biomechanical role as an adjunct to treatment of airway collapse through nerve stimulation.

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**269 SLEEP ENHANCEMENT TECHNOLOGY: A SURVEY OF APPS**

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**Introduction:** The ever-evolving market for sleep technologies far outpaces the ability of providers to understand and counsel patients about developments in this area. Although significant literature has validated the performance of sleep tracking technologies, there is limited evidence regarding sleep enhancement technologies. Our study systematically surveys currently available commercial sleep enhancement smartphone applications to empower both providers and patients alike.

**Methods:** We systematically searched the App Store (Apple) and Google Play Store (Android) in the US on 26 May 2020 using the keyword “sleep.” This survey is inclusive of all smartphone applications found.

**Results:** We identified 342 apps: 70.2% were found on Android (N=240) and 29.8% on Apple (N=102). Ninety-five percent of apps offer a free version. The majority of sleep apps are intended for use during wake (65.8% exclusively during wake; 28.7% during both wake and sleep), with only 5.6% intended to be used during sleep alone. Most apps purport to enhance rather than measure sleep (78.7% versus 1.8%). The vast majority of apps claim to enhance sleep via reductions in sleep latency (65.8%). Reduced sleep latency is primarily achieved using a combination of non-verbal auditory stimuli such as nature sounds (84.4%), artificial stimuli (64.5%), and instrumental music (77.1%).

**Conclusion:** Interestingly, most sleep apps are designed to be used while awake, prior to sleep, and on focus of the enhancement of sleep, rather than measurement, by targeting sleep latency. Given the multitude of available sleep enhancement apps, many of which are free to try, these should be considered a reasonable strategy for providers and consumers to consider for empowering patients to improve sleep!

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**270 SLEEP ENHANCEMENT TECHNOLOGY: A SURVEY OF DEVICES**

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**Introduction:** Innovations in consumer sleep technologies have risen exponentially and providers struggle to keep up with patient expectations in this area. Although there is high quality data on the validity on commercial sleep monitoring devices, there has been a rise in devices for the explicit purpose of sleep enhancement. We sought to identify existing consumer sleep devices that claim to enhance sleep, provide a comprehensive review of the main characteristics of these devices, and look into the types of evidence the developers offered to support their claims.

**Methods:** Using a scoping review framework we identified and mapped out the main characteristics of sleep enhancement devices in the consumer market. We systematically used a common search engine and the FDA database using various combinations of sleep-related search terms, such as “sleep enhancement device”. Through an iterative process, we identified and categorized devices based on the intervention target. Devices that were exclusively for clinical use and required a prescription, such as for the treatment of obstructive sleep apnea or diagnosed insomnia, were excluded.

**Results:** We identified 34 sleep enhancement devices, all 34 were found via web search and one was also found in the FDA Database. We defined the following overlapping categories: reduce sleep latency (94.1%), increase restorative sleep (17.6%), and/or “other” (32.4%). About half of the devices use sound (44.1%), 26.5% use visual stimuli, and 11.8% use vibration. Additionally, roughly a third of all devices claim to entrain brain signals associated with sleep. Half of devices found operate near the bed without being in contact with the consumer, 44.1% are worn on the body, and the remaining 5.9% operate in bed, near the consumer.

**Conclusion:** For the most part, commercial sleep enhancement devices target sleep latency or claim to increase the restorative power of sleep. These devices generally use auditory, visual, and vibratory stimuli, and half are worn on the body. Lack of evidence supporting whether these devices actually improve sleep questions the utility of such devices and demonstrates the need for validation standards for consumer sleep enhancement devices.

**Support (if any):** Department of Defense Military Operational Medicine Research Program (MOMRP)
Conclusion: Our results demonstrated the accuracy of a cloud-based sleep analytics platform on an open dataset, using various combinations of ecologically valid physiological signals. EOG and EMG channels can be easily self-administered using sticker-based electrodes and can be added to existing home sleep apnea test (HSAT) kits significantly improving their utility. ICWs are already capable of accurately measuring EEG/EOG (Muse, InteraXon Inc., Toronto, Canada; Dreem band, Dreem, USA) and IHR derived from ECG (Movesense, Suunto, Finland) or photoplethysmogram (Oura Ring, Oura Health Oy, Finland) or through non-contact ballistocardiogram/radio-based measurements (Dozee, Turtle Shell Technologies, India; Sleepiz, Sleepiz AG, Switzerland). Therefore, a well-validated cloud-based staging platform solves a major technological hurdle towards the proliferation of remote monitoring and telehealth in sleep medicine.

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LONG-TERM MONITORING OF TRAIT-LIKE CHARACTERISTICS OF THE SLEEP ELECTROENCEPHALOGRAM USING EAR-EEG

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Introduction: Wearable electroencephalogram (EEG) monitoring has a remarkable potential, it is safe, scalable and can track neural signatures for long periods. One such signature is the power spectra of non-rapid-eye-movement (NREM) sleep which has been shown to demonstrate a trait-like characteristic. Changes in personalized signatures has been associated with biomarkers of Alzheimer’s disease and is of great interest for early detection and clinical management. This work investigates monitoring of signatures using a wearable device that records EEG from the ear (ear-EEG) and compares the intra- and inter-individual similarity of the neural signatures with that from central scalp-EEG.

Methods: We initiated a two phased in-home study, monitoring 20 subjects for 4 nights (A), followed by a delayed but continued monitoring of 10 subjects for 12 nights (B). In A, subjects wore a dry-electrode ear-EEG system and a partial PSG, in B the subjects wore only the ear-EEG system. Subjects were instructed to follow their usual time schedule and lifestyle. Sleep stages were scored manually according to AASM in A and automatically in B. The grand average power spectra of NREM2 sleep were computed and log-transformed prior to calculating the cosine similarity for determination of the intra- and inter-individual similarity.

Results: The ear-EEG and scalp-EEG analysis showed that mean intra-individual similarity was higher than mean inter-individual similarity. Permutation tests indicate that the observed mean difference is statistically significant p<0.01 for both montages. Comparing the distributions of intra-individual similarities for ear-EEG and scalp-EEG, the observed mean difference is statistically significant p<0.05, in favor of a more stable ear-EEG signature. Comparing ear-EEG signatures between A and B, considering nights from A as reference, all subjects from B were most similar with its own reference signature. Considering signatures from individual nights the accuracy paring subjects from A and B were 88% correct.

Conclusion: Nocturnal ear-EEG measures trait-like characteristics as reliable as scalp-EEG. The neural signature is stable over time within healthy subjects and demonstrated its ability as a personalized signature.

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AUTOMATIC SLEEP STAGING WITH PHOTOPLETHYSMOGRAPHY AND ACCELEROMETER IN A COMMUNITY-BASED POPULATION

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Introduction: The study aims to validate the automatic sleep staging system (ASSS) with photoplethysmography (PPG) and accelerometers embedded in smart watches in community-based population

Methods: 75 healthy subjects were randomly recruited form 304 staffs in an industrial firm who volunteered for this study. A four-stage classifier was designed based on Linear Discriminant Analysis using PPG and accelerometers. To better validate the system performance, the leave-one-out approach was applied in this study. The performance of ASSS was assessed with the epoch-by-epoch and whole-night agreement for sleep staging against manual scoring of overnight polysomnography.

Results: The mean agreement of four stages across all subjects was 61.1% (95% CI, 58.9-63.2) with kappa 0.55 (0.52-0.58). The mean agreement for wake, light sleep (LS), deep sleep (DS), and REM was 53.4%, 84.1%, 40.3%, 75.6%, respectively. The whole-night agreement was good-excellent (Intra-class correlation coefficient, 0.74 to 0.84) for total sleep time, sleep efficiency, wake after sleep onset, and duration of wake and REM. The agreement was fair for sleep onset and LS duration, but poor for DS duration.

Conclusion: Our result showed that PPG and accelerometers based smart watches have proper validity for automatic sleep staging in the community-based population.

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MULTIMODAL LONGITUDINAL SLEEP TRACKING COMBINING WEARABLE, SMARTPHONE TAP ANALYSIS AND ELECTRONIC QUESTIONNAIRES

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Introduction: The proliferation of wearable and smartphone technologies has enabled continuous monitoring of sleep using data from different channels (physiological [wearables], behavioural [phone usage] and ecological momentary assessment [EMA self-report]). As these modalities use different methods to assess sleep, information gaps suggested by discrepancies between estimates may be filled in through cross-referencing among the modalities to produce a more accurate sleep measurement. Moreover, the pattern of discrepancies could inform about specific sleep and peri-sleep behaviors (e.g. phone use before bedtime).

Methods: 198 staff and students from the National University of Singapore (61 male, mean age 26.15±5.83 years) were recruited for an 8-week study. Sleep timings were assessed daily from three modalities: a wearable sleep and activity tracker (Oura ring), estimations from smartphone touchscreen interactions (tappigraphy) and smartphone

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