

## Comparison of Two Home Sleep Monitors Designed for Self-Use

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**Abstract :** Background: Polysomnography (PSG) recordings are regularly used in research and clinical settings to study sleep and sleep-related disorders. Typical PSG studies are conducted in professional laboratories and performed by qualified researchers. However, the number of sleep labs worldwide is disproportionate to the increasing number of individuals with sleep disorders like sleep apnea and insomnia. Consequently, there is a growing need to supply cheaper yet reliable means to measure sleep, preferably autonomously by subjects in their own home. Over the last decade, a variety of devices for self-monitoring of sleep became available in the market; however, very few have been directly validated against PSG to demonstrate their ability to perform reliable automatic sleep scoring. Two popular mobile EEG-based systems that have published validation results, the DREEM 3 headband and the Z-Machine, have never been directly compared one to the other by independent researchers. The current study aimed to compare the performance of DREEM 3 and the Z-Machine to help investigators and clinicians decide which of these devices may be more suitable for their studies. Methods: 26 participants have completed the study for credit or monetary compensation. Exclusion criteria included any history of sleep, neurological or psychiatric disorders. Eligible participants arrived at the lab in the afternoon and received the two devices. They then spent two consecutive nights monitoring their sleep at home. Participants were also asked to keep a sleep log, indicating the time they fell asleep, woke up, and the number of awakenings occurring during the night. Data from both devices, including detailed sleep hypnograms in 30-second epochs (differentiating Wake, combined N1/N2, N3; and Rapid Eye Movement sleep), were extracted and aligned upon retrieval. For analysis, the number of awakenings each night was defined as four or more consecutive wake epochs between sleep onset and termination. Total sleep time (TST) and the number of awakenings were compared to subjects' sleep logs to measure consistency with the subjective reports. In addition, the sleep scores from each device were compared epoch-by-epoch to calculate the agreement between the two devices using Cohen's Kappa. All analysis was performed using Matlab 2021b and SPSS 27. Results/Conclusion: Subjects consistently reported longer times spent asleep than the time reported by each device (M= 448 minutes for sleep logs compared to M= 406 and M= 345 minutes for the DREEM and Z-Machine, respectively; both  $p < 0.05$ ). Linear correlations between the sleep log and each device were higher for the DREEM than the Z-Machine for both TST and the number of awakenings, and, likewise, the mean absolute bias between the sleep logs and each device was higher for the Z-Machine for both TST ( $p < 0.001$ ) and awakenings ( $p < 0.04$ ). There was some indication that these effects were stronger for the second night compared to the first night. Epoch-by-epoch comparisons showed that the main discrepancies between the devices were for detecting N2 and REM sleep, while N3 had a high agreement. Overall, the DREEM headband seems superior for reliably scoring sleep at home.

**Keywords :** DREEM, EEG, sleep monitoring, Z-machine

**Conference Title :** ICSDM 2022 : International Conference on Sleep Disorders and Medicine

**Conference Location :** San Francisco, United States

**Conference Dates :** September 27-28, 2022