures. The model was evaluated on split-night PSG sleep studies, where CPAP titration began midway through the recording. Data from 32 subjects with moderate to severe OSA were included, with ground truth sleep stages annotated by trained technicians according to AASM guidelines. A 3-fold cross-validation protocol was applied to ensure robust evaluation.

Results:

Our proposed MP-CNN achieved a **macro F1-score of 0.685 and a Cohen's Kappa of 0.523** in three-stage classification, with **per-stage sensitivity/specificity of 0.693/0.908 (Wake), 0.520/0.930 (REM), and 0.818/0.669 (NREM)**. These results demonstrate competitive or superior performance compared to existing approaches that rely on more intrusive signals. Feature ablation studies further revealed that downsampled statistical features were essential for improving model performance, particularly in REM detection. In addition, the model showed a strong correlation with ground truth sleep metrics, such as **total sleep time (Pearson's r = 0.85)**. We also assessed demographic effects by stratifying subjects by gender, BMI, and age. No statistically significant differences in performance were observed across subgroups, although females and younger subjects exhibited slightly higher agreement in some cases. Overall, the model generalized well across demographic factors, indicating that demographic variability was not a primary source of cross-dataset performance differences.

Conclusions: Our results demonstrate the feasibility of leveraging CPAP-derived respiratory signals for unobtrusive sleep stage classification. The MP-CNN architecture enables accurate sleep staging without the need for additional sensors, offering a scalable and cost-effective solution for home-based sleep monitoring. Future work will focus on extending the framework to include deep sleep detection and adaptive integration with automatic positive airway pressure (APAP) systems.
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Associations Between Sleep Health and Gut Microbiota: A Metagenomic Analysis in a Community-Based Sample in Hong Kong

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Introduction: The gut-brain axis plays a pivotal role in health and disease. Previous studies have shown that sleep problems disrupt gut microbiota composition, which have been linked to inflammation, metabolic dysregulation, and cognitive impairments. However, evidence of sleep-gut microbiota relationships in community-dwelling populations is limited, with most studies relying on subjective sleep assessments and 16S sequencing microbiome analyses. This study addresses these gaps by employing both validated subjective and objective actigraphy-based sleep assessments, combined with high-resolution shotgun metagenomic profiling with the aim to investigate the associations between gut microbiota diversity and composition with sleep health.
Materials and methods: This cross-sectional study recruited participants from community in Hong Kong. A total of 645 participants (mean age: 53 ± 14 years; 64% female) provided stool samples for shotgun metagenomic profiling and completed sleep questionnaires assessing sleep related parameters including sleep-wake pattern, insomnia severity index and excessive daytime sleepiness. Actigraphy data (Actiwatch Spectrum PRO, Philips Respironics) was available for 567 participants meeting wear-time criteria (≥3 valid days with <33.3% missing data/day). Sleep parameters included total sleep time (TST), sleep onset latency (SOL), wake after sleep onset (WASO), sleep efficiency (SE) and sleep fragmentation index (SFI) were generated from actigraphy. Multivariable linear models adjusted for age, sex, BMI, education, smoking and alcohol drinking habits, chronic disease history, depression and COVID-19 infection history were used to assess associations between gut microbiota diversity and sleep parameters. Species-level associations were identified using MaAsLin2, with false discovery rate correction.
Results: Gut microbiota alpha diversity indices were significantly reduced in individual with SE < 80% (adjusted beta [95% CI]: richness: -24.76 [-39.24, -10.28], P < 0.001; Shannon index: -0.13 [-0.23, -0.04], P = 0.008;). PERMANOVA tests revealed that SE and SFI significantly influenced gut microbiota composition (SE < 80%: R^2 = 0.003, P = 0.018; SFI: R^2 = 0.003, P = 0.031). In contrast, subjective sleep assessments were not associated with either alpha or beta diversity of the gut microbiota. MaAsLin2 identified 13 species significantly associated with SE < 80% and SFI. For example, *Coprobacillus cateniformis* and *Clostridium scindens* were positively associated with SFI (Coef = 0.0006, P < 0.001, Q = 0.192; Coef = 0.0002, P = 0.007, Q = 0.322). *Odoribacter splanchnicus* and *Phocaeicola plebeius* were reduced in individual with SE < 80% (Coef = -0.0002, P = 0.008, Q = 0.348; Coef = -0.004, P = 0.024, Q = 0.469). Elevated *P.plebeius* abundance was associated with increased TST (Coef = 0.004, P = 0.028, Q. = 0.517). Increased *C.scindens abundance* was also associated with higher WASO (Coef = 0.0001, P = 0.004, Q = 0.283).
Conclusions: Our findings demonstrate that gut microbiota diversity and specific bacterial taxa are strongly associated with actigraphy-measured sleep parameters, particularly with sleep efficiency and fragmentation, in a community-based adult population. Notably, no significant associations were observed between gut microbiota and subjectively measured sleep parameters. These results highlight the potential

for microbiota-targeted interventions to improve sleep health. Future studies are needed to confirm these findings, explore underlying mechanisms, and evaluate the causality in longitudinal and interventional studies.

Sleep Timing and Cardiovascular Events: A Systematic Review & Meta-Analysis

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Introduction: Cardiovascular disease risk is associated with multiple aspects of sleep health. There is a large body of evidence linking short and long sleep durations as well as sleep disorders like obstructive sleep apnea and insomnia with the occurrence of cardiovascular events. However, the risk of cardiovascular events with circadian factors such as sleep timing is less well studied. We performed a systematic review to determine the effect of bedtime or sleep onset timing on the risk of cardiovascular events (acute coronary events and stroke) and mortality.
Materials and methods: We performed a systematic search of the MEDLINE, Embase, Scopus, and Cochrane Central Register of Controlled Trials (CENTRAL) databases. Two authors independently screened the titles/abstracts and the full texts to identify studies that observed the risk of cardiovascular events and mortality based on bedtime or sleep onset timing. The risk of bias among the included studies was adjudged using the ROBINS-E tool. Meta-analysis was performed using a random effects model to estimate the pooled hazard ratios of cardiovascular mortality with early and late sleep timings. The review protocol was prospectively registered in PROSPERO.
Results: A total of seven studies were included. The exposure was measured either as bedtime using a questionnaire (five studies) or as sleep onset timing using actigraphy over one week (two studies). The outcomes included cardiovascular mortality (three studies), cardiovascular events (three studies), coronary events (two studies), and stroke (one study). All studies had some concerns of risk of bias. All studies adjusted for confounders, including age, sex, smoking status, socioeconomic status, and various clinical risk factors. Among three studies comprising of 95,764 subjects, meta-analyses revealed increased risk of cardiovascular mortality among both early sleepers (bedtime/sleep onset before 10 or 11 PM; HR = 1.23, 95% confidence intervals: 1.07 – 1.42, I^2 = 0%) and late sleepers (bedtime/sleep onset after 12 AM; HR = 1.37, 95% CI: 1.12 – 1.68, I^2 = 25.3%) compared to those with intermediate sleep timings. Meta-analyses could not be performed to assess the risk of cardiovascular events due to the variable definitions of the outcome. All three studies found an increased risk of cardiovascular events with early sleep timing (before 9 or 10 PM), whereas two out of three studies found an increased risk of cardiovascular events with late sleep timing (after 12 AM) compared to intermediate sleep timings. One out of two studies found that late sleep timing increased the risk of acute coronary events. The sole study that reported on stroke found an increased risk with both early (at/before 9 PM) and late (after 12 AM) bedtime.
Conclusions: We found that both early and delayed bedtime/sleep onset timings can increase the risk for cardiovascular events and mortality compared with intermediate sleep timings. Public health interventions to improve sleep health should incorporate measures to optimize both sleep duration and timing.

Bedtime Stress and Prefrontal Cortex Hemodynamics During Sleep: A Pilot Study Using Wearable fNIRS and Salivary Biomarkers

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Introduction: Psychological stress is a well-known disruptor of sleep quality, yet little is known about how stress modulates brain activity during sleep. While neuroimaging studies have advanced our

understanding of stress responses during wakefulness, technical and methodological barriers have hindered investigation of stress-related neural dynamics during sleep. This pilot study aimed to explore whether bedtime stress is reflected in cortical hemodynamics during the first sleep cycle. We further examined which signal features and prefrontal subregions are most sensitive to stress indicators.
Materials and methods: A longitudinal N-of-1 design was conducted with a healthy adult male over 15 consecutive nights. Stress was assessed using three complementary indicators: salivary cortisol (mean = 3.4 nmol/L), secretory immunoglobulin A (sIgA; mean = 295.3 μg/mL), and subjective perceived stress scores (range 2–8; mean = 4). Sleep-related hemodynamics were recorded using a wireless, wearable 27-channel functional near-infrared spectroscopy (fNIRS) system (Brite 24) targeting the prefrontal cortex. Supplementary physiological data (heart rate, respiratory rate, and sleep timing) were collected using Fitbit Sense. fNIRS signals were preprocessed to remove physiological artifacts, and time-, frequency-, and nonlinear-domain features were extracted from both oxyhemoglobin (ΔO2Hb) and deoxyhemoglobin (ΔHHb) signals. An ensemble feature-ranking algorithm, integrating six machine learning and statistical methods, was used to identify stress-related signal features and channels.
Results: Cortisol was most strongly associated with time-domain features—particularly signal mean at channel 16 (left rostral lateral prefrontal cortex, RLPFC)—with correlation coefficients reaching |r| = 0.74. Sample entropy of ΔHHb at channel 26 also showed strong negative associations (r = –0.70). sIgA was moderately associated with Hurst exponent and Poincaré plot asymmetry at channels 21 and 26 (r = 0.53–0.61). Perceived stress showed robust correlations with nonlinear features such as crest factor (ΔHHb, channel 16; r = 0.68) and skewness (ΔO2Hb, channel 16; r = –0.65). While each indicator related to distinct feature sets, channel 16 emerged as a common site associated with all three stress measures. Additional associations were observed in the mid- and caudal dorsolateral prefrontal cortex (channels 3 and 20). The ventrolateral PFC showed no significant relationships with any stress markers.
Conclusions: This study introduces a novel, ecologically valid framework for assessing how stress manifests in the sleeping brain. Our findings highlight the relevance of the RLPFC and DLPFC in processing stress during early sleep, extending known wake-state functions of these regions into the nocturnal domain. The integration of wearable fNIRS, real-world biomarker tracking, and personalized analysis (via an N-of-1 design) provides a powerful methodology for sleep neuroscience. These results lay the groundwork for future multi-night, multi-participant studies and demonstrate the potential for next-generation stress monitoring and personalized sleep medicine. As stress increasingly contributes to sleep disorders, tools that noninvasively reveal how the brain processes stress during sleep could support earlier interventions, self-tracking, and more precise behavioral and clinical guidance.
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Association between Work Engagement and Psychomotor Vigilance among Physicians in a Japanese University Hospital: Stratified Analysis by Age Group and Medical Specialty

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Introduction: Work engagement is a positive and fulfilling psychological state related to one's work, often considered the opposite of burnout. In clinical settings, higher work engagement among physicians has been associated with better patient care and lower turnover rates. Since the COVID-19 pandemic, there has been growing concern about the work environment and mental health of healthcare professionals. This study aimed to examine age- and specialty-related differences in work engagement and its

association with psychomotor vigilance, an objective indicator of sleep debt, among physicians at a Japanese university hospital.
Materials and methods: Among 836 physicians, 391 (response rate: 46.8%) completed a questionnaire and underwent a 3-minute brief Psychomotor Vigilance Test (PVT-B) after work. The total score of the Utrecht Work Engagement Scale (UWES-17) was used as the dependent variable. Independent variables included depressive symptoms (Center for Epidemiologic Studies Depression Scale: CES-D) and PVT performance (lapse355), with sex, BMI, age group (20s, 30s, 40s, ≥50s), and sleep duration (<5 h or ≥5 h) as covariates. Stratified analyses were performed by age group and by specialty (medical vs. surgical). Statistical significance was defined as $p < 0.05$. Statistical analyses were conducted by SAS version 9.4 software (SAS Institute Inc., Cary, NC).
Results: Stratified analyses were performed by age group and by specialty (medical vs. surgical). Statistical significance was defined as $p < 0.05$. UWES scores were significantly lower in the 20s ($\beta = -13.8$, $p <= 0.01$) and 30s ($\beta = -10.1$, $p <= 0.01$) compared to ≥50s. Lapse355 was negatively associated with UWES ($\beta = -0.3$, $p <= 0.01$), and CES-D showed a marginal association ($\beta = -3.9$, $p = 0.08$). In adjusted models that substituted objective PVT measures for subjective sleepiness, model fit improved ($\Delta R2=0.018$, $\Delta F=7.58$, $p<=0.01$). In age-and specialty stratified analyses, the association was more evident among physicians with a surgical specialty in their 20s.
Conclusions: The results from present study suggest that work engagement is associated with PVT performance, an objective indicator of sleep debt, especially among young physicians at a Japanese university hospital.
These findings highlight the need for early intervention in cognitive and mental fatigue among early-career physicians.
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Sleep Temporal Entropy: A Novel Sleep Fragmentation Biomarker Predicting Cardiometabolic Disease and Mortality Risk

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Introduction: Sleep fragmentation involves frequent arousals and irregular sleep stage transitions, which impair physiological recovery and contribute to increased cardiometabolic and mortality risk. Conventional fragmentation metrics such as Wake After Sleep Onset (WASO), Sleep Efficiency (SE), and Arousal Index (ArI) rely on arbitrary thresholds and fail to capture the temporal complexity of sleep transitions. Advanced EEG-derived indices offer deeper insights but are less practical for long-term monitoring and have rarely been evaluated against serious outcomes. To address these limitations, we developed a novel metric—Sleep Temporal Entropy (STE) which quantifies variability in the duration derived from the hypnogram. This study aimed to evaluate STE's ability to predict adverse health outcomes, compare its performance with traditional and existing metrics, and examine its relationship with mortality and cardiometabolic disorders.
Materials and methods: We analyzed data from the Shanghai Sleep Health Study Cohort (SSHSC, n=3,219, clinic-based) and the Sleep Heart Health Study (SHHS, n=4,862, community-based). STE was

calculated by applying Shannon entropy to the temporal distribution of each sleep stage (Wake, N1, N2, N3, REM), yielding both whole night and stage-specific. In both cohorts, five machine learning models including Extreme Gradient Boosting (XGBoost) were trained to predict cardiometabolic conditions and mortality. SHapley Additive exPlanations (SHAP) were used to assess the relative importance of each feature. In SHHS, survival analysis was conducted using Cox proportional hazards regression models. STE values were categorized into quintiles, and hazard ratios (HRs) with 95% confidence intervals (CIs) were calculated across unadjusted and adjusted models. Proportional hazards assumptions were tested, and restricted cubic splines were used to evaluate non-linearity.
Results: In both cohorts, STE—especially REM and N3-stage STE—ranked consistently among the most important predictors in SHAP analysis, surpassing conventional fragmentation metrics. In SSHSC, XGBoost achieved the highest predictive performance (AUC = 0.84, accuracy = 0.81), with STE contributing more than WASO or ArI in predicting hypertension, diabetes, and hyperlipidemia. In SHHS, machine learning models confirmed STE's relevance in predicting all-cause and cardiovascular mortality. Cox regression revealed a U-shaped association between STE and mortality risk. Compared to the reference quintile (Q3), participants in the lowest quintile of REM STE had a significantly elevated risk of all-cause mortality (HR = 1.58, 95% CI: 1.16–2.15) and cardiovascular mortality (HR = 2.83, 95% CI: 1.66–4.80). Similarly, participants in the highest REM STE quintile also showed increased CVD mortality risk (HR = 2.13, 95% CI: 1.14–3.96). Overall STE showed similar U-shaped patterns, whereas Wake STE exhibited a linear positive association with both outcomes.
Conclusions: STE provides a more comprehensive quantification of sleep fragmentation and irregularity than traditional metrics, offering a multidimensional assessment of sleep quality. Our findings demonstrate that STE is a robust predictor of cardiometabolic disorders and mortality, as evidenced by its performance in both machine learning models and Cox regression analyses. Notably, the U-shaped risk association for STE suggests an optimal range of STE for better health.

The life style, sleep time and sleep duration of the people in different social stratums during previous four decades in Taiwan

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Introduction:

Nearly half of adults report poor sleep quality, though most do not meet diagnostic criteria for insomnia. The concept of "poor sleep" has been introduced to describe insufficiently restorative sleep or reduced satisfaction in the absence of a clinical disorder(Leger et al.). Risk factors include unmodifiable characteristics such as age and sex, as well as modifiable contributors like lifestyle and sleep habits.

We hypothesize that demographic and lifestyle factors influence self-reported sleep quality. This study aims (1) to summarize sleep epidemiology with respect to quality, duration, and time, and (2) to examine associations between sleep quality and demographic and lifestyle factors, including age, sex, social stratum, sleep time and duration, and habitual inactivity.

Materials and methods:

The Taiwan Social Change Survey (TSCS) can be accessed on the Survey Research Database organized by the Institute of Sociology and the Center for Survey Research of the Academia Sinica in Taiwan (Taiwan Social Change Survey). It provides cross-sectional and panel study data that reveals Taiwan's economic, social, and cultural changes from 1984 till today.

Eight features were included in the analysis: year of survey, gender, age, social stratum, habitual inactivity, sleep time, sleep duration and sleep quality. The surveys spanned 1984–2022 and involved

participants aged 19–97 (mean 44.3) years. Social stratum was classified into six levels, from core cities to less-developed towns. Habitual inactivity was categorized into four levels: often, sometimes, rarely, and never. Sleep time was grouped into four categories: (1) 18:00–22:00 (earlier–early), (2) 22:00–24:00 (later–early), (3) 00:00–02:00 (earlier–late), and (4) 02:00–05:00 (later–late). Sleep quality was defined by frequency of sleep loss (never, rarely, sometimes, often). After data cleaning, 30,902 records remained for analysis. Chi-square tests and ordinal logistic regression were applied to identify risk factors.

Results:

Overall, 9.2 ± 3% of participants reported often experiencing poor sleep quality. Social stratum was excluded after chi-square test ($p > 0.10$). Female gender emerged as the strongest predictor (odds ratio [OR] = 1.39, $p = 0.031$), followed by habitual inactivity (OR = 0.91, $p = 0.045$). Later sleep time (OR = 1.19, $p = 0.36$) and shorter sleep duration (OR = 0.90, $p = 0.60$) showed nonsignificant associations, with fluctuating p-values among different years. Epidemiology demonstrates that earlier sleep time exhibits longer sleep duration. Age was not a significant factor; although prevalence of poor sleep was higher in individuals aged ≥70 years (7.8%), prior literature suggests this is more attributable to inactivity, limited social engagement, and comorbid conditions rather than aging itself(Ohayon et al.).

Conclusions:

1. Females are more likely to experience poor sleep.
2. Habitual inactivity is associated with poor sleep.
3. Good sleep quality may still be achievable with late sleep time or short sleep duration, awaiting further validation.

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Sleep quality and hypertension: correlation between Pittsburgh Sleep Quality Index (PSQI) scores and the prevalence of hypertension and blood pressure reduction patterns

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Introduction: This study investigated the association between sleep quality and hypertension, evaluating the correlation of Pittsburgh Sleep Quality Index (PSQI) scores with hypertension prevalence and blood pressure dipping patterns.
Materials and methods: From anonymized subjective and objective sleep and blood pressure data collected via commercial wearable health devices from over 150,000 volunteers, we screened and included 17,462 participants with complete blood pressure data, among whom 5,490 had PSQI scores. Participants were stratified into "high sleep quality" (PSQI ≤5) and "low sleep quality" (PSQI ≥6) groups. Chi-square tests were used to compare hypertension prevalence between the two groups. Further analysis was conducted on 926 hypertensive patients, categorized into "dipper" and "non-dipper/reverse-dipper" groups, with chi-square tests performed to assess sleep quality differences.
Results: Among 17,462 participants, 3,882 (22.2%) had hypertension. In the 5,490 participants with PSQI scores, the hypertension prevalence was higher in the "low sleep quality" group (17.9%) compared to the "high sleep quality" group (13.9%), indicating that poor sleep quality was associated with an increased risk of hypertension (99.9% CI, *p* = 0.0008617). However, among the 926 hypertensive patients, no statistically significant difference in subjective sleep quality was observed between dippers and non-dippers/reverse-dippers.
Conclusions: Higher PSQI scores (worse sleep quality) were associated with an elevated risk of hypertension. However, subjective sleep quality did not significantly differ between dippers and non-

dippers/reverse-dippers, suggesting that abnormal blood pressure circadian rhythms may not directly contribute to perceived sleep disturbances. Further research incorporating objective sleep monitoring is warranted.

Effects of a 12-Week Machine-assisted Strengthening Program on sleep health in Frail Older Adults

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Introduction: Insomnia is a common sleep-related complaint in the elderly. Rehabilitation has been shown to have multiple benefits for the elderly, and a new trend of machine-assisted strengthening programs has been developed. Therefore, we compared the effects of a 3-month machine-assisted strengthening program to traditional physical therapy according to composite insomnia symptoms related to falling and the SATED questionnaire among community-dwelling frail older adults.
Materials and methods: A randomized controlled trial included 59 frail older adults (mean age:78.0±8.2 years) in north-eastern Taiwan. The intervention group (N=31) underwent a 12-week machine-assisted strengthening program using SMARC system, performing twice-weekly sessions that targeting 8 muscle groups, while the control group (N=28) received traditional physical therapy. We reviewed the sleep health of the participants with a self-reporting questionnaire, including composite insomnia symptoms related to falling and the SATED scale.
Results: The control group showed no statistical significant change in SATED questionnaire and composite insomnia symptoms related to falling before and after traditional rehabilitation. The intervention group showed improvement in composite insomnia symptoms related to falling (-0.65±0.91, $p<0.01$). When focusing on individual insomnia symptoms, the intervention group showed statistical improvement on 'trouble falling asleep' (-0.13±0.34, $p=0.04$), 'trouble with waking up during the night'(-0.29±0.46, $p<0.01$), and 'trouble with waking up too early and not being able to fall asleep again' (0.20±0.40, $p=0.01$).
Conclusions: Machine-assisted strengthening can improve the participants' composite insomnia symptoms related to falling and individual aspects of insomnia. Larger-scale research is still needed for further understanding.

Menopausal Hormone Therapy and Cardiovascular Outcomes in Menopausal Women with Obstructive Sleep Apnea

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Introduction: Menopause exacerbate the risk of cardiovascular events in women with obstructive sleep apnea (OSA). The efficacy and safety of menopausal hormone therapy (MHT) in cardiovascular outcomes in this population remain unclear.
Materials and methods: We conducted a propensity score-weighted cohort study using data from 363 menopausal women with OSA from a tertiary medical hospital. Patients were stratified based on MHT use (59 treated vs. 304 untreated). Baseline demographics, comorbidities, and apnea-hypopnea index (AHI) were balanced via overlap weighting. Outcomes included heart failure (HF) and major adverse cardiovascular events (MACE), analyzed using Cox regression with follow-up periods of 3 and 10 years.
Results: After weighting, baseline characteristics including age, AHI, and comorbidities showed no significant differences between groups. At 3 years, MHT was not significantly associated with reduced risk for HF (HR: 0.800, 95% CI: 0.167-3.837, $p=0.781$) or MACE (HR: 0.815, 95% CI: 0.226-2.932, $p=0.754$). Similarly, at 10 years, no significant reductions were observed in HF (HR: 0.836, 95% CI: 0.277-2.521, $p=0.751$) or MACE (HR: 0.902, 95% CI: 0.359-2.265, $p=0.826$).

Conclusions: Menopausal hormone therapy in menopausal women with OSA did not significantly impact the incidence of heart failure or major cardiovascular events over both short and long-term follow-up periods. Further studies with larger cohorts are warranted to confirm these findings.

Association between snoring and in vitro fertilization outcomes among infertile women

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Introduction: Snoring is well known to increase risk of metabolic and cardiovascular consequences in general population, with limited attention to reproductive health. The study aim to explore the association between snoring and in vitro fertilization (IVF) outcomes in infertile women, focusing on embryological parameters and pregnancy outcomes.
Materials and methods: 632 infertile women, aged 24 to 45 years, undergoing their first IVF treatment, were continuously recruited at the Reproductive Center of Peking University People's Hospital from January 2018 to Nov 2021. All patients with their husbands' assistance completed a questionnaire including snoring status and frequency before ovulation induction (OI). Embryology parameters were observed during the first IVF cycle, with subsequent follow-up to assess pregnancy outcomes.
Results: Results: Of the 579 subjects, 33.5% reported occasional snoring, and 8.8% reported frequent snoring. A multiple linear regression model adjusted for confounding factors, indicated that frequent snorers had higher β-coefficients for the number of blastocysts and available embryos compared to non-snorers (both $P < 0.05$). Among 551 subjects who completed the first embryo transfer, 6.2% suffered biochemical pregnancy loss, Frequent snorers had a higher likelihood of biochemical pregnancy loss compared to non-snorers and occasional snorers (5.7% vs. 14.6%, $P = 0.033$; 4.8% vs. 14.6%, $P=0.026$). Multivariable analysis revealed that frequent snoring (adjusted odds ratio, aOR: 2.95, 95% confidence interval, CI: 1.06-8.24, $P = 0.039$) was a risk factor for biochemical pregnancy loss, while high-density lipoprotein cholesterol (HDL-C) level (aOR: 0.21, 95% CI: 0.05-0.92, $P = 0.038$) was found to be a protective factor after IVF.
Conclusions: Frequent snoring is associated with a reduced number of available oocytes and is a risk factor for biochemical pregnancy loss after IVF. However, this observed association should be interpreted with caution, as the potential effects of undiagnosed obstructive sleep apnea (OSA) have not been excluded.
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Personalized Sleep Extension in a Pilot Study: Effects and Moderators

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Introduction: Chronic short sleep is associated with adverse health outcomes, yet effective behavioral interventions remain understudied. This pilot study examined the efficacy of a tailored sleep extension (SE) intervention incorporating behavior change techniques and explored the moderators of treatment response.
Materials and methods: Eleven chronically short-sleeping adults (<6.5 hours; 25±1.5 years) completed a 3-day baseline, 4-day sleep hygiene education (SH), and 7-day 90-min SE protocol. Daily sleep was

assessed via actigraphy and sleep diary. We first assessed overall intervention effects on seven sleep parameters, then examined phase-specific changes in sleep duration. Given substantial between-participant variability in sleep response (ICC = 28–54%), we further tested whether baseline individual characteristics moderated SE outcomes using simple slope analysis for significant moderators.
Results:

SE significantly improved sleep duration but showed mixed effects on sleep quality and stability. SH increased time in bed (β = 0.72 h, p = 0.019), SE further increased time in bed (β = 1.49 h, p < 0.001), and tended to increase actual sleep duration (β = 0.55 h, p =0.059). However, increased sleep duration was accompanied by greater fragmentation (β = 9.435, p = 0.015) and lower sleep efficiency (β = -5.49, p = 0.024), although no change in subjective sleep quality. And, intervention did not change sleep efficiency, latency, and circadian timing. Exploratory analysis showed that emotional stability, baseline sleep duration, and sleep barrier reduction during interviews would moderate the SE effect on actual sleep duration.

Conclusions: This pilot study supports the feasibility and effectiveness of a personalized SE protocol in extending sleep among short-sleeping adults. While SE increased sleep duration, it also led to greater fragmentation, suggesting a trade-off during adaptation. Importantly, individuals with lower emotional stability, longer baseline sleep duration, and more barriers solved benefited the most. These findings highlight the need to tailor behavioral sleep interventions based on individual psychological and sleep-related characteristics.
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Utility of the General Practice Sleep Scale “GPSS” among women in childbearing age in comparison to existing OSA screening tools

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Introduction: Background: The risk of developing obstructive sleep apnoea (OSA) increases during pregnancy. However, underdiagnosis of OSA during pregnancy continues and can have adverse maternal and fetal outcomes. Hence, it is vital in clinical practice to screen high risk women in childbearing age for presence of OSA.
Aims: In this study, we assessed the utility of the new OSA screening tool – the “GPSS” (General Practice Sleep Scale) among women in childbearing age in comparison to existing traditional OSA screening tools – the Epworth sleep scale (ESS) and STOP-Bang.
Materials and methods: Methods: This was a retrospective study including all women aged 18-35 years with either a completed GPSS/STOP-bang/ESS, or data available to retrospectively derive the GPSS/STOP-bang/ESS score, and who underwent diagnostic polysomnography (PSG) in the Northern Territory of Australia.
Results: Results: 30 women (median age 30.6 (IQR 26, 33.5), n=8 (26.7%) indigenous Australian, median apnoea hypopnea index (AHI) 9.5 (IQR 3.2, 12.9)) were included for analysis. 70% recorded OSA

(50% mild, 6.7% moderate and 13% severe) with minor, non-significant differences in age and Indigenous status between those with OSA (median age 31.4 (IQR 26.6, 33.5), 28.6% Indigenous) and those without (median age 27 (IQR 26, 31), 22.2% Indigenous). Notably, the ESS was higher among patients without OSA than with (median 15 (IQR 12, 15) vs. 8 (IQR 6, 19), p=0.063) and frequency of a heightened ESS (ESS>8) was greater for those without OSA (77.8%) vs. those with (47.6%), showing a sensitivity and specificity of 47.6 & 22.2% respectively. The median STOP-bang score among those with OSA was 2 (IQR 2, 3) (47.6% moderate risk (score≥3)) vs. 1 (IQR 1, 3) (33.3% moderate risk) among those without, showing sensitivity and specificity of 47.6 & 66.7% respectively for a moderate risk score. The median GPSS score among those with OSA was 10 (IQR 7, 11) (76.2% moderate risk (score≥7)) vs. 8 (IQR 4, 10) (55.6% moderate risk) among those without, showing sensitivity and specificity of 76.2 & 44.4% respectively for a moderate risk.
Conclusions: Conclusions: This study illustrates a high prevalence of OSA in women of childbearing age. However, daytime symptoms appeared more commonly among those patients without OSA. The GPSS tool showed much higher sensitivity for OSA, while the STOP-bang showed higher specificity, indicating both may be of use in different clinical scenarios for this demographic. Further prospective studies are warranted to assess the performance of the GPSS amongst pregnant women.
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Relaxation of social time pressure affects subjective sleep quality and its associations vary depending on chronotype

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Introduction: Modern societal factors frequently impede the attainment of good sleep quality by many healthy adults. We investigated the chronotype-specific predictors of changes in subjective sleep quality following the relaxation of social time pressure during COVID-19 pandemic social restrictions in Japan.
Materials and methods: The internet-based Global Chrono-Corona Survey (GCCS) study received approval from the Ariel University Human Research Ethics Committee, Faculty of Health Sciences (AU-HEA-MK-20200629). A total of 1,649 participants completed the Japanese version of this study during the initial COVID-19 social restrictions. The final sample for analysis were 1,252 (34.6 ± 13.8 years, 67% female). Logistic regression analyses were used to assess changes under modified social time pressure in sleep quality by chronotype group (early, intermediate or late) from changes in patterns of daily behaviors.
Results: During social restrictions, subjective sleep quality deteriorated with decreased sleep duration and delays in sleep timing in the intermediate chronotype, while late chronotypes' reduction in sleep quality was associated with delayed sleep timing. Improved subjective sleep quality was associated with increased sleep duration and minimal sleep timing delay in the early and intermediate chronotypes. In late chronotypes, improved sleep quality was also associated with longer outdoor light exposure. These findings indicate that the determinants of changes in subjective sleep quality under modified social time pressure are at least partially chronotype-specific. Maintaining sleep timing may universally enhance subjective sleep quality during perturbations of social schedules. Moreover, in late chronotypes, the exposure to daylight may improve sleep quality, regardless of changes in sleep behaviors.
Conclusions: These insights may contribute to the development of effective strategies for promoting better sleep quality in modern societies where insufficient sleep is becoming increasingly widespread.
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Hypersomnia

Does Kleine-Levin Syndrome Have Circadian Dysfunction?

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Introduction: Kleine-Levin Syndrome (KLS) involves periodic hypersomnia relapses and debilitating neurobehavioral disturbances, yet the existence of circadian rhythm dysfunction remains debated.
Materials and methods: We conducted a study integrating between-group comparisons with a within-subject design. Circadian rhythms were evaluated under a modified constant routine protocol in 22 KLS patients (mean age 23.5 ± 15.1 years) and 48 age-, sex-, and BMI-matched healthy controls (mean age 20.8 ± 6.2 years). Habitual sleep–wake patterns were assessed via wrist-worn actigraphy. Endogenous circadian markers—including phase [dim light melatonin onset (DLMO), core body temperature minimum (CBTmin)], amplitude, and MESOR—were derived from 24-hour melatonin and CBT profiles. Importantly, a subgroup of six KLS patients was evaluated in both remission and relapse states.
Results: Between-group comparisons revealed no significant differences in sleep-wake patterns, circadian phase markers (e.g., DLMO), amplitude, or MESOR between KLS patients and healthy controls. The one exception was a statistically lower baseline melatonin level in the KLS relapse group compared to controls (1.9±1.1 vs. 3.2±1.9 pg/mL, p=0.007), though this difference is unlikely to be clinically significant. In contrast, the within-subject paired analysis revealed a significant and dynamic phase advance during relapse. Specifically, DLMO advanced by a mean of 1.4 hours (p=0.031) and CBTmin advanced by a mean of 1.9 hours (p=0.019). In contrast to this phase shift, there were no significant changes in the amplitude or MESOR for either melatonin or CBT between the remission and relapse states. This marked phase shift in KLS patients contrasted with the high circadian stability observed in controls assessed twice.
Conclusions: KLS is not associated with persistent abnormalities in circadian phase, amplitude, or MESOR. Instead, the disorder is characterized by a distinct and dynamic phase advance during symptomatic relapses. These findings provide novel insight into the circadian pathophysiology of KLS, highlighting the circadian system's phase-shifting mechanism as a potential therapeutic target.
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Prevalence, clinical, and sleep laboratory characteristics among patients presenting with excessive daytime sleepiness in Thailand, a tertiary care setting

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Introduction: Excessive daytime sleepiness (EDS) is a significant clinical issue associated with high morbidity, including increased risk of accidents, impaired cognitive performance, and mood disturbances. In Thailand, research on hypersomnolence disorders remains limited. This study aimed to determine the prevalence, clinical features, and sleep laboratory characteristics of patients presenting with EDS at Siriraj Hospital.
Materials and methods: This retrospective study analyzed data from patients who presented with EDS and underwent a Multiple Sleep Latency Test (MSLT) at the Siriraj Sleep Center between January 2018 and December 2023. The primary outcome was the prevalence of hypersomnia disorders. Secondary outcomes included clinical features and sleep laboratory findings.
Results: A total of 99 patients were included in the analysis. Of these, 45.5% were male. The average age was 32 years, the total sleep time was 7.53±1.17 hours, and the mean Epworth Sleepiness Scale (ESS) score was 12.17±5.87, with significant differences observed among narcolepsy (NC), idiopathic hypersomnia (IH), and sleep insufficiency and others groups (p = 0.033) which significant 2-group comparison of idiopathic hypersomnia and others group. The most common diagnosis was sleep insufficiency (n=18), followed by obstructive sleep apnea (OSA; n=15), idiopathic hypersomnia (n=14), and narcolepsy (n=12).

Conclusions: Clinical presentions of disorders of hypersomnolence were usually overlaped and most were nonspecific. Objective testing with PSG and MSLT were essential for making a precise diagnosis.
Acknowledgments: Siriraj Sleep Center, Thailand

Insomnia

Gender differences, psychological factors, and sleep parameters in paradoxical insomnia and non-paradoxical insomnia

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Introduction: Paradoxical insomnia is characterized by a discrepancy between subjective sleep perception and objective sleep measurements. Despite growing research interest, the underlying mechanisms of paradoxical insomnia remain poorly understood. This study aimed to investigate gender differences and identify key clinical, self-reported, and objective sleep characteristics that distinguish paradoxical insomnia from non-paradoxical insomnia.
Materials and methods: A total of 862 participants were analyzed. Data on demographics, clinical characteristics, biochemical parameters, depression, anxiety and polysomnographic (PSG) were collected. Gender differences were assessed, and the relationship between self-reported and objective sleep measures was examined. Logistic regression analysis was conducted to identify factors associated with paradoxical insomnia.
Results: Paradoxical insomnia was present in 30.51% of the study population. Logistic regression identified older age (OR = 1.019, p = 0.004), gender (OR = 0.643, p = 0.007), lower Insomnia Severity Index (ISI) scores (OR = 0.947, p = 0.032), and heightened somatic symptoms from the Hamilton Depression Rating Scale (HAMD) (OR = 1.374, p = 0.010) as independent predictors of paradoxical insomnia. No significant differences in biochemical parameters were observed between groups. Gender analysis revealed that females with paradoxical insomnia were older and had higher ISI scores than males, while males had higher BMI in both non-paradoxical insomnia and paradoxical insomnia groups.
Conclusions: Paradoxical insomnia is prevalent among individuals with insomnia, with gender and psychological factors, such as somatic symptoms of depression, playing key roles. Further research is needed to explore the underlying mechanisms and inform targeted interventions.
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Effectiveness of Stepped-Care Chinese Herbal Medicine and Psychotherapy on Improving Sleep in Adults with Insomnia: A Stepped-Wedge Cluster Randomized Trial

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Introduction: Insomnia is one of the most common sleep disorders in adults, with global prevalence rates ranging between 2.3% and 25.5%. Cognitive behavioral therapy for insomnia (CBT-I) and pharmacotherapy are recognized as common treatments for managing insomnia. However, access to

CBT-I is often limited, while low acceptance rate of pharmacotherapy is also a well-known limitation. Therefore, it is imperative to identify alternative treatments that are accessible, effective and acceptable.

Traditional Chinese medicine (TCM), including Chinese herbal medicine (CHM), has been proved to be effective for treating insomnia and is particularly popular in Eastern Asia. In Hong Kong (HK), 34.5% of insomnia patients choose TCM, making it the leading treatment option and reflecting strong cultural acceptance. However, most previous Chinese medicine studies on insomnia were well-controlled randomized trials, and real-world evaluations are lacking. This study aims to examine the effectiveness of stepped-care CHM and psychotherapy intervention in treating insomnia in adults in four clinical centers.
Materials and methods: (1) Study design
This stepped-wedge, cluster randomized trial recruited 366 adults with insomnia in HK between April and November 2024. The 18 geographic districts in HK are grouped into 4 clusters of 4 to 6 districts each, with randomization conducted at cluster level. The intervention was implemented sequentially in one cluster at a time based on a pre-generated random number, while the other clusters remained unexposed. After four steps, all clusters received the intervention. The study was approved by HK Baptist University Research Ethics Committee and prospectively registered with the Chinese Clinical Trial Registry (ChiCTR2400083685).

(2) Population
Adults with an insomnia severity index (ISI) score ≥ 14.

(3) Stepped-care intervention
The intervention consists of two levels. In level 1, the CHM treatment was based on TCM syndrome differentiation, classifying participants into three subtypes: excess syndrome, treated with Jia Wei Xiao Yao powder; deficiency syndrome, treated with Gui Pi decoction; and excess-deficiency complex syndrome, addressed with Huang Lian E Jiao decoction and Jiao Tai bolus. This level lasted 6 weeks, with participants taking a 5-gram herbal formula twice daily. Those without sleep improvement (ISI score≥ 14 after level 1 treatment) progressed to level 2, which involved an 8-week personalized CHM intervention and 8-session psychotherapy.

(4) Outcome
Outcome assessments were conducted at baseline and post-intervention. The primary outcome was ISI. The acceptance rate was operationalized as adherence rate by counting unconsumed sachets. Participants' self-management skills for handling insomnia and awareness of sleep health were also measured.
Results: All participants (age [SD]: 45.50 [13.08]; female: 282 [77.05%]) received the level 1 treatment, among whom, 49 (age [SD]: 47.61 [12.83]; female: 34 [69.39%]) progressed to the level 2 treatment. Only level 1 treatment significantly reduced insomnia severity (mean difference [95% CI]: -3.38 [-4.03 to -2.73]; $p<0.0001$; level 2: -0.90 [-2.49 to 0.69]; $p=0.26$). The adherence rate was high, at 84.8%. 98.4% of participants reported improved self-management skills for handling insomnia, while 97.3% expressed increased awareness of their sleep health.
Conclusions: The stepped-care CHM and psychotherapy is effective and acceptable in treating insomnia, empowering participants in self-managing insomnia and increasing awareness of sleep health.

Aberrant Effective Connectivity Within and Between the Default Mode Network, Executive Control Network and Salience Network in Chronic Insomnia Disorder – towards identifying the hyperarousal state

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Introduction: The hyperarousal hypothesis is a key conceptual model for the pathogenesis of chronic insomnia disorder (CID). The model is based on the observed persistent state of physiological, cognitive,

and emotional hyperactivation in CID patients, but its neurofunctional mechanisms are not fully understood.
Resting state functional MRI studies in CID patients have demonstrated altered functional connectivity (FC) in the default mode network (DMN), executive control network (ECN) and salience network (SN), which are involved in self-referential processing, internal mentation, emotional plasticity, and goal-directed attention.
While FC offers insights into co-activation patterns among brain regions, it does not provide directionality or causality of these interactions. In contrast, effective connectivity (EC) describes the influence of one brain region over another, incorporating temporal and causal effects of the regions in a neural circuit.
We hypothesized that effective connectivity between key nodes of the DMN, ECN and SN is disrupted in individuals with CID, impairing the SN's ability to modulate and “switch” between DMN and ECN, as the neurofunctional substrate of the hyperarousal state in CID.
Materials and methods: We recruited 31 CID patients, compliant with the ICSD–IIITR criteria, and 24 age-, sex-, and education-matched healthy controls (HC). All participants filled out Insomnia severity index (ISI), Beck depression inventory (BDI) and Epworth sleepiness scale (ESS) and were scanned on a 3T MRI system, obtaining structural and functional data. SPM 12 (Statistical Parametric Mapping) was used to analyse the results. Spectral dynamic causal modelling (spDCM) was applied to the chosen regions of interest (ROIs) within and between the DMN, SN and ECN. One-sample test was used to define the connections significantly different from zero within each group, and two-sample test was performed to determine the connections significantly different between both groups. Two-stage false discovery rate correction was applied.
Results: There were three significant connections, present only in the CID group – suppressive from the dorsolateral prefrontal cortex (DLPFC) to the right hippocampus (HippR) (-0.110±0.258, p=0.035), excitatory from the dorsomedial prefrontal cortex (DMPFC) to the ventromedial prefrontal cortex (VMPFC) (0.206±0.342, p=0.018), and excitatory from the common medial prefrontal cortex (MPFC) to the right anterior insula (AIR) (0.067±0.172, p=0.019). The analysis in the control group revealed two significant excitatory connections – from the posterior cingulate cortex (PCC) to AIR (0.148±0.242, p=0.001), and from precuneus to PCC (0.441±0.388, p=0.033), which are absent in the patients’ group. In addition, CID patients scored higher on the ISI (18±4.00 vs 4±2.85, p <0.001) and BDI (13±7.57 vs 5±4.72, p<0.001) questionnaires compared to HC. Significant negative correlations between DLPFC to HippR connectivity and both ISI (rho=-0.507, p<0.001) and BDI (rho=-0.272, p<0.05) scores were identified.
Conclusions: Our results indicate that effective connectivity among the DMN, ECN and SN is altered in individuals with CID. Disruptions within the DMN and between the DMN, SN and ECN reflect an impaired ability to appropriately shift between internally and externally directed cognitive states—an imbalance potentially underlying the hypervigilant state of CID.
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Sleep Architecture and REM Sleep Without Atonia in Post-COVID-19 Insomnia

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Introduction: Insomnia associated with COVID-19 infection is a common complaint in long-COVID. Studies to date have predominantly examined post-COVID-19 sleep disturbances with questionnaires. We aimed to investigate whether there are distinctive polysomnographic findings in post-COVID-19 insomnia compared to non-COVID-related chronic insomnia.
Materials and methods: We included 150 patients with chronic insomnia, stratified into three groups: post-COVID-19 insomnia, chronic insomnia during the pandemic without a history of COVID-19 infection, and pre-pandemic chronic insomnia. All patients underwent one-night video polysomnography (v-PSG). The sleep architecture, respiratory variables and REM sleep without atonia (RWA) were compared across the groups.

Results: Classical polysomnographic variables showed no significant differences across groups with regard to total sleep time, sleep efficiency, sleep stage percentages, and the apnea-hypopnea index. Post-COVID-19 insomnia patients had significantly increased RWA at both the chin and the flexor digitorum superficialis (FDS) (p= 0.020 for both), and higher nocturnal heart rates (p= 0.046). Sleep-bout analysis indicated shorter sustained N3-sleep periods (p= 0.001) and longer onset to stable REM-sleep (p= 0.016) in the post-COVID-19 insomnia group. Although sleep transitions did not withstand multiple comparison corrections, they revealed a trend towards decreased N3-sleep continuity and increased probabilities of transitioning to lighter stages (N3→N3: unadjusted-p= 0.012; REM→N1: unadjusted-p= 0.027) in the post-COVID-19 insomnia.
Conclusions: Classical PSG profile of post-COVID-19 insomnia does not differ from non-COVID-related chronic insomnia. However, subtle differences in RWA and sleep integrity suggest that post-COVID-19 insomnia is driven not merely by pandemic-related stress factors but by additional physiological alterations linked to viral CNS involvement.

Differential Efficacy of Online Group BBTI on Fatigue and Sleep in Depressed Patients with Insomnia Symptoms Based on Sleep Reactivity: A Pilot Study

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Introduction: Fatigue and insomnia symptoms are highly prevalent in patients with depressive disorder, severely impeding their quality of life and treatment outcomes. Behavioral-Based Therapy for Insomnia (BBTI) has potential in enhancing sleep quality and alleviating depressive symptoms, which may also relieve the fatigue symptom. This study aims to investigate the differential efficacy of online group BBTI on fatigue and insomnia symptoms in depressed patients with insomnia symptoms, based on their sleep reactivity as measured by the Ford Insomnia Response to Stress Test (FIRST) score.
Materials and methods: Participants meeting the criteria of the Mini-International Neuropsychiatric Interview 6.0 for major depressive episode and with Insomnia Severity Index (ISI) ≥8 were randomized into two online groups: the BBTI group (n=33) and the sleep education group (n=16). After excluding four participants due to missing FIRST scores, 33 and 12 participants respectively remained in the intervention and control groups. Measures included subjective assessments (insomnia severity, sleep quality, fatigue, mood) and objective testing with polysomnography (PSG). PSG was conducted for two consecutive nights at baseline (using the second night data to exclude first-night effects) and post-intervention. At baseline, 45 participants were categorized into high sleep reactivity (SR) (n=24) and low SR (n=21) groups based on FIRST scores (>21). Clinical and sleep characteristics were compared between these groups. Twenty-nine participants (13 in high SR group; 16 in low SR group) completed all follow-ups in the BBTI group. Repeated-measures ANOVA was used to compare intervention effects between high SR and low SR groups across baseline, post-intervention, and 3- and 6-month follow-ups.
Results: Among the 45 patients with depressive episodes and insomnia symptoms, high SR was associated with increased subjective depressive symptoms (measured by the Beck Depression Inventory, BDI), reduced subjective positive affect (measured by the Positive and Negative Affect Schedule, PANAS), elevated subjective negative affect (measured by the PANAS), and higher objective sleep microarousal indices (all $p < 0.05$). The interaction between time and SR was statistically significant for the Fatigue Severity Scale (FSS; p = 0.010, partial $\eta^2 = 0.358$) and the microarousal index (MAI; $p = 0.003$, partial $\eta^2 = 0.446$). For FSS, high SR patients exhibited higher initial fatigue that decreased significantly post-intervention ($p < 0.05$), while low SR patients showed minimal change. For MAI, high SR patients had higher baseline microarousal indices that decreased significantly post-intervention ($p < 0.05$), whereas low SR patients showed less change. The interaction for subjective sleep onset latency (SSOL) approached significance ($p = 0.056$, partial $\eta^2 = 0.185$), with high SR patients showing a trend toward longer initial SSOL that improved over time, though changes were not statistically significant. Other subjective and objective sleep parameters did not show statistically significant interaction effects differences between the high and low SR groups.
Conclusions: Depressed patients with insomnia symptoms and high SR are characterized by higher negative affect, lower positive affect, more severe depressive symptoms, and increased objective sleep

fragmentation. The online group BBTI intervention significantly reduced fatigue and microarousals in this subgroup, although these improvements did not reach statistical significance at later follow-up time points.

Embodied AI coach for delivering CBT-I in virtual reality- a pilot feasibility study

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Introduction: Recent AI advancements have shown promise in digitalizing psychotherapeutic interventions, including CBT-I, for more cost-effective and scalable interventions. However, most dCBT-I chatbots are limited by their provision of predefined responses in a text-based format. They lack embodied presence of AI (i.e. Embodied AI) for enhancing users' engagement. This also restricts AI's ability to perceive user behaviors and respond adaptively. This study aims to explore the feasibility of using Embodied AI coach for delivering CBT-I in virtual reality (VR).
Materials and methods:
Subjects
Inclusion criteria: 1) adults of Chinese ethnicity, 2) presence of insomnia, as indicated by a score of 8 or higher on the Insomnia Severity Index (ISI).

VR-Based CBT-I program
Embodied AI-Avatar coach
The virtual avatar was designed based on a typical therapist prototype, with a warm and approachable demeanor. Human-like animations (e.g., sitting, talking) and refined facial expressions, including lip synchronization and eye blinking, were integrated. Besides, the avatar made real-time adjustment of its position and eye gaze, as enabled by the movement tracking of the users. The avatar was powered by ChatGPT with an overarching prompt of character's backstory (e.g., roleplaying real-world therapists). A rule-based prompt structure (e.g., a CBT-I workflow) was imposed to determine which following sets of prompts should be utilized by ChatGPT, given users' current reply or question. Thus, a standardized conversation flow with personalized information was achieved. Moreover, the avatar had access to an external knowledge bank with CBT-I knowledge.

Content Design
The interventional content is based on our previous studies with 4 weekly CBT-I modules including (1) psychoeducation about insomnia and sleep restriction, (2) sleep hygiene and behavioral strategies, (3) cognitive restructuring and constructive worry strategies, and (4) stress management and relaxation training.

Procedure
Eligible participants were enrolled in a 4-week Chinese-speaking VR-based CBT-I program, with one module being delivered each week. Participants were asked to complete the ISI and user survey in the final session.
Results: In total, 7 participants (71% female; mean age: 27.14 yrs) were recruited and 6 of them completed the program. In the completer analysis, the results from the pre-intervention (M=10.17, SD=1.94) and post-intervention (M=7, SD=2.97) ISI scores indicated that the VR-based CBT-I program significantly reduced insomnia symptoms (t(6)=-2.71, p=.04), with an apparent large effect size (d=1.26). The user survey demonstrated a good level of satisfaction, with 67% of users showing moderate to strong intentions to continue using this virtual AI-Avatar coach to manage their sleep problems. Moreover, 67% of users felt that the utilization of embodied AI and virtual environments resulted in enhanced user experience and engagement.

Conclusions: The pilot data showed promising results with positive user feedback of utilizing Embodied AI Avatar coach to deliver CBT-I among individuals with insomnia. Further development to better leverage immersive technology and further formal comparative study with traditional dCBT-I intervention is needed.
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The Association between Sleep Vulnerability and Autonomic Response to Nocturnal Arousals

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Introduction: Sleep vulnerability is an individual trait reflecting the tendency to experience sleep disturbances under stress. It's assessed via self-report using the Ford Insomnia Response to Stress Test (FIRST), which measures the likelihood of sleep disruption in response to everyday stressors. Higher FIRST scores consistently predict development of insomnia disorder. Although prior research links high sleep vulnerability to heightened physiological arousal, dynamic processes underlying autonomic nervous system (ANS) responses, especially recovery following nocturnal arousals, remain poorly understood. This study aimed to investigate how high versus low sleep vulnerability individuals differ in ANS reactivity and recovery patterns following experimentally induced arousals during nocturnal sleep, assessing their potential as physiological markers of insomnia risk.
Materials and methods: Forty healthy adults (M = 24.1 ± 3.1 years) were recruited based on FIRST pre-screening, including a high vulnerability group (HV, n = 19; 10 females; FIRST ≥ 23) and a low group (LV, n = 21; 12 females; FIRST ≤ 18). During overnight polysomnography, auditory stimuli (1-second 1000 Hz pure tones) were presented via speakers during sleep in ascending intensity sequences (40–90 dB, 13-second intervals). Each stimulus sequence began when at least 10 seconds of stable EEG activity were presented and were terminated if EEG-defined arousal occurred. ANS reactivity was indexed by peak heart rate (HR) following arousal onset, while recovery reflected the efficiency of HR return to baseline. Baseline HR was calculated as the average of 2–12 heartbeats prior to cortical arousal. ANS reactivity was also quantified by the area under curve (AUC) from baseline to peak HR. Higher values indicated stronger reactivity. ANS recovery was assessed as the AUC across the 30 beats after the HR peak, divided by peak amplitude; larger values indicated slower recovery and poorer autonomic regulation.
Results:

During NREM sleep, the HV group exhibited significantly higher HR peak responses compared to the LV group ($t(38) = 0.858, p = .005$), while no group differences were observed during REM sleep or when all stages combined. In contrast, AUC-based reactivity showed no differences across NREM , REM, or combined sleep stages.

ANS recovery was significantly slower in the HV group when combining all stages ($t(38) = 2.351, p = .024$), while no group differences were observed during REM or NREM sleep.

Conclusions: Our findings suggest that ANS recovery, rather than reactivity, may better represent a physiological marker of sleep vulnerability. The discrepancy between peak HR and AUC-based ANS reactivity may reflect differences in arousal-to-peak latency, with the LV group showing a slower, more gradual HR rise that yields comparable AUC values to the HV group's sharper, faster responses. In contrast, the slower recovery process in the HV group likely reflects reduced parasympathetic modulation, impairing the ability to return to physiological homeostasis following arousal. These findings underscore the importance of recovery dynamics in understanding sleep vulnerability and support the potential utility of targeting ANS recovery for early detection and intervention of insomnia disorder. Future research is needed for understanding ANS reactivity mechanism.

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The effectiveness of self-help cognitive behavioural therapy for insomnia in adults: a systematic review and meta-analysis

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Introduction: Uptake of cognitive behavioural therapy for insomnia (CBT-I) as a first-line treatment for chronic insomnia is limited due to a shortage of trained therapists, access barriers, and economic burden. Self-help CBT-I appears to be a viable alternative due to its promising scalability, accessibility, and affordability. To date, the effectiveness of self-help CBT-I on insomnia severity among adults with insomnia symptoms has not been extensively explored. This meta-analysis aims to evaluate the overall effectiveness of self-help CBT-I on insomnia severity and to identify potential characteristics associated with greater estimated treatment effects.
Materials and methods: We systematically searched PubMed, Embase, PsycINFO, CINAHL Plus, Web of Science, the Cochrane Library Core, and two Chinese databases (China National Knowledge Infrastructure [CNKI] and Wanfang Data) for articles published up to 4 April 2025. Randomized controlled trials (RCTs) comparing self-help CBT-I with a control condition were included if they involved adults with insomnia symptoms and reported insomnia severity as an outcome. Two independent reviewers screened the search records and extracted data from eligible RCTs. Hedges' g was pooled using a random-effects model, with post-intervention insomnia severity as the primary outcome. Subgroup analyses and meta-regressions were performed to identify characteristics potentially associated with enhanced treatment efficacy. The Cochrane Risk of Bias 2.0 tool was used to assess study quality. This meta-analysis followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines and was pre-registered on PROSPERO (registration number: CRD420251009153).
Results: A total of 33 RCTs (37 intervention vs. control comparisons) involving 6,187 participants (mean age range: 27.3–71.8 years), conducted in upper-middle- or high-income countries, were included. Self-help CBT-I interventions were mainly delivered via mobile apps or web platforms, with varying levels of support ranging from none to guided assistance. Compared with control conditions, self-help CBT-I demonstrated large effect sizes in reducing insomnia severity at post-intervention (g =-0.97, 95% CI: -1.19 to -0.75; I^2 = 93.09%), moderate to large effects at 1–5 months post-intervention (g = -0.67, 95% CI: -0.83 to -0.51; I^2 = 70.20%), and at 6–12 months post-intervention (g = -0.78, 95% CI: -1.03 to -0.52; I^2 = 82.24%). Larger effect sizes were observed in trials that included relapse prevention components or were delivered via web platforms. No significant differences were found based on adaptation of CBT-I content, level of support, or provision of incentives. Of the included studies, 6 were rated as having a high risk of bias, 13 as having some concerns, and 14 as having a low risk of bias.
Conclusions: Compared with control conditions, self-help CBT-I demonstrated effectiveness in managing adult insomnia, regardless of the level of support or delivery format. Further rigorous research is warranted to evaluate the effectiveness of self-help CBT-I in low-income countries.

Associations of Subjective and Objective Sleep with Impulsivity and Probabilistic Reasoning

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Introduction: Growing evidence suggests that insomnia symptoms are associated with heightened impulsive behaviors and altered decision-making patterns. However, there remains limited research regarding the link between objectively measured sleep and decisional impulsivity, a form of decision-making characterized by the acceptance of undue uncertainty, or failure to adapt to environmental changes. According to the dual systems model, since the developing brain is characterized by the imbalance of increased reward-seeking and immature impulse control, inadequate sleep may exacerbate one's propensity to hasty decision making during late adolescents and early young adulthood. This study aimed to explore the associations of objective and subjective sleep with trait impulsivity and decision-making, specifically performance on a probabilistic reasoning task, in youth.
Materials and methods: Youth participants aged 18-25 were recruited and were invited to complete a battery of self-report questionnaires including Insomnia Severity Index (ISI) for insomnia severity, Pittsburgh Sleep Quality Index (PSQI) for sleep quality, and the Barratt Impulsiveness Scale (BIS) for trait impulsivity. Objective sleep was prospectively assessed over seven nights using wrist actigraphy. Probabilistic reasoning was measured by a behavioral task (beads task) with two scenarios (easy, less uncertainty vs. intermediate, more uncertainty). Multiple regression analyses were used to examine the association of subjective and objective sleep parameters with self-reported impulsivity and probabilistic reasoning task performance.
Results: Thirty-seven participants (mean age: 18.5 ± 1.71 years, female: 62.3%) were included in the study. Multiple regression analyses showed that actigraphy-estimated wake after sleep onset (WASO) was significantly and negatively associated with beads task performance in the easy scenario ($\beta = -0.79$, $p = .036$), even after controlling for subjective sleep (ISI and PSQI scores), suggesting that increased nocturnal wake time after sleep onset was associated with fewer beads drawn before decision-making, reflecting a more impulsive, jumping-to-conclusions reasoning style. No significant association was found between WASO and performance in the intermediate scenario with more uncertainty. Additionally, there were no significant associations observed between other objective sleep parameters (Sleep Onset Latency, Total Sleep Time, Sleep Efficiency) or subjective sleep measures (ISI, PSQI) and task performance in either scenario. Furthermore, objective or subjective sleep parameters were not significantly associated with trait impulsivity, as measured by BIS.
Conclusions: Disrupted sleep, characterized by objectively measured increased nocturnal awakenings, was significantly associated with more impulsive decision-making. On the other hand, subjective reports of insomnia symptoms and sleep quality were not linked to decision-making performance. Further research should consider exploring underlying mechanisms and examining sleep macro- and micro-structure in relation to decision-making and impulsivity in youth.
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Long-Term Risk of Dementia in middle-age and older adults with Sleep Disorders: Evidence from 20 Years of Nationwide Taiwanese Data

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Introduction: A growing body of research has identified an association between various sleep disorders and increased dementia risk; however, the extent to which specific types of sleep disorders differentially

contribute to dementia onset remains unclear. This research aimed to utilize comprehensive population-representative data to understand the risk of dementia in patients with sleep disturbances, and to compare the effects and risk factors of different types of sleep disorders on the risk of dementia.
Materials and methods: A retrospective study contained adults ≥40 years of age who enrolled in National Health Insurance Research Database (NHIRD) from 2000 to 2020. The subjects are: 1) patients with sleep disorders encompassed insomnia, sleep-related breathing disorders (SBDs), and restless leg syndrome (RLS) as their primary or secondary diagnosis according to the International Classification of Diseases; 2) aged 40 years or older; 3) with at least ten years of observable data in the health database. The incidence rate of all-cause dementia, Alzhemer's disease (AD), vascular dementia (VD) per 1,000 person-years will be observed. Cox proportional hazards model will focus on risk factors associated with dementia.
Results: Among the 236,837 participants, the majority were classified as having insomnia (n= 233,529), followed by those with sleep-related breathing disorders (SBDs; n= 2,367) and restless legs syndrome (RLS; n= 1,209). The overall incidence of all-cause dementia among subjects with sleep disorders was 7.83 per 1,000 person-years (PYs), with incidences of AD and VD reported at 1.31 and 1.11, respectively. Kaplan–Meier survival analysis revealed significantly lower dementia-free survival among participants with RLS (log-rank p< .0001). Participants with RLS exhibited the highest incidence of dementia (15.55/1,000 PYs) and demonstrated significantly elevated risks of all-cause dementia (adjusted hazard ratio [aHR], 1.96; 95% confidence interval [CI], 1.73–2.21), AD (aHR, 4.73; 95% CI, 4.57–4.90), and VD (aHR, 4.73; 95% CI, 4.57–4.90) compared to those with insomnia. Additional risk factors included advanced age, female sex, depression, alcohol abuse, and a high comorbidity burden.
Conclusions: RLS confers the highest risk of all-cause and subtype-specific dementia compared with insomnia and SBDs. Advanced age, female sex, depression, alcohol abuse, and a high comorbidity burden further compound this risk, underscoring the need for targeted screening and management strategies in these vulnerable populations.
Acknowledgments: sleep disorders, insomnia, sleep-related breathing disorder (SBDs), restless leg syndrome (RLS), Alzheimer's disease (AD), vascular dementia (VD), National Health Insurance Research Database (NHIRD)

Cognitive Function and Frontotemporal Functional Connectivity in Patients with Major Depressive Disorder and Comorbid Insomnia Symptoms: A Cerebral Hemodynamics Perspective

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Introduction: The underlying mechanism of major depressive disorder (MDD) with insomnia symptoms (IS) is still unclear. Our research is aimed to investigate the changes in the frontotemporal functional connectivity and cognitive function in patients with MDD and comorbid IS.
Materials and methods: We recruited 82 patients with MDD, including 50 comorbid with IS (MDD-IS), 32 without insomnia (MDD-nIS), and 35 healthy controls (HCs). The MATRICS Consensus Cognitive Battery (MCCB) was used to assess their cognitive function, and a resting-state functional near-infrared spectroscopy (fNIRS) was applied to measure the intensity of their frontotemporal functional connectivity (FC).
Results: A comparative cognitive function analysis showed both MDD-IS and MDD-nIS groups had significantly more impairments than the HC group in multiple domains: information processing speed, attention/vigilance, working memory, verbal learning, visual learning, and reasoning/problem-solving (all with $p < 0.001$, except reasoning/problem-solving with $p = 0.008$). In social cognition, the MDD-IS group had more pronounced impairments than the MDD-nIS group, which also performed worse than the HC group ($p < 0.001$). Using fNIRS, distinct frontotemporal and interregional functional connectivity (FC) changes were found among MDD subgroups differentiated by sleep disturbance. Compared to MDD-nIS and HC groups, the MDD-IS group exhibited significant frontotemporal hypoconnectivity ($p = 0.02$), with specific deficits in four pathways: left triangular part-left premotor cortex ($p = 0.010$), right triangular part-left oculomotor cortex ($p = 0.018$), right triangular part-right premotor cortex ($p = 0.026$), and left

oculomotor cortex-right premotor cortex (p = 0.003). Further analysis revealed additional dysconnectivity between prefrontal and premotor regions in MDD-IS patients compared to HC, involving connections between left and right dorsolateral prefrontal cortex (DLPFC) and right premotor cortex (p = 0.002 and p = 0.017, respectively). Subgroup-specific reductions were observed in MDD-IS patients compared to MDD-nIS, particularly in connectivity between the left triangular part and left oculomotor cortex (p = 0.049), and between left oculomotor and left premotor pathways (p = 0.034). Notably, both MDD subgroups showed impaired connectivity between the right oculomotor and right premotor regions compared to HC (p = 0.004), indicating this pathway may be a transdiagnostic neural signature of MDD. Correlation analyses showed significant associations between cognitive performance and interregional FC in the MDD-IS subgroup. Verbal learning capacity was positively correlated with connectivity between the left oculomotor and right premotor cortices. Visual learning performance demonstrated coordinated neural coupling through four pathways: left DLPFC-right premotor cortex, left triangular part-left oculomotor cortex, right DLPFC-right premotor cortex, and left oculomotor-right premotor cortex. Reasoning and problem-solving abilities were positively associated with connectivity patterns between the left triangular-left oculomotor and left triangular-left premotor regions.
Conclusions: These findings indicate that MDD patients with sleep disturbances exhibit characteristic cognitive impairments potentially linked to dysfunctions in frontotemporal and oculomotor-premotor networks. This research advances our understanding of the neural circuits through which sleep disturbances affect cognitive phenotypes in depression, and the related FC patterns could serve as potential biological markers and therapeutic targets.

Prediction of treatment outcome on digital cognitive behavioural therapy for insomnia using machine learning and usage data

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Introduction: Digital cognitive behavioural therapy for insomnia (dCBT-I) is recognized as an accessible and scalable intervention for treating insomnia. However, its effectiveness depends on patient adherence. Machine learning (ML) holds potential for outcome prediction, as it is designed to optimize predictive accuracy. Unlike classical statistical methods, which aim to describe relationships between variables based on predefined assumptions, ML can capture complex, nonlinear, and individualized patterns in data. This study employs ML techniques to evaluate the accuracy of ML models in predicting remission after intervention.
Materials and methods: The study recruited 35 participants aged 18-25 years (Mean ISI Score±SD:19.3±2.97;60% Female) to use a 28-day dCBT-I app. They met the DSM-IV-TR criteria for insomnia disorder, with an Insomnia Severity Index (ISI) score of 15 or higher. Those were excluded if they had a history of sleep disorders (other than insomnia), mental disorders (other than depression and anxiety), intellectual disabilities, severe suicidality, current pharmacological treatment or structured psychotherapy, or had recently engaged in shift work or trans-meridian travel.
During the intervention, participants provided daily sleep diaries, and their usage data was automatically tracked. App usage features, including daily usage durations (e.g., time spent on an app page), usage patterns (e.g., mean and maximum daily usage), time spent on each page (e.g., latest review time on a given day), and noncontinuous use of the app (e.g., number of days between two discrete usage) were recorded.
The state-of-the-art ML algorithms were used to predict whether participants achieved a post-intervention ISI score below 8, indicating remission of insomnia. We applied five-fold cross-validation and grid search for hyperparameter tuning, used the Synthetic Minority Over-sampling Technique (SMOTE) to address class imbalance, and evaluated model performance using the Receiver Operating Characteristic–Area

Under the Curve (AUC). Statistical significance between models was assessed using the DeLong test. SHapley Additive exPlanations (SHAP) was used to identify the important factors contributing to the models' predictions.
Results: In the study, 9% of participants (n=3) dropped out, while 91% (n=32) completed the 28-day dCBT-I app. In the completer analysis, 81% of participants experienced reduced ISI score (Mean Pre ISI Score±SD:19.41±3.15,Mean Post ISI Score±SD:11.94±5.65,Cohen's d=1.69,p<.001). Across all predictive models, XGBoost achieved the highest performance to predict remission (AUC=0.88,F1=0.86;p<.001), significantly outperforming other models (p<.05). Furthermore, Feature Importance analysis revealed that noncontinuous use of the app was the most predictive factors for remission after intervention across all models. Those remitted from insomnia (<8) (Mean days±SD:4.75±6.85) had a shorter gap in noncontinuous use of the app compared with other participants (Mean days±SD:7.08±3.80,p=.02).
Conclusions: Our findings indicate that ML models with users' engagement and adherence data of dCBT-I can accurately predict treatment outcome. In addition, noncontinuous use of the app emerged as the most important factor influencing model performance in predicting remission of insomnia, highlighting the importance of fostering sustained participation and adherence in digital interventions.
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Subtyping and Prognosis of Insomnia Disorder Based on Clinical, Psychological, and Sleep EEG Features

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Introduction: Insomnia disorder (ID) is a clinically heterogeneous condition, limiting the effectiveness of standardized interventions. This study applied data-driven approaches to identify ID subtypes based on clinical, psychological, and sleep EEG features, and to assess their distinct profiles and treatment outcomes.
Materials and methods: Subjects aged 18–65 years, meeting DSM-5 criteria for ID without other sleep disorders, were included. Comprehensive clinical and psychological evaluations and polysomnographic (PSG) monitoring were conducted to collect clinical, psychological, and sleep EEG features. Clinical features included the Pittsburgh Sleep Quality Index (PSQI), Hamilton Depression Rating Scale (HAMD), Hamilton Anxiety Rating Scale, and Multidimensional Fatigue Inventory (MFI); psychological characteristics included the Pre-Sleep Arousal Scale (PSAS), Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), Sleep Hygiene Index (SHI), Perceived Stress Scale (PSS), among others; sleep EEG features encompassed sleep structure and continuity, spectral power, and sleep spindle measures. Equivalent doses of benzodiazepine receptor agonists (BzRA) and antidepressants were recorded. PSQI and HAMD scores at 8 weeks post-treatment were used as outcome measures.
Feature selection was performed using a normalized correlation matrix, followed by dimensionality reduction via Uniform Manifold Approximation and Projection (UMAP). K-means clustering was employed based on optimal parameters based on silhouette coefficients and neighborhood preservation. Analysis of variance (ANOVA) and Kruskal-Wallis tests were utilized to compare subtype differences in characteristics and clinical outcomes, with significance set at two-tailed $P<0.05$.
Results: A total of 220 participants completed baseline assessments. Feature selection yielded 7 clinical features, 9 psychological characteristics, and 57 EEG metrics. Three distinct subtypes emerged from UMAP dimensionality reduction and K-means clustering:
Subtype 1, labeled "Deep Sleep Deficient Insomnia" (28.2%), had significantly older participants ($F=4.78$, $p=0.009$), highest depression severity ($F=11.19$, $p<0.001$), shortest duration of N3 slow-wave sleep ($F=6.27$, $p=0.002$), and higher NREM β-band total power ($H=24.40$, $p<0.001$). This subtype received the highest equivalent dosage of BzRA ($F=14.74$, $p<0.001$) and showed significantly poorer improvement in

PSQI scores at 8 weeks compared to other subtypes, as well as significantly worse HAMD outcomes compared to subtype 3 (F=8.47, p<0.001).
Subtype 2, "Stress Related Insomnia" (32.3%), displayed notable clinical anxiety (F=4.00, p=0.020) and fatigue (F=9.24, p<0.001), along with the highest insomnia vulnerability (F=4.30, p=0.015), pre-sleep arousal (F=14.62, p<0.001), rumination (F=7.40, p=0.001), and sleep hygiene issues (F=10.91, p<0.001). EEG analysis revealed reduced δ-band total power compared to other subtypes (H=12.63, p=0.002). This subtype received moderate BzRA dosages and demonstrated better overall improvement in PSQI scores at 8 weeks than subtype 1.
Subtype 3, "Spindle Deficient Insomnia" (39.5%), presented mild insomnia severity (F=5.63, p=0.004), lowest perceived stress (F=14.18, p<0.001), increased micro-arousals (F=3.532, p=0.031), and reduced spindle activity (H=66.55, p<0.001). Subtype 3 patients received the lowest equivalent dosages of BzRA and antidepressants, achieving the best overall outcomes in both PSQI and HAMD at 8 weeks.
Conclusions: This study identified three data-driven subtypes of insomnia with distinct EEG and clinical profiles, which were predictive of treatment response. These findings highlight the potential of personalized, subtypes-based management strategies for insomnia disorder.
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Sleep Architecture and Neurocognitive Performance in Insomnia Comorbid Obstructive Sleep Apnea Patients

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Introduction: Insomnia and obstructive sleep apnea (OSA) are the two most prevalent sleep disorders. Approximately 30% of individuals with insomnia also meet the diagnostic criteria for OSA, forming a comorbid condition known as Comorbid Insomnia and Sleep Apnea (COMISA). This co-occurrence could lead to elevated risk of disrupted nocturnal sleep, impaired daytime and cognitive function compared to the individual condition. However, few have examined the negative consequences of COMISA using objective cognitive measures. This study aimed to examine the differences in sleep architecture and neurocognitive functions between COMISA and insomnia-only patients, and to investigate whether COMISA is associated with greater sleep and cognitive impairment.
Materials and methods: Participants who met DSM-V criteria for chronic insomnia were included in this study. All participants underwent one night of home-based polysomnography (PSG) and performed a battery of neurocognitive tests including Psychomotor Vigilance Task (PVT), Balloon Analogue Risk Task (BART), Go/No-Go, and N-back tasks (0-, 1-, and 2-back) to assess vigilance, impulse control, and working memory, respectively. OSA was defined as an apnea–hypopnea index (AHI) ≥15 events/hour. Daytime sleepiness and fatigue were assessed using the Epworth Sleepiness Scale and the Multidimensional Fatigue Inventory. Group comparisons between COMISA and insomnia-only participants were conducted using independent t-tests or Mann–Whitney U tests, wherever appropriate. Mean reaction time for the PVT, Go/No-Go, and N-back were further analyzed using generalized linear models with a gamma distribution and log link, adjusting for age, gender, and BMI.
Results: A total of 147 adults (mean age: 46.2 ± 14.81 years, males: 21.77%) were recruited in Hong Kong. Thirty participants were classified as COMISA and 117 as Insomnia-only. Compared to the insomnia-only group, COMISA participants were older, had higher BMI, were more likely to be male, and reported significantly greater daytime sleepiness (12.30 ± 3.99 vs. 10.15 ± 4.49; $P = 0.018$) but not daytime fatigue. PSG-derived data revealed that the COMISA group had significantly higher oxygen desaturation index, total arousal count, and REM arousal index ($P < 0.005$), but no differences in total sleep time, sleep onset latency, sleep efficiency, or wake after sleep onset. For the neurocognitive performance, COMISA participants exhibited slower reaction time on the PVT (459.02 ± 163.95 vs. 397.64 ± 95.32 ms; $P = 0.047$), Go/No-Go (522.52 ± 74.67 vs. 473.35 ± 71.56 ms; $P = 0.001$), and N-back (570.84 ± 65.46 vs. 528.56 ± 83.85 ms; $P = 0.004$) tasks, with no group differences in error rates. After

adjusting for age, gender, and BMI, COMISA participants showed longer mean reaction time on both the 1-back ($B = 0.077$, 95% CI: 0.015–0.139; $P = 0.016$) and 2-back ($B = 0.083$, 95% CI: 0.016–0.150; $P = 0.015$) conditions.
Conclusions: Individuals with COMISA reported greater daytime sleepiness but not higher levels of fatigue compared to those with insomnia alone. Although there was no difference in sleep architecture, COMISA exhibited impairments in vigilance and attention, particularly under higher cognitive load. These findings highlight the need for targeted screening and cognitive monitoring in this high-risk subgroup.
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Actigraphy-Derived Circadian Rhythm Patterns as the Predictors of Anxiety and Depression in Individual with Insomnia Symptoms: Results of Principal Component Analysis

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Introduction: Emerging evidence links insomnia, circadian rhythm disruption, and mood disorders like anxiety and depression. However, the specific associations between disrupted circadian patterns and mood disorders in insomnia are not well understood. This study examined these relationships in adults with insomnia symptoms.
Materials and methods: Participants were community-dwelling residents from Hong Kong with insomnia (Insomnia Severity Index, ISI ≥ 10), excluding those with comorbid Major Depressive Disorder (MDD) and anxiety disorders. They completed 7-day wrist actigraphy using the ActiGraph GT3X, and mood disorders were assessed via the Structured Clinical Interview for DSM-5 Disorders (SCID-5). Six circadian rhythm parameters were extracted to assess rhythm stability, fragmentation, and day-night activity distribution, including Interdaily Stability (IS), Intradaily Variability (IV), average activity intensity and onset time of the lowest 5-hour nocturnal period (L5, L5hr), and the highest 10-hour diurnal period (M10, M10hr). Principal Component Analysis (PCA) was applied for dimensionality reduction, with components explaining more than 15% of the variance retained, supported by the elbow point in the scree plot. Multivariate logistic regression (adjusting for sex, age, education, marital status, employment, income, BMI, ISI score, and sleep duration) examined associations between circadian dimensions and MDD and Generalized Anxiety Disorder (GAD). To validate the findings, XGBoost models were used, with SHAP values determining feature importance and contribution.
Results: A total of 267 participants (Mean age: 43.4 years, 20.6% male) were included. Among them, 17 (6.4%) had GAD and 18 (6.7%) had MDD. Based on PCA, three principal components were extracted: Dimension 1 (Dim.1, 31.6% of variance), Dim.2 (22.4%), and Dim.3 (19.5%), together accounting for 73.5% of the total variance. Dim.1 was characterized by a delayed circadian phase (M10hr, L5hr), high IV, low IS, and lower daytime activity (M10), reflecting a delayed, unstable, and disorganized rhythm pattern. Dim.2 showed a delayed circadian phase with high IS and low IV, indicating a delayed yet well-consolidated rhythm structure. Both higher Dim.1 and Dim.2 were associated with younger age. Dim.3 was associated with elevated daytime and nighttime activity levels and low IS, suggesting reduced day-night differentiation. Results showed that Dim.1 was significantly associated with a higher probability of MDD (OR = 1.61, 95% CI: 1.12–2.31), and Dim.2 with GAD (OR = 1.69, 95% CI: 1.09–2.64). The XGBoost models showed good predictive performance, with AUCs of 0.88 for MDD and 0.78 for GAD. SHAP values indicated higher Dim.1 values were correlated with higher risk of MDD, and higher Dim.2 with higher risk of GAD.
Conclusions: The concurrence of insomnia and a delayed, irregular and disorganized circadian rhythm pattern were associated with higher risk of MDD, while that of insomnia with a delayed but regular circadian pattern are associated with higher risk of GAD. Future research is needed to determine whether

treating different subtypes of circadian rhythm patterns in insomnia could alleviate mood symptoms and even prevent the onset of mood disorders.
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Association of Personality Profiles with Sleep Disturbance, Depression and Anxiety in Individuals with Insomnia Disorder: A Latent Class Analysis

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Introduction: Insomnia disorder is highly comorbid with psychiatric disorders, such as anxiety and depression. Certain personality trait profiles have been identified as transdiagnostic risk factors for co-occurrence and increased severity of psychiatric disorders. However, empirical research exploring personality profiles in individuals with insomnia and their relationship with insomnia severity and mood symptoms remains limited. The present study aims to understand the relationship between personality profiles and depression, anxiety, insomnia severity, and well-being in individuals with insomnia disorder.

Materials and methods: 218 Chinese participants who underwent Diagnostic Interview for Sleep Patterns and Disorders(DISP) and the Structured Clinical Interview for DSM Disorders(SCID) to screen for sleep and psychiatric disorders, respectively were recruited from the community study in Hong Kong and. All Participants (Mean age=46 yrs ± 14.93; female: 76.6%; Presence of comorbid psychiatric disorder: 35.3%) has completed questionnaires including the Big Five Inventory(BFI) for personality traits , symptoms of anxiety, depression, and insomnia, well-being measurement including quality of life, and other insomnia-related measures such as excessive daytime sleepiness, sleep reactivity, sleep hygiene, and rumination. The subjects also completed 7-day sleep diary recording of their sleep-wake patterns, including total sleep duration(TST), sleeptime(ST), wake after sleep onset(WASO), sleep onset latency(SOL), and waketime(WT). Latent class analysis(LCA) was used to identify personality subgroups controlling for age, sex, and psychiatric history. ANOVA was further conducted to investigation the between-subject differences of sleep and mood-related outcomes in personality subgroups.
Results: LCA identified three subgroups characterized as vulnerable, typical, and resilient profiles. The vulnerable group (9.2%) exhibited significantly higher neuroticism(N: 4.07±0.338) and lower conscientiousness(C: 2.55±0.491), agreeableness(A: 3.01±0.532), openness to experience(O: 2.48±0.639), and extraversion(E: 1.95±0.516), while the resilient group (23.4%) showed the opposite pattern (N: 2.49±0.488; C: 3.97±0.348; A: 3.94±0.399; O: 3.50±0.661; E: 3.05±0.561). The typical group (67.4%) scored nearly average on all traits (N: 3.30±0.469; C: 3.30±0.525; A: 3.35±0.399; O: 3.11±0.524; E: 2.63±0.498). The vulnerable group demonstrated significantly higher insomnia severity ($F[2,215]=9.08$, $p<0.001$), more depressive($F[2,215]=16.9$, $p<0.001$) and anxiety symptoms($F[2,215]=24.9$, $p<0.001$), lower quality of life($F[2,215]=19.3$, $p<0.001$), compared to typical group, then followed by resilient group. Vulnerable group also reported significantly higher mental fatigue($F[2,215]=3.15$, $p=0.045$), greater daytime sleepiness($F[2,215]=3.35$, $p=0.037$), and sleep reactivity to stress($F[2,215]=5.16$, $p=0.006$) compared to Resilient group only. Resilient group has significantly less rumination($F[2,215]=12.2$, $p<0.001$) and better sleep hygiene($F[2,215]=3.61$, $p=0.029$) compared to the other groups while typical and vulnerable group had no significant difference. No significant difference were found in all variables related to sleep-wake patterns among three groups.
Conclusions: High Neuroticism along with low extraversion, agreeableness, conscientiousness, and openness to experience are associated with increased risk of sleep and mood disturbance among individuals with insomnia disorders, suggesting the existence of subgroups within the insomnia

population. These findings indicate the need for further phenotyping subgroups of insomnia in order to develop personalized treatment for insomnia.
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Movement Disorders

Electroencephalographic slowing during REM sleep is a marker of cholinergic dysfunction in Lewy body disorders

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Introduction: Lewy body diseases, including Parkinson's disease (PD) and dementia with Lewy bodies (DLB), represent the second most common neurodegenerative disease in older adults. Recent work has implicated progressive cholinergic system dysfunction as a key contributor to cognitive decline and disease progression in Lewy body disorders. Despite this, simple, non-invasive biomarkers of cholinergic impairment are lacking. Given that cholinergic neurons are actively involved in REM sleep and play a central role in cortical activation, alterations in EEG during REM sleep may offer a unique window into cholinergic network dysfunction.
In this study, we investigated whether REM EEG slowing in particular reflects disruption of key cholinergic hubs, the nucleus basalis of Meynert (NBM) and pedunculopontine nucleus (PPN), and whether this electrophysiological marker relates to cognitive impairment in Lewy body disorders.
Materials and methods: This cross-sectional study included 105 participants: 25 with DLB (mean age = 74.6 ± 6.0 years), 40 with PD (mean age = 64.2 ± 8.6 years), and 40 controls without cognitive impairment (mean age = 66.3 ± 7.7 years). All participants underwent comprehensive neuropsychological assessment and overnight polysomnography. A subset of participants also completed structural and resting-state fMRI within 12 months of their other assessments. Absolute REM spectral power was computed across frontal, central, and occipital regions for standard frequency bands (δ, θ, α, σ, β), and a slowing ratio was defined as [(δ+θ)/(α+σ+β)]. NBM volumes were extracted from T1-weighted images, and seed-based functional connectivity was assessed between the NBM and resting-state networks, and between the PPN and thalamus, using the Schaefer 400, Tian subcortical, and probabilistic NBM atlases. Group differences in REM spectral power were assessed using general linear models with permutation testing. Linear regressions were used to examine associations between neuroimaging variables and REM EEG slowing across α-synucleinopathies. All analyses included age and sex as covariates, applying FDR correction where appropriate.
Results: DLB participants showed significantly greater REM EEG slowing in occipital regions compared to PD and controls (p_{FDR} = 0.006). Power spectral changes were not associated with NMB volume. However, occipital REM slowing was significantly correlated with; aberrant NBM functional connectivity to the visual (p_{FDR} =0.034), ventral attentional (p_{FDR} =0.034), default mode (p_{FDR} =0.037), and frontoparietal (p_{FDR} =0.037) networks; and deficits in global cognition (MMSE; p_{FDR} =0.020), verbal learning (RAVLT recall; p_{FDR} =0.009), and executive function (Trails B; p_{FDR} =0.020). Altered PPN connectivity to the thalamus was correlated with REM slowing across regions (frontal, p_{FDR} = 0.008; central, p_{FDR} =0.033; occipital, p_{FDR} =0.033).
Conclusions: This study demonstrates that REM EEG slowing is associated with cholinergic network dysfunction across Lewy body diseases, and correlates with cognitive impairment across multiple domains. These findings suggest REM EEG slowing may be a non-invasive and transdiagnostic marker of cholinergic dysfunction and cognitive decline in Lewy body disorders, with relevance for disease monitoring, prognosis, and stratification in clinical trials.

Smartphone-based digital phenotyping of motor and non-motor biomarkers across early stages of α-synucleinopathies

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Introduction: Recent advances in smartphone-based digital measurements for neurodegenerative α-synucleinopathies, including Parkinson's disease (PD), have demonstrated promising results in symptom assessment. Nevertheless, existing applications generally have a narrow scope of symptom coverage (e.g., focusing solely on motor features). Thus, we developed a smartphone application *SmartBrainApp* in Hong Kong to comprehensively assess both motor (e.g., movement, speech and facial expression) and non-motor (e.g., psychomotor, cognition, impulsivity) functions of PD (26 tests total). In the current study, we aimed to: 1) validate *SmartBrainApp* among clinical PD patients, and 2) evaluate the ability of the App to detect subtle motor and non-motor changes in the prodromal stage of α-synucleinopathies, i.e., idiopathic/isolated rapid eye movement sleep behaviour disorder (iRBD).
Materials and methods: The validation study was conducted in 44 PD patients (mean age: 67.6 ± 5.5 years; 79.6% male) and 44 age- and sex-matched controls (67.1 ± 5.5 years; 79.6% male), who underwent clinical and traditional paper-and-pencil-based neurocognitive assessments and also completed the *SmartBrainApp* assessment. The content (expert review), construct (correlation with traditional tests), criterion (PD vs. control discrimination) validity, acceptability, and feasibility were evaluated. Test-retest reliability was assessed in a subset of 37 subjects (19 controls and 18 PD). A further assessment was conducted in 125 iRBD patients (68.4 ± 6.5 years; 72.8% male) and 95 age- and sex-matched controls (67.6 ± 5.4 years; 72.6% male), and a comparison of traditional and App features was carried out.
Results: Among 26 tests, 21 (81%) showed satisfactory validity (significant correlation with the traditional assessment and group differences), and 17 of these (81%) also showed acceptable test-retest reliability (intraclass correlation coefficient > 0.6). When combining all digital tests, the sensitivity and specificity for distinguishing PD patients from controls were 88.9% and 85.2%, respectively, reaching an area under the curve (AUC) of 0.93. Among them, pronation-supination movement (AUC = 0.88, accuracy = 84.1%) and leg agility (AUC = 0.84, accuracy = 80.7%) were the optimal App-based motor tests predicting PD. The feasibility was supported by high completion rates (≥ 97.7%) across the assessments, with 97.0% of subjects indicating that the assessments were not difficult to complete and 75.8% preferred the digital format over traditional paper-based methods. In addition, our smartphone-based App was able to capture subtle but significant PD-like abnormalities of iRBD patients in some motor (leg agility, finger tapping, reading and monologue) and non-motor (executive and attentional cognitive functions) tasks that were not detected by conventional assessments. By using all the features of *SmartBrainApp*, the AUC for distinguishing iRBD from controls reached 0.72.
Conclusions: *SmartBrainApp* demonstrated satisfactory validation properties in most motor and non-motor tasks and effectively identified a series of early motor/non-motor deficits in iRBD that were not detected by conventional assessments. This innovative approach addresses the critical need for accessible and objective assessments that can capture the multifaceted nature of PD, potentially enabling earlier detection and more precise monitoring of symptom evolution compared to conventional clinical evaluations.

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Narcolepsy

Nocturnal Fragmentation and Dream Enactment behaviors in Narcolepsy: Diagnostic Biomarkers Associated with Hypocretin-1 Deficiency

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Introduction: Narcolepsy, a rare chronic neurological disorder, is characterized by excessive daytime sleepiness (EDS) and disrupted nocturnal sleep patterns, substantially compromising patients' quality of life. While EDS and cataplexy are hallmark features, nocturnal manifestations remain undercharacterized. This study investigates distinctive sleep phenotypes in narcolepsy, particularly nocturnal frequent awakenings（at least ≥5 times） and REM sleep-related dream enactment behaviors (RBD-like symptoms), aiming to establish clinically relevant biomarkers for early diagnosis and mechanistic exploration.
Materials and methods: In this retrospective cross-sectional study, we analyzed 126 patients with EDS from Xuanwu Hospital from 2023 to 2025, stratified into three groups: type 1 narcolepsy (NT1, n=78), type 2 narcolepsy (NT2, n=21), and clinical controls (CC, n=27; suspected central hypersomnia with normal cerebrospinal fluid hypocretin-1 [hcrt-1] levels and negative multiple sleep latency test [MSLT] results). Data collection included standardized questionnaires assessing 35 sleep symptoms and polysomnography (PSG) metrics. Comparative analyses employed χ^2 tests, ANOVA, and ROC curve modeling to identify narcolepsy-specific signatures.
Results: Narcolepsy patients exhibited near-universal EDS (97.4%), with high rates of cataplexy (NT1: 85.7%), hypnagogic hallucinations (38.4%), and sleep paralysis (42.3%). Notably, nocturnal disturbances significantly distinguished narcolepsy from controls: frequent awakenings (89.7% vs. 59.2%; χ^2=9.437, P=0.002) and dream enactment behaviors (50.0% vs. 25.9%; χ^2=4.022, P=0.045). PSG revealed narcolepsy-specific pathophysiology, including elevated periodic limb movement indices (13.5±28.1 vs. 4.8±19.9/h; P=0.002) and arousal indices (24.6±11.4 vs. 17.7±9.0/night; P=0.014). In NT1, arousal indices inversely correlated with CSF hcrt-1 levels (r=−0.257, P=0.016). ROC analysis identified three discriminators: cataplexy (AUC=0.798, sensitivity 88.9%, specificity 70.7%), frequent awakenings (AUC=0.633, sensitivity 85.9%, specificity 40.7%), and dream enactment (AUC=0.608, sensitivity 47.5%, specificity 74.1%).
Conclusions: Nocturnal fragmentation (frequent awakenings) and REM-related motor dysregulation (dream enactment) emerge as clinically significant features of narcolepsy, serving as accessible diagnostic red flags. These phenotypes facilitate early differentiation from other sleep disorders, potentially minimizing diagnostic delays. The inverse relationship between hcrt-1 deficiency and nocturnal hyperarousal in NT1 suggests hypocretinergic modulation of sleep stability, providing novel mechanistic insights. These findings underscore the importance of comprehensive nocturnal evaluation in narcolepsy workups and lay groundwork for targeted biomarker development.
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Hypothalamic Functional Connectivity, Depressive Symptoms, and Post-Treatment SOREMPs in Narcolepsy Type 1: Links to Sleep Latency and Mediation Mechanisms

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Introduction: Narcolepsy type 1 (NT1) is characterized by sleep-onset rapid eye movement periods (SOREMPs), reflecting dysregulated rapid eye movement (REM) sleep control. Treatment response variability in SOREMP persistence remains poorly understood, particularly regarding hypothalamic functional connectivity (FC) and depressive symptoms. This study investigated clinical, polysomnographic, and neuroimaging differences between NT1 patients with low (0-1) versus high (≥2) post-treatment SOREMPs, and explored whether hypothalamic FC mediates the relationship between depressive symptoms and SOREMPs outcomes.
Materials and methods: One hundred ten NT1 patients were categorized into low (n=62) and high (n=48) post-treatment SOREMPs groups. Demographic, clinical variables (symptoms and questionnaires), and polysomnography (PSG)/multiple sleep latency test (MSLT) parameters were compared. Resting-state fMRI assessed hypothalamic FC with whole-brain regions. LASSO regression modeled associations between FC, sleep latency, and clinical variables, while mediation analysis tested hypothalamic pathways as mediators of depression-SOREMP relationships.
Results: High post-treatment SOREMPs patients exhibited shorter pre/post-treatment REM sleep latency, lower post-treatment wakefulness index, and higher depressive symptom prevalence compared to low SOREMPs patients. Hypothalamic FC differed significantly between groups: low SOREMPs patients showed enhanced connectivity in right medial hypothalamus-right thalamus/left precuneus, left medial hypothalamus-left inferior parietal lobule (IPL), and right lateral hypothalamus-left IPL pathways, but reduced connectivity in left lateral hypothalamus-right insula/left anterior cingulate cortex pathways ($p < 0.05$, GRF-corrected). LASSO regression identified left medial hypothalamus-left IPL FC as a significant predictor of post-treatment MSLT mean sleep latency ($\beta = 0.272$, $p = 0.001$), alongside age and pre-treatment sleep latency. Mediation analysis revealed complete mediation by two hypothalamic pathways: depressive symptoms predicted reduced right lateral hypothalamus-left IPL FC (indirect effect: 0.15-1.05), associated with fewer SOREMPs, and increased left lateral hypothalamus-right insula FC (indirect effect: 40 0.08-1.14), associated with more SOREMPs.
Conclusions: Hypothalamic-parietal/insular FC abnormalities link depressive symptoms to post-treatment SOREMP variability in NT1, with specific pathways mediating opposing effects on REM sleep regulation. These findings highlight hypothalamic connectivity as a critical neural substrate for treatment response, integrating sleep-wake and emotional processing networks. Targeting these pathways may improve personalized management for NT1 patients with comorbid depression and treatment-resistant SOREMPs.

Does body mass index differentiate the clinical and sleep characteristics of Chinese children and adults with narcolepsy type 1 differently?

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Introduction: Narcolepsy is a rare sleep disorder caused by the deficiency of hypocretin neurons located in the hypothalamus. Children and adults with narcolepsy show different clinical picture especially for the obesity. The aim of the present study is to investigate whether body mass index (BMI) affect the clinical and sleep characteristics of Chinese children and adults with narcolepsy type 1 (NT1) differently.
Materials and methods: A total of 172 patients with NT1 were included from Peking University People's hospital. Patients with obesity, overweight and normal body weight were defined according to Chinese obesity and overweight criteria for children and adults. Clinical and sleep characteristics were compared between patients with obesity, overweight, and normal BMI in Chinese children and adults with narcolepsy, respectively.
Results: Age at disease onset, sleepiness onset, cataplexy onset and age at disease diagnosis were not significantly different among NT1 patients with obesity, overweight and normal BMI regardless of in children or adults with narcolepsy. Higher blood pressure was noted in children or adults with NT1 with obesity compared to patients with narcolepsy with normal BMI. Higher scores for abnormal eating behaviours, especially for uncontrolled eating behaviours were noted in children with obesity compared to children with normal BMI, whereas this abnormal eating behaviour was not observed in adults with

narcolepsy with different BMI groups. A lower percentage of sleep paralysis was only noted in child NT1 patients with obesity compared to child NT1 patients with normal BMI but not in adult NT1 patients with different BMI groups as well. A higher percentage of stage N1 sleep and a higher apnoea hypopnea index (AHI) were noted in adult NT1 patients with obesity compared to adult patients with normal BMI, whereas these differences were not noted in child NT1 patients with different BMI groups. Shorter mean sleep latency on multiple sleep latency test (MSLT) was noted in children/adults with obesity or overweight versus children/adults with normal BMI.
Conclusions: Obesity is associated with lower hypocretin-1 levels and shorter mean sleep latency on MSLT regardless of in children or adults with NT1. Childhood obesity is associated with abnormal eating behaviours and lower percentage of sleep paralysis in NT1 patients. Adulthood obesity is associated with higher percentage of stage N1 sleep and higher AHI in NT1 patients. Obesity therefore affects the clinical and sleep characteristics differently in children and adults with NT1. Future management of narcolepsy should be different in different age groups as shown by the different phenotype of obesity in children and adults with narcolepsy.
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Clinical Phenotypes and Longitudinal Evolution Patterns in Narcolepsy: A Prospective Cohort Study Based on Symptom Cluster Analysis

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Introduction: To explore the heterogeneity and dynamic evolution of clinical phenotypes in narcolepsy by constructing a longitudinal subtype framework using prospective cohort data, and to assess the feasibility of phenotype-based prediction models in clinical practice.
Materials and methods: This study included 252 patients diagnosed with narcolepsy or idiopathic hypersomnia from a prospective cohort at Xuanwu Hospital, Capital Medical University (2021–2024). Baseline and follow-up data were collected at five time points, including clinical symptoms, Epworth Sleepiness Scale (ESS), Ullanlinna Narcolepsy Scale (UNS), REM Sleep Behavior Disorder Questionnaire (RBDQ-HK), polysomnography (PSG), Multiple Sleep Latency Test (MSLT), and cerebrospinal fluid (CSF) hypocretin-1 levels. Principal component analysis (PCA) was used to extract core symptom domains. Hierarchical clustering was conducted at each time point to define clinical phenotypes. The stability of cluster structures was evaluated by Adjusted Rand Index (ARI) and Feature Overlap Index (FOI). Symptom trajectories were visualized using Sankey diagrams. Generalized linear mixed models (GLMM) were used to model the longitudinal occurrence probability of cataplexy, hallucinations, and sleep paralysis. A random forest model was constructed to predict phenotypes based on clinical features.
Results: Five principal components were identified, representing cataplexy, hallucinations, sleep paralysis, sleep initiation/maintenance, and REM sleep behavior abnormalities. Four stable clinical phenotypes were observed across timepoints: (1) non-cataplexy, (2) hallucination-dominant, (3) isolated cataplexy, and (4) paralysis-dominant. These phenotypes demonstrated robust structural stability (baseline ARI=0.78; follow-up peak ARI=0.85) and external generalizability (validation cohort ARI=0.69; FOI > 0.95 across phenotypes). Longitudinally, phenotypes showed both symptom persistence and dynamic switching, with distinct trajectories in treatment-naïve vs. treated patients. The simplified prediction model using top 10 clinical variables achieved comparable accuracy to the full model (accuracy > 80%).
Conclusions: Narcolepsy exhibits diverse and evolving clinical phenotypes that are not fully captured by conventional NT1/NT2 classification. Our data-driven clustering approach reveals symptom-specific trajectories and provides a stable, generalizable framework for clinical subtype identification. These findings support the development of phenotype-informed diagnostic and treatment strategies for narcolepsy.

Attention and Inhibition Deficits in Narcolepsy Type 1：Behavioral and Electrophysiological Markers

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Introduction: Cognitive impairments in narcolepsy type 1 (NT1) significantly compromise daily functioning, but their neural mechanisms remain unclear.
Materials and methods: This study employed multimodal electroencephalography (EEG) analyses to investigate electrophysiological substrates of attention and inhibition deficits in NT1 and their association with clinical characteristics, particularly orexin deficiency. High-density EEG recordings were acquired during a Go/NoGo task from 39 NT1 patients and 41 age-/sex-matched healthy controls. Behavioral analyses reveled that compared to controls, NT1 patients exhibited significantly prolonged reaction times and increased errors across both Go and NoGo conditions.
Results: Electrophysiological analyses demonstrated that NT1 patients showed: (1) delayed Go-P3 latencies, meaning impaired response preparation; (2) reduced NoGo-P3 amplitudes, reflecting deficient inhibitory control; and (3) attenuated theta-band power and inter-trial phase consistency across conditions. Notably, decreased theta-band power correlated with both lower orexin levels and slower reaction times.
Conclusions: These findings suggest that orexin deficiency may mediate theta-band oscillation impairments in NT1, which mechanistically contribute to cognitive dysfunction. Thus, we propose theta-band oscillations as a clinically translatable biomarker for NT1-related cognitive deficits, with promising implications for objective monitoring of disease progression and developing EEG-targeted neuromodulation therapies.
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Weight loss response to GLP-1 RA in adults with narcolepsy cataplexy

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Introduction: Patient with narcolepsy cataplexy(NC) often has weight gain and obesity, probably due to orexin/hypocretin deficiency, which makes the diet more difficult in NC. Glucagon-like peptide-1 receptor agonists (GLP-1RAs) have been demonstrated effective for weight loss in obesity with diabetes or non-diabetes, obstructive sleep apnea, knee osteoarthritis and so on, while while their effects on obesity in NC remain unclear. This study explores the weight loss effects of one GLP-1 RAs (semaglutide) in adults with NC.
Materials and methods: This study was conducted between July 2024 and Mar 2025 at the Division of Sleep Medicine, Peking University People's Hospital. Weight loss effects of 12 adults with NC and obesity receiving semaglutide plus lifestyle interventions (Group A) and 24 sex-, age-,and BMI-matched adults with non-NC (Group B), as well as 12 adults with NC and obesity receiving lifestyle interventions alone(Group C). Weight and side effects were measured weekly, while clinical examinations, biological measurements, and questionnaires conducted at baseline and Week 12.
Results: Overall, the average age of the three groups is 29.69±7.63 years, and the vast majority (70.83%) were male in Group A and C(24 adults with NC and obesity). At baseline, the BMIs were 34.09±2.08 for Group A, 33.44±2.38 for Group B and 32.20±4.49 for Group C, with no statistical difference. Both Groups A and B completed 12 weeks on injectable semaglutide with losing 7.72%±4.47% and 7.73%±3.20% bodyweight respectively, while Group C lost 2.41%±2.68% bodyweight. And the weight loss from the baseline was 4.12%, 5.97%, 7.72% for Group A, and 2.56%, 5.43%, 7.73% for Group B,

and 1.46%, 1.79%, 2.41% for Group C at Weeks 4, 8, 12, respectively. Additionally, in Group A, 8(66.7%) patients lost≥5% weight, 5(41.67%) patients lost≥10% weight; in Group B, 20(83.3%) patients lost≥5% weight, 6(25%) patients lost≥10% weight; and in Group C, 2(16.67%) lost≥5% weight, with no patients achieving≥10%. The reported adverse events in patients using semaglutide were mainly nausea, vomiting, constipation, and diarrhea.
Conclusions: In adults with NC and obesity, injectable semaglutide resulted in weight loss similar to that observed in matched patients with simple obesity and had a similar side effect profile, while better than lifestyle intervention alone. Although patients with NC have a deficiency in orexin/hypocretin, they can still successfully lose weight with the GLP-1 RAs.
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Consciousness Denied: The First Cross-National Autoethnographic Study of Diagnostic and Treatment Pathways in Type 1 Narcolepsy

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Introduction: Type 1 narcolepsy (T1N) is a rare neurological condition characterized by orexin deficiency, affecting approximately 1 in 2,000 individuals globally. While clinical features and diagnostic criteria are well established, real-world patient diagnostic journeys across different healthcare systems remain critically underexplored. This study presents the first autoethnographic account of a Type 1 narcolepsy patient navigating six healthcare systems over an 11-year period, validated by cerebrospinal fluid analysis confirming undetectable orexin levels (<50 pg/mL).
Materials and methods: Autoethnographic patient-researcher methodology documented Type 1 narcolepsy patient experience across mainland China, Singapore, Hong Kong SAR (China), Germany, Spain and Sweden (2014-2025). The dual patient-researcher position provided unprecedented access to institutional mechanisms typically unavailable to external investigators. Data included detailed clinical encounters, diagnostic procedure timelines, pharmaceutical access attempts, institutional accommodation responses, comprehensive medical correspondence, and comparative policy reviews. Cross-cultural analysis systematically compared diagnostic accuracy, treatment availability, financial barriers, accommodation provision, and medical literacy using identical patient presentation. Findings were triangulated with epidemiological and policy literature to contextualize individual experience within documented system-level patterns.
Results: Dramatic disparities emerged across systems, revealing systematic rather than individual barriers.

Diagnostic access: Sweden (free orexin testing) > China (affordable PSG+MSLT, orexin testing available) > Hong Kong (expensive, genetic testing only) > Singapore (prohibitive costs, orexin testing unavailable in public healthcare).

Cross-border medical recognition: Sweden immediately accepted China's sleep study documentation without requiring additional testing. Germany, Spain, and Hong Kong explicitly rejected identical clinical evidence, forcing expensive retesting.

Treatment availability: Sweden (heavily subsidized Modafinil at minimal cost, free sodium oxybate through public healthcare) > Spain (subsidized but heavier patient contributions) >> China (prohibitive Modafinil costs ~$3000 monthly, accessible locally-manufactured Pitolisant) > Hong Kong/Singapore (Modafinil criminalized and unregistered, available only through regulatory appeals).

Institutional medical literacy: Sweden maintained sophisticated national patient database of ~1000 individuals. China updated comprehensive open-access national clinical guidelines in 2022, officially recognizing narcolepsy as rare condition since 2023, promoting locally-manufactured Pitolisant as first-line treatment. Singapore demonstrated concerning knowledge gaps, minimized condition as "person falls

asleep suddenly" in official health communications, with senior medical experts describing orexin deficiency as "evidence suggests" while explicitly denying established autoimmune pathophysiology.

Employment and accommodation: Sweden's private insurance systematically denied work capacity protection of T1N patients while social insurance resisted permanent disability recognition. Singapore demonstrated institutional employment stigma with public sector HR personnel commenting employees "will get fired if seen napping".

Systematic patterns revealed developed nations without rare disease infrastructure created greater barriers than developing nations with targeted resources. Treatment criminalization in Singapore contrasted with near-free provision in Sweden for identical medical necessity.
Conclusions: This study provides the first autoethnographic, cross-national comparative analysis of Type 1 narcolepsy diagnostic pathways. Findings demonstrate that healthcare responses correlate with diagnostic literacy rather than national economic development. Results underscore urgent need for harmonized international diagnostic protocols, equitable pharmaceutical access, and evidence-based accommodation and compensation policies. Patient-researcher methodologies offer invaluable insights complementing traditional clinical research for future guideline development.
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Other

Effects on quality of life and daytime sleepiness between patients treated with CPAP versus CPAP alternatives

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Introduction: Obstructive sleep apnea is the most common sleep related breathing disorder characterised by recurrent episodes of partial or complete airflow obstruction during sleep. If left untreated, it is associated with increased morbidity and mortality. Continuous Positive Airway Pressure (CPAP) remains the primary treatment for most OSA patients due to its efficacy in maintaining airway patency during sleep. However, poor patients compliance to CPAP therapy is a significant barrier to its long-term success, often due to discomfort or inconvenience. In recent years, various surgical interventions have emerged as a promising alternatives for OSA treatment, particularly for patients who are intolerant to CPAP. We would like to compare the improvement in the quality of life and daytime sleepiness of patients with OSA between those treated with CPAP therapy and those treated with CPAP alternatives.
Materials and methods: We conducted a pilot study in the Otorhinolaryngology clinic of University Malay Medical Centre. Patients aged 18 to 80 years old who were diagnosed with OSA of all levels, received interventions in the form of CPAP or CPAP alternatives were recruited to participate in the study. 48 patients completed the Epworth Sleepiness Scale (ESS) and the Calgary Sleep Apnea Quality of Life Index (SAQLI) questionnaires pre and post intervention (within the span of 2 weeks to 2 months).
Results: Both CPAP and CPAP alternatives were effective in improving patient outcomes, as shown by significant reductions in daytime sleepiness (ESS) and improvements in sleep-related quality of life (SAQLI) from pre- to post-treatment within each group.
Comparison between groups, no statistically significant differences were found in Post ESS ($p = 0.429$) or Post SAQLI scores ($p = 0.551$). The magnitude of improvement in sleepiness and quality of life was similar across both treatments. Although the CPAP group demonstrated slightly higher mean Post SAQLI scores, this difference was small and not clinically meaningful.

Conclusions: This preliminary study concluded that there is improvement in the quality of life and daytime sleepiness of patients with OSA treated with CPAP and CPAP alternatives. Though short term improvements are comparable between the two groups of patients, future studies need to be done to assess long term improvement of both arms, compliance of patients to CPAP therapy as well as the long term effectiveness of CPAP alternatives, such as surgical interventions and mandibular advancement devices.
Acknowledgments: I would like to thank the personnels below whom created and validated the questionnaires used
1) W. Ward Flemons and Marlene A Reimer: Development of a disease specific Health Related Quality of Life Questionnaire for Sleep Apnea

2) Norkhafizah Saddle, Hazama Mohamad, Nor Idaho Mohd Yusof, Dasmawati Mohammad, Norehan Mokhtar and Wan Zaripah Wan Bakar: Validity and reliability of the Malay Version of Sleep Apnea Quality of Life Index (SAQLI)

Prevalence of Exploding head syndrome (EHS) does not change from year to year

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Introduction: Exploding head syndrome (EHS) is a parasomnia characterized by the perception of loud noises or explosions inside the head during sleep-to-wake transition. However, the prevalence of EHS remains unclear. It is unknown whether the prevalence has changed from year to year. Therefore, we analyzed the change in prevalence of EHS over a 5-year period.
Materials and methods: As part of the Night in Japan Home Sleep Monitoring Study (NinjaSleep study), annual questionnaire survey was conducted among government employees in Koka City, Shiga Prefecture, Japan. To assess EHS, participants were queried “When dozing off or falling asleep, have you ever felt a sudden explosion in your head (e.g., bang, bang) or had the sensation that an explosion had occurred inside your skull?” from 2020 to 2024. Approval for the study protocol (R2017-111) was obtained from the Ethics Committee of the Shiga University of Medical Science.
Results: In total, 1.9% (29/1504), 1.6% (29/1832), 2.6% (48/1873), 1.6% (29/1811), and 2.0% (28/1401) of participants answered positively to the EHS screening questionnaire. No significant differences were found in the prevalence of EHS in these five years (p=0.187).
Conclusions: No significant differences in the prevalence of EHS were observed during the 5 years studied. Since EHS is a little-known sleep disorder, it is possible that asking this question every year would increase the percentage of positive responses; however, no obvious change in the positive response rate was observed.
Acknowledgments: We express our gratitude to the participants of Koka City. We thank Aiko Sagara, Kazuko Awazu, and Taeko Toyoda for their assistance with the data collection. The complete list of collaborators in the NinJa Sleep Study is as follows: Hiroshi Kadotani, Uyanga Tsovoosed, Yukiyoshi Sumi, Akiko Harada, Chie Omichi, Ayaka Ubara, Kohei Nishikawa, Masanori Takami, Kazuki Ito, Isa Okajima, Arichika Matsuda, Aiko Sagara, Taeko Toyoda, and Yuji Ozeki (Department of Psychiatry, Shiga University of Medical Science), Hiroki Inoue, Hitoshi Yamanaka, Keitaro Miyaji, Shota Nakatsuchi, Isao Kikuta, Kumiko Kashino, Saki Takahashi, and Koudai Tagawa (Koka City).

Does self-reported sleep duration reflect actigraphy-reported sleep duration in male youth soccer players?

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Introduction: Adequate sleep is essential for health, athletic performance, and recovery, particularly for young athletes facing the demands of continuous practice and competition. However, young athletes often obtain less sleep than recommended. While objectively tracking sleep using devices can be costly for most sports organizations, many rely on self-reported sleep as part of daily wellness assessments. Thus, it is important to determine the accuracy of self-reported sleep indices, as this may influence their effectiveness as part of a monitoring system. This study aimed to compare the agreement between daily self-reported and actigraphy-based sleep duration in male youth soccer players.
Materials and methods: Forty-eight young male soccer players (mean ± SD, age: 16.7 ± 0.9 years) reported their perceived sleep duration and completed sleep diaries daily while also wearing an actigraphy device for 35 consecutive days (a total of 1,116 individual actigraphy observations and 917 self-reported observations were collected). The reliability and agreement between objective and subjective measures of sleep were estimated. Agreement between measurements was assessed using Bland-Altman limits of agreement, with acceptable limits of agreement set at <30 minutes.
Results: The mean objectively measured sleep duration per participant over the investigated period was 06:41 ± 00:33 h, with a coefficient of variation of 16.1%, while the mean self-reported sleep duration per participant over the same period was 07:48 ± 00:35 h, with a coefficient of variation of 12.0%. The mean time in bed was 08:11 ± 00:33 h, with a coefficient of variation of 14.9% per participant. Results indicated a disagreement between objective and subjective sleep duration, with a mean bias of -1:00 h (95% Confidence Interval (CI): -1:09 to -00:57 h), indicating an overestimation of self-reported sleep duration by 01:00 h and a potential disagreement range of over 2:30 h, as the 95% limits of agreement ranged from -2:09 to 0:15 h (95% CI: lower -02:32 to -02:12 h and upper 00:09 to 00:28 h), suggesting considerable individual variability in agreement. When comparing the time in bed against the perceived sleep duration, data demonstrated a mean bias of 00:28 h (95% CI: 00:21 to 00:35 h), while the limits of agreement ranged from -00:46 to 01:43 h (95% CI: lower -00:56 to -00:39 h and upper 01:36 to 01:53 h).
Conclusions: The current results suggest that coaches and practitioners working with youth soccer players should interpret and use self-reported sleep indices with caution. Self-reported sleep duration appears to align more closely with the objective time in bed than with the actual sleep duration. Thus, when possible, other methods for sleep monitoring should be considered, either alone or in combination with self-reported measures.
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Pediatric

The effectiveness of transcranial magnetic stimulation on sleep structure and quality of life in children with autism

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Introduction: Sleep disorders are common in children with autism spectrum disorder (ASD).Transcranial magnetic stimulation (TMS) could be effect the excitability of neuronal cells that leading to improvements of sleep and quality of life in autistic children.Now a day, studies on clinical mechanisms of TMS in sleep disorders associated with ASD are limited.Therefore,our study aimed to explore the effects of TMS on sleep structure and qualityof life in children with ASD.
Materials and methods: The recruitment was directly informed through parents of autistic children in special education school in Nakhon Pathom Province,Thailand.Twenty children with ASD who met the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, were

selected in our protocol. The low-frequency TMS 2Hz,5Hz and 5Hz respectively and intensity of 3mT,15mT and 30mT respectively were targeted on the prefrontal and dorsolateral cortex on both sides in children with ASD 2 times per week,The frequency and intensity were adjusted every 2 weeks up to maximum frequency and intensity at 6 weeks of treatment.The Sleep Disturbance Scale for Children (SDSC)was performed before treatment and at 12 weeks of intervention. Independent sample *t*-tests and difference *t*-tests were used for statistical analysis of the data.
Results: Before treatment the total SDSC score in difficulty falling asleep, sleep maintenance, awakening disorders, sleep-wake transition disorders, excessive daytime sleepiness, and nocturnal hyperhidrosis scores were high in all ASD children.After TMS were performed in all ASD children, after 8,16 and 24 session of TMS Treatment with protocal of intensity and freqency adjustment every 4 weeks,the total SDSC score in difficulty falling asleep, sleep maintenance, sleep-wake transition disorders, and excessive daytime sleepiness scores were significantly decreased at 24 sessions of treatment (P<0.01). The difference t-test analysis showed that after 24 treatment sessions, the reduction rates of the total SDSC score, difficulty falling asleep, sleep maintenance, awakening disorders, sleep-wake transition disorders, excessive daytime sleepiness, and nocturnal hyperhidrosis dimensions were significantly decreased. (P<0.01).
Conclusions: Low-frequency TMS targeting the prefrontal and dorsolateral cortex in children with ASD can effectively improve their sleep status, and significant improvement can be achieved after 12 weeks (24sessions) of treatment.Moreover all of children had improved in quality of life in field of ability to learn and communication.Further study in multicenter and large scale population should be performed to achieve more significant statatistic data and could be advocated to apply as a non invasive choice of treatment in clinical practic worldwide to improve quality of sleep and quality of life in autistic children.
Acknowledgments:

I would like to express their sincere gratitude to all of patients and their parents for their participation of this research.I also extend our appreciation to staff of our clinic and special education school in Nakhon Pathom Province, Thailand for providing the necessary facilities and advocacy message to parents of autistic children.Special thanks to my parent for their guidance,encouragement and private fund for this study.

Effects of Ambient Temperature and Pollen Exposure on Sleep, Respiratory Events, and Apnea-Specific Pulse Rate Response in Children with Sleep Disordered Breathing

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Introduction: Increased nasal resistance is a recognized risk factor for pediatric sleep-disordered breathing (SDB). Ambient temperature variations and elevated pollen concentrations might modulate upper airway inflammation and obstruction, which may potentially alter sleep architecture, SDB severity and autonomic function in children.
Materials and methods: A retrospective analysis of in-laboratory diagnostic polysomnography (PSG) data in 690 Chinese children (median age 6.0 years [IQR: 4.0-9.0]) was conducted. The children were present with habitual snoring or witnessed apneas between January 2017 and December 2024.
Daily ambient temperature records and pollen counts (expressed as pollen grains per cubic meter of air, grains/m³) were obtained from official sources. High pollen days were defined as calendar days with ≥100 grains/m³ atmospheric pollen concentration. ΔHR was defined as the difference between the maximum and minimum heart rates within an event-related window around each respiratory event, calculated directly from the continuous heart rate recordings. This metric quantitatively reflects sympathetic activation during sleep apnea events. Associations between pollen concentration, ambient temperature and PSG parameters were analyzed.

Results: Participants exhibited a median age of 6.0 years (interquartile range [IQR]: 4.0–9.0). PSG-confirmed OSA was present in 302 children (43.7%), with a median obstructive apnea-hypopnea index (OAHI) of 3.9 events/hour (IQR 1.8–10.7).
Lower minimum, mean, and maximum ambient temperatures were significantly associated with greater proportion of NREM stage 3(ρ = -0.130, p = 0.001; ρ = -0.124, p = 0.001; ρ = -0.113, p = 0.003) . And ambient temperatures demonstrated positive correlations with proportion of NREM stage 2 (ρ = 0.134, p < 0.001; ρ = 0.122, p = 0.001; ρ = 0.126, p = 0.001). No significant associations were observed between ambient temperatures and OAHI, SpO_2, WASO, sleep latency, or sleep efficiency.
Children monitored on days with higher ambient pollen levels (≥100 grains/m³, median 210 [IQR 160–358]) exhibited significantly lower nadir oxygen saturation (91% [88–93] vs. 92% [89–95], p = 0.014) and less ΔHR (36.9 [29.3–44.8] vs. 39.4 [31.4–47.3] bpm, p = 0.029) compared to those monitored during low-pollen exposure periods. Notably, no significant differences were observed in OAHI, arousal index, sleep latency, or sleep efficiency (all p > 0.05), indicating that the observed effects are independent of conventional sleep-disordered breathing metrics.
Conclusions: These findings suggest that elevated environmental pollen concentrations might exert subtle but measurable effects on sleep architecture, nocturnal oxygenation and autonomic regulation. Ambient factors might be considered as effect modifiers when evaluating sleep apnea-induced pathophysiological consequences in children with sleep disordered breathing.
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Association Between Spindle Wave Activity and Subjective Sleep Evaluation in Drug-Naïve Adolescents With ADHD and Sleep Complaints

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Introduction: Sleep disorders are frequently observed in neurodevelopmental conditions, and approximately 50% of individuals with attention-deficit/hyperactivity disorder (ADHD) are reported to experience some form of sleep disturbance (Cortese S. et a ., *Journal of the American Academy of Child & Adolescent Psychiatry,* 2009). Several studies have examined abnormalities in sleep architecture and sleep-related cognitions in ADHD. However, these studies are often limited by factors such as insufficient control groups, heterogeneity in the diagnostic criteria for ADHD, failure to exclude comorbid psychiatric condition, and potential confounding effects of medication. (Bertisch S.M., *Sleep*, 2014).
Our previous research suggested a paradoxical dissociation between subjective and objective sleep assessments in individuals with ADHD from childhood to adulthood (Kato T. et al., Journal of Attention Disorders, 2023). However, the underlying mechanisms of this dissociation remain unclear. Recent studies have suggested a potential association between cognitive functioning and spindle wave (SW) activity during sleep. This study investigated the relationship between SW parameters and subjective sleep perception in drug-naïve adolescents with and without ADHD who underwent clinical polysomnography for sleep-related complaints.
Materials and methods: We retrospectively analyzed data from patients under the age of 18 (n = 70) who presented with sleep disturbances at the Department of Psychiatry and Sleep Medicine at Kurume University Hospital between April 2015 and March 2020. ADHD was diagnosed based on DSM-5 criteria. Patients with comorbid conditions known to affect sleep structure—narcolepsy (NL), idiopathic hypersomnia (IH), obstructive sleep apnea (OSA; AHI ≥ 5), restless legs syndrome (RLS), or periodic limb movement disorder (PLMD)—were excluded. After applying these criteria, the final sample comprised 40 patients. Spindle wave parameters obtained from polysomnography (PSG) were compared between the ADHD and non-ADHD groups. Subjective sleep quality was assessed using the Japanese version of the Epworth Sleepiness Scale (JESS) and the Pittsburgh Sleep Quality Index (PSQI). This study was approved by the Ethics Committee of Kurume University.
Results:

1. The ADHD group showed significantly higher scores on the JESS (15.9 ± 4.4 vs. 11.3 ± 5.3; p = 0.0342) and the PSQI (8.8 ± 2.7 vs. 5.8 ± 2.4; p = 0.0124) compared to the non-ADHD group.
2. PSG analysis revealed significantly higher SW counts (112 ± 10.2 vs. 24 ± 4.8; p = 0.0361) and SW frequency per hour (93.5 ± 10.3 vs. 23 ± 4.6; p = 0.0272) in the ADHD group, particularly in the slow spindle frequency range.
3. In the ADHD group, the number of slow SW events was positively correlated with the PSQI sleep duration component (C3) (r = 0.8452, p = 0.0341) and negatively correlated with the subjective sleep duration reported immediately after PSG (r = -0.7516, p = 0.0315).

Conclusions: These findings suggest that increased spindle activity—particularly within the slow spindle range—may influence the process of subjective sleep evaluation in drug-naïve adolescents with ADHD, independent of comorbid sleep or psychiatric disorders and pharmacological influences.

Effectiveness of a nurse-led community-based infant sleep intervention programme: The Sleep Easy Programme (SleEP), Singapore

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Introduction: Sleep plays a vital role in infant development, ensuring optimal brain function and overall health. However, infant sleep problems are common, affecting up to 25% of infants who experience difficulties with sleep onset and problematic night wakings. Early intervention is crucial, but effective community-based programmes are limited. This study aimed to describe and explore the implementation and preliminary outcomes of a nurse-led, community-based intervention programme designed to identify and address early sleep disturbances in infants.
Materials and methods: The Sleep Easy Programme (SleEP) is a nurse-led, community-based programme implemented across multiple primary care centres in Singapore, targeting mainly infants aged 0-6 months. It consists of a three-tiered intervention approach. In Tier 1, parents complete a 22-item questionnaire adapted from the Brief Infant Sleep Questionnaire (BISQ) during routine well-baby visits at four different timepoints and receive anticipatory guidance on age-specific sleep management. Infants identified with sleep concerns (questionnaire score > 5) proceed to Tier 2, where they are referred to a National University Hospital sleep nurse for individualized teleconsultation and education on sleep interventions. Tier 3 involves referral to a sleep psychologist for infants with persistent sleep problems requiring further intervention. Descriptive statistics were used to analyse trends in referral rates, and parents' confidence levels in managing their infants' sleep and perception of the usefulness of the teleconsultation.
Results: Between November 2024 and June 2025, a total of 1,375 questionnaires were completed. The scores for 344 (25.0%) of these were greater than 5, suggesting sleep concerns in the infants and necessitating referral to Tier 2 for further intervention.

Among 163 infants screened at multiple timepoints, 32 (19.6%) were referred to Tier 2 at their first screening. During their second screening, 23 (71.9%) of these infants showed improvement and did not meet the referral threshold again, indicating positive sleep behaviour changes following the interventions. For the remaining 131 infants who were not referred initially, only 15 (11.6%) crossed the referral threshold upon subsequent assessments, suggesting sustained sleep health in the majority.

Overall, the Tier 2 referral rate among infants who were screened at multiple timepoints decreased from 19.6% at the first screening to 14.7% at the second, suggesting a trend towards improved sleep patterns following nurse-led education and intervention. 100% of parents reported increased confidence in managing their infants' sleep post-teleconsultation and/ or usefulness of the teleconsultation.
Conclusions: Preliminary findings from SleEP highlight the impact of structured, nurse-delivered sleep education and teleconsultation support in reducing sleep-related concerns within the first 6 months of life. The integration of sleep health into routine nursing assessments reinforces the expanded role of

community nurses in early childhood development. Further research with a control group would be needed to establish effectiveness conclusively.
Acknowledgments: My gratitude goes to the NUP nurses for their role in screening and educating the families. I would also like to thank the NUH Evidence-Based Nursing Unit for their guidance as well.

ASSOCIATION BETWEEN PARASOMNIAS AND CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER: A CROSS-SECTIONAL STUDY IN VIETNAM

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Introduction: Attention deficit hyperactivity disorder (ADHD) is frequently associated with sleep disturbances, including parasomnias, which may worsen ADHD symptoms. However, the relationship between ADHD and parasomnias remains underexplored, particularly in newly diagnosed pediatric populations. This study aimed to determine the prevalence of parasomnias and identify associated factors in children with ADHD.
Materials and methods: A cross-sectional study was conducted on 629 children aged 6 – 12 years newly diagnosed with ADHD according to DSM-5 criteria at Vietnam National Children's Hospital. Parasomnias were classified using the ICSD-3, and data on comorbidities and sleep behaviors were collected through structured interviews and sleep diaries. Univariate and multivariate logistic regression analyses were performed to determine significant associations.
Results: Parasomnias were identified in 27.8% of children with ADHD, with NREM-related parasomnias being the most prevalent. The presence of comorbid psychiatric disorders, particularly tic disorders, anxiety–depression, learning disorders, and intellectual disability, significantly increased parasomnia risk (OR 2.49 – 4.29, $p < 0.001$). Sleep talking was the strongest independent predictor (OR = 5.74, $p < 0.001$). ADHD clinical subtypes were not significantly associated with parasomnias.
Conclusions: Parasomnias are common in children with ADHD and are strongly linked to comorbid conditions and sleep-related behaviors. These findings emphasize the need for routine sleep assessments in ADHD management. Future studies should incorporate longitudinal designs and objective sleep assessments to better understand underlying mechanisms and intervention strategies.
Acknowledgments: We extend our sincere gratitude to the Psychiatry Department at the Vietnam National Children's Hospital for their invaluable support and collaboration in conducting this study. We also thank all the participants and their families who participated. We would like to thank the Sleep Lab Center of the Vietnam Society of Sleep Medicine in Dalat, Vietnam, for their assistance and support.

Obstructive sleep apnea and sleep disorders in children with attention deficit hyperactivity disorder

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Introduction: Sleep disorders are common yet often underdiagnosed in children with attention-deficit/hyperactivity disorder (ADHD). These disturbances can exacerbate ADHD symptoms and negatively affect cognitive, emotional, and behavioral functioning. This study aimed to describe the prevalence of obstructive sleep apnea (OSA) and other sleep disorders in children with ADHD using standardized diagnostic criteria, and to identify associated clinical and behavioral factors
Materials and methods: A cross-sectional study was conducted on 629 children aged 6 to 12 years (mean age: 7.8 ± 1.5 years) who were diagnosed with ADHD. Sleep disturbances were assessed using the Children's Sleep Habits Questionnaire (CSHQ), the Pediatric Sleep Questionnaire (PSQ), and Respiratory polygraphy. Sleep disorders were classified based on the International Classification of Sleep

Disorders, Third Edition (ICSD-3). Multivariate logistic regression was used to identify associated risk factors.
Results: Sleep disorders were diagnosed in 70.0% of children with ADHD. The most common disorders were insomnia (40.2%), OSA (23.4%), parasomnias (27.8%), restless legs syndrome (10.5%), and delayed sleep-wake phase disorder (4.8%). The inattentive ADHD subtype, psychiatric comorbidities, tonsil and adenoid hypertrophy, iron-deficiency anemia, and sleep-related behaviors in children with ADHD were significantly associated with sleep disturbances.
Conclusions: Sleep disorders are highly prevalent and diverse in children with ADHD. Early identification and targeted management of sleep disturbances, particularly OSA and insomnia, are essential to improving sleep quality and optimizing ADHD outcomes. Routine sleep screening should be integrated into clinical ADHD evaluations.

The Mechanism of Ferroptosis in Chronic Intermittent Hypoxia Induced Liver Injury and the Regulation Role of Nrf2

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Introduction: Obstructive sleep apnea (OSA) is characterized by chronic intermittent hypoxia (CIH), which can induce or exacerbate liver injury. Ferroptosis, marked by iron overload and lipid peroxidation, is closely linked to liver injury, but its mechanistic role in CIH-related liver damage remains unclear. Evidence suggests that the antioxidant regulator Nrf2 may protect against ferroptosis-driven injury, though the mechanisms require further exploration. This study established a CIH-induced liver injury mouse model to investigate the role of ferroptosis in CIH-induced liver injury and the protective effect and molecular mechanism of Nrf2 in ferroptosis mediated CIH-induced liver injury.
Materials and methods: In this study, utilizing a CIH model in 4-week-old male mice, we investigated ferroptosis and the potential involvement of Nrf2 in CIH-related liver injury. Post-modeling, serum ALT/AST activity, hepatic iron, MDA, SOD, GSH, histopathology (HE, Masson, Prussian blue staining), mitochondrial ultrastructure (TEM), and ferroptosis-related molecules (GPX4, SLC7A11, TFR1, ACSL4) mRNA/protein levels were analyzed.
Results: Chronic intermittent hypoxia (CIH) exposure in mice induced liver ferroptosis, evidenced by elevated ALT/AST levels, disrupted hepatic architecture, fibrosis, iron overload, mitochondrial damage (outer membrane rupture, cristae loss), oxidative stress (increased MDA, decreased SOD/GSH), and dysregulated ferroptosis markers (downregulated GPX4/SLC7A11, upregulated TFR1/ACSL4). Interventions with DFO (iron chelator) and Lip-1 (ferroptosis inhibitor) reversed these effects, restoring liver function, reducing iron deposition, mitigating mitochondrial injury, and normalizing oxidative/ferroptosis-related biomarkers. Nrf2 activation via sulforaphane (SFN) further alleviated CIH-induced damage, lowering body/liver weight, reducing fibrosis, and modulating ferroptosis markers (upregulating GPX4/SLC7A11/FSP1, downregulating TFR1/ACSL4), whereas Nrf2 inhibition (brusatol, BRU) exacerbated injury.
Conclusions: Chronic intermittent hypoxia exposure can induce lipid peroxidation and iron ion overload, triggering ferroptosis and leading to liver injury in mice. Activation of the Nrf2 signaling pathway can effectively alleviate chronic intermittent hypoxia-related liver injury by reducing iron ion accumulation and upregulating FSP1 expression to inhibit lipid peroxidation, thereby suppressing the ferroptosis process.
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Pulmonary Rehabilitation in Pediatric Scoliosis: A Prospective Pilot of a Risk-Stratified Perioperative Respiratory Pathway involving polysomnography and transcutaneous carbon dioxide measurements

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Introduction: Children with scoliosis are predisposed to perioperative respiratory complications due to restrictive lung mechanics, impaired muscle strength, and ventilation-perfusion mismatch. These risks are further amplified in neuromuscular and syndromic subtypes. Preoperative pulmonary compromise often remains subclinical but becomes evident under the stress of anesthesia and postoperative recovery. This study aimed to evaluate a structured, risk-based pathway that integrates pulmonary assessment and individualized respiratory support to optimize surgical outcomes in children undergoing scoliosis correction.

Materials and methods:

This was a prospective observational study involving 19 children referred to pediatric pulmonology 2–4 weeks prior to scoliosis surgery. Each patient underwent a comprehensive preoperative evaluation, including clinical assessment, spirometry (pre- and post-bronchodilator), extended pulmonary function testing (PFTs) in children over 8 years, polysomnography (PSG), transcutaneous CO_2 ($TcCO_2$) monitoring, and arterial blood gas analysis when indicated.

Patients were stratified into high-risk (presence of neuromuscular disease, Cobb angle >90°, FVC <60%, or sleep hypoventilation) or low-risk groups. High-risk patients were initiated on non-invasive ventilation (NIV) for at least 2–4 weeks preoperatively. Mechanical insufflation-exsufflation (MI-E) was added based on clinical judgment. Postoperatively, all patients received NIV support for at least one month. Respiratory outcomes were monitored through chest radiographs and clinical evaluation.

Results:

Nineteen patients (mean age 10.7 years; 10 females) were enrolled, of whom 15 underwent surgery. The etiologies of scoliosis included syndromic (40%), neuromuscular (26%), congenital (20%), and idiopathic (13%). Six children were classified as high-risk (five with neuromuscular disease, one with FVC <40%). These patients were initiated on BIPAP with a median preoperative duration of six months. In contrast, low-risk patients used BIPAP for a median of one week preoperatively.

Five neuromuscular patients underwent PSG, with 75% demonstrating moderate-to-severe sleep-disordered breathing and hypoventilation. Postoperatively, NIV was continued in all patients, with long-term continuation in neuromuscular cases. MI-E was used in seven patients, including both with FVC <40%. Two complications were reported—one dural tear with cerebrospinal fluid pleural leak and one case of hypotension. The average hospital stay was 5.4 days, with a mean PICU stay of 2 days.

Statistical analysis showed a significant difference in preoperative FVC values between high- and low-risk groups ($p = 0.031$). However, no statistically significant differences were observed in hospital stay ($p = 0.529$) or MI-E use ($p = 1.0$), likely due to small sample size and variability in disease severity.

Conclusions:

This risk-stratified perioperative respiratory pathway effectively identified high-risk children and facilitated the implementation of tailored respiratory interventions. The integration of preoperative NIV and postoperative continuation, along with MI-E where indicated, was feasible and likely contributed to favorable clinical outcomes. While statistical significance in outcome differences was limited, the pathway demonstrated clinical value and safety. Future studies with larger cohorts and control groups are warranted to validate and refine this model of personalized perioperative respiratory care.

Exploring the Impact of Technology Use in Children with and without Neurodisabilities. Findings from a Cross-Sectional Study

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Introduction: In clinical practice, parents of children with neurodisabilities (ND) sometimes report that technology use helps their children settle down before bedtime, despite the general advice to avoid screen use prior to bed. There is limited research focusing on bedtime technology use and its impact on sleep in children with ND. This cross-sectional comparative study examined sleep patterns and technology use in children with ND by comparing them to a cohort of neurotypical (NT) peers to inform tailored sleep management guidance for children with ND.
Materials and methods: The primary prospective study was conducted across three Australian paediatric hospital sites where parents or caregivers of children aged 2–18 years with a diagnosed ND condition and referred for diagnostic polysomnography (PSG) were recruited. A smaller group of NT children undergoing a clinical PSG study were recruited from one clinical site for comparison. Caregivers completed a study-designed questionnaire which examined device type, frequency of use, duration, reported helpfulness and data regarding any sleep problems in the participant. Comparison of groups was performed using chi-square tests. Qualitative thematic analysis of caregiver free text responses was also undertaken.
Results: There were 192 participants in the ND group (53.1% male, mean age 10.1) and 35 participants in the NT group (48.6% male, mean age 10.1). Frequency of "everyday" device use was generally high in both groups but was 10% higher in the ND group. Older children with ND showed a statistically significant higher frequency of device use than younger children (p=0.002). Caregiver report of sleep symptoms in their child was higher amongst participants in the ND group compared to those in the NT group (53% and 29% respectively). Amongst participants in the ND group, 18% reported sleep symptoms when device use was low ("never/little") whereas 42% reported sleep symptoms when device use was described as high ("more than 1-2 days per week"). 40% of caregivers in the ND group reported technology use at bedtime to be "somewhat" helpful compared to 14% of participants in the NT group. Differences between device use within different ND condition subtypes as well as qualitative analysis of free text responses from caregivers were also evaluated in this study.
Conclusions: There was a high prevalence of technology use at bedtime in all children, with those with ND reported to have overall higher use. This study strongly suggests an association between bedtime technology use and a higher report of sleep symptoms in children with ND. Despite this finding, just under half of the caregivers in the ND group indicated some perceived benefit of technology use at bedtime for their child, suggesting that the relationship between sleep and screen time is complex in this population. Our findings highlight the importance of not only providing guidance to families about the potential negative impact of technology use around bedtime for their child's sleep but also a need to consider modified advice for children with ND, to balance potential benefits from technology use that may be key to assisting parents with implementing day to day routines

Association of Outdoor Artificial Light at Night with Sleep Duration and Social Jetlag Among Preschool-aged Children

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Introduction: Recent studies have increasingly focused on the influence of outdoor artificial light at night (ALAN) on children's sleep patterns. However, its specific impact on sleep duration and social jetlag in this population remains underexplored. In densely populated urban centers such as Hong Kong, children are increasingly exposed to elevated levels of nighttime illumination. Our previous research demonstrated the detrimental effects of electronic screen use on children's sleep. The present study aimed to examine the association between outdoor ALAN exposure and both sleep duration and social jetlag among preschool-aged children in Hong Kong. The findings are expected to provide important insights into the impact of light pollution on pediatric sleep health and support the development of preventive strategies.
Materials and methods: This study included 3,686 preschool children recruited from kindergartens across four geographical regions in Hong Kong. Parent-completed questionnaires provided information on socioeconomic status (SES), as well as children's and parents' sleep–wake patterns. Outdoor ALAN exposure was assessed within a 1,000-meter radius of each participant's kindergarten address using satellite imagery data, with a spatial resolution of approximately 1,000 meters. To estimate the associations between ALAN exposure and children's sleep duration and social jetlag, a Generalized Linear Mixed Model (GLMM) was employed, with geographical region included as a random effect. Social jetlag misalignment was defined as a difference greater than one hour between weekday and weekend midsleep time, corresponding to the 75th percentile of the distribution in our sample. Bedtime screen exposure was defined as the use of electronic screens within one hour before bedtime.
Results: The mean age of the participants was 3.85 ± 0.99 years, with 52.85% being girls. The average sleep duration was 626.6 ± 60.2 minutes per day. ALAN exposure ranged from 10.18 to 84.28 nW/cm²/sr. A significant negative association was observed between ALAN exposure and children's sleep duration, with each unit increase in ALAN corresponding to an estimated decrease of approximately 0.198 minutes in sleep duration (P =0.003). After adjusting for age, sex, family income, parental education level, and bedtime screen exposure, the association became marginal (β = –0.11, P = 0.070). A significant interaction was identified between ALAN exposure and bedtime screen exposure ($P_{interaction}$ = 0.043), indicating that children exposed to screens at bedtime were more susceptible to ALAN-related reductions in sleep duration (β = –0.21, P < 0.001). We further examined the relationship between ALAN exposure and social jetlag. Children in the highest quartile of ALAN exposure had a significantly higher risk of social jetlag misalignment (OR = 1.131, 95% CI: 1.03–1.68; P_{trend} = 0.009), based on multivariable-adjusted models.
Conclusions: This study found that higher levels of outdoor ALAN were associated with shorter sleep duration and a greater risk of circadian disruption among preschool-aged children. Future research aiming to address the adverse effects of ALAN on children's sleep should also account for indoor light exposure, particularly from electronic screens, to inform the development of more targeted and effective interventions.
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Impaired attention function and increased REM sleep EEG Theta/Beta Ratio in pediatric REM sleep-related obstructive sleep apnea

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Introduction: To explore whether daytime attention function is impaired in children with rapid eye movement sleep related obstructive sleep apnea (REM-OSA), and to investigate the correlation between attention performance and REM sleep electroencephalogram (EEG) relative power in children with REM-OSA.
Materials and methods: Ninety-nine children aged 6–11 years with symptoms of snoring or mouth breathing during sleep were recruited from the Sleep Center of Beijing Children's Hospital. The parents of children completed the SNAP-IV questionnaire. All children completed the Attentional Networks Test for Interactions and Vigilance - executive and arousal components (ANTI-Vea) and underwent overnight

polysomnography. Children were grouped according to obstructive apnea/hypopnea index (OAHI): 16 children with non-OSA, 51 children with non-REM-OSA and 32 children with REM-OSA. The REM sleep EEG relative power spectral and theta/beta ratio (TBR) on frontal, central and occipital regions was analyzed.
Results: There were no group differences for SNAP-IV questionnaire scores. Children with REM-OSA exhibit increased reaction time variability in executive vigilance compared with non-OSA and non-REM-OSA (all $p<0.05$). There were more errors in invalid condition of ANTI-Vea in REM-OSA group compared with non-REM-OSA ($p < 0.05$). There were no significant differences in delta, theta, alpha, sigma and beta relative power on frontal, central and occipital regions among three groups. Compared to non-OSA and non-REM-OSA groups, REM-OSA group had higher TBR on central region during REM sleep ($p < 0.05$). Overnight OAHI in REM sleep stage to OAHI in NREM sleep stage was positively associated with reaction time variability in executive vigilance and errors in invalid condition of ANTI-Vea. TBR on central region during REM sleep was positively correlated with errors in invalid condition of ANTI-Vea.
Conclusions: Children with REM-OSA exhibit impaired daytime attention function, characterized by increased reaction time variability in executive vigilance. REM sleep TBR may reflect the nocturnal electrophysiological activity in children with REM-OSA, which is related to orienting attention function during the day.

Psychiatric Disorders Affecting Sleep/Wake

Sleep regularity, actigraphic rest-activity rhythms and light exposure patterns in patients with bipolar depression and evening chronotype

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Introduction: Sleep and circadian rhythm disturbances, which are closely related to light exposure, are closely related to bipolar disorder (BD). Eveningness, fragmented and irregular sleep are common features in BD. A lower Sleep Regularity Index (SRI) score has been reported in euthymic BD patients compared to healthy controls, particularly among those with phase delay. This study focuses on a vulnerable group of patients with bipolar depression and eveningness and we hypothesized that a lower SRI correlates with greater delays in sleep and light exposure.
Materials and methods: This study analysed the baseline data obtained from an ongoing randomized controlled trial (ClinicalTrials.gov ID: NCT05357313) involving patients with non-seasonal bipolar depression and eveningness (defined as a Morningness-Eveningness Questionnaire, MEQ score < 42). The assessments included 1-week prospective sleep diary and actigraphy, and one sample of overnight urinary 6-sulfatoxymelatonin (aMT6s). In addition to basic sleep parameters, non-parametric analyses were applied to both rest-activity rhythm (RAR) and white light (WL) exposure actigraphic data. Key actigraphic metrics included: SRI (range 0-100, higher scores indicating greater regularity), intradaily variability (IV; range ≥ 0, higher values indicating increased activity-rest fragmentation), and L5/M10 start times (onset of the 5-hour/10-hour periods with minimal/maximal average activity or light exposure). The associations between SRI and the sleep/light metrics were explored by Pearson (r) or Spearman (r_s) correlation, where appropriate.
Results: Thirty-two patients with bipolar depression (mean age = 42.0±11.4 years, female: 84.4%) and evening chronotype (MEQ score mean ± SD = 34.3±8.2) were included in the analysis. The SRI scores ranged from 44.6 to 95.0, with a mean of 71.1±14.7. A lower SRI score correlated with a later rest start time (r = -0.481, p = 0.005), a later sleep start time (r = -0.491, p = 0.004), shorter time in bed (TIB; r = 0.418, p = 0.017), and reduced total sleep time (TST; r = 0.413, p = 0.019). Regarding light exposure, a lower SRI correlated with a later light exposure L5 start time (r_s = -0.562, p = 0.001) and a higher IV (r = -0.475, p = 0.006). No correlation was found between SRI and the creatinine-adjusted urinary aMT6s levels (r = 0.162, p = 0.459).
Conclusions: In patients with bipolar depression and evening chronotype, a lower sleep regularity, as measured by SRI, correlated significantly with delayed sleep timings, shorter sleep duration, and an

increased variability of light exposure. Our study underscores the intricate relationship among sleep regularity, timing, and light exposure. The findings suggest the potential to integrate therapeutic interventions that target improving sleep regularity, aligning sleep timing, and optimizing light exposure patterns to enhance outcomes in patients with bipolar depression and eveningness.
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Obstructive Sleep Apnea and Psychiatric Co-morbidities: A Territory-Wide Study in Hong Kong

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Introduction: The bidirectional relationship between obstructive sleep apnea (OSA) and psychiatric disorders is increasingly recognized. However, most existing studies rely on convenient clinical samples, focus on symptoms rather than formal psychiatric diagnoses, and are typically limited to adult populations. There is a lack of large-scale, population-based studies examining OSA and its associated psychiatric co-morbidity across the lifespan.
Materials and methods: We conducted a retrospective study using the data from Clinical Data Analysis and Reporting System (CDARS), covering over 90% of health services in Hong Kong. Patients of all ages with at least one psychiatric diagnosis (ICD-9-CM codes 290–319) between 2014 and 2023 were included. Those with missing or implausible data (age < 0 or death before diagnosis date) were excluded. OSA was identified by ICD-9-CM codes 780.51, 780.3, and 780.57. Each OSA patient (OSA group) was matched with a non-OSA psychiatric control (Controls) by sex and age at first psychiatric diagnosis using propensity score matching. An "archive date" was set as the date of the first OSA diagnosis. Psychiatric diagnoses within ±2 years of the archive date were captured as the psychiatric comorbidity surrounding the diagnosis of OSA. For the Controls, we match the time interval between the archive date to the first psychiatric diagnosis with the OSA group to ensure comparable observation windows. Age at archive date was stratified into child (<18), adult (19–64), and senior (65+) groups. Diagnoses were grouped into anxiety, depression, bipolar disorder, psychosis, dementia, substance-related disorders, insomnia, sexual/gender identity disorders, eating disorders, ADHD/hyperkinetic disorders, autism, and others. Group differences were tested using chi-square, Fisher's exact, or t-tests with False Discovery Rate correction (significance: adjusted $p < 0.05$).
Results: We identified 11400 patients in the OSA group (64.3% male; mean age = 50.3±21.3), of whom 14% were children, 61.5% adults, and 24.5% seniors. Insomnia was significantly more prevalent in the OSA group across all ages (children: 1.6 vs. 0.2%; adults: 2.8 vs. 0.8%; seniors: 5.5 vs. 1.3%). In children, OSA was associated with higher rates of intellectual disability (19.8 vs. 10.6%) and eating disorders (3.6 vs. 0.8%). Among adults and seniors, anxiety (21.3 vs. 17.3%; 17.0 vs. 12.2%) and depression (15.1 vs. 10.0%; 12.9 vs. 8.4%) were more common in the OSA group. Bipolar disorder (2.8 vs. 1.8%) was also significantly higher in adults with OSA. Conversely, co-morbid substance-related disorders and psychosis were significantly lower in the OSA group. Dementia appeared lower in seniors with OSA (21.2 vs. 23.9%), though became insignificant in a sensitivity analysis limited to diagnoses after the archive date (13.0 vs. 11.9%).
Conclusions: This study provides an age-stratified description of psychiatric diagnostic patterns associated with OSA in a real-world psychiatric population. Our findings confirm well-established associations between OSA and mood or sleep disorders. In contrast, substance-related disorders and psychosis were significantly less prevalent in the OSA group, which may reflect underdiagnosis due to help-seeking behaviors, diagnostic overshadowing, or assessment barriers specific to these populations.
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An AI-Driven Model for Depression Detection Using Sleep Heartbeat and Breathing Signals

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Introduction:
Autonomic dysfunction, marked by changes in heart rate and breathing patterns, is a core symptom of depression. However, the role of autonomic dysfunction during sleep as a marker for depression is not well understood. This study evaluates the utility of polysomnography (PSG)-derived cardiorespiratory signals for depression detection.
Materials and methods:
We examined clinical polysomnography (PSG) data and electronic health records collected between 2021 and 2025 from Sir Run Run Shaw Hospital (RRS). Depression cases were identified based on the International Classification of Diseases, 10th Revision (ICD-10) diagnosis codes, Hamilton Depression Rating Scale (HAMD) scores of 8 or higher, and/or chief complaints suggestive of depression. Age- and sex-matched controls were selected based on ICD-10 diagnoses or HAMD scores. A foundational model approach was employed: abdominal (ABD) signals and RR intervals (RRI) derived from electrocardiogram signals were first used to pre-train a model to predict other PSG channels. Subsequently, the model was fine-tuned using logistic regression for depression classification. Data from RRS was used for model training and internal validation (randomly split into 90% training and 10% internal testing sets). Model performance was assessed using the area under the receiver operating characteristic curve (AUROC), sensitivity, and specificity.
Results:
The study included 1303 depression cases and 1978 controls. The mean age was 48.9 ± 17.4 years for cases and 48.9 ± 17.3 years for controls, with 66.2% and 66.1% female, respectively. The model achieved an AUROC of 0.761, with an accuracy of 0.706, sensitivity of 0.735, and specificity of 0.674 in the internal validation set.
Conclusions:
Our findings demonstrate that AI-driven analysis of sleep-derived heartbeat and breathing signals can effectively detect depression, with moderate sensitivity and specificity. By leveraging cardiorespiratory signals, this model offers a sleep-based solution for in-home depression screening. This approach paves the way for precision mental health tools that support early identification and intervention for depression in community settings.
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REM Behavior Disorders

Integrated gut microbiome and metabolome analysis in isolated REM sleep behavior disorder

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Introduction: Isolated REM sleep behavior disorder (iRBD) is considered as the most specific prodromal marker of alpha-synucleinopathies, including Parkinson's disease (PD). Emerging evidences suggest similar gut microbiota dysbiosis between iRBD and PD. Fecal metabolomics provide a functional readout of microbial activity, and several key metabolites may play crucial roles in the pathophysiology of PD, including substrates of choline metabolism, amino acids (glutamate and tyrosine), bile acids and long chain saturated fatty acids. However, to date, fecal metabolomics of iRBD has not been thoroughly investigated. This study aims to explore the alterations in fecal microbiome and metabolome in patients with iRBD, along with their possible interactions.
Materials and methods: This is a cross sectional study, including 224 video-polysomnography confirmed iRBD (68.2 ± 7.3 years old, male 73.2 %) and 127 healthy controls (65.7 ± 7.5 years old, male 62.2 %). Fresh stool samples were collected from both groups. Gut microbiota was analyzed using shotgun metagenomic sequencing. Untargeted fecal metabolomics were performed using liquid chromatography–mass spectrometry.
Results: Fecal metabolomics analysis identified 296 metabolites distributed across 37 metabolic pathways. After adjusting for age and gender, 57 differential metabolites were identified (false discovery rate [FDR] < 0.1). Majority of the differential metabolites (N = 45) were more abundant in the iRBD group, including elevated fatty acids (Oleic acid, Myristic acid, traumatic acid) and lipid peroxidation products (15,16-DiHODE, 12(13)-DiHOME, 16-hydroxyhexadecanoic acid), suggesting the potential presence of an inflammatory state and oxidative stress in the gut of iRBD patients. Elevated levels were also observed for amines such as phenylethanolamine, anandamide (AEA), L-histidinol, as well as lithocholic acid, indole and its derivative 2-oxindole. For the metabolites which were decreased in iRBD, Leucine has the most significant depletion, which may indicate disrupted branched-chain amino acid (BCAA) catabolism in iRBD patients.
For the metagenomics, a total of 21 differential microbial species were found between iRBD and controls (false discovery rate [FDR] < 0.1 after adjusted age and gender). For example, the abundances of Anaeromassili bacillus sp An250, Christensenellaceae bacterium NSJ 63 and Lachnospiraceae bacterium NSJ 29 were increased, while Clostridium fessum and Faecalibacterium prausnitzii were depleted in the iRBD group. We then examined the correlations between differential metabolites and microbial species in both groups. Of note, iRBD-enriched species Christensenellaceae bacterium NSJ 63 was widely associated with fecal metabolites indole, leucine, lysophosphatidylglycerol (lysoPG) and lithocholic acid, while these associations were not found in the control group, suggesting that the pathogenesis of iRBD may be closely linked to gut microbiota–mediated metabolic reprogramming.
Conclusions: The gut metabolome, including BCAA degradation, bile acid biosynthesis, phospholipid biosynthesis and tryptophan metabolism, is altered in iRBD, providing important biological insights into the gut–brain pathophysiology of alpha-synucleinopathies. Gut microbiota imbalance may be a driving factor underlying the gut metabolic alterations. These findings support a role for microbial metabolites as potential targets for the development of new biomarkers and therapies in iRBD.
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Progression of prodromal markers of alpha-synucleinopathy neurodegeneration in the first-degree relatives of patients with REM sleep behavior disorder: a 7-year prospective study

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Introduction: Idiopathic REM sleep behavior disorder (iRBD) is the most specific prodromal phase of alpha-synucleinopathies, including Parkinson's disease (PD) and dementia with Lewy bodies (DLB). Emerging evidence suggests a familial predisposition of iRBD, highlighted by the familial aggregation of RBD-spectrum features (e.g., dream enactment behaviors) and prodromal markers of alpha-synucleinopathies (e.g., motor dysfunction) in the first-degree relatives (FDRs) of iRBD patients. Building on these cross-sectional observations, this longitudinal 7-year follow-up study aims to further evaluate the progression of neurodegeneration markers and subsequent clinical neurodegenerative development in the FDRs of patients with iRBD compared to the FDRs of controls, in the established Hong Kong family cohort.
Materials and methods: This prospective matched cohort study included 156 FDRs of patients with iRBD and 130 FDRs of controls as the referent individuals. Comprehensive clinical assessments were conducted, including interviews on sleep patterns and disorders, neuropsychiatric examinations, motor tests using the Unified Parkinson's Disease Rating Scale part III (UPDRS-III), and a series of questionnaires at baseline and follow-up. Additionally, 69 FDRs of iRBD patients and 40 control FDRs underwent video-polysomnographic assessments (v-PSG) at both time points. Linear and generalized linear mixed model analyses were employed to study the longitudinal changes.
Results: The mean follow-up duration for FDRs of iRBD patients and control individuals were 6.6 years and 6.8 years, respectively (P = 0.28). Baseline age (54.6 ± 9.0 vs. 55.3 ± 7.2 years, P = 0.46) and sex distribution (48.7% vs. 44.6% males, P = 0.49) were comparable between the two FDR groups. FDRs of iRBD patients consistently exhibited trends of increased RBD features at both baseline and follow-up, including self-reported dream enactment behaviors and electromyographic activity of chin mentalis evaluated by v-PSG. Over the observation period, six FDRs of iRBD (Cumulative incidence 4.0%) and one FDR of controls (Cumulative incidence 0.8%) were newly diagnosed with iRBD (group effect, P < 0.001; group*time effect, P <0.001). Other prodromal markers, such as motor function assessed by UPDRS-III total score and sub-score for bradykinesia, showed greater impairment in FDRs of iRBD patients (group effects, P = 0.02 and P = 0.01), while gait instability demonstrated a significant group*time interaction effect (P = 0.01). However, global cognitive function did not differ significantly between the two groups. During the follow-up, two FDRs of iRBD patients were clinically diagnosed with PD (Cumulative incidence 1.3%), whereas no FDRs of control were diagnosed with PD. None of the FDRs in either group was diagnosed with dementia.
Conclusions: These findings further confirm the familial aggregation of RBD features and alpha-synucleinopathy neurodegeneration markers among FDRs of iRBD patients. Upon 7-year prospective follow-up, FDRs of iRBD patients exhibited higher incidences of RBD features (including iRBD diagnosis), progression of neurodegenerative features and clinical diagnosis of incident PD, highlighting FDRs of iRBD as high-risk populations for future neuroprotective interventions.
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Environmental Exposures, Clinical Characteristics and Gut Microbial Features in Patients with Early α-Synucleinopathies and Their Cohabiting Partners

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Introduction: Idiopathic REM sleep behavior disorder (iRBD), a prodromal stage of α-synucleinopathies, exhibits gut dysbiosis characterized by enriched pro-inflammatory bacteria and depleted short-chain fatty acids (SCFA)-producing bacteria. Previous studies have shown that microbiome is shaped by shared environment, with cohabiting spouses exhibiting strong similarities. However, whether iRBD-related microbiome dysbiosis exists in iRBD spouses (RS), and how lifestyle and clinical factors affect their gut microbiome remain unclear. This study aims to characterize clinical, lifestyle and gut microbial features in RS, and explore the underlying host-microbiome interplays.
Materials and methods: This cross-sectional study included 58 video-polysomnography-confirmed iRBD patients (69.5±6.6 years, 87.9% male), 58 RS (66.1±6.8 years, 12.1% male) and 58 unrelated controls (UC, 66.0±6.9 years, 13.8% male). UC were 1) age- and sex-matched with RS; 2) not cohabiting with or genetically related to iRBD couples; and 3) had spouses free of RBD or neurodegeneration. Participants underwent clinical assessments, questionnaires, and fecal shotgun metagenomic sequencing. Dietary information was collected using a 20-item questionnaire. Data were analyzed using SPSS 29.0 and R 4.4.2.
Results: Compared to UC, RS trended toward a higher prevalence of possible RBD (defined as RBDQ-HK total score > 18: 8.9% vs. 1.8%, p=0.098). RS also exhibited higher prevalence of depression and upper gastrointestinal (GI) disorders. Additionally, the occurrence of injuries in iRBD patients was positively associated with depression in their spouses (p=0.029). In contrast, lower GI symptoms—as reflected by Rome-IV diagnosed constipation, bowel movement frequency, and SCOPA-AUT subscores—appeared to be milder in RS versus UC (p=0.050, p=0.088, p=0.014, respectively).

Regarding lifestyle, RS had significantly lower dietary diversity and higher consumption of salty snacks and animal fat than UC. Further analyses within iRBD couples showed positive correlations between patients and their cohabiting spouses in education level, consumption of most food groups (16/20, 80%), cognitive function, and upper GI symptoms.

Metagenomic analyses revealed comparable gut microbial composition between RS and UC, with no significant differences in alpha or beta diversity, or any individual taxa. However, compared to iRBD patients, RS showed significantly reduced observed species, as well as microbial dissimilarity after adjusting for age, sex and constipation. Nine species and five genera differed significantly between RS and iRBD patients, with RS displaying higher abundances of SCFA-producing genera *Agathobaculum*, *Faecalibacterium* and *Roseburia*. Host-microbiome interaction analyses showed that longer constipation duration was negatively correlated with all these SCFA-producing genera, while constipation was associated with reduced *Faecalibacterium* abundance. Additionally, higher consumption of unhealthful plant-based foods, including refined grains and bakery products, was negatively correlated with *Agathobaculum* abundance.
Conclusions: iRBD spouses exhibit higher prevalence of depression and upper gastrointestinal symptoms, alongside lower constipation rates and dietary diversity. Despite shared environmental and lifestyle factors, iRBD spouses did not display RBD-like gut dysbiosis; instead, their microbiota featured a possible enrichment of SCFA-producing bacteria, suggesting a "healthier gut" phenotype. Lifestyle factors, particularly fewer bowel disorders (e.g., constipation), are likely associated with these health-promoting bacteria.

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Habitual diet and gut microbiome correlates in isolated REM sleep behavior disorder

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Introduction: Accumulating evidence indicates that habitual diet, including plant-based dietary patterns, are associated with the risk of developing neurodegenerative alpha-synucleinopathy. However, the role of dietary pattern and its correlation with gut microbiome at prodromal alpha-synucleinopathy, i.e., among patients with isolated REM sleep behavior disorder (iRBD), are largely unclear. This study aims to evaluate the associations of dietary patterns with iRBD and their interactions with gut microbial dysbiosis. Additionally, the effect of dietary factors on neurodegenerative progression in patients with iRBD was further examined.
Materials and methods: A total of 287 iRBD patients (66.9 ± 7.1 years, 74.6% males) and 208 controls (66.6 ± 7.3 years, 68.3% males) were involved in the study. Plant-based diet indices (overall plant-based diet index, oPDI; healthful plant-based diet index, hPDI; and unhealthful plant-based diet index, uPDI) were derived from food frequency questionnaire based on 20 food groups. The shotgun metagenomic sequencing for microbiome was performed in 452 subjects (261 iRBD vs. 195 controls) for further diet-microbiome analyses. After a median of 4.1 years, 45 (15.7%) iRBD patients converted to alpha-synucleinopathies. The impact of habitual diet on neurodegenerative outcomes were analysed using Cox proportional hazards models.
Results: Multivariable logistic regression models showed that subjects in the highest quartile of hPDI experienced 52% lower odds of iRBD (OR [95% CI]: 0.48 [0.29, 0.80], P = 0.005) compared to the lowest quartile, whereas that of uPDI would increase the odds of iRBD by 73% (1.73 [1.03, 2.91], P = 0.04). In terms of individual food groups, iRBD patients had lower intake of whole grains and were prone to consume more refined grains. Notably, the association of uPDI with iRBD was significantly more pronounced in subjects with depression (OR [95% CI]:1.93 [1.26, 2.95], P = 0.002) and those who were physically inactive (P = 0.01). Gut metagenomic analysis revealed that habitual diet was linked to the variations in microbial composition and changes in individual microbes among iRBD patients. Further mediation analyses suggested that 39.1% (P = 0.006) of the effects of uPDI on iRBD were mediated by iRBD-enriched microbial species *Ruthenibacterium lactatiformans*. During follow-up, iRBD with higher baseline coffee drinking had a decreased risk of converting to alpha-synucleinopathy (Multivariate-adjusted HR [95% CI] = 0.22 [0.06, 0.74], P = 0.01), especially parkinsonism-first conversion (0.11 [0.02, 0.66], P = 0.02), whereas increased whole grain consumption was associated with lower risk of dementia (0.06 [0.004, 0.87], P = 0.04).
Conclusions: Patients with iRBD consumed more unhealthful plant-based diet and a decreased intake of healthful plant-based foods, such as whole grains. The habitual diet in iRBD is closely associated with gut microbiome dysbiosis with predictive value for neurodegenerative progression. The findings suggest that diet, gut microbiome, and their interplay might hold potential value for future interventions in alpha-synucleinopathy neurodegenerative diseases.

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Automated analysis of home video for screening REM sleep behaviour disorder

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Introduction: Isolated REM sleep behavior disorder (iRBD), a prodromal syndrome of alpha-synucleinopathy neurodegeneration is characterized by vivid and often action-packed dream enactment behaviors (DEBs) during REM sleep. Early detection of iRBD benefits in preventing the progress of neurodegeneration, and sleep-related injuries caused by DEBs. With the availability of ambulatory home-PSG measurement, emerging studies have supported the validity of screening and diagnosing varieties of sleep disorders, including iRBD, at home setting. In corroborating a diagnosis of iRBD, the use of video-polysomnogram (vPSG) will help to document sleep related movement during REM sleep. However, the detailed manual analysis of vPSG recording is time-consuming and labor-intensive. There has been increasing number of studies exploring the automated video analysis method in distinguishing iRBD from healthy controls, albeit most of them were conducted in laboratory settings. Here we aimed to explore the automated video analysis for screening RBD at the home setting.
Materials and methods: This study included 35 patients with iRBD and 35 non-RBD controls, with the diagnoses confirmed (or excluded) by prior in-laboratory vPSG monitoring, respectively. All subjects underwent home vPSG (Nox A1s) with time-synchronized infrared-night-vision video recording (XIAOMI C700/TP-Link C212). Sleep-wake stages were scored by certified polysomnographic technologists. For the automated video analyses, pixel-value differences between adjacent 2-seconds-frames were calculated to quantify the intensity of movements from REM sleep videos, generating a temporal motion signal. Motion signals were compared with manually score movements results (based on criteria proposed by Frauscher B, 2009). Then, following features of motion signal were compared between iRBD and controls: movement counts (counts of motion signal larger than 1.2/1.4/1.6/1.8 times median of motion signal's peaks [baseline, indicating a "static status" of sleep]) per minute, movement duration percentage (duration of motion signal larger than 1.2/1.4/1.6/1.8 times baseline), and averaged normalized intensity.
Results: We firstly compared motion signals versus manually scored movements during REM sleep. A total of 95 major jerk/movements (e.g., whole body jerk, gross body movement, raising the arm, isolated elevation of one leg) were manually identified from five iRBD patients (66.4 ± 7.4 years, 80.0% male), while the motion signal threshold of 1.2/1.4/1.6/1.8 times baseline identified these movements with sensitivities of 100.0/96.3/91.3/87.9% and specificities of 35.63/83.21/92.31/95.67%, respectively. Then, we compared the motion signals between iRBD patients (67.9 ± 6.6 years, 71.4% male) and controls (66.7 ± 6.8 years, 31.4% male), whose results showed that iRBD group exhibited significantly higher values than controls in movement counts (e.g., 1.6 times: median [IQR]: 2.03 [1.25-3.33] vs 0.23 [0.13-0.50] per minute, $P < 0.001$), movement duration percentage (e.g., 1.4 times: 8.7% [6.1-13.1%] vs 1.2% [0.7-3.7%], $P < 0.001$), and averaged normalized intensity (1.61 [1.45-1.96] vs 1.25 [1.16-1.47], $P < 0.001$).

Conclusions: This study suggested that automated video analysis method would be able to identify epochs with possible behavioral events and differentiate iRBD patients from controls. The findings may highlight the feasibility of using ambulatory home-PSG measurement with infrared-night-vision camera to screen RBD at home settings.
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Association Between Iron Metabolism Biomarkers and REM Sleep Behavior Disorder: A Mendelian Randomization Study

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Introduction: REM sleep behavior disorder (RBD) is a parasomnia characterized by loss of muscle atonia during REM sleep, often preceding neurodegenerative diseases such as Parkinson's disease. Emerging evidence suggests that iron metabolism may play a role in neurodegenerative processes, but its association with RBD remains unclear. This study investigates the causal relationship between iron metabolism biomarkers and RBD using Mendelian randomization (MR).
Materials and methods: We performed a two-sample MR analysis to evaluate the effects of genetically predicted iron metabolism biomarkers, including ferritin, iron, total iron-binding capacity (TIBC), and transferrin saturation (TSAT), on RBD risk. Genetic instruments were obtained from genome-wide association studies (GWAS) of iron metabolism traits, and summary-level RBD data were sourced from a large publicly available GWAS. Several MR methods were applied, including inverse variance weighted (IVW), MR-Egger, weighted median, weighted mode, and simple mode, to ensure robust findings. Sensitivity analyses, including Cochran's Q test, MR-Egger intercept, and leave-one-out analysis, were conducted to assess pleiotropy and heterogeneity.
Results: Our MR analysis demonstrated that genetically predicted higher ferritin levels were associated with a lower risk of RBD (IVW: $\beta = -0.15$, SE = 0.25, $p = 0.57$; MR-Egger: $\beta = -1.22$, SE = 0.46, $p = 0.01$; Weighted median: $\beta = -0.47$, SE = 0.29, $p = 0.11$). For serum iron levels, the IVW method showed a negative association with RBD risk ($\beta = -0.03$, SE = 0.14, $p = 0.83$), while the MR-Egger method suggested a stronger negative effect ($\beta = -0.48$, SE = 0.30, $p = 0.12$). TIBC exhibited a weak positive association with RBD (IVW: $\beta = 0.07$, SE = 0.12, $p = 0.55$; MR-Egger: $\beta = 0.16$, SE = 0.28, $p = 0.57$). For TSAT, no clear association with RBD was observed (IVW: $\beta = -0.02$, SE = 0.08, $p = 0.79$; MR-Egger: $\beta = -0.18$, SE = 0.14, $p = 0.21$). Sensitivity analyses indicated no substantial heterogeneity (Cochran's Q test: $p > 0.05$ for all exposures) and no significant horizontal pleiotropy (MR-Egger intercept $p > 0.05$).
Conclusions: Our findings suggest a potential protective role of ferritin in RBD, with a stronger effect observed in MR-Egger analysis. While other iron metabolism markers, including iron, TIBC, and TSAT, did not show strong causal evidence, the direction of effect estimates warrants further investigation. Future studies are needed to explore the underlying mechanisms linking iron metabolism to RBD and its progression to neurodegenerative diseases.

Neurodegeneration and Sleep Instability: A CAP-Based Comparison in RBD Patients

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Introduction:

REM Sleep Behavior Disorder (RBD) involves dream enactment and loss of REM muscle atonia. Idiopathic RBD (iRBD) often precedes α-synucleinopathies such as Parkinson's Disease (PD), Dementia

with Lewy Bodies (DLB), and Multiple System Atrophy (MSA). Identifying early physiological changes in these patients is critical for intervention and monitoring. The Cyclic Alternating Pattern (CAP), a measure of sleep instability, and the Epworth Sleepiness Scale (ESS), a subjective measure of daytime sleepiness, may reflect early neurodegenerative changes. We conducted a pilot investigation to assess whether these markers differ between RBD patients with and without neurodegeneration.

Materials and methods:

This cross-sectional case-control study included 8 patients recruited from a tertiary sleep and movement disorders clinic. All patients had PSG-confirmed RBD, with 4 classified as iRBD (no evidence of neurodegenerative disease after ≥12 months of follow-up) and 4 as nRBD (clinical diagnosis of PD, DLB, or MSA).

All participants were 18 years or older and underwent diagnostic overnight PSG demonstrating REM sleep without atonia (RSWA) and/or dream enactment behavior. The ESS was completed within one month of the PSG. Patients were excluded if they were taking medications that could significantly alter sleep architecture (e.g., sedatives, antidepressants) or had comorbid sleep disorders such as obstructive sleep apnea with an apnea-hypopnea index (AHI) ≥ 15.

Sleep recordings were manually scored in accordance with AASM criteria. Sleep macrostructure parameters included total sleep time (TST), wake after sleep onset (WASO), and sleep efficiency. CAP was scored visually and included CAP rate (percentage of NREM sleep containing CAP sequences), average CAP duration, and the distribution of phase A subtypes (A1, A2, A3). REM-related arousals and total nocturnal arousals were also recorded.

Descriptive statistics were used to compare groups. Given the small sample size, inferential statistical testing was interpreted with caution. Exploratory correlations between ESS scores and PSG features were examined.

Results:

The nRBD group demonstrated a higher CAP rate (47.8% ± 9.1) compared to the iRBD group (36.2% ± 7.6, $p < 0.001$). A2 and A3 subtypes were significantly more prevalent in the nRBD group ($p = 0.002$ and $p = 0.009$, respectively), while A1 subtype was lower. REM sleep in nRBD was more fragmented, with increased arousals (12.4 ± 4.1 vs. 7.9 ± 3.6, $p < 0.001$), and macrostructure was also impaired, with greater WASO and lower sleep efficiency.

Conclusions:

Our findings suggest that patients with RBD and neurodegenerative disease exhibit marked sleep instability, particularly reflected in CAP metrics and REM fragmentation. Subjective daytime sleepiness, as measured by ESS, also trended higher in the nRBD group and correlated with CAP-related disruptions, suggesting that these may serve as early physiological signals of underlying neurodegeneration. CAP analysis and ESS may serve as accessible and non-invasive markers to help identify RBD patients at elevated risk of neurodegeneration. Further validation in larger cohorts is needed to confirm these preliminary findings and refine their diagnostic utility.

Neural correlates of decisional impulsivity across early stages of α-synucleinopathy: a case-control functional magnetic resonance imaging study

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Introduction: Idiopathic rapid eye movement sleep behavior disorder (iRBD) is the strongest prodromal markers of α-synucleinopathy, including Parkinson's disease (PD), dementia with Lewy bodies, and multiple system atrophy. PD patients demonstrated altered impulsivity, usually attributed to dopaminergic agonists. Our previous study observed a complex construct of altered impulsivity in iRBD and early PD patients, manifested as decreased risk taking and increased reflection impulsivity. While corticostriatal circuits have been implicated in decisional impulsivity in healthy individuals, their precise role underlying decisional impulsivity across early α-synucleinopathy remains unclear. This study aims to investigate the neural correlates associated with the altered decisional impulsivity in early α-synucleinopathy.
Materials and methods: This was a case-control study conducted among controls, iRBD, and PD patients. Early PD patients were diagnosed with United Kingdom PD Brain Bank criteria with motor symptoms onset within five years. Participants underwent clinical assessments and 3T MRI scanning, including structural, resting-state, and task-based fMRI. Decisional impulsivity was measured using the Balloon Analogue Risk Task (BART) for risk taking and beads task for reflection impulsivity. Regions of interest (ROIs) were selected along corticostriatal circuits. Seed-based functional connectivity (FC) was computed with subcortical ROIs serving as seeds.
Results: A total of 97 patients, including 25 controls (mean age=67.7, male 57.7%), 40 iRBD patients (mean age=70.6, male 72.5%), and 32 PD patients (mean age=69.7, male 89.7%) were recruited. PD and iRBD patients exhibited elevated reflection impulsivity compared to controls, as evidenced by fewer extracted beads (PD vs. iRBD vs. controls: 3.6 ± 2.4 vs. 3.7 ± 2.1 vs. 4.9 ± 2.6, P=0.03). Meanwhile, risk taking level on the BART was comparable among groups. fMRI analyses revealed augmented neural activities in both ventral and dorsal striatum in iRBD patients during risky decision-making in the BART. Regarding the reflection impulsivity, PD and iRBD patients exhibited enhanced BOLD activations in mPFC during "beads-drawing" phase compared to controls, whereas iRBD patients showed additional involvement of right ACC/OFC and left parietal lobe during the same phase ($P_{FWE} < 0.05$, TFCE). Further ROI analyses corroborated the findings and additionally revealed increased engagement in bilateral ventral striatum(VS) in PD patients (PD vs. control: right NAc: 0.07[-0.41,0.70] vs. -0.59[-1.55,-0.26], P=0.002; left NAc: 0.35[-0.21,1.16] vs. -1.13[-2.06,0.05], P=0.03), whereas enhanced activation in right VS in iRBD patients (iRBD vs. controls: -0.06[-0.66,0.44] vs. -0.59[-1.55,-0.26], P=0.002). Seed-based FC analyses revealed attenuated connectivity in PD patients between right NAc and multiple regions including the bilateral frontal and parietal cortex, striatum, thalamus, and cerebellum. Additionally, iRBD patients displayed decreased FC between the pallidum and both the putamen and OFC. ($P_{FWE} < 0.05$).
Conclusions: Alterations of decisional impulsivity, especially the reflection impulsivity, have already occurred in early α-synucleinopathies. Neuroimaging analyses revealed both the disrupted connectivity which potentially impaired reward networks and the recruitment of corticostriatal circuits contributing to decisional impulsivity deficits. Notably, altered decisional impulsivity in iRBD might reflect compensatory mechanisms following striatal dopamine neurons denervation, suggesting its potential utility as a phenoconversion marker.
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Sleep Deprivation Accelerates α-Synuclein Pathology via Per2-Mediated Lysosomal Dysfunction in Mice with REM Sleep Behavior Disorder

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Introduction: Rapid eye movement sleep behavior disorder (RBD) is a well-recognized prodromal manifestation of α-synucleinopathies such as Parkinson's disease (PD). Sleep deprivation has been shown to disrupt circadian gene expression and aggravate dopaminergic neurodegeneration, while autophagy–lysosomal dysfunction represents one of the core mechanisms driving α-synuclein accumulation in PD. However, whether sleep deprivation accelerates α-synuclein pathology by disturbing circadian regulation and lysosomal homeostasis during the RBD stage remains unclear.
Materials and methods: An RBD mouse model was generated by bilaterally injecting α-synuclein preformed fibrils (PFFs) into the sublaterodorsal tegmental nucleus (SLD) of 8-week-old mice. Successful modeling was confirmed at 12-week-old by polysomnographic recordings, which verified RBD phenotypes. At 20 weeks, the mice were subjected to a 7-day sleep deprivation protocol. To investigate the molecular consequences of sleep deprivation in RBD mouse, we first performed RNA sequencing of the substantia nigra, which revealed enrichment of circadian rhythm and autophagy–lysosomal pathways. These findings were further validated by multi-timepoint quantitative real-time PCR experiments(RT-qPCR) assessing circadian gene dynamics. In parallel, α-synuclein pathology, lysosomal function, and PD-like behavioral impairments were evaluated using Western blotting, immunostaining, and motor function tests.
Results: Sleep-deprived RBD mice exhibited exacerbated α-synuclein aggregation, increased loss of tyrosine hydroxylase (TH) positive neurons in the substantia nigra, and earlier onset of PD-like motor impairments. Multi-timepoint RT-qPCR revealed suppressed Per2 expression and dampened circadian rhythmicity, accompanied by marked lysosomal dysfunction as confirmed via Western blotting. Concurrently, we demonstrated that Per1/2 knockout mice also exhibited significant lysosomal impairment and a reduction in TH-positive dopaminergic neurons in the substantia nigra, implicating the involvement of core circadian genes in lysosomal homeostasis. To specifically determine the role of Per2, we performed AAV-mediated knockdown of Per2 in the substantia nigra of RBD mice, which reproduced the lysosomal dysfunction and α-synuclein accumulation observed following sleep deprivation. Conversely, Per2 overexpression in the substantia nigra mitigated these pathological changes and delayed disease progression.
Conclusions: These findings identify Per2-mediated lysosomal dysfunction as a critical mechanism by which sleep deprivation promotes the transition from RBD to α-synucleinopathy, providing novel insight into the circadian regulation of prodromal PD progression.
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Gut microbiota in major depressive disorders with rapid eye movement behavior disorder: tracing a subtype of depression with underlying neurodegeneration

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Introduction: REM sleep behavior disorder (RBD) is a parasomnia associated with α-synucleinopathy. RBD features are more common in major depressive disorder (MDD). While initially postulated as an antidepressant-induced phenomenon, emerging evidence suggests that MDD comorbid with RBD (MDD+RBD) represents underlying neurodegeneration. The gut–brain axis is increasingly recognized in both depression and neurodegeneration, with PD-like gut dysbiosis observed in idiopathic RBD (iRBD). This study aims to characterize gut microbiome in MDD+RBD to explore its potential as a distinct depressive subtype with neurodegenerative features for etiological understanding and intervention.
Materials and methods: This case-control study included four groups: patients with MDD+RBD, age- and sex-matched MDD without RBD (MDD-only), healthy control (HC), and iRBD without a psychiatric disease. RBD diagnosis was confirmed by video-polysomnography. MDD+RBD was defined as MDD onset preceding the appearance of RBD. Fecal samples were analyzed using metagenomic sequencing.
Results: A total of 420 participants were included: 124 HC, 80 MDD-only, 82 MDD+RBD and 134 iRBD. The mean age and sex distribution were comparable among HC (65.7 ± 7.0 years, 61.3% male), MDD-only (65.6 ± 6.5 years, 50.0% male), and MDD+RBD (66.3 ± 5.6 years, 62.2% male). However, iRBD group was slightly older (67.9 ± 6.1 years) and had a higher proportion of males (78.4%) compared to the HC group.

1. **Psychiatric and gastrointestinal features:** The psychiatric profiles of MDD-only and MDD+RBD were largely comparable. Regarding gastrointestinal features, lower Bristol stool scale scores (BSS, harder stool) were observed in iRBD and MDD+RBD, compared to MDD-only and HC (3.3 ± 1.2 vs 3.2 ± 1.5 vs 4.2 ± 1.3 vs 4.1 ± 1.1, $q < 0.001$).
2. **Neurodegenerative biomarkers**: The total likelihood ratio for prodromal PD (excluding RBD) was higher in MDD+RBD than iRBD, MDD-only and HC (1.78 ± 1.11 vs 1.38 ± 0.97 vs 0.74 ± 0.70 vs 0.44 ± 0.55, p-value < 0.001).
3. **Microbial profiles**: After adjusting for age, sex and BSS, MDD+RBD exhibited a distinct microbial composition compared to both HC ($R^2 = 0.012$, q-value = 0.003) and MDD-only ($R^2 = 0.011$, q-value = 0.013), while its microbiota composition was similar to that of iRBD ($R^2 = 0.0052$, q-value = 0.26). In contrast, MDD-only was similar to HC in terms of microbial clustering. Taxonomic analysis, adjusting for age, sex and BSS, revealed that MDD+RBD displayed a gut dysbiosis with both PD-associated species (e.g., enriched *Akkermansia muciniphila, Ruthenibacterium lactatiformans*, and depleted SCFA-producer *Faecalibacterium prausnitzii*) and depression-related (e.g., enriched *Eggerthella lenta* and decreased *Coprococcus eutactus*) alterations. Random Forest model showed that microbial species and GI features could effectively differentiate MDD+RBD from MDD-only (AUC = 0.78).

Conclusions: MDD+RBD exhibited a gut dysbiosis similar to that of iRBD, whereas MDD-only subjects resembled more closely to HC, suggesting that MDD+RBD is likely a variant of depression with underlying neurodegeneration. In addition, the gut microbiome might serve as a promising biomarker for early neurodegenerative risk stratification in psychiatric populations. Our findings offer novel insights into microbiota-gut-brain axis, highlighting its role in the intersection of depression and neurodegeneration.
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Sleep Breathing Disorders

Determining the Minimum Nights Required for Reliable Wearable-Based Assessment of Sleep Architecture and HRV in OSA, Insomnia, and COMISA

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Introduction: Single-night polysomnography (PSG) often fails to capture the full spectrum of sleep architecture and autonomic variability due to night-to-night variability, particularly in patients with OSA, insomnia, or co-morbid insomnia with obstructive sleep apnea (COMISA). While wearable devices now provide a scalable solution for multi-night assessment, the optimal number of nights required for reliable measurement remains uncertain. This study aims to determine the minimum number of nights needed to achieve stable estimates of sleep parameters and heart rate variability (HRV) metrics using the Belun Ring (BR) in individuals with OSA, insomnia, or COMISA.
Materials and methods: A cohort of 123 adults (median age: 61 years; 52% female; median BMI: 24.7; 30% OSA, 52% insomnia, 18% COMISA) underwent multi-night BR monitoring (median: 6 nights; IQR: 5-7; ≥100 minutes/night) following screening by a clinical psychologist and pulmonologist. Insomnia was defined by an Insomnia Severity Index (ISI) ≥15 or a diagnosis per ICSD-3 criteria, and COMISA was defined as meeting insomnia criteria with AHI ≥15 events/h. Sleep metrics included total sleep time (TST), sleep efficiency (SE), REM sleep, wake time, sleep onset latency (SOL), wake after sleep onset (WASO), and HRV time-domain metrics. Reference values were derived from the average of all available nights. The concordance correlation coefficient (CCC) was used to evaluate agreement between N-night averages and reference values, with 1,000 bootstrapped simulations performed for each N-night scenario.
Results: Across all participants, most metrics achieved a lower 95% CI of CCC ≥0.85 by the third night, with simulations confirming that three nights were sufficient for stable estimates. SOL exhibited the highest variability, requiring more than six nights to reach comparable precision. Stratified analyses revealed that participants with insomnia or COMISA required three nights for reliable estimation of insomnia-related metrics, whereas OSA patients required four or more nights for WASO to reach CCC ≥0.85. While two nights of recording substantially improved accuracy, three nights effectively minimized night-to-night variability in both sleep architecture and HRV metrics.
Conclusions: This study is the first to establish evidence-based recommendations for the minimum number of nights required for reliable wearable-based assessment of sleep and HRV in patients with OSA, insomnia, and COMISA. Our findings demonstrate that three nights of wearable monitoring provide robust and stable estimates, offering a practical and scalable alternative to single-night PSG. These results have significant clinical implications for optimizing insomnia management and enhancing COMISA detection in both psychiatric and sleep medicine practice.

Deep Learning-based Identification of Severe Obstructive Sleep Apnea using Sagittal MRI Images

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Introduction: Obstructive sleep apnea (OSA) is a common disorder caused by repeated upper airway obstruction during sleep, often due to soft tissue collapse. It results in oxygen desaturation, daytime sleepiness, and cardiovascular complications. The gold standard diagnostic test, polysomnography (PSG), requires overnight hospitalization and is affected by the first night effect, where an unfamiliar environment alters sleep patterns. Imaging-based methods have been studied to complement PSG. X-ray cephalometry is useful for skeletal features but cannot clearly depict soft tissues, even though enlarged soft tissue often causes airway obstruction. Magnetic resonance imaging (MRI) visualizes soft

tissue well, yet there is no standard method to interpret its relation to OSA severity, and diagnosis still depends on physician experience.
The aim of this study was to design a lightweight and transparent convolutional neural network (CNN) for classifying severe OSA from MRI images, and to evaluate its performance against standard deep CNN models such as VGG16 and ResNet-50.
Materials and methods: We analyzed 132 patients with OSA at Hakodate Medical Center, including 66 severe cases (apnea-hypopnea index, AHI ≥ 30) and 66 non-severe cases. All patients underwent PSG and MRI. The tongue region was extracted from MRI and resized to 224 × 224 pixels, with augmentation by rotation and translation.
Our CNN consisted of a single convolutional layer with a 29 × 29 kernel, followed by batch normalization, ReLU activation, and max pooling. Feature maps were divided into severe and non-severe groups, then aggregated by global average pooling and passed to a 2-unit softmax layer. Each unit corresponded to one filter with fixed weights, improving transparency. Dropout and L2 regularization were applied to reduce overfitting.
The model was trained with Adam optimizer (initial learning rate 0.005, decayed exponentially) for 300 epochs, with a batch size of 10. Performance was evaluated by 10-fold cross-validation repeated five times. For benchmarking, transfer learning with VGG16 and ResNet-50 was also performed.
Results: The proposed CNN had about 23,000 parameters, compared to 138 million in VGG16 and 25 million in ResNet-50. Despite being lightweight, our model achieved an average accuracy of 76% in classifying severe vs. non-severe OSA, comparable to both VGG16 and ResNet-50.
The variance of accuracy was slightly larger in our model, reflected by a higher standard deviation, but overall classification performance was maintained. Importantly, the transparent structure of our CNN allows direct association between filters and classes, providing the potential to analyze clinically relevant features after training.
Conclusions: This study demonstrates that accurate classification of severe OSA from MRI can be achieved not only with large deep CNNs but also with a lightweight and transparent CNN model. Although performance was similar among the three models, our model required far fewer parameters, offering efficiency and interpretability.
These findings suggest that CNN-based MRI analysis may provide an objective method for OSA assessment and reduce reliance on physician experience. Future work will focus on analyzing learned filters to clarify the relationship between soft tissue morphology and OSA severity, aiming to support clinical diagnosis.
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Polycystic Ovary Syndrome is associated with Masked Hypertension in Reproductive-Aged Women: Role of Obstructive Sleep Apnea

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Introduction: Women with polycystic ovary syndrome (PCOS) face increased cardiovascular disease risk earlier than others. This study aimed to identify abnormal blood pressure(BP) profile in patients with reproductive-aged PCOS compared to matched controls, and determine whether OSA contributes to elevated blood pressure and masked hypertension in patients with PCOS.
Materials and methods: The study finally included 176 reproductive-aged women who scheduled to receive firstly assisted reproductive technology (ART), including 111 patients with PCOS according to the Rotterdam criteria and 65 controls matched age and BMI, from reproductive center of Peking University People’s Hospital between July 2023 and October 2024. All participants underwent standard office BP measurements, and overnight home sleep apnea test (HSAT) by NOX-T3 device before ART cycle, followed by 24-hour ambulatory blood pressure monitoring (ABPM) the next morning. ANCOVA and generalized linear models compared groups in 24-hour BP readings, multivariate linear regression

examined links between OSA severity and BP measurements, and logistic regression assessed the relationship between OSA and masked hypertension and its component, all adjusting for confounders such as age, BMI, central obesity, HOMA-IR, and DM.
Results: Women with PCOS demonstrated higher rates of masked hypertension (daytime and 24-hour hypertension) compared to matched controls (3.1% vs. 18.0%, *P*=0.018;4.6% vs. 17.1%, *P*=0.044), even after adjusting for HOMA-IR factor. This cardiovascular risk profile was accompanied by a markedly higher prevalence of OSA in the PCOS cohort (44.1% vs. 20.0%, *P*<0.001), with a mean AHI of 7 events/hour. Within the PCOS group, we observed a dose-response relationship between OSA severity and the prevalence of masked hypertension and its components (all *P*<0.01). Multivariate regression analysis confirmed that AHI was positively correlated with ambulatory BP measurements, including 24-hour, daytime, and nocturnal systolic/diastolic BP (β = 0.56, 0.34, 0.49, 0.31, 0.77, 0.45, respectively; all *P*<0.001), and it also as a significant risk indicator for masked hypertension in PCOS patients (adjusted *P*<0.05). Using the clinically relevant threshold of AHI≥10 events/hour, OSA was associated with substantially increased risks of masked hypertension, including daytime hypertension (aOR=8.20, 95% CI: 1.74-38.62, *P*=0.008), and 24-hour hypertension (aOR=6.33, 95% CI: 1.39-28.90, *P*=0.017). A similar trend was observed for nocturnal hypertension, though this did not reach statistical significance (aOR=3.31, 95% CI: 0.91-12.03, *P*=0.069). Importantly, differences in 24-hour BP profiles between PCOS and non-PCOS groups disappeared entirely when patients with OSA were excluded from the analysis.
Conclusions: Women with PCOS exhibit higher 24-hour BP levels and increased rates of masked hypertension compared to matched controls, primarily mediated by OSA. This finding strongly suggests that OSA may be a key contributor linking PCOS to abnormal blood pressure regulation and increased cardiovascular risk in reproductive-aged women.
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Comparison of the 1st Half of the Night Polysomnography (3 Hours) vs. Full Night Analysis in Asian Population: A Cohort Study

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Introduction: Although full-night polysomnography (FN-PSG) is the gold standard for diagnosing obstructive sleep apnea (OSA), split-night polysomnography (SN-PSG) is generally used in practice given the limitations in resource and time. However, the diagnostic accuracy and cut-off threshold of the SN-PSG remains unclear, particularly in Asian populations. This study aimed to study the correlations of apnea-hypopnea index (AHI) analyzed from the SN-PSG to that of the FN-PSG. Diagnostic accuracy was analyzed using various AHI cut-off thresholds.
Materials and methods: Three-hundred-and-ninety-seven FN-PSGs conducted with the NOX-A1 system during November 2020–August 2024 at Ramathibodi Sleep Disorders Center were identified. To represent SN-PSG, data from the FN-PSG were divided for the first 3-hours to be analyzed and re-generated. Sleep and respiratory parameters between the first 3-hour-SN-PSG and FN-PSG were compared using concordance correlation coefficients (CCC). Analyses for specific phenotype including REM/NREM AHI, supine/non-supine AHI were performed. Sensitivity and specificity were calculated for 3-hour-AHI and oxygen desaturation index (ODI) against FN-PSG data.
Results: The CCC between 3hour-AHI and FN-AHI was 0.93 with higher correlation for NREM-AHI (CCC = 0.95) than REM-AHI (CCC = 0.79). The higher correlation was seen in supine-AHI (CCC = 0.89) than non-supine-AHI (CCC=0.60). Across severity of OSA the CCC were 0.71, 0.63, 0.60, and 0.86. for no-OSA, mild, moderate, and severe OSA respectively.
Sensitivity and specificity for 3hour-AHI cut-off threshold of ≥5, ≥15, and ≥30 events/hour were 72.7%/87.2%, 70.6%/91.3%, and 93.3%/96%, respectively. Sensitivity and specificity for 3-hour-ODI cut-off threshold of ≥5, ≥15, and ≥30 events/hour were 69%/91.5%, 75.5%/97.4%, and 94.7%/99.7%,

respectively. The combination of 3hour-AHI with 3hour-ODI at the cut-off threshold of ≥15 improved specificity to diagnose moderated OSA to 98.3%, with lower sensitivity of 18.7%.
Conclusions: Overall, 3hour-AHI provide a reliable estimate of full-night-AHI, particularly for severe OSA. The high correlation of 3hour-AHI occurred for NREM-AHI, and supine-AHI but not for REM-AHI and non-supine -AHI. The best accuracy for OSA diagnosis were at the cut-off threshold of ≥30 for both 3-hour-AHI, and 3-hour-ODI. However, combining 3-hour-AHI with 3-hour-ODI at the threshold of ≥15 improved specificity markedly. This data may guide the decision to perform SN-PSG in the real-world practice.
Acknowledgments: We would like to express our sincere gratitude to our mentors and all the staff at the Ramathibodi Sleep Disorders Center for their support in data acquisition throughout the study period, especially the certified sleep technicians for their diligent work in data recording. This research would not have been possible without everyone's dedication.

Digital Health Engagement and CPAP Adherence: Analysis of Patient Interaction with the myAir App

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Introduction:

Adherence is a crucial indicator in assessing the efficacy of continuous positive airway pressure (CPAP) therapy for sleep apnea. Although telemedicine enhances adherence and mobile apps represent a viable approach, individual variations may exist in the level of engagement with these apps.

Materials and methods:

A retrospective chart analysis was performed on patients utilizing the myAir app, compatible with ResMed CPAP devices, across four hospitals in Japan from January 2023 to April 2024. Patients can track their CPAP usage and obtain guidance on appropriate use by employing the app. The app has a function whereby patients receive a maximum of five inquiries monthly regarding their sleepiness, which they can evaluate on a five-point scale, and their responses are transmitted to medical institutions. We classified patients who did not respond within a one-month period as having poor engagement. We transformed responses on a 5-point scale about how sleepy they were into 1–5 points, with larger scores denoting more sleepiness. The average of multiple replies indicated post-treatment sleepiness. We extracted data on usage from medical records for the initial month following the beginning of treatment. Good adherence was characterized by using the device for four or more hours during a minimum of 70% of the observation period. Patients were divided into two groups according to adherence, and comparisons were made for background characteristics, app engagement, and pre- and post-treatment sleepiness.

Results:

The study comprised 62 patients: 56 males and 6 females, with a mean age of 51.3 ± 12.3 years, a mean apnea-hypopnea index (AHI) upon diagnosis of 44.5 ± 18.4 events per hour, and a mean body mass index (BMI) of 28.3 ± 5.1 kg/m². Within one month of CPAP therapy, 27 patients had good adherence, while 35 exhibited poor adherence. Age, sex, AHI, and BMI were not significantly different between the groups. However, the group with poor adherence had significantly higher leak levels (10.4 vs 18.1 L/min, p=0.002) and a significantly higher percentage of poor app engagement (18.5% vs 42.9%, p=0.042). Excluding patients with poor app engagement, 22 individuals in the good adherence group and 23 in the poor adherence group reported on sleepiness via the apps. Post-treatment sleepiness scores were 2.0 and 2.8 points, respectively, on a 5-point scale, with the poor adherence group exhibiting significantly higher sleepiness (p=0.009).

Conclusions:

Reduced leak levels and good app engagement were proposed as indicators of favorable short-term CPAP adherence. Furthermore, among patients exhibiting good app engagement, individuals in the poor adherence category demonstrated minimal improvement in sleepiness.

Artificial Intelligence Diagnosis of Obstructive Sleep Apnea: Bayesian Meta-Analyses of 80 Studies with 248 Models

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Introduction:

Among 1 billion patients worldwide with obstructive sleep apnea (OSA), 90% remain undiagnosed. Their main barrier is the overnight polysomnogram, which requires specialized equipment, skilled technicians and inpatient beds available only in tertiary sleep centers. In recent years, artificial intelligence (AI) has made significant strides, offering promising new avenues for OSA diagnosis.

Materials and methods:

We systematically searched PubMed, Embase, Scopus, Web of Science and IEEE Xplore till 20th July 2024. Two blinded reviewers selected English-language articles of studies comparing the diagnostic performance of AI models using 8 inputs (facial recognition, overnight audio, awake speech, electrocardiography, electroencephalography, pulse oximetry, photoplethysmography or multimodal), versus conventional diagnosis [apnea-hypopnea index (AHI) from PSG or home sleep apnea test (HSAT)]. We excluded studies if they only detected apneic events without providing a patient-level diagnosis, or if they did not use a train-test split or k-fold cross-validation for model evaluation. We assessed the risk of bias via QUADAS-2, performed Bayesian bivariate meta-analysis and meta-regression, computed 95% credible intervals, visualized summary receiver operating characteristic curves with 95% prediction regions, assessed publication bias via Copas-like selection modeling, and graded evidence quality via GRADE, following a PROSPERO-registered protocol. Analyses were conducted using *R* and *Stan*.

Results:

From 6,254 records, we included 80 studies (low-moderate bias) with 248 AI models trained/tested on 35,300/30,420 participants. Across 8 modalities, AI demonstrated good or excellent diagnostic performance compared to conventional diagnosis. The pooled sensitivity (Sn) and specificity (Sp) of each modality, arranged from the highest to lowest Sn, were: pulse oximetry [Sn: 91.1% (89.4–92.7%), Sp: 86.1% (82.1–89.4%)]; overnight audio [Sn: 90.3% (86.9-93.1%), Sp: 86.7% (83.1-89.7%)]; multimodal inputs [Sn: 89.2% (81.5-94.3%), Sp: 87.1% (82.6-90.8%)]; facial recognition [Sn: 84.9% (77.1–90.7%), Sp: 71.2% (60.7–81.4%)]; awake speech [Sn: 82.9% (80.0–86.4%), Sp: 83.3% (80.7–86.1%)]; electroencephalography [Sn: 81.6% (73.4-88.8%), Sp: 78.2% (64.1-87.0%)]; electrocardiogram heart rate variability [Sn: 79.0% (74.9%–82.7%), Sp: 75.0% (67.9%–82.3%)]; photoplethysmography [Sn: 70.8% (63.3-77.2%), Sp: 91.7% (86.8-95.1%). Bayesian meta-regression demonstrated similar diagnostic performance across AHI cut-offs. Deep learning (convolutional neural networks) was the most accurate classification algorithm for facial recognition (91.1% sensitivity, 79.2% specificity), pulse oximetry (93.7% sensitivity, 89.4% specificity) and photoplethysmography (75.9% sensitivity, 93.5% specificity) models, and performed better than domain expert manual feature extraction for pulse oximetry and electroencephalography models. Overnight audio models were more sensitive when using higher sampling frequencies and non-contact microphones. Smartphone versus professional camera/microphone inputs showed similar performance. Among 30 multimodal AI models, all used pulse oximetry with electroencephalography, electrocardiography, airflow and/or thoracic signals. Performance did not correlate with the number of modalities. Publication bias was shown to be unlikely to alter conclusions. The evidence was of high quality.

Conclusions:

AI models trained on overnight audio and pulse oximetry achieved excellent diagnostic accuracy—far superior to STOP-Bang and comparable to common HSATs in clinical practice. Smartphones are a reliable source of images and audio, and AI performance is mainly driven by a small number of essential inputs. Digital medicine should be further explored and externally validated for accessible and equitable OSA diagnosis.

Long-Term Outcomes of Combined Sleep Surgery for Obstructive Sleep Apnea: A 14-Year Retrospective Study in Hong Kong Patients

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Introduction: This is the first retrospective study to evaluate long-term outcomes of combined sleep surgery for OSA patients in Hong Kong over a 14-year period (2010-2024). The study aims to assess postoperative outcomes during early (<2 years), intermediate (2-4 years), long-term (4-8 years), and very long-term (>8 years) follow-ups for patients who underwent sleep surgery at the Department of Dentistry and Maxillofacial Surgery, United Christian Hospital, Hospital Authority.
Materials and methods: All subjects underwent maxillomandibular advancement surgery and advancement genioplasty as primary treatments. Simultaneous intra-pharyngeal surgery and/or staged transverse expansion surgery were performed based on individual clinical needs. Inclusion criteria included pre-operative Apnea-Hypopnea Index (AHI) ≥ 5 and age at surgery ≥ 16. Objective outcomes were evaluated at various post-operative time points using polysomnography including Apnea-hypopnea index (AHI), Respiratory Disturbance Index (RDI), Oxygen Desaturation Index (ODI) and Lowest Oxygen Saturation (LSAT). Subjective outcomes were assessed using Epworth Sleepiness Scale (ESS).
Results: A total of 44 OSA subjects (male: 38, female: 6; age: 43.61 +/- 13.15 [mean +/- SD], range: 22-67; BMI: 24.11 +/- 3.85) underwent sleep surgery. Significant improvement in AHI was observed with reduction from 44.64 +/- 18.59 to 9.64 +/- 8.10 events per hour in the early post-operative stage (<2 years, p<0.001), to 16.80 +/- 11.06 events per hour in the intermediate term (2-4 years, p<0.001), 18.48

+/- 9.45 events per hour in the long term (4-8 years, p<0.001) and to 20.35 +/- 10.33 events per hour in the very long term (>8 years, p<0.01).

However, partial relapse was observed with AHI increasing significantly between the early postoperative stage (<2 years) and the intermediate term (2–4 years) (p = 0.02) and between the early postoperative stage and the long term (4–8 years) (p <0.001) and the very long term (>8 years) though it was not statistically significant (p = 0.15). A similar trend was observed in RDI and ODI values. LSAT significantly improved from preop 75.30 +/- 10.76 to 85.72 +/- 5.91 (<2years, p<0.001), then dropped to 85.36 +/- 2.74 (2-4years, p=0.001) and 81.46 +/- 5.87 (4-8years, p<0.001) and 80.88 +/- 6.47 (>8years, p=0.480). Nonetheless, improvement in ESS score was reported post-operatively after combined sleep surgery. Possible reasons for AHI increase in long term & very long term could be due to laxity of upper airway soft tissue with time, skeletal relapse, normal aging and weight gain.
Conclusions: This retrospective study highlights the short-and long-term effectiveness of combined sleep surgeries for OSA patients in Hong Kong. There was significant reduction in AHI and was sustained even in the very long term (>8 years), although partial relapse in AHI was observed during long term follow-ups. These findings emphasize the importance of continued monitoring and adjunct therapies to sustain the benefits of MMA-based OSA surgery.
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Higher Ambient Temperatures may Increase Sleep Apnea–Specific Pulse-Rate Response in obstructive sleep apnea

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Introduction: Obstructive sleep apnea (OSA) features repeated sympathetic activation, elevating cardiometabolic and neurocognitive risks. The heart rate response to respiratory events, measured by ΔHR (the difference between the lowest heart rate during the event and the peak following airway reopening), reflects sympathetic activity and correlates with adverse cardiovascular outcomes. Environmental temperature may influence autonomic function: lower temperatures may enhance baseline sympathetic tone and modify ΔHR, while higher temperatures could further elevate the heart rate response. We hypothesize that elevated ambient temperatures are associated with exaggerated post-apneic heart rate elevation in patients with OSA.
Materials and methods: We retrospectively analyzed data from 2,169 Chinese adult participants diagnosed with OSA using in-laboratory polysomnography between January 2017 and December 2024. Ambient temperature data were obtained from official sources. ΔHR was defined as the difference between the maximum and minimum heart rates within an event-related window around each respiratory event, calculated directly from the continuous heart rate recordings. This metric quantitatively reflects sympathetic activation during OSA events and has demonstrated predictive value for adverse cardiovascular outcomes. Associations between ΔHR, OSA severity, and ambient temperature were analyzed.
Results: 1,840 males and 329 females with a median age of 41.0 years (interquartile range [IQR]: 34.0–50.0) and a median body mass index (BMI) of 26.8 kg/m² (IQR: 24.6–29.4) were included in this study. Participants exhibited a median apnea-hypopnea index (AHI) of 32.5 events/hour (IQR: 14.9–59.1). Higher ambient temperatures were significantly associated with greater ΔHR. Specifically, the minimum, mean, and maximum temperatures over 1-day and 7-day periods all demonstrated statistically significant positive correlations with ΔHR ($p < 0.05$ for all comparisons). Stepwise linear regression analysis indicated that each 10°C increase in the 7-day average minimum temperature corresponded to a significant 0.96 bpm increase in ΔHR (95% confidence interval [CI]: 0.48–1.44).

During the warmer season (defined as minimum temperature ≥ 4°C), ΔHR showed the strongest correlation with the previous 7-day minimum temperature (ρ = 0.103, p < 0.001). Conversely, no significant correlation was observed during the colder season (minimum temperature < 4°C; with central heating utilized in 617 out of 1,018 days in Beijing) (ρ = 0.010, p = 0.761). The association between higher temperatures and greater ΔHR was more pronounced among those with BMI ≥ 28 kg/m² (β = 0.109, 95% CI: 0.024–0.194). No significant associations were observed between ambient temperatures and AHI, SpO_2, sleep latency, or sleep efficiency.
Conclusions: Higher temperature may modulate the compensatory autonomic response to respiratory events in OSA patients, especially among those with higher BMI and during warmer seasonal periods. Ambient factors might be considered as effect modifiers when evaluating OSA-induced pathophysiological consequences.
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ASSOCIATION OF UPPER AIRWAY MORPHOLOGICAL PHENOTYPES WITH OBSTRUCTIVE SLEEP APNEA IN MIDDLE-AGED KOREAN ADULTS

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Introduction: Obstructive sleep apnea (OSA) is a multifactorial disorder characterized by the recurrent collapse of the upper airway during sleep. It is commonly associated with obesity, enlarged pharyngeal soft tissues, and restricted craniofacial skeletal structures. The present study aims to investigate the relationship between (i) craniofacial morphology and (ii) volumetric measurements of the upper airway and surrounding soft tissues, and the prevalence of OSA in middle-aged Korean adults.
Materials and methods: This cross-sectional study was conducted using data from a population-based cohort of Korean adults. A total of 89 participants (mean age: 61.65 ± 6.27 years; 50 males, 39 females) from the Korean Genome and Epidemiology Study in Ansan were included in the analysis. All participants underwent 1.5-Tesla MRI-based volumetric assessment of the upper airway (Magnetom Espree; Siemens Healthcare, Erlangen, Germany) and overnight in-home polysomnography (Embletta X-100; Embla Systems, Broomfield, CO, USA) between 2014 and 2015. Based on their apnea-hypopnea index (AHI), participants were categorized into two groups: no OSA (AHI <10 events/hour) and OSA (AHI ≥10 events/hour). Using Amira 5.4.0 image analysis software, a total of 23 volumetric measurements (airway and surrounding soft tissues) and 15 linear and angular cephalometric measurements were obtained from the upper airway MRI scans.
Results: Based on multivariable linear regression analysis adjusted for age, sex, BMI, diabetes, and cardiovascular disease, several MRI-based volumetric and cephalometric features were significantly associated with the OSA group compared to the non-OSA group. Among the volumetric measurements, the OSA group exhibited a narrower anteroposterior dimension of both the retropalatal and retroglossal airways (β [SE] = -1.88 [0.66] (p=0.01); and -2.48 [0.95] (p=0.01), respectively), as well as a longer overall airway length (β [SE] = 3.69 [1.61], (p=0.02)). In terms of cephalometric characteristics, the OSA group showed a significantly greater maxillo-mandibular discrepancy and increased upper facial height compared to the non-OSA group (all p-values <0.05).
Conclusions: This study identified distinct craniofacial and upper airway morphological features in individuals with OSA, including reduced anteroposterior airway dimensions and increased airway length. These findings emphasize the important role of upper airway phenotypes in the pathophysiology of OSA in middle-aged Korean adults.
Acknowledgments: This study was supported by the Korea Centers for Disease Control and Prevention (2014-E71003-00, 2015-P71001-00); Basic Science Research Program through the National Research Foundation of Korea (NRF), funded by the Ministry of Education (NRF-2022R1I1A1A01065700); Korea Center for Gendered Innovations for Science and Technology research (GISTeR), through the Center for

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Sleep and Survival: A Low-Cost Home Ventilation Strategy for Children with Neuromuscular disease in Resource-Limited Settings

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Introduction:

Children with neuromuscular disorders are especially vulnerable to sleep-related breathing disturbances and chronic respiratory failure, which is a leading cause of death in these children. In many low- and middle-income countries, delivering comprehensive care is challenging due to high out-of-pocket costs and limited access to specialized equipment. This study presents real-world data from a pediatric neuromuscular clinic in India, highlighting how low-cost, innovative strategies can support effective home ventilation and sleep care in resource-limited settings.

Materials and methods: This is a retrospective observational study. We included children with NMD up to 18 years of age who attended our tertiary pediatric neuromuscular clinic between January 2018 and February 2025. Clinical profiles, Level-1 Polysomnography (PSG) data when available, along with treatment and outcomes, were analysed.
Results:

415 children (63.6% male) diagnosed with NMD were included. The majority of our cohort had spinal muscular atrophy (SMA, n=213), followed by Duchenne muscular dystrophy (DMD, n=96), and the remaining had other NMD (n=106).

302/415 (72.2%) children had a PSG done with a median Apnea-Hypopnea Index (AHI) of 7.6 (0.3 to 78) per hour of total sleep time, with 64.14% of children having moderate to severe OSA.

HMV was initiated in 351/415 (84.5%) of children. 78/213 (36.6%) of children with SMA1 and SMA2 received DMT-like gene therapy (n=35), Risdiplam (n=22), and Spinraza (n=21). 18 children had a tracheostomy, 55 used mechanical insufflation-exsufflation(MI-E), 34 were on NG feeds, and 28 had a PEG tube with fundoplication done. Optimizing care in these children reduced recurrent hospital admissions in 74% of children. 25 children expired due to respiratory failure.

Among 351 children on HMV, 68% were remotely monitored via video and telephone consultations. A 24/7 emergency contact number along with technician support was provided to families, many of whom travel from across India and often lack access to specialized respiratory care locally. Smaller hospitals frequently hesitate to initiate BiPAP in acutely unwell children, making remote guidance and continuity of care essential.

To overcome the financial burden of out-of-pocket healthcare expenses in India, families utilize affordable Indian-manufactured BiPAP devices (costing <$500 USD) or rent BiPAP and MI-E machines for $40 and $120/month, respectively. Additional support through crowdfunding has helped cover the cost of

diagnostics and treatment, while the donation of 40 BiPAP units to our neuromuscular disease unit has further expanded access. Equally important has been the role of family WhatsApp groups, which have become a powerful tool for real-time support, shared learning, and fostering a sense of community among caregivers facing similar challenges and simultaneously raising awareness.

Conclusions:

A low threshold for initiation of BiPAP when indicated without a PSG initially is a reasonable practical approach in resource-limited settings. Early initiation of cough assist and HMV helped reduce morbidity and mortality.

This model of care—combining remote monitoring, low-cost locally manufactured respiratory devices, rental options, and philanthropic support—demonstrates a sustainable approach to delivering HMV. Such strategies provide a practical framework for scalable and equitable chronic respiratory care in other low- and middle-income countries.

Interpretable Machine Learning Using Questionnaire Data: A Scalable Approach for Sleep Apnea Screening

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Introduction: Early detection of sleep apnea is critical to preventing long-term cardiovascular and metabolic complications. However, traditional screening methods often rely on costly bio-signal measurements or symptom-dependent questionnaires that may miss at-risk individuals. This study presents a clinically applicable machine learning framework that leverages easily obtainable questionnaire data to support large-scale, low-cost early screening of sleep apnea while providing clear, interpretable insights for clinical decision-making.
Materials and methods: We developed an XGBoost model to classify individuals into normal/mild and moderate/severe sleep apnea groups using only demographic and lifestyle-related variables. Data were drawn from the Sleep Heart Health Study (SHHS) , with relevant features selected from 12 questionnaires, during the first (SHHS1) and second (SHHS2) visits. These features cover physiological, behavioral, medical history, and treatments information. For interpretability, we applied SHapley Additive exPlanations (SHAP) and TreeExplainer2Rule (Te2Rule) to generate rule-based explanations aligned with clinical reasoning. These methods enable clear visualization of the model's decision-making process, making the results easier to interpret and more convincing. They also offer valuable insights into which features most influence the predictions.
Results: The model achieved an AUC of 0.793, with 64.88% accuracy, 60.84% precision, 55.59% sensitivity, 72.11% specificity, and F1-score of 0.581 in identifying moderate to severe cases using questionnaire data from the first visit. When combined with follow-up visit data—reflecting physiological and behavioral changes over a 5-year period—the additional information improved model performance. Specifically, the model achieved an AUC of 0.753, with 68.45% accuracy, 65.90% precision, 63.13% sensitivity, 72.88% specificity and F1-score of 0.645. Key clinical predictors included neck circumference (with a common decision threshold of 35-38 cm), age, waist circumference, and BMI (common decision threshold of 25.5). Male sex and a history of hypertension were linked to increased risk, while coffee consumption showed a surprising negative association with sleep apnea severity. Most of these insights align with known clinical risk factors and offer practical decision rules that can be easily applied in clinical settings. Additionally, SHAP values have an additive property, allowing for transparent breakdowns of how predictions are calculated for each patient—providing useful insights that may support personalized behavioral interventions.
Conclusions: Despite the inherent limitations of self-reported data, our model achieved significant improvement in AUC and specificity compared to existing sleep apnea screening questionnaires (e.g., STOP-BANG). The enhanced model's performance—particularly the improved class balance when incorporating both first-visit and follow-up information—highlights the value of long-term monitoring and

data collection. This study demonstrates the potential of explainable AI to support cost-effective, scalable, and interpretable sleep apnea screening. The SHAP method explains the impact of each feature on the model's output, while Te2Rule illustrates how the model combines high-impact features to arrive at a final decision.

Adenosine A_{2A} Receptor Activation Protects Against Chronic Intermittent Hypoxia Induced Kidney Injury by PKA-ERK1/2 pathway

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Introduction: Obstructive sleep apnea-hypopnea syndrome (OSAHS), marked by chronic intermittent hypoxia (CIH), is a well-established risk factor for chronic kidney injury. The Adenosine A_{2A} receptor ($A_{2A}R$), a G-protein-coupled receptor family member, is hypothesized to play a key protective role against chronic kidney damage. However, the precise mechanism linking $A_{2A}R$ activation to CIH-induced renal injury remains unclear and requires further investigation.
Materials and methods: In this study, mice underwent daily CIH exposure for 7.5 hours over four weeks. Thirty minutes prior to each CIH session, animals received intraperitoneal injections of either the $A_{2A}R$ agonist CGS21680 or the $A_{2A}R$ antagonist SCH58261. Additionally, $A_{2A}R$ knockout mice were included in the experimental design to evaluate the receptor's specific effects on renal outcomes.
Results: The findings revealed that exposure to CIH impaired the renal function of mice, which was evidenced by elevated levels of serum creatinine (SCr), blood urea nitrogen (BUN), and urine β2-Microglobulin (β2-MG). Moreover, the renal tubules exhibited morphological damage. In the kidney tissue of CIH-exposed mice, oxidative stress and inflammation were triggered, as indicated by a significant rise in oxidative damage markers (8-OHdG and MDA) and inflammatory mediators (IL-6 and TNF-α mRNA). Additionally, the protein expression of PKA and p-ERK1/2 was upregulated. When mice were treated with the $A_{2A}R$antagonist SCH58261 or underwent $A_{2A}R$ knockout, more pronounced functional and morphological renal tissue damage occurred, such as tubular atrophy and a substantial increase in fibrotic area. Furthermore, more severe oxidative and inflammatory damage was observed, along with decreased PKA and p-ERK1/2 levels. Conversely, treatment with an $A_{2A}R$agonist yielded the opposite outcome. In summary, the study demonstrated that $A_{2A}R$activation played a vital protective role in mitigating chronic kidney tissue damage under CIH conditions.
Conclusions: Our results demonstrated that chronic intermittent hypoxia (CIH) triggered renal dysfunction in mice through oxidative stress and inflammatory activation, while $A_{2A}R$ activation effectively mitigated these pathological processes. Mechanistic investigations revealed that $A_{2A}R$s exerted their protective effects by activating the PKA/ERK signaling pathway, which subsequently reduced oxidative damage and inflammatory responses while restoring renal function (Figure 6). These findings suggest that $A_{2A}R$-mediated PKA/ERK pathway activation serves as a critical protective mechanism against CIH-induced renal impairment, indicating its potential therapeutic value for hypoxia-related kidney disorders.
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Unveiling the circHDAC9/miR-138-5p/SIRT1 Axis: A Novel Mechanism Linking Obstructive Sleep Apnea-Hypopnea Syndrome to Cognitive Impairment through Senescence-Associated Neuronal Autophagy

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Introduction: To investigate the circHDAC9/miR-138-5p/SIRT1 pathway in Intermittent Hypoxia (IH)-induced cognitive impairment for Obstructive Sleep Apnea-Hypopnea Syndrome(OSAHS) complication diagnosis and therapies.
Materials and methods: Ten 3-month-old male C57 mice were randomly divided into a control group (normoxic environment) and a model group (IH: 4.6-4.8% O_2 for 60 seconds followed by 20% O_2 for 30 seconds cyclically,8 h/day). Cognitive function was assessed using the Morris water maze test. Hippocampal tissues were analyzed for histopathology, apoptosis, senescence, autophagy, mitochondrial structure, protein expression, and gene/protein levels via HE staining, Tunel staining, β-gal staining, transmission electron microscopy, immunofluorescence, and Real Time PCR/Western blotting. In vitro experiments used HEK293T cells to validate miR-138-5p targeting SIRT1 and circHDAC9 via dual luciferase assays, and HT22 cells to confirm circHDAC9 expression and its interaction with SIRT1 using FISH and RIP.
Results: Model group mice exhibited significantly impaired cognitive function ($p<0.05$), increased hippocampal neuron aging, apoptosis, and autophagy ($p<0.0001$), upregulated miR-138-5p, and downregulated circHDAC9 and SIRT1 ($p<0.001$). Aging-related molecules and autophagy-related proteins were upregulated ($p<0.001$), pro-apoptotic Bax increased, anti-apoptotic Bcl2 decreased ($p<0.001$), and telomere length shortened ($p<0.0001$). Cell experiments confirmed miR-138-5p directly targets SIRT1 and circHDAC9, reducing luciferase activity ($p<0.0001$), and revealed an interaction between circHDAC9 and SIRT1.
Conclusions: OSAHS triggers cognitive decline through a "senescence-autophagy-apoptosis" cycle via circHDAC9/miR-138-5p/SIRT1 axis disruption. CircHDAC9's dual regulation (sponging miR-138-5p and interacting with SIRT1) reveals therapeutic targets.
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The Role of Mouth Tape for CPAP Users in OSA Patients with Mouth Breathing

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Introduction: Continuous positive airway pressure (CPAP) is the standard treatment for obstructive sleep apnea (OSA), but its effectiveness depends on patient adherence. Mouth breathing during CPAP therapy is common among patients with OSA and is associated with reduced adherence. Current strategies to address this issue include the use of a chin strap with a nasal mask or switching to an oronasal mask.

Mouth taping has recently emerged as a potential intervention; however, its impact on CPAP adherence remains unstudied. This study aims to evaluate whether mouth tape improves CPAP adherence in patients with OSA. Secondary outcomes include daytime sleepiness (Epworth Sleepiness Scale [ESS]), snoring (visual analog scale [VAS]), night awakenings, mouth/throat dryness, air leakage, and adverse effects.
Materials and methods: This randomized crossover study compared CPAP adherence with and without silicone hypoallergenic mouth tape in participants who exhibited mouth breathing during CPAP therapy. Participants received CPAP therapy with or without mouth tape for 30 days, then crossed over to the other intervention for another 30 days, with a 7-day washout period between phases. After each period, CPAP data (adherence, apnea–hypopnea index [AHI], and leakage) and questionnaires were collected. Tape application involved cutting silicone hypoallergenic tape to 2–4 cm based on facial structure and applying it vertically over the philtrum to seal both the upper and lower lips.
Results: Sixty-two patients with OSA (36 males; AHI [mean ± standard deviation], 45.8 ± 22.2 events/h; age, 57.7 ± 17.6 years; BMI, 27.9 ± 7.1 kg/m^2) were randomized. Participants using mouth tape, compared to without mouth tape, showed higher CPAP adherence: average use increased by 51.8 minutes/day (95% CI, 33.1–70.4) and by 41.4 minutes/used day (95% CI, 27.9–55.0). Frequency of use increased by 14.2% (95% CI, 9.3–19.0), with 17.6% more days reaching ≥ 4 hours/night (95% CI, 12.7–22.6). Good adherence increased with an odds ratio of 4.5 ($p < 0.001$). Mouth tape significantly improved ESS, snoring VAS, mouth/throat dryness, and night awakenings ($p < 0.05$). Adverse effects were reported.
Conclusions:
Using mouth tape in patients with mouth breathing during CPAP improved CPAP adherence in both duration and frequency. Unfavorable symptoms related to OSA, or CPAP were alleviated, leading to better sleep quality.
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Tailored palatal surgery for obstructive sleep apnea patients with lateral pharyngeal wall collapse based on DISE phenotyping

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Introduction: Obstructive Sleep Apnea (OSA) is a heterogeneous disorder caused by a combination of anatomical and physiological factors that lead to upper airway collapse during sleep. Drug-Induced Sleep Endoscopy (DISE) provides real-time visualization of dynamic upper airway obstruction and has emerged as a valuable tool for individualized surgical planning. Among the various sites of collapse, the lateral pharyngeal wall has been increasingly recognized as a key contributor to airway obstruction in OSA. The aim of this study was to evaluate the utility of DISE in guiding the selection of palatal surgical techniques and to assess their clinical efficacy in OSA patients with lateral pharyngeal wall collapse.
Materials and methods: Patients with moderate to severe OSA underwent DISE to determine their patterns of upper airway obstruction. DISE phenotyping revealed a high prevalence of lateral pharyngeal wall collapse in this population. Surgical interventions were selected based on the severity and pattern of collapse observed.
Results: Patients were stratified to undergo soft palate webbing flap pharyngoplasty, relocation pharyngoplasty, or expansion sphincter pharyngoplasty according to their DISE findings. Uvuloplasty (e.g., soft palate webbing flap) was recommended for patients with mild to moderate OSA and minimal lateral wall collapse (< grade I) in DISE findings. Relocation pharyngoplasty was performed in patients with moderate lateral wall collapse (> grade II) and tonsillar hypertrophy (over grade 2 tonsil hypertrophy). Expansion sphincter pharyngoplasty was indicated for those with severe circumferential narrowing and significant lateral pharyngeal wall involvement (> grade III) in DISE findings and over grade 2 bilateral tonsil hypertrophy. Clinical outcomes showed that soft palate webbing flap pharyngoplasty achieved a 40.1% success rate, with mean apnea-hypopnea index (AHI) decreasing from 25.7 to 15.1 in selected

cases of primary snoring and mild to moderate OSA. Relocation pharyngoplasty resulted in a 52.9% success rate and a 65.8% response rate in patients with moderate lateral wall collapse and enlarged tonsils. Expansion sphincter pharyngoplasty yielded favorable outcomes in severe OSA cases, with marked improvements in AHI and retropalatal patency.
Conclusions:

DISE-directed surgical planning allows for phenotype-based stratification and targeted correction of airway collapse in OSA. Tailoring palatal surgery according to specific collapse patterns—particularly those involving the lateral pharyngeal wall—leads to improved clinical outcomes and reduced surgical failure. This individualized approach represents a significant advancement in the personalized management of sleep-disordered breathing.

Chronic Intermittent Hypoxia Impairs Genioglossus Activity and Alters Upper Airway Negative Pressure Reflex in a Rat Model

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Introduction: This study aimed to investigate the effects of chronic intermittent hypoxia (CIH) on upper airway neuromuscular regulation in a rat model. Electromyographic activity of the genioglossus muscle was recorded to assess functional changes. Additionally, graded negative pressure was applied to the pharyngeal cavity to evaluate alterations in the negative pressure reflex, providing insight into how CIH may influence upper airway stability in sleep-disordered breathing.
Materials and methods: In this study, 34 healthy male Sprague-Dawley rats were randomly assigned to either a control group (n=10) or a CIH group (n=24). Chronic intermittent hypoxia (CIH) was induced by exposing rats to alternating hypoxic/normoxic conditions (7%–21% O_2) for 8 hours daily (9:00–17:00) over a 10-week period. Custom-designed unilateral nasal blockers of varying sizes were used to increase inspiratory effort by partially obstructing nasal airflow, thereby simulating increased negative pharyngeal pressure. Pharyngeal pressure gradients under different obstruction conditions were recorded. Electromyographic (EMG) activity of the genioglossus muscle was measured at baseline and under graded negative pressure stimulation applied to the pharyngeal cavity at weeks 4, 7, and 10. The control group was maintained under normoxic conditions. At the end of the study, all rats were euthanized, and genioglossus muscle samples were harvested for histological analysis via hematoxylin and eosin (HE) staining.
Results: At week 4 of CIH exposure, genioglossus EMG activity significantly increased (96.36 ± 6.78 μV vs. 59.55 ± 3.76 μV, $P < 0.001$), indicating compensatory activation. However, EMG activity declined significantly by week 7 (64.36 ± 3.30 μV), and returned to baseline by week 10 (58.64 ± 17.17 μV, $P > 0.05$). In both control and CIH groups, EMG activity increased in response to graded negative pharyngeal pressure ($P < 0.05$), though this reflex weakened over time in the CIH group. Histological analysis revealed that CIH caused muscle fiber disarray, irregular morphology, and disrupted nuclear distribution in the genioglossus.
Conclusions: Upper airway negative pressure enhances genioglossus activity in a pressure-dependent manner. Short-term CIH induces compensatory neuromuscular activation, but prolonged hypoxic exposure impairs this response and leads to structural muscle damage. These findings highlight the time-dependent impact of CIH on upper airway dilator muscle function, providing insights into the pathophysiology of OSA-related upper airway collapse.

Decline in $CD4^+$ Naïve T Cell Levels Correlates with OSA Severity in Adult and Pediatric Patients

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Introduction: Studies on naïve T cells in Obstructive sleep apnea (OSA) patients still remain limited.This study was designed to explore the circulating levels of $CD4^+$ naïve T cells in patients with OSA across ages.
Materials and methods: The study involved participants from both adult and pediatric populations. For adult patients, we applied the CIBERSORT deconvolution algorithm to infer the relative abundance of cell types based on microarray data. For children, we leveraged the previous pediatric single-cell transcriptome data to quantify cell type proportions. Weighted gene co-expression network analysis (WGCNA) was performed to explore potential significant gene modules associated with $CD4^+$ naïve T cells. The correlation analysis was utilized to explore the relationship between $CD4^+$ naïve T cell levels and OSA severity. Functional enrichment analyses were conducted to elucidate potential cell biological processes of $CD4^+$ naïve T cells in both adult and pediatric patients.
Results: The $CD4^+$ naïve T cell subset exhibited a decline trend and was closely linked to the characteristics of OSA in both adult and pediatric patients. The levels of $CD4^+$ naïve T cells were negatively correlated with Apnea–Hypopnea Index (AHI) in adults (R = -0.441, p = 0.017) and pediatric patients (R = -0.559, p = 0.010).Functional enrichment analyses revealed that oxidative stress was a common biological feature in $CD4^+$ naïve T cells shared by adult and pediatric patients with OSA.
Conclusions: $CD4^+$ naïve T cells exhibited an age-independent depletion in OSA patients and correlated with OSA severity.

Effect of adenotonsillectomy on lipid profile in children with obstructive sleep apnea

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Introduction: Limited evidence addressing effects of adenotonsillectomy (T&A) on lipid profiles in childhood obstructive sleep apnea (OSA). The aim of this study is to elucidate changes in lipid profiles after surgery in children with OSA.
Materials and methods: Children aged 4-16 years with clinical symptoms and polysomnography (PSG)-diagnosed OSA (apnea-hypopnea index, AHI >1) were recruited from a tertiary medical center and received T&A as the treatment for OSA. All children had the postoperative PSG studies, and examined for lipid profiles (i.e. total cholesterol, triglyceride, low-density lipoprotein [LDL], and high-density lipoprotein [HDL]) before and 6 months after surgery.
Results: This study included 124 children (mean age, 6.3±3.0 years; 65% boy). T&A resulted in a significant reduction of the AHI from 12.3±17.9 to 2.9±5.7 per hour (P <0.001). After surgery, total cholesterol (162.9 to 164.4 mg/dL, P = 0.51), triglyceride (79.3 to 79.9 mg/dL, P = 0.87), and LDL (97.0 to 96.5 mg/dL, P = 0.75) were not significantly changed. The HDL was significantly increased from 53.3 to 55.7 mg/dL after surgery (P = 0.03). Moreover, the LDL/HDL ratio was significantly decreased from 1.99 to 1.87 after surgery (P = 0.004).
Conclusions: Adenotonsillectomy (T&A) treatment may provide beneficial effects on lipid profiles in children with obstructive sleep apnea (OSA).
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Comparative Effects of Nasal and Oronasal Masks on Airway Collapse and Oxygenation During CPAP-Assisted DISE

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Introduction: Mask type can influence the effectiveness of CPAP therapy in patients with obstructive sleep apnea (OSA). However, how nasal versus oronasal masks differ in their anatomical and physiological effects remains unclear. We aimed to compare their impact on site-specific upper airway collapse and oxygen saturation during CPAP titration using drug-induced sleep endoscopy (DISE).
Materials and methods: In this randomized crossover study, 30 patients with OSA underwent DISE and polysomnography using both nasal and oronasal masks. CPAP was delivered in incremental steps (0–20 cmH_2O), and airway collapse at four VOTE regions (Velum, Oropharynx, Tongue base, Epiglottis) was scored at each pressure level. Pharyngeal opening pressure (PhOP) was defined as the pressure required to reduce VOTE score 2 obstruction. Oxygen saturation was simultaneously monitored.
Results: Nasal masks significantly improved obstruction at the velum, oropharynx, and tongue base at 10 cmH_2O, whereas oronasal masks improved only oropharyngeal collapse. The PhOP required to alleviate velum obstruction was significantly lower with nasal masks (Vap: 6.0 [4.0–10.0] vs 16.0 [11.0–22.0] cmH_2O, $p<0.001$). Nasal masks also yielded significantly higher SpO_2 between 6–12 cmH_2O. No mask type adequately resolved epiglottic collapse.
Conclusions: Compared to oronasal masks, nasal masks more effectively resolved airway obstruction and improved oxygenation during CPAP titration. These findings support the preferential use of nasal interfaces when feasible and suggest the need for individualized mask selection based on anatomic response and physiological outcome.

Screening prediction models using artificial intelligence for moderate-to-severe obstructive sleep apnea in patients with acute ischemic stroke

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Introduction: Obstructive sleep apnea (OSA) is common after stroke. Still, routine screening of OSA with polysomnography (PSG) is often unfeasible in clinical practice, primarily because of how limited resources are and the physical condition of patients. In this study, we used several artificial intelligence techniques to predict moderate-to-severe OSA and identify its features in patients with acute ischemic stroke.
Materials and methods: A total of 146 patients with acute ischemic stroke underwent PSG screening for OSA. Their baseline demographic characteristics, including age, sex, body mass index (BMI), Epworth Sleepiness Scale (ESS) score, and stroke risk factors, were recorded. Logistic regression analysis was conducted to identify significant features associated with moderate-to-severe OSA in patients with stroke. These significant features were used with six machine learning and ensemble learning algorithms, namely decision tree, support vector machine, random forest, extreme gradient boosting (XGBoost), adaptive boosting (AdaBoost), and gradient boosting, to compare the performance of several predictive models.
Results: Multivariate logistic regression analysis revealed that age, sex, BMI, neck circumference, and ESS score were significantly associated with the presence of moderate-to-severe OSA. According to the machine learning and ensemble learning results, the XGBoost model achieved the highest performance,

with an area under the receiver operating characteristic curve of 0.89 and an accuracy and F1 score of 0.80.
Conclusions: This study identified key factors contributing to moderate-to-severe OSA in patients with ischemic stroke. The XGBoost model exhibited high predictive performance, indicating it has potential as a supporting tool for decision-making in health-care settings.
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Gender Differences in Changes in Sleep-Related Physical and Mental Symptoms and Quality of Life Following CPAP Treatment in Patients with OSA

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Introduction: Poor sleep quality, memory impairment, emotional disorders, and reduced quality of life (QOL) are prominent symptoms among individuals with obstructive sleep apnea (OSA). Continuous Positive Airway Pressure (CPAP) therapy is widely recognized as the gold standard treatment for OSA. However, the diagnostic criteria and treatment approaches for OSA have historically been based on male-centric models, potentially overlooking gender-specific symptomatology. The objective of this study was to investigate gender differences in changes in sleep-related physical and mental symptoms, as well as QOL, after CPAP treatment among individuals with OSA.
Materials and methods: A prospective study with a repeated measures design was conducted at a sleep outpatient clinic within a medical center. Individuals diagnosed with OSA, defined by an apnea-hypopnea index (AHI) ≥ 5 events per hour as measured by polysomnography, were included. Daytime sleepiness, sleep quality, cognitive function, anxiety and depression, and QOL were assessed using the Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), Mini-Mental State Examination (MMSE), Hospital Anxiety and Depression Scale (HADS), and the World Health Organization Quality of Life-BREF (WHOQOL-BREF), respectively. Measurements were collected at four time points: baseline (T0, before CPAP initiation), 1 month (T1), 3 months (T2), and 6 months (T3) after CPAP initiation. Repeated measures analyses were conducted to evaluate changes over time.
Results: A total of 121 participants were enrolled, with a mean age of 50.78 years. The male-to-female ratio was approximately 5.4:1 (19 females). Among them, 111 participants initiated CPAP therapy, and 69 completed the 6-month follow-up (T3). CPAP adherence over time did not significantly differ between genders. At baseline, females exhibited significantly poorer sleep quality compared to males ($p = .007$). Following CPAP initiation, improvements were observed in daytime sleepiness, sleep quality, cognitive function, anxiety, and QOL across participants, with notable gender differences. In the fully adjusted repeated measures model, females consistently demonstrated poorer sleep quality ($\beta = -3.23$, $p < .0001$) and greater improvement in cognitive function ($\beta = 0.70$, $p = .025$) compared to males across all follow-up points. No significant gender differences were observed in changes in daytime sleepiness, anxiety, depression, or QOL.
Conclusions: This study demonstrated that CPAP treatment effectively improved daytime sleepiness, sleep quality, cognitive function, anxiety, and QOL among individuals with OSA. Notable females exhibited persistently poorer sleep quality but greater improvements in cognitive function compared to males following CPAP therapy. No significant gender differences were identified in changes in daytime sleepiness, anxiety, depression, or overall quality of life. These findings highlight the need for gender-sensitive approaches in the evaluation and management of sleep-related symptoms in OSA patients undergoing CPAP treatment.

Challenges of acute non-invasive ventilation in patients with schizophrenia

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Introduction: Acute hypercapnic respiratory failure (AHRF) is a life-threatening emergency. Non-invasive ventilation (NIV) is the standard of care, but its delivery can be challenging in patients with significant psychiatric comorbidity. We aim to evaluate the acute outcome for patients with schizophrenia presenting with AHRF requiring NIV
Materials and methods: We conducted a retrospective longitudinal observational cohort study of consecutive admissions to a single tertiary centre for AHRF requiring acute NIV from 1st January 2017 to 31st December 2019. Cases were included if they had underlying chronic obstructive pulmonary disease (COPD) or overlap between COPD and obstructive sleep apnea (Overlap). We excluded patients requiring invasive ventilation or admissions to intensive care units.
Results: Among the 261 admissions, there were 110 recurrent admissions from 37 individual patients, of which 40.5% had schizophrenia. COPD (83.8%) was the predominant underlying chronic respiratory condition. Patients with schizophrenia were significantly younger (63.7 ± 9.8 vs 76.1 ± 8.7, p =0.000) and less likely to be on domiciliary respiratory support (26.7% vs 59.1 %, p= 0.052). Mean initial pH from blood gas was 7.3 in both but patients with schizophrenia were assessed to have lower level of consciousness and to be more challenging for acute NIV therapy. Patients with schizophrenia had shorter duration of hospitalisation (7 vs 9.5 days, p=0.004) and acute NIV therapy (3 vs 5 days, p= 0.026). They also had shorter median time to readmission (18 vs 69 days, p = 0.017). Multivariate log regression showed chronic schizophrenia was the only independent predictor of recurrent admissions for acute NIV therapy (odds ratio 7.277, p = 0.008).
Conclusions: Patients with comorbidity of chronic schizophrenia may pose a unique challenge to acute NIV therapy. Though the duration of acute NIV therapy and hospitalization may be shorter, they have a higher risk of recurrent admissions for AHRF requiring acute NIV.

The Overlooked component: Proportion of Central Hypopnea in Obstructive Sleep Apnea Patients

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Introduction: Nearly 1 billion people globally are affected by Obstructive sleep apnea (OSA), with 425 million adults aged 30–69 having moderate to severe disease.
OSA involves repeated airflow reduction or cessation due to upper airway narrowing during sleep, causing hypoxia, arousals, and autonomic dysfunction.
These changes contribute to metabolic syndrome, hypertension, cardiovascular diseases, and cognitive decline.
Despite its prevalence, OSA remains underdiagnosed and untreated, and may coexist with central events. Central sleep apnea (CSA) results from impaired respiratory rhythm and is influenced by sleep stage, position, and gas exchange.
Differentiating OSA from CSA is essential, as both require distinct diagnostic and therapeutic approaches.
Materials and methods: This was a prospective cross-sectional single-center study consisting of 172 patients who fulfilled inclusion and exclusion criteria. A structured proforma was used to record demographics, symptoms, comorbidities, family history, and physical exam findings. All patients underwent Level-1 polysomnography.
For those diagnosed with OSA, hypopneas were manually classified as central or obstructive.
Central hypopnea proportion and revised Apnea-Hypopnea Index (excluding central events) were calculated.
The association between central hypopneas and clinical characteristics was then analyzed.

Results:

- 367 patients of OSA, who were diagnosed by level 1 polysomnography laboratory were screened for eligibility, and 172 patients were enrolled in the study.
  The proportion of central hypopnea in our study population was 7.35% (2.02% -18.95%). When analysed by OSA severity, the median proportion of central hypopnea was highest in mild OSA (22.97%), followed by moderate (11.04%) and severe (3.07%). The differences among groups were statistically significant.
  Central hypopnea had weak negative correlation with age and Body- mass index (BMI)
  Central hypopnea was lesser in type-2 diabetes and hypertensive patients.
  Excluding central hypopneas from AHI calculation reclassified 23.1% of mild OSA patients as no OSA, 20.9% of moderate as mild with 2.3% as no OSA, and 6.7% of severe as moderate.
  When central hypopneas were counted as a part of central events, 3 out of 172 patients i.e. 1.7% could be labelled as central sleep apnea.

Conclusions:

- The study was conducted with the thought that although scoring hypopnea into obstructive and central is optional according to AASM scoring manual version-3 , it is important to score central and obstructive hypopnea separately. Our study shows that central hypopnea is found in significant proportions in patients of OSA and may have diagnostic and therapeutic implications.

Abbreviations: OSA – obstructive sleep apnea, AHI – Apnea- Hypopnea Index ,CPAP- Continuous positive airway pressure

Nighttime Light Exposure Predicts Higher Sleep Apnea Risk: A Prospective Study with Explainable Machine Learning

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Introduction: Nighttime artificial light is an increasingly prevalent environmental exposure that may affect sleep health. However, its role in the development of sleep apnea remains underexplored. We investigated the longitudinal association between objective nighttime light exposure and incident sleep apnea, and evaluated its relative contribution and independence using explainable machine learning.
Materials and methods: A total of 84,774 adults (62.43±7.82 years; 55.0% female) without sleep apnea at baseline were included. Nighttime light exposure was derived from seven-day wrist-worn actigraphy recordings and categorized into quartiles. Incident sleep apnea was identified from hospital and primary care records. Cox proportional hazards models were used to estimate hazard ratios (HRs) with sequential adjustment for demographic, behavioral, and clinical covariates. An XGBoost-based survival model with SHapley Additive exPlanations (SHAP) was further used to assess the relative importance and interaction profile of each predictor.
Results: Over a median of 9.3 years (total 773,025 person-years), 802 participants were diagnosed with sleep apnea. Participants exposed to ≥32.5 lux at night (upper quartile) had a 36% higher risk of developing sleep apnea compared to those exposed to ≤1.4 lux (lowest quartile) (HR=1.36; 95% CI: 1.07–1.73; p_{adj} = 0.032). SHAP-based interpretation demonstrated that nighttime light exposure was among the predictors included in the cumulative 90% of total model importance, based on mean absolute SHAP values across all 23 covariates. Compared to other top predictors such as BMI category and

physical activity, which exhibited stronger interaction patterns (maximum SHAP interaction strength = 0.05), nighttime light showed minimal interaction with other covariates (maximum = 0.02). Along with non-significant results from likelihood ratio tests for interaction terms with age, sex, chronotype, diet, and physical activity (all $p_{adj} > 0.05$, respectively), these findings support the independent and robust role of nighttime light exposure in predicting sleep apnea risk.
Conclusions: Nighttime light exposure is a robust and novel predictor of sleep apnea risk. Further studies are needed to determine whether nighttime light exposure can serve as a modifiable environmental target for sleep apnea prevention.
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Exploring the treatment journey of Obstructive Sleep Apnoea: A scoping review on the perspectives of Chinese patients

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Introduction: Globally, obstructive sleep apnoea (OSA) is a common sleep-related breathing disorder, thought to affect up to 23.6% of patients of Chinese ethnicity. However, little is known about the perspectives of the Chinese patient population and the key factors underpinning their health behaviours and treatment engagement. This scoping review aims to systematically synthesise the literature to understand Chinese patient perspectives towards OSA and its management.
Materials and methods: A systematic search was conducted in Jul 2023 and May 2024 across CINAHL, Embase, Medline, PsycINFO, and Scopus in Chinese and English for studies including the concepts: obstructive sleep apnoea, adult Chinese patients, treatments (CPAP, surgery, mandibular devices, pharmacotherapy, positional therapy, complementary therapies, lifestyle changes), and psycho-social-behavioural factors. Search results were screened and data extracted by 2 independent reviewers. Publications meeting the following criteria were included in this review: adult patients (≥ 18 years) self-identifying as Chinese with OSA (sample); patient experiences of various OSA treatments (phenomenon of interest); primary studies published in a peer-reviewed journal and written in English or Chinese (design); inclusion of a patient-reported outcome related to their OSA treatment at any stage of the treatment trajectory (evaluation).
Results: From the 976 results, 49 studies were retrieved, comprising of 16,239 adults (mean age: 47 years, 80% male); conducted primarily in China, Hong Kong, Taiwan and Singapore. Studies were broadly synthesised into the following patient-centred domains: beliefs about OSA, treatment preferences, acceptance, satisfaction, and adherence. Considerable heterogeneity was observed in the measurement of treatment acceptance and satisfaction, coupled with insufficient reporting of factors influencing treatment preference. Notable limitations included the under-representation of older women and migrant Chinese populations and the limited coverage of health beliefs and health behavioural change.
Conclusions: Factors influencing patient engagement with OSA treatments are multifactorial. Patients' health beliefs and sociocultural factors play an important role in treatment acceptance and adherence. Future research should focus on patient-centred approaches to identify strategies to promote behavioural change and provide culturally sensitive care.

Development and Validation of a Reversible Obstructive Sleep Apnea Pig Model Using Cross-Linked Sodium Hyaluronate

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Introduction: Obstructive sleep apnea (OSA), affecting >900 million adults globally, lacks translational animal models that accurately replicate human pathophysiology. Current models (e.g., rodents, canines,monkeys) suffer from anatomical mismatches, irreversibility, or ethical constraints. This study introduces a method to induce upper airway obstruction by injecting a cross-linked sodium hyaluronate mixture into the pharynx and palate of Bama pigs, creating an animal model that simulates recurrent upper airway collapse in patients with OSA. This model features a definable and controllable obstruction plane with a reversible degree of obstruction. The modeling effect was evaluated by polysomnography (PSG), upper airway computed tomography (CT), and HIF-1α, which provided assurance at the clinical presentation, imaging, and biochemical levels for subsequent studies in this animal model. Histopathologic analysis of various respiratory tract locations, combined with monitoring of TNF-α and IL-6 in upper airway secretions and serum, helped to determine the respiratory system response to OSA conditions.

Materials and methods:

- **Model Design**: Palatal-pharyngeal injections of sodium hyaluronate/iohexol/penicillin (19.25 ml avg.) in Bama pigs (n=4) under Zoletil®/Remimazolam anesthesia.
- **Validation Metrics**:
  - Polysomnography (PSG) quantifying AHI/ODI and SpO_2 desaturation.
  - Serial CT imaging measuring airway volume/cross-sectional area.
  - Histopathology (H&E/Masson staining) and ELISA for HIF-1α, IL-6, TNF-α in serum/airway secretions.
- **Reversibility**: Longitudinal monitoring over 28 days post-injection.

Results:

1. **Effective Obstruction Induction:**
   - **AHI surged to 23.25 ± 2.99 events/hr (p=0.003) post-injection, with minimum SpO_2 dropping to 72.25 ± 14.18% .**
   - **CT confirmed airway narrowing (min. cross-section: 157.48 ± 29.14 mm^2 → 46.18 ± 10.91 mm^2, p=0.0112) .**
2. **Reversible Physiology:**
   - Gradual AHI normalization to 8.00 ± 1.41 events/hr by day 14, correlating with airway volume recovery (5,420 → 11,157 mm^3, p=0.0308) .
3. I**nflammatory Pathways:**
   - Serum HIF-1α and IL-6 surged acutely post-obstruction .
   - Histopathology revealed lymphocytic infiltration, alveolar septal thickening (p=0.0118), and pharyngeal hyperkeratosis .
4. **Key Correlations:**
   - **AHI strongly linked to airway anatomy (cross-section: R2=0.7421, p<0.001) .**
   - **TNF-α in secretions correlated with AHI (R2=0.3949, p=0.003) .**

Conclusions: In this study, we successfully established a reversible, safe, and reliable animal model of OSA using a novel technique involving the precise multi-point injection of a cross-linked sodium hyaluronate mixture into the palatopharyngeal region of pigs via the oral cavity. This model accurately simulates upper airway collapse, leading to obstruction, closely mimicking the pathophysiology of OSA in patients.Consequently, it serves as an invaluable tool for future research on OSA.

Efficient and Effective Telemonitoring System for CPAP Adherence Using Digital Transformation

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Introduction: In Japan,the national Health Insurance System began covering CPAP therapy with mandatory monthly clinic visits in 1998, later permitting visits once every two months in 2013 and every three months during the COVID-19 pandemic in 2022. These regulatory adjustments resulted in a substantial increase in CPAP users. Previously, our clinic depended predominantly on manual methods to collect adherence data from multiple providers, necessitating improvements in monitoring efficiency and effectiveness. To address these challenges, we developed the Remote Monitoring Network for CPAP Adherence. Additionally, we conducted a comparative analysis of CPAP usage between individuals demonstrating good and poor adherence before and after three months of enrollment in tele-monitoring to assess its impact.
Materials and methods: The Remote Monitoring Network for CPAP Adherence utilizes 3G connectivity (SIM) to integrate adherence data from CPAP devices into individual provider cloud servers. This data is efficiently transferred to medical charts using Application Programming Interfaces (APIs) and Robotic Process Automation (RPA). It enables a seamless flow of information and remote adjustment of CPAP pressure without in-person visits.
For analysis, patients were classified as good users (≥70% monthly CPAP use) or poor users (<70%). In line with insurance guidelines, physicians contacted poor users monthly to offer personalized support and address barriers such as mask discomfort, nasal congestion, and psychological resistance.
To minimize manufacturer-related bias, that could affect data collection and interpretation, our analysis focused exclusively on 1,589 Philips CPAP users from our total patient population. Of these patients 1,314 (82%) were categorized as good users and 273 (18%) as poor users. For assessment of the tele-monitoring impact, we selected random samples, comprising 473 good users and 142 poor users. These samples were not adjusted for gender and age, to maintain real-world representation in our patient population. We evaluated the adherence changes before and after three months implementation of tele-monitoring.
Results: Between June 2020 and April 2025, 67.2% (2,909 out of 4,330) of CPAP users transitioned to remote monitoring, exhibiting a consistent upward trajectory.Following tele-monitoring implementation, adherence remained stable among good users, with 83.5% (395 out of 473) maintaining their status and 16.5% (78 users) shifting to poor adherence. Among poor users, 63.4% (90 out of 142) sustained low adherence, while 36.6% (52 users) improved to good adherence.
Conclusions: Remote tele-monitoring for CPAP adherence is both feasible and effective, reducing clinic visit frequency and related costs, enhancing time management and operational efficiency for patients and healthcare providers alike with improving productivity. Disclosure of APIs and RPAs by each company is essential to the success of this initiative. The predominance of good users in our cohort may reflect the effectiveness of our clinical protocol.
Tele-monitoring did not notably affect patient attitudes toward CPAP adherence in this study. Defining adherence and motivating low-use patients remain ongoing issues, and integrating Digital Transformation (DX) with Artificial General Intelligence (AGI) is needed to enhance care quality and efficiency.
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Can Awake End-tidal CO2 Predicts Sleep-related Hypoventilation in Children with Neuromuscular Diseases?

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Introduction: Children with neuromuscular diseases (NMD) are at risk for hypoventilation, which often first manifests during sleep. Polysomnography (PSG) is the gold standard for detecting sleep-related hypoventilation (SRH) and determining the need for noninvasive positive pressure ventilation. This study aimed to evaluate whether awake end-tidal carbon dioxide (EtCO2), a simple and noninvasive outpatient measure, can predict SRH in children with NMD. We hypothesized that patients with SRH may exhibit high-normal awake EtCO2 values.
Materials and methods: We retrospectively reviewed medical records of children (0–18 years) with congenital NMD who underwent diagnostic PSG at Ramathibodi Hospital. From PSG results, SRH was defined as >2% of total sleep time (TST) with EtCO2>50 mmHg. Children with NMD were divided into those with SRH and without SRH groups. Demographic and anthropometric data and neuromuscular diagnoses were collected. Awake parameters including baseline oxygen saturation (SpO2), pulmonary function tests (PFTs), awake EtCO2, venous partial pressure of carbon dioxide (PCO2), and serum HCO3 were extracted. The collected variables were compared between the SRH and non-SRH groups.
Results: A total of 50 diagnostic PSG records were included. The mean age was 12.34 ± 3.50 years; 76% were male and 48% had Duchenne muscular dystrophy. SRH was identified in 8 PSGs (16%). Baseline characteristics did not differ significantly between patients with and without SRH. Awake EtCO2 values were significantly higher in patients with SRH compared to those without SRH (42.25 ± 3.77 vs 33.52 ± 3.29 mmHg, $p<0.001$). Serum bicarbonate (HCO3) levels were also significantly higher in patients with SRH (26.92 ± 2.53 vs 22.77 ± 2.56 mEq/L, $p=0.002$). Venous PCO2 trended higher in patients with SRH but did not reach statistical significance. ROC analysis showed high diagnostic accuracy for predicting SRH, with AUCs of 0.966 for awake EtCO2 and 0.892 for serum HCO3. An awake EtCO2 cutoff of 38.5 mmHg yielded 87.5% sensitivity and 95.2% specificity, while a serum HCO3 cutoff of 25.2 mEq/L yielded 80% sensitivity and 80.8% specificity. Based on the 16% prevalence of SRH in our cohort, the positive predictive value (PPV) and negative predictive value (NPV) were calculated. For awake EtCO2 >38.5 mmHg, the PPV was 77.8% and the NPV was 97.6%. For serum HCO3 >25.2 mEq/L, the PPV was 44.4% and the NPV was 95.5%. These findings indicate that both awake EtCO2 and serum HCO3 have high NPV, suggesting potential utility in stratifying the lower-risk cases.
Conclusions: Our findings suggest that awake EtCO2 and serum HCO3 may serve as simple and noninvasive indicators for early SRH detection. These tools could help guide clinical decisions and facilitate timely PSG referral and intervention, especially when PSG is delayed or unavailable.
Acknowledgments: This study was conducted at Ramathibodi Hospital, Mahidol University, Bangkok, Thailand, with no financial support. The authors report no conflicts of interest.

Prevalence of high risk for obstructive sleep apnea in Thai patients undergoing elective general surgery

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Introduction: Limited studies have shown that a high proportion of patients undergoing elective surgery under general anesthesia (GA) are at high risk for obstructive sleep apnea (OSA), with 80% remaining undiagnosed. This study aims to determine the prevalence of high-risk OSA in Thai patients undergoing elective general surgery under GA and to explore its association with surgical categories and perioperative complications based on STOP-Bang scores.

Materials and methods: This cross-sectional study was conducted between August 2020 and February 2021. The inclusion criteria were Thai patients ≥18 years admitted to Siriraj Hospital for elective general surgery under GA. Exclusion criteria included patients scheduled for bariatric, airway, or neck mass surgery, those whose surgeries were canceled or had anesthetic substituted, and patients unable to complete the questionnaires. Before surgery, all subjects completed the STOP-Bang and associated questionnaires, and relevant medical records, including anesthetic notes, were reviewed.

Results: Of the 300 participants, 162 patients (54%) were classified as being at high risk for OSA (STOP-Bang values of ≥3). Among surgical categories, urologic surgery had the highest prevalence (69%) while breast surgery had the lowest (25.7%). High-risk patients shared several characteristics compared to the low-risk group, including being predominantly male, having a larger neck circumference, older age, higher body mass index (BMI), underlying hypertension, cardiovascular diseases, and higher anesthetic risk. However, no significant association was found between the STOP-Bang scores and postoperative complications.
Conclusions: Up to 54% of Thai patients undergoing elective general surgery under GA were at high risk for OSA, with the highest prevalence seen in those undergoing urologic surgery. Increasing awareness of preoperative OSA screening could help prevent future adverse outcomes.
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Success rate of Portable Polysomnography in Snoring and Obstructive Sleep Apnea Patients in ENT Clinic Srinagarind Hospital, Khon Kaen University

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Introduction: Study objectives: To study the success rate of portable PSG, used in diagnosis and treatment monitoring in the snoring and sleep disorders clinic, Department of Otorhinolaryngology, Faculty of Medicine, Khon Kaen University, Thailand
Materials and methods: This study is a retrospective descriptive study in adult patients over 18 years old who received services at a snoring and sleep disorders clinic, Department of Otorhinolaryngology, Srinagarind Hospital from 2012 – 2019. Patient information was collected from Srinagarind Hospital's medical records. The collected data consisted of general patient information. Data based on the modified STOP BANG questionnaire, clinical data, physical examination, underlying diseases, portable PSG examination data results. All data were analyzed through percentage statistics and spearman correlation.
Results: There were 1,028 new patients, 110 were pediatric patients and 918 were patients over 18 years old. 58 patients were unable to retrieve data. The remaining 858 cases(93.5%) 550 were male (64.1%) and 308 female(35.9). Most of the cases, 256 patients (29.3%) aged between 50-60 years. 680 cases were diagnosed with OSA (79.2%) Most of the patients had modified STOP BANG at 4 points, 30%. There were 659 patients who tested PSG or 76.8%, divided into port PSG 599 cases, 69.8% of the patients were diagnosed with severe OSA 34.4% and moderate OSA 25.5%. There were 12 cases with re-test for PSG, or 1.8%. When studying the relationship between modified STOP BANG and the results of portable PSG, it was found that modified STOP BANG was greater than 2 and AHI with cut off value greater than 15 was found sensitivity 86.7% and specificity 26.4%. The Spearman correlation coefficient was 0.25 at $P < 0.01$ when comparing modified STOP BANG with portable PSG results. The majority of patients in the clinic 490 patients(57.1%) used CPAP, 83 cases(9.7%) were treated by surgery and 13 cases(1.5%) used mandibular advancement devices . After treatment with additional life style modifications most of the patients' symptoms improved.
Conclusions: Portable polysomnography has the advantage of ease of use, better accessibility and lower cost. It can be utilized for diagnosis of OSA in areas in which in lab PSG is not yet fully accessible, with minimal data loss or inconclusive diagnoses.
Acknowledgments: This study was approved by Khon Kaen University Ethics Committee project no. HE641573. We thank you Mrs. Arunya Kotelong the clinic nurse for assistance in data collection.

A Machine Learning Model for Predicting Obstructive Sleep Apnea Using Anthropometric and Bioimpedance Data

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Introduction: Obstructive sleep apnea (OSA) is a prevalent and serious sleep disorder associated with various complications. Polysomnography (PSG) remains the gold standard for diagnosis but is limited by cost, accessibility, and time. This study investigates an alternative method for identifying patients with severe OSA (Apnea–Hypopnea Index [AHI] ≥ 30) using bioelectrical impedance analysis (BIA) and basic outpatient anthropometric data.
Materials and methods: Data were retrospectively collected from patients who underwent both BIA and full-night PSG at Taipei Medical University–Shuang Ho Hospital Sleep Center (N = 6574). Anthropometric features (e.g., age, sex, body mass index, neck and waist circumference) and BIA-derived metrics (e.g., total body water, extracellular/intracellular water ratio, muscle percentage, and basal metabolic rate) were included.

Various machine learning models—including logistic regression (LR), k-nearest neighbors (kNN), Naïve Bayes (NB), support vector machines (SVM), random forest (RF), and XGBoost—were trained to classify OSA severity. Model performance was evaluated via stratified cross-validation and testing set analysis.
Results: Patients with severe OSA (N=3686) had higher values in age and showed elevated BMI, neck and waist circumference, visceral fat level (all $p < 0.01$), compared to non-severe OSA patients (N=2888).

BIA metrics such as reduced total body water, lower muscle percentage, and increased extracellular/intracellular water ratio were significantly associated with severe OSA.

Regarding model performance, Naïve Bayes, Logistic Regression, and XGBoost achieved the best performance. Naïve Bayes showed the highest accuracy (69.20%) and F1-score (67.6%), while Logistic Regression provided the best AUC (77.35%).
Conclusions: This study demonstrates that body composition and anthropometric features obtained from BIA can serve as effective predictors for severe OSA (AHI ≥ 30). The proposed machine learning framework, particularly models such as Naïve Bayes, Logistic Regression, and XGBoost, achieved clinically acceptable performance in identifying high-risk patients using only outpatient-accessible data. This approach offers a scalable, low-cost, and non-invasive alternative to PSG-based diagnosis.

Obstructive sleep apnea (OSA) –The Iceberg In The Sea Of Comorbidities

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Introduction: Obstructive Sleep Apnea (OSA) is the second most common sleep disorder, affecting nearly 1 billion adults worldwide.[3] The AASM's recent campaign rightly emphasizes that *OSA is more than a snore!*[4] OSA is often the hidden contributor to diabetes, hypertension, dyslipidemia, stroke, AF, insomnia, depression, GERD, asthma, cognitive decline, and RLS.
Materials and methods: Five life-changing OSA cases transformed by PAP therapy

- **Case 1 (ComOSAR; OSA + RLS/PLMS):** A 73-year-old overweight female with hypertension, Bronchial asthma, pulmonary hypertension, and depression exhibited persistent symptoms despite PAP therapy. Repeat PSG showed severe OSA (AHI 33.9/hr), poor sleep efficiency, PLM index 128/hr, and labs showed iron deficiency. This presentation aligns with *ComOSAR*[5], observed in ~24% of OSA patients.
- **Case 2 (MS + OSA):** A 66-year-old obese female with stable multiple sclerosis and incidental MCA aneurysm presented with dyspnea; PSG revealed moderate OSA (AHI 21.7/hr). OSA commonly worsens MS symptomatology—including fatigue, cognition, and quality of life.
- **Case 3 (UARS):** A 35-year-old obese female with daytime somnolence, tachycardia, idiopathic intracranial hypertension, and empty-sella syndrome showed mild OSA on Level 1 PSG (AHI 13.3/hr) but a Level 3 study revealed 1,575 flow-limited breaths, diagnostic of *Upper Airway*

Resistance Syndrome (UARS)—a condition producing significant sleep fragmentation and daytime dysfunction despite low AHI .

- **Case 4 (Fibromyalgia + Parasomnias):** A 60-year-old obese female with fibromyalgia, rhinitis, and parasomnias exhibited severe OSA (AHI 53/hr). BiPAP titration (IPAP 14/EPAP 10 cm H_2O) resolved sleep paralysis, hypnopompic hallucinations, and significantly reduced fibromyalgia fatigue within a month.
- **Case 5 (OSA-related AF):** A 41-year-old obese hypertensive surgeon with paroxysmal atrial fibrillation and severe OSA (AHI 32/hr) showed a reduction in arrhythmias from 73→24 events on CPAP and further to 12 on BiPAP (IPAP 17/EPAP 12 cm H_2O), with complete apnea resolution

Results: PAP therapy demonstrated profound, system-wide benefits:

1. **ComOSAR**: Resolution of PLMS and RLS symptoms, improved sleep efficiency and PAP adherence—critical as coexistence of OSA and RLS correlates with higher insomnia, cognitive, metabolic, and psychiatric comorbidity .
2. **MS + OSA**: Reduction in daytime fatigue and cognitive load, with enhanced quality of life.
3. **UARS**: Significant decreases in flow-limited breathing episodes and daytime dysfunction following targeted CPAP therapy.
4. **Chronic pain & parasomnias**: Rapid cessation of sleep disturbances and reduction in fibromyalgia-induced fatigue, paralleling research showing PAP benefits in chronic pain conditions.
5. **Cardiovascular**: Substantial reduction in atrial arrhythmias; literature supports a ~30–40% reduction in AF recurrence with PAP therapy, due to improved oxygenation, reduced sympathetic activity, and attenuation of atrial remodeling.

Conclusions: PAP therapy not only treats sleep-disordered breathing—it also mitigates neurophysiological disturbances, chronic pain, and cardiovascular comorbidities. Proactive screening and management of OSA is essential in populations with MS, ComOSAR, and AFib to enhance overall health and quality of life.

Acknowledgments: **References:**

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Prevalence and Modulating Factors of Upper Airway Collapse Sites in OSA Patients Assessed by Drug-Induced Sleep Endoscopy: A Meta-Analysis

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Introduction: Drug-induced sleep endoscopy (DISE) is an established diagnostic tool for dynamically evaluating upper airway obstruction sites in patients with obstructive sleep apnea (OSA). However, significant variability in reported prevalence rates of obstruction sites across studies has highlighted the critical need for a systematic and comprehensive analysis.

Materials and methods: This meta-analysis aimed to synthesize the prevalence rates of upper airway obstruction sites (velum, oropharynx, tongue base, and epiglottis) as assessed by DISE. We also sought to quantitatively evaluate the impact of sedative type, method of sedation assessment, and patient demographic characteristics (age, body mass index, apnea-hypopnea index, and male ratio) on both the prevalence of obstruction and inter-study heterogeneity. Methods A random-effects model-based meta-analysis was performed using the metaprop function in R. Prevalence rates were calculated for the four obstruction sites based on the VOTE classification system. Subgroup analyses were conducted according

to the type of sedative used and the method of sedation assessment. Publication bias was evaluated using Egger's test and the Trim-and-Fill method. The effects of covariates were analyzed via meta-regression using the rma.glmm function from the metafor package.
Results: In an analysis comprising a total of 3,842 patients, velum obstruction was the most prevalent at 75% (95% CI: 0.67-0.82), followed by tongue base at 40% (95% CI: 0.33-0.48), oropharynx at 31% (95% CI: 0.25-0.37), and epiglottis at 24% (95% CI: 0.17-0.32). High heterogeneity ($I^2 > 80\%$) was observed across all sites. Significant publication bias ($p < 0.0001$, right asymmetry) was identified specifically for epiglottic obstruction. After applying the Trim-and-Fill method, the adjusted prevalence of epiglottic obstruction increased substantially to 0.4611 (95% CI: 0.3373-0.5898), suggesting an underreporting bias in studies that reported high prevalence rates. Multivariate meta-regression analysis revealed that the heterogeneity in velum obstruction (I^2=37.40%) was largely explained by sedation-related variables and demographic factors. However, high residual heterogeneity persisted for other sites (oropharynx, tongue base, and epiglottis). Notably, Midazolam use and sedation assessment based on clinical signs were associated with higher obstruction prevalence in some areas. Age, BMI, AHI, and male ratio also acted as significant moderating variables for site-specific obstructions.
Conclusions: This DISE-based meta-analysis elucidated the multilevel nature and site-specific patterns of upper airway obstruction, reaffirming the velum as the most common obstruction site. Our findings highlight that the high variability in DISE outcomes is influenced by sedation protocols and patient characteristics. This underscores the necessity for standardizing sedation protocols and considering patient characteristics in future research, thereby advocating for personalized treatment approaches.

Sleep and cardiovascular outcomes are worse in people with co-morbid obstructive sleep apnoea and chronic respiratory disease: insights from consumer data

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Introduction: Respiratory disease and obstructive sleep apnoea (OSA) are individually associated with increased risk of cardiovascular disease (CVD) and all-cause mortality. People with co-morbid respiratory disease and OSA (co-ROSA) may be at increased cardiovascular risk due to worse night-time hypoxemia which may be exacerbated by disrupted sleep. However, there is a lack of data assessing sleep and cardiovascular risk in co-ROSA.
Materials and methods: We used an international consumer sample of 321,307 nights of sleep data (Withings Sleep Analysers and Scan Watches) from 2573 people with a self-reported doctor diagnosis of respiratory disease (asthma, chronic obstructive pulmonary disease, emphysema) and/or OSA. The odds of self-reported CVD (heart attack, stroke, coronary heart disease, congestive heart failure) and sleep metrics were compared in co-ROSA, respiratory disease and OSA using logistic regression and ANCOVA, respectively, while controlling for age, sex, and BMI. It was hypothesised that people with co-ROSA would have poorer sleep (less total sleep time, higher sleep irregularity, and decreased sleep efficiency), and greater incidence of cardiovascular disease, than people with respiratory disease or OSA alone.
Results: Participants were middle-aged (53.2±13.7yrs, mean±SD), predominantly male (73.2%), with high BMI (31.1±6.5kg/m^2), and normal sleep duration (7.2±1.2hrs). People with co-ROSA had shorter sleep duration (7.07hrs±82 minutes) than people with respiratory disease (7.41hrs±65 minutes), as well as higher night to night variability (rmssd of sleep duration=137.78±93.41) compared to respiratory disease alone (122.89±58.90), and poorer sleep efficiency (85%±9.17) than respiratory disease alone (89%±7.33). However, there were no differences between co-ROSA and OSA. Co-ROSA was associated with 53% increased odds of CVD compared to respiratory disease 95%CI [30, 92], p=0.02, but not OSA, OR 66%, 95%CI [42, 105], p=0.08.
Conclusions: Overall sleep quality was worse in co-ROSA than respiratory disease alone, with shorter sleep duration, greater night to night variability, and poorer sleep efficiency. In line with this finding, CVD is also more prevalent in co-ROSA than respiratory disease alone. OSA often goes undiagnosed in

people with co-morbid respiratory disease as it can be more challenging to diagnose in this population. OSA diagnosis should be prioritised in people with respiratory disease to improve sleep outcomes and better identify CVD risk. The nearable and wearable technology utilised in this study is a promising new tool that could aid in the diagnosis and management of OSA in more challenging and under-diagnosed populations.

"INNOVATING SLEEP APNEA SCREENING: TELE-OSA QUESTIONNAIRE- A NOVEL TELEPHONIC SCREENING TOOL FOR MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA"

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Introduction:

- Prevalence of obstructive sleep apnea (OSA) varies between 6-17% in general adult population. Untreated severe OSA has 2-3-fold increased risk of all-cause mortality. Despite high prevalence, OSA often remains undiagnosed.
- Access to polysomnography (PSG), gold standard for diagnosis, can be limited in LMICs like India due to several factors like availability of sleep centers, geographical distribution (often concentrated in urban areas), cost of services, referral processes, awareness and workforce shortages.
- Consequently, sleep clinics often experience overwhelming patient loads and prolonged waiting times, underscoring urgent need to streamline screening and triage pathways.
- Drawbacks of existing screening questionnaires are usage of objective parameters (anthropometric measurements) and reliance on age, gender, and BMI which can introduce biases.

Materials and methods:

- This was a retrospective, single centre, observational study. 522 patients who underwent level 1 PSG during 2022-2024 in our sleep laboratory were included. All patients filled a self-administered 12-item questionnaire tool in vernacular language (Hindi) during time of admission.
- Eligibility
    - Inclusion:- Adult patients aged >18 years and have completely filled 12-item questionnaire during time of admission.
    - Exclusion :- Patients who have not filled the questionnaire, already on treatment for OSA, pregnant women and those with technically inadequate polysomnography studies.
- Statistical analysis was done in IBM-SPSS-version-26.0 statistical software. Exploratory factory analysis was done and 7 questions were selected. Sample was randomly divided into two parts: development (80%,n=421) and testing subsample (20%, n=101). Multi-variate logistic regression analysis was done on development subsample to construct the model. Finally, we assessed the discriminative performance of this score in both development and test subsamples and determined cross-validation and diagnostic accuracy.

Results:

- TELE-OSA questionnaire includes five items (snoring, stops breathing while sleeping, wake up from sleep due to gasping/chocking, nocturia and nocturnal GER).

- Cutoff score of 6 was identified, demonstrating high specificity (83%) and moderate sensitivity (55%).
- TELE-OSA had high specificity compared with existing screening questionnaires [STOP-BANG (59%), STOP (66%), GOAL (45%), NOSAS (78%) No-apnea (53%)] and highest diagnostic accuracy [AUC: TELE-OSA-0.77, STOP-BANG-0.76, STOP-0.71, GOAL-0.77, NOSAS-0.77, No-apnea-0.68].

Conclusions:

- This study introduces the Tele-OSA Questionnaire, a novel telephonic screening tool designed to facilitate the identification of individuals at risk for moderate to severe OSA.
- It includes only the construct of the disease (OSA) and does not include risk factors associated with the disease.
- It can be used via telephonic interview or surveys, even by proxy informants viz., bedpartners.
- The developed questionnaire has acceptable psychometric properties at the cutoff score of 6. Further, properties across different cut-offs and prevalence are also provided so that users may choose a specific cut-off according to the population in which they intend to use the questionnaire.
- Existing screening questionnaires have high sensitivity but less specific which increases the burden on sleep labs. Tele-OSA is a highly specific questionnaire and can reduce the burden on sleep centres, making diagnostic processes more accessible in resource-constrained settings.

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Effects of strength training on blood pressure and arterial stiffness in adults with moderate to severe obstructive sleep apnea: a randomized controlled trial

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Introduction:

Obstructive Sleep Apnea (OSA) is a sleep disorder characterized by partial (hypopnea) or complete (apnea) interruptions in airflow through the upper airways during sleep, leading to reduced oxygen saturation. OSA is closely associated with cardiovascular complications, such as elevated blood pressure (BP) and increased arterial stiffness—mainly driven by sleep fragmentation and intermittent hypoxia. Although continuous positive airway pressure (CPAP) is the first-line treatment for OSA, its effectiveness is often limited by poor adherence. Consequently, physical exercise—particularly strength training (ST)—has emerged as a promising non-pharmacological strategy to improve cardiovascular health in different populations. In individuals with OSA, ST may reduce body fat—especially in the cervical region—through exercise may alleviate upper airway narrowing. However, it remains unclear whether ST can reduce BP and arterial stiffness in adults with OSA. Thus, this randomized controlled trial aimed to evaluate the effects of an eight-week ST program on ambulatory, office, and central BP, as well as arterial stiffness, in adults with moderate to severe OSA.

Materials and methods:

Participants aged 18 years or older with a confirmed diagnosis of moderate to severe OSA (based on the apnea-hypopnea index; AHI) were recruited from a sleep laboratory. Stratified by sex and OSA severity, participants were randomly assigned to either a ST group or a control group (CG). The ST group performed three sessions per week, consisting of eight resistance exercises, while the CG participated in two sessions per week of stretching exercises. OSA severity was assessed using full overnight polysomnography. Additionally, systolic and diastolic [BP (ambulatory, office, and central] and arterial stiffness were evaluated. Generalized Estimating Equations (GEE) were used to analyze group-by-time interactions, with a significance level set at $p < 0.05$.

Results: A total of 26 adults (mean age: 54.6 ± 7.2 years; BMI: 36.1 ± 7.9 kg/m²; AHI: 52.2 ± 27.4 events/hour) were included. Significant group-by-time interactions were found for 24-hour systolic BP (CG: +5.3 ± 2.4 mmHg vs. ST: −2.9 ± 3.2 mmHg; p = 0.041), daytime systolic BP (CG: +4.6 ± 2.5 mmHg vs. ST: −2.8 ± 2.8 mmHg; p = 0.050), and daytime mean BP (CG: +3.7 ± 1.6 mmHg vs. ST: −2.3 ± 2.0 mmHg; p = 0.021). In addition, a significant reduction was also observed in OSA severity (AHI CG: -3.5 ± 3.8 events/hour vs. ST: −20.9 ± 6.1 events/hour; p = 0.015). No significant differences were observed between groups regarding office and central BP, or arterial stiffness.
Conclusions:

An eight-week strength training program significantly reduces ambulatory blood pressure and OSA severity in adults with moderate to severe OSA, even without changes in arterial stiffness. These findings support the role of strength training as a potential adjunct non-pharmacological intervention for cardiovascular risk management in this population.

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The Effectiveness of a Smart Sleep Apnoea Self-Management Support Program (4S) in Improving Cardiovascular Risk and Quality of Life in Subjects with Moderate to Severe Obstructive Sleep Apnea: A Randomized Controlled Trial

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Introduction: Obstructive Sleep Apnea (OSA) affects 9% to 38% of the global population, contributing to cardiovascular diseases and a reduced quality of life. Self-management strategies, including increased physical activity, weight control, and regular monitoring, can help reduce symptoms and lower the risk of complications. This study assessed the effectiveness of the 1-year Smart Sleep Apnea Self-Management Support Program (4S) in improving cardiovascular health risks.
Materials and methods: This was a two-arm randomized controlled trial. Eligible patients had moderate to severe OSA, a BMI >23, and engaged in less than 150 minutes of moderate physical activity per week. Participants were recruited from two hospitals and randomly allocated to either the 4S intervention group or the General Hygiene Information (GHI) control group.
The 4S intervention included: (i) Two 30-minute brief motivational interviewing sessions,
(ii) Scheduled theory- and theme-based instant messages and phone calls, (iii) Personalized chat-based

coaching, and (iv) An e-platform for goal setting and self-monitoring.
The GHI control group received general health information at similar frequencies and in a comparable format. Quantitative assessments were conducted at baseline, 4 months, and 12 months. A linear mixed model was used to compare changes in cardiovascular risk factors between the 4S intervention group and the GHI control group.
Results: A total of 123 participants (73.2% male, mean age 60 years, BMI 30 kg/m²) with moderate to severe OSA were recruited. Baseline characteristics did not differ between the two groups. The intervention group showed increases in Positive Airway Pressure (PAP) use and engagement in moderate physical activity. There was a significantly greater increase in PAP use in the intervention group compared to the control group. However, the difference in changes in engagement in moderate physical activity was not statistically significant between the two groups. The intervention group showed significant reductions in body weight, waist circumference, systolic blood pressure, and triglyceride levels compared to baseline. These reductions were significantly greater in the intervention group compared to the control group.
Conclusions: The 4S program demonstrated significant improvements in cardiovascular health risk factors among physically inactive, overweight individuals with moderate to severe OSA. By promoting self-management and sustainable health behaviors, the program may provide an effective approach to improving outcomes for individuals with OSA.
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Oscillometric Lung Function and Its Association with Obstructive Sleep Apnea Risk

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Introduction: Obstructive sleep apnea (OSA) is a sleep disorder characterized by repeated episodes of upper airway blockage during sleep, leading to apnea or hypopnea. An apnea is defined as a episode as a reduction in airflow of ≥ 90% lasting at least 10 seconds. A hypopnea is defined as a reduction in airflow of ≥ 30% lasting at least 10 seconds and associated with a ≥ 4% decrease in pulse oxygenation. Collapse or narrowing of the upper airway during sleep is OSA patient can increase resistance airflow in the upper airway. Oscillometry provides a non-invasive comprehensive assessment of lung function by analyzing airway resistance, reactance, and compliance. This multi-dimensional approach allows for detecting abnormalities in the peripheral airways. Oscillometry is a method used to assess upper airway resistance by applying small pressure oscillations to the airway during normal breathing. It measures respiratory system impedance, which includes airway resistance (Rrs) and reactance (Xrs). In OSA patients, increased upper airway resistance, usually in the supine position, can be detected using oscillometry.
Materials and methods: A total of 262 subjects aged 40 years and older were included in this study. The risk of OSA was determined using the STOP-Bang questionnaire, which evaluates clinical parameters including snoring, tiredness during daytime, observed apnea, and high blood Pressure-body mass index, age, neck circumference, sex. Pulmonary function was assessed and evaluated using an oscillometry. Subjects were categorized into low-risk and high-risk groups for OSA. Statistical analyses were performed using independent t-tests and chi-square tests, with a p-value < 0.05 considered statistically significant.
Results: There was no significant difference in age between the groups. High-risk subjects for OSA were more likely to be male ($p = 0.02$), have a higher BMI ($p < 0.05$), and a larger neck circumference ($p < 0.05$). Smoking was also more common in the high-risk group ($p = 0.03$). Comorbidities such as diabetes, cardiovascular disease, and kidney disease were significantly more prevalent in the high-risk group. Oscillometry parameters and respiratory patterns showed no significant differences between the groups.
Conclusions: Individuals at high risk for OSA had significantly higher BMI, neck circumference, smoking prevalence, and comorbid conditions. However, oscillometry findings did not differ between the risk groups, suggesting that respiratory impedance may not be a sensitive marker for differentiating OSA risk.

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Technology/Technical

Snoring Sound Detection: An Explorative Study on Use of TensorFlow.js for Sleep Quality Monitoring

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Introduction:

This study presents the development and evaluation of a browser-based snoring detection application leveraging TensorFlow.js. The application was designed to perform real-time monitoring and analysis of snoring patterns as a non-invasive method for assessing sleep quality and conducting preliminary screening for potential sleep apnea.

Materials and methods:

The model was trained on a dataset comprising 500 seconds of snoring audio (300 seconds from publicly available sources and 200 seconds of researcher-generated samples) and 500 seconds of background noise recordings. Testing was conducted over a cumulative duration of 200 seconds in various acoustic environments. All audio files were processed using Google's Teachable Machine platform, which segments input into 1-second intervals. No manual preprocessing or noise reduction techniques were applied. Model training was conducted using the Teachable Machine's built-in binary classification system powered by the TensorFlow framework, for 100 epochs using default hyperparameters. Model performance was evaluated based on sensitivity and specificity using a separate test split of the dataset.

Results:

Performance evaluation revealed a high overall accuracy of 94.12%, supported by a sensitivity of 95.00%, specificity of 93.22%, precision of 93.44%, and an F1-score of 94.71%. These findings indicate the system's strong ability to reliably detect snoring events while minimizing false positives from ambient background noise. The model maintained consistent performance across varying acoustic environments without requiring manual preprocessing or noise filtering, underscoring the robustness of the browser-based approach. Additionally, the application was able to generate session-level statistics, such as snoring duration, frequency, and proportion, which enhance its utility for practical sleep quality monitoring.

Conclusions:

The solution offers several advantages, including requiring no specialized hardware beyond a standard microphone, functioning entirely within a web browser without installation, ensuring privacy by processing all audio data locally, and providing detailed session statistics such as snoring duration, count, and percentage. This work demonstrates the potential of leveraging modern web technologies for accessible sleep monitoring solutions. It shows a high level of accuracy in distinguishing snoring sounds from ambient noise and provides relevant statistical information for sleep quality assessment. This approach opens new opportunities for creating user-friendly and widely accessible sleep monitoring technologies. Future research involving larger-scale studies with diverse user characteristics and environmental

conditions is recommended to validate the system's external applicability and robustness in real-world settings. Furthermore, its web-based design enables potential integration with other health platforms or wearable devices for broader sleep monitoring applications.

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Z4IP – Comprehensive Sleep and Activity Phenotyping Through Multifactor Mobile Data Integration

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Introduction: The ubiquity of smartphones offers unprecedented opportunities for scalable, real-time data collection over extended periods in naturalistic settings. We developed a proprietary mobile app (Z4IP; iOS and Android compatible) to collect multi-stream objective and subjective data for building a comprehensive profile of individual sleep, activity and wellbeing. Each of six functional modules, cognitive tests, questionnaires, audio diaries, time-use diaries, movement patterns and wearable integration, can be customized to satisfy different protocol requirements, and has been field-tested in studies involving community-dwelling, lab-based and hybrid monitoring. Here we assessed the feasibility of long-term monitoring via sleep and activity diaries across different age groups and study contexts: 1) freshmen monitored over their first semester in college (20 weeks); 2) junior doctors undergoing shifts during residential training (8 weeks); 3) older adults past statutory retirement age (10 days).
Materials and methods: Z4IP provides three modes of assessment: 1) ecological momentary assessments (EMA) within study-specific time windows (cognitive tests, questionnaires, audio diaries); 2) self-reports at participant's convenience (time-use diaries); and 3) continuous passive smartphone-derived metrics (movement patterns) and wearable-based behavioural phenotyping (Oura Ring). To foster sustained engagement, the platform incorporates a task completion and reward system, providing personalized feedback through participants' smartphones and enabling large-scale backend monitoring for researchers.
Compliance rates for the two components which demand the most active effort from participants — daily EMA incorporating a sleep diary, and time-use diary — were evaluated across the three aforementioned studies to assess the app's feasibility for long-term monitoring across different age groups.
Results: In Study 1 involving college freshmen (N=638; 51.7% female; mean age [SD]=20.4 [1.3]), the compliance rate of daily EMA questionnaires changed by -1.6% (linear fit) per week (80.1% in week 1 to 45.2% in week 20, end of study). Time-use diaries were completed for three separate fortnights: weeks 1–2, 84.0%; weeks 7–8, 66.2%; and weeks 15–16, 52.6%.
In Study 2, daily EMA compliance rates for medical interns (N=96; 59.4% female; mean age [SD]=24.7 [1.1]) changed by -3.8% (linear-fit) per week (77.1% in week 1 to 52.4% in week 8, end of participation). Time-use diary completion rate averaged 65.2% across the study.
The 10-day compliance rate in Study 3 involving older adults (N=411; 49.6% female; mean age [SD] = 74.2 [2.7]) was 92.3% for EMA questionnaires and 96.0% for time-use diaries.
Conclusions: The EMA sleep diaries effectively complemented wearable-derived objective sleep measures to provide comprehensive and sustainable sleep assessment, demonstrating Z4IP's robust utility for long-term monitoring. Although a gradual decline in compliance was observed over time — as is typical in longitudinal studies — engagement remained notably high. Over half of the freshmen completed EMA and time-use diaries through their examinations (week 16). Despite demanding internship shift schedules, most medical interns maintained daily reporting. High adherence among older adults further

underscores the app's accessibility and user-friendliness. These results highlight Z4IP's potential as a scalable and adaptable tool for sustained digital phenotyping in real-world settings.
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Manual Versus Automated Polysomnography Scoring: Inter-rater Accuracy in a Single-Center Thai Cohort

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Introduction: The demand for trained sleep study personnel is rising, but the relative accuracy of advanced sleep technicians (ASTs), sleep disorder specialists (SDSs), and commercial autoscoring software (AUTO) has not been quantified in Thailand. We evaluated inter-rater agreement, scorer bias, and clinical comparability among these three methods.
Materials and methods: A retrospective analysis was performed on 250 consecutive diagnostic polysomnography (PSG) studies recorded between September 2022 and February 2023 (102 women, 148 men; mean age 48.5 ± 17.5 y; BMI 29.1 ± 6.6 kg/m²). Each record was independently scored by a randomly assigned certified AST (n = 10), a blinded SDS and AUTO (default settings). Sleep stages, respiratory events and derived indices were extracted. Categorical agreement was assessed with Cohen's κ; continuous agreement with intraclass-correlation coefficients (ICC, two-way random, absolute agreement). Bias and limits of agreement were evaluated using Bland–Altman analysis. Apnoea–hypopnoea index (AHI), arousal index (ARI) and sleep efficiency (SE) were compared across raters with repeated-measures ANOVA and Tukey post-hoc tests (α = 0.05).
Results: AST–SDS staging agreement was almost perfect (κ = 0.832–0.980). In contrast, AST–AUTO agreement ranged from slight for NREM1 (κ = 0.081) to moderate for wake (κ = 0.599), producing stage-specific differences between AST-SDS and AST-AUTO for every stage except NREM2 (overall $p < 0.0001$; NREM2 $p = 0.099$). For respiratory events, AST–SDS reliability was substantial to perfect (ICC = 0.684 for central apnoea; 0.945–0.998 otherwise), whereas AST–AUTO reliability spanned poor (central apnoea, ICC = 0.023) to strong (mixed apnoea, ICC = 0.869). The same pattern emerged for derived indices: AST–SDS ICCs were excellent for AHI (0.982), ARI (0.982) and periodic limb movements (PLMs, 0.965); AST–AUTO ICCs were moderate for AHI (0.564) and ARI (0.496) and poor for PLMs (0.149). Bland–Altman plots showed significant bias across all variables ($p \leq 0.0487$). Repeated-measures ANOVA revealed significant rater effects for AHI ($p = 0.042$) and ARI ($p = 0.028$); SE differed for seven of ten ASTs ($p < 0.006$). Post-hoc tests confirmed AST differed from AUTO for AHI ($p = 0.013$) and ARI ($p = 0.030$) but not from SDS.
Conclusions: Manual scoring conducted by ASTs and SDSs, following the AASM 2020 guidelines, shows a strong level of agreement and minimal bias. In contrast, the commercial AUTO algorithm demonstrates lower reliability and clinically significant discrepancies, particularly regarding NREM1 sleep, central apneas, and periodic limb movement detection. Therefore, expert review remains crucial until the performance of these algorithms is improved. This data serves as a foundation for national training standards and identifies specific areas for improvement, including NREM1, PLMs, and CA discrimination, to guide the development of future AI-enhanced autoscoring tools.
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An innovative solution to positional therapy for obstructive sleep apnea - Pilot Study

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Introduction: Obstructive sleep apnea (OSA) is a prevalent global health issue, with a significant subset, positional OSA (POSA), affecting up to 60% of patients. While continuous positive airway pressure (CPAP) is the gold standard treatment, poor compliance due to discomfort remains a major limitation. Existing positional therapies often act as aversive stimuli, leading to suboptimal long-term adherence. This pilot study evaluated a novel, comfort-focused approach using a commercially available G-shaped maternity pillow as a positional therapy device for POSA, hypothesizing that its supportive design would effectively maintain lateral sleep positioning and improve respiratory outcomes.
Materials and methods: In this prospective pilot study, 18 adult patients with confirmed POSA (per Cartwright's criteria) were enrolled. The study protocol involved: (1) a baseline inpatient polysomnography (PSG) without intervention; (2) a two-week actigraphy period to establish baseline sleep patterns; (3) a subsequent inpatient PSG with the G-shaped maternity pillow; (4) Psychomotor Vigilance Task (PVT) testing pre- and post-intervention; and (5) validated sleep questionnaires (Karolinska Sleepiness Scale, Samn-Perelli Fatigue Scale, PANAS) to assess subjective sleep quality, alertness, and mood. Respiratory indices, sleep architecture, and sleep position data from the two PSGs were compared using paired statistical tests.
Results: Use of the maternity pillow resulted in a significant improvement in respiratory parameters. The median apnea-hypopnea index (AHI) decreased from 17.5 to 8.92 events/hour ($p<0.01$) and the oxygen desaturation index (ODI) from 14.8 to 6.41 events/hour ($p<0.01$). The pillow was highly effective in enforcing lateral sleep, increasing the median lateral sleep time from 19.7% to 84.2% of total sleep time ($p<0.01$). Although total sleep time and sleep efficiency decreased during the single-night intervention, participants demonstrated improved morning alertness on PVT testing (faster response times, $p=0.03$) and reported less fatigue ($p=0.02$). Patient acceptance was notably high, with 83.3% preferring the pillow over CPAP and 61.1% continuing its use post-study.
Conclusions: These preliminary findings suggest that a G-shaped maternity pillow is an effective and well-tolerated positional therapy for POSA, significantly reducing AHI and ODI by successfully promoting lateral sleep. Its high acceptance rate highlights its potential as a comfortable and accessible alternative for CPAP-intolerant patients. This study introduces a promising new category of positional therapy based on positive support rather than aversion. Larger, long-term trials with an acclimatization period are warranted to confirm these efficacy and compliance findings in a real-world setting.

A Smartphone-based Intervention to Improve Light Exposure in Young Adults

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Introduction: Light exposure patterns play a critical role in regulating circadian rhythms and promoting optimal sleep quality. Modern lifestyles often involve insufficient daytime sunlight exposure and excessive artificial light at night, disrupting sleep-wake cycles and impairing alertness and cognitive performance. Smartphone-based behavioural interventions offer a promising scalable approach to optimize individual light exposure and health. In this study, we introduce a novel, digital, smartphone-based intervention that tunes behaviour to optimize light exposure—enhancing daytime light intake while reducing nighttime exposure—with the goal of improving sleep quality and daytime functioning in young adults.
Materials and methods: Seventeen healthy young male adults (average age ± SD = 28.1 ± 4.5 years) participated in this study comprising a baseline and an intervention phase (10–14 days each). Light exposure was measured using wearable sensors with a 1-min sampling rate, for the continuous quantification of illuminance, spectral composition of light, and melanopic Equivalent Daylight Illuminance (mEDI). Daytime outdoor time (7AM–7PM) was estimated using a machine learning model trained to classify light data as indoor or outdoor. Sleep quality and duration were monitored using the same devices and sleep diaries. Baseline sleep quality and daytime sleepiness were assessed using the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS), respectively. During the

intervention phase, participants received personalized WhatsApp nudges encouraging greater daytime exposure and reduced evening exposure to light. Evening nudges were sent three hours before baseline average bedtime. Outcome measures included time spent outdoors and above the recommended 250 mEDI (in minutes and as a percentage of wear time), average mEDI levels during daytime, as well as sleep metrics (e.g. Bed time, Get up time, Time in bed, Sleep efficiency, number of awakenings, etc.).
Results: At baseline, participants reported a mean PSQI score of 5.6 ± 3.3 and an ESS score of 7.2 ± 3.3. The digital intervention successfully enhanced outdoor time in 14 out of 18 participants (77.8%). That increment ranged between 4 to 78 minutes of outdoor time per day with improvements being more pronounced on weekdays compared to weekends. On average, on weekdays, daily outdoor time was increased from 84.6 ± 48.9 (at baseline) to 100.5 ± 51.7 minutes ($p = 0.03$). Accounting for the sensor's weartime, this translated to an increase from 12.6 ± 7.2% to 15.6 ± 7.1% ($p = 0.01$) of outdoor time during daytime. Time spent above 250 mEDI was also increased from 15.0 ± 8.9% to 18.7 ± 9.2% ($p = 0.008$). Additionally, mEDI levels increased marginally from 350.6 ± 280.2 lx to 470 ± 272.7 lx ($p=0.07$) during waketime. These outcome measures were not different between baseline and intervention on weekends. Nighttime mEDI levels and most sleep metrics were comparable between conditions, with fewer maximum awakenings during the intervention ($p=0.04$).
Conclusions: Our findings demonstrate the potential of a scalable smartphone-based intervention to enhance weekday light diets in young adults living busy, modern lifestyles. By significantly increasing daytime light exposure and mEDI, our approach holds promise for enhancing circadian alignment, reducing daytime sleepiness and performance, and improving nighttime sleep.
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Estimating Daytime Productivity from Sleep-Time Biosignals with a Reduced Feature Set

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Introduction: Inadequate or poor-quality sleep erodes next-day alertness, psychomotor speed, and working-memory accuracy, all of which translate directly into lost productivity and safety risks. Conventional metrics such as total sleep time or stage proportions capture only fragments of sleep physiology and require cumbersome polysomnography. We therefore investigated whether a compact overnight biosignal array could directly forecast three concrete daytime outcomes—subjective sleepiness, psychomotor vigilance, and working-memory performance—and, if so, how few sensors were sufficient.
Materials and methods: After two adaptation nights, twenty healthy men (28.4±4.9 y) spent four experimental nights in the laboratory (lights-off 22:00, lights-on 06:00); 59 recordings remained after artefact rejection and signal-quality screening. Signals were sampled at 1 kHz via a Biosignalsplux hub: 3-lead ECG, respiratory-inductance belt, palmar electrodermal activity (EDA) and bilateral external-oblique EMG. Twenty-five features—heart-rate-variability indices (pNN20, RMSSD, LF/HF, etc.), respiration rate/amplitude, EDA burst counts/amplitudes and EMG RMS—were z-scored participant-wise and fed to a three-layer Transformer encoder (d_model = 64, eight heads, cosine-decay Adam, early stopping at 100 epochs). At 06:00, 07:00 and 09:00 participants completed (i) the Stanford Sleepiness Scale (SSS) for self-rated alertness, (ii) a 5-min psychomotor vigilance task (PVT-B) for median reaction time, and (iii) a 3-back task for percent-correct working-memory accuracy. Four-fold cross-validation quantified performance. Shapley values ranked feature importance and guided two ablation routes: (i) dropping low-value sensors and (ii) dropping only low-value features.
Results: The full model explained $R^2 = 0.68–0.77$ of variance in median PVT reaction time and up to 0.76 in 3-back accuracy across the three test times; SSS sleepiness classification peaked at F1 = 0.81 at 07:00 (06:00 = 0.70, 09:00 = 0.71). Approximate 95 % confidence intervals confirmed robustness (reaction-time R^2 0.64–0.80). HRV indices reflecting parasympathetic tone (pNN20, RMSSD) and sympatho-vagal balance (LF/HF), together with EDA burst counts, dominated psychomotor-speed prediction, whereas respiratory-stability metrics (mean RR, RR SD) emerged alongside HRV for working-memory accuracy. Removing the respiration belt and EMG electrodes—retaining only ECG and EDA—

reduced reaction-time R^2 by < 0.20 while preserving ≥ 85 % of baseline performance, demonstrating a practical two-sensor solution.
Conclusions: An overnight recording of only heart-rate and skin-conductance signals can accurately forecast next-morning alertness (SSS score), psychomotor speed (median PVT reaction time), and working-memory accuracy (3-back percent correct) without explicit sleep-stage scoring. Transformer models capture long-range physiological patterns, and Shapley-guided pruning reveals that a two-channel wearable is enough for reliable early-shift screening of cognitive readiness. These findings support applications in shift-work fatigue management, driver vigilance checks, and remote-operator scheduling. Limitations include an all-male sample, controlled laboratory conditions, and a restricted cognitive battery. Future work will expand validation to larger, gender-balanced cohorts, real-world environments, and broader cognitive tasks, paving the way for longitudinal occupational deployment.

Neurological Disorders Affecting Sleep

Diagnostic Potential of Sleep Spindles in drug-naïve Schizophrenia Using Standard PSG Data: A Retrospective Pilot Study

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Introduction: In 2007, Ferrarelli et al. reported significant reductions in the number, amplitude, and duration of sleep spindles during non-REM stage 2 sleep in patients with schizophrenia. These abnormalities were not observed in non-schizophrenic populations. Further studies have found similar spindle abnormalities in early-onset, drug-naïve patients and even in first-degree relatives.
Based on these findings, abnormalities in sleep spindles among drug-naïve patients with schizophrenia have drawn attention as potential diagnostic markers.
In this study, we conducted a pilot analysis using polysomnography (PSG) data obtained with a standard clinical montage from previously recorded drug-naïve Japanese patients with schizophrenia at Kurume University Hospital, aiming to evaluate the diagnostic utility of sleep spindle activity in schizophrenia.
Materials and methods: We analyzed PSG data collected at Kurume University Hospital between January 2001 and December 2025 from seven drug-naïve schizophrenia patients (diagnosed according to DSM-IV and never previously treated with antipsychotic medication) and seven healthy controls. Various spindle parameters—frequency, detection time, duration, and amplitude—were analyzed using spindle detection software and compared across four electrode sites (C3, C4, O1, and O2). Additionally, the effects of an initial administration of 2 mg of risperidone were evaluated.
Results: As a result, the drug-naïve schizophrenia group exhibited significantly lower spindle frequency and detection time, particularly at the C3 electrode site, compared to healthy controls. In particular, the frequency and detection time of fast spindles (12–15 Hz) were markedly reduced in drug-naïve schizophrenia patients (Frequency: Sc = 35.69, HC = 98.25, p< 0.01; Detection time: Sc = 242.5, HC = 708.9, p < 0.01).
Only slight decreases in these values were observed after risperidone administration.
In drug-naïve patients, ROC curve analyses revealed high diagnostic accuracy, with an AUC of 0.94 for both frequency and detection time of fast spindles. Both specificity values were 1.000. Similarly, the AUC for detection time of total spindles (9–15 Hz) was also 0.94, with a sensitivity of 1.000.
In patients administered risperidone, the AUCs for detection time of total and fast spindles still exceeded 0.7.
Conclusions: This study demonstrated that drug-naïve Japanese patients with schizophrenia exhibit reduced sleep spindle activity, particularly at the C3 electrode site, based on standard PSG data. Fast spindle frequency and detection time demonstrated excellent diagnostic performance, while total spindle detection time contributed to disease exclusion, suggesting their complementary diagnostic utility. The minimal changes observed after risperidone administration support the potential role of sleep spindles as trait markers.
These findings highlight the feasibility of using standard PSG data as a non-invasive tool for the early

detection of schizophrenia. To further validate these results, prospective studies with larger sample sizes using PSG data obtained with standard electrode montages are warranted.

Clinical evidence of Traditional Chinese Medicine for post-stroke sleep disorders

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Introduction: Sleep disorders are prevalent complications among stroke survivors. Current clinical guidelines and expert consensus indicated a limited repertoire of effective interventions, underscoring the urgent need for further research to advance clinical practice. Previous studies have reviewed the literature on Traditional Chinese Medicine (TCM) interventions, specifically Chinese herbal medicine (CHM) and acupuncture, for post-stroke sleep disorders, demonstrating a substantial volume of research and suggesting several potentially beneficial therapeutic approaches. However, a comprehensive review of the overall clinical evidence remains lacking. This study employs an evidence-based approach to systematically collate and appraise modern clinical research on TCM interventions for post-stroke sleep disorders, aiming to establish a robust clinical evidence framework. The findings are intended to inform clinical decision-making and guide future research priorities.
Materials and methods: A comprehensive computerized search was conducted across multiple databases including PubMed, Embase, the Cochrane Library, and Chinese databases (CNKI, Wanfang, VIP, and CBM) , to identify clinical studies investigating TCM for post-stroke sleep disorders. Two independent researchers performed literature screening and data extraction. Quantitative analysis (meta-analysis) was applied to randomized controlled trials (RCTs), while qualitative analysis was used for non-randomized studies. The methodological quality of included systematic reviews was assessed using A Measurement Tool to Assess Systematic Reviews 2 (AMSTAR 2), reporting quality was evaluated using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020, and the risk of bias for RCTs was analyzed using the Cochrane Risk of Bias tool (RoB 1.0).
Results: The final analysis included 13 systematic reviews, 137 RCTs, 13 non-randomized controlled trials, 9 case series, 1 case-control study, and 1 case report. For systematic reviews, AMSTAR 2.0 and PRISMA assessments revealed low overall methodological and reporting quality. The results suggested that TCM showed efficacy in improving subjective sleep quality. Among the RCTs, for post-stroke insomnia, high-quality evidence suggested that acupuncture was superior to sham acupuncture in improving subjective sleep quality. Moderate-to-low quality evidence supported the advantages of CHM and acupuncture, either used alone or in combination with hypnotic, in improving subjective sleep outcomes. Additionally, low-quality evidence suggested that combining CHM with cognitive behavioral therapy for insomnia (CBT-i) yielded better subjective sleep improvements compared to CBT-i alone. For post-stroke sleep apnea, moderate-to-low quality evidence demonstrated that combining CHM or acupuncture with continuous positive airway pressure (CPAP) therapy was more effective than CPAP alone in improving the AHI and blood oxygen saturation. Regarding other post-stroke sleep disorders, low-quality evidence highlighted the potential benefits of acupuncture in improvement of subjective sleep quality and daytime sleepiness.
Conclusions: The review of clinical evidence suggested that TCM interventions (CHM and acupuncture) may improve subjective sleep quality, objective sleep parameters, and reduce daytime sleepiness in patients with post-stroke sleep disorders. However, the overall quality of the available evidence was limited. Future research should prioritize large-scale, high-quality RCTs to strengthen the clinical recommendations of TCM for post-stroke sleep disorders.

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