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SLEEP TRACKER: HOW ACCURATE DOES IT NEED TO BE?

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Introduction: Commercial sleep tracker devices offer the ability to measure an individual's sleep patterns, providing a portable and low-cost option to collect sleep-wake data to enhance fatigue management and minimize alertness impairment. While multiple studies have reported that sleep parameters estimated with these devices differ from gold-standard polysomnography (PSG), the extent to which these differences are acceptable is not known. Here, we provide a method to quantitatively assess whether sleep-duration errors generated by sleep trackers hinder our ability to assess alertness impairment.

Methods: To obtain representative statistics of sleep-duration errors, we performed a literature review and identified 14 studies that compared estimations of sleep parameters between 18 unique commercial sleep trackers and PSG. Then, we used the well-validated Unified Model of Performance (UMP), a mathematical model that predicts alertness impairment as a

function of sleep history, to quantitatively assess the effect of sleep-duration errors on alertness predictions. For this purpose, we performed 20,000 simulations in which an individual slept 8 hour per night for 30 consecutive days. Each day, we randomly sampled sleep-duration errors using the obtained representative statistics and computed daily alertness-prediction errors. We repeated these simulations for 5 and 9 hours of sleep per night. We assumed that sleep-duration errors that lead to alertness-prediction errors of ≤30 ms (i.e., the within-subject variability under well-rested conditions) are not a concern.

Results: Based on the 14 studies, sleep trackers yielded sleep-duration errors with a mean of 22 minutes and a standard deviation of 44 minutes. Using these statistics to sample daily errors, we found that, at the end of the 30 days of UMP simulations, these sleep-duration errors led to a mean alertness-prediction error of ~20 ms, with ~75% of the errors ≤30 ms. We also found that, for each additional minute of sleep-duration error, the prediction error increased by ~1 ms. These results were consistent when the hours of sleep per night varied from 5 to 9 hours.

Conclusion: On average, sleep trackers lead to alertness-prediction errors that are consistently smaller than the within-subject variability of alertness impairment, suggesting that they are an alternative approach for measuring sleep duration.

Support (if any):