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Validity of a non-contact sleep monitor

How accurate can it measure sleep?

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A sleep monitor employing non-intrusive radar technology and machine learning can provide automatic sleep stage classification in healthy subjects. Polysomnography (PSG) is the medical gold standard for objective sleep measurements. The present study validates a non-contact sleep sensor using radar technology and machine learning against PSG. The results show that the monitor can provide automatic sleep stage classification with a precision close to PSG in a sample of healthy, mostly young subjects.

The sleep monitor (Somnofy®) uses respiration and movement data derived from radar technology to classify sleep stages using machine learning. In addition to sleep staging, multiple sensors collect data from the sleeping environment (i.e., light intensity and colour composition, audible noise level and atmospheric variables).

71 healthy, mostly young individuals spent a night at a sleep laboratory and their sleep was measured by both PSG and the novel monitor. A total of five sleep specialists took part in manual scoring of PSG and each recording was scored separately by two sleep specialists. The study aimed to investigate the validity of both quantitative sleep parameters as well as qualitative sleep staging of wakefulness, light and deep sleep and REM sleep.

Agreement on quantitative sleep parameters between the sleep monitor and PSG ranged from excellent to poor. For all presented parameters, the PSG scorers agreed more with each other than with the monitor measurements. The difference was smallest for light sleep stage and total sleep time, for which Somnofy was about as reliable as PSG.

The detailed analysis of the sleep staging abilities of the new monitor reveal a substantial agreement with PSG across all four sleep stages. The PSG scorers reached excellent agreement with each other. Comparing overall accuracy on sleep stages was very good. Somnofy furthermore correctly identified if a person was sleeping or awake 97 percent of the time, and correctly identified if a person was awake or asleep 72 percent of the time. The latter is especially worth noting, as correctly classifying people being awake when they lie completely still is very challenging for accelerometer-based wearables — these typically correctly classify 34-65 percent of the time.

The present study demonstrates the ability of the novel sleep monitor to estimate sleep and wake periods in a healthy population. Compared to the manually scored PSG, it scored sleep/wake highly accurate, with 97 percent of sleep periods and 72 percent of wake periods scored correctly.

Looking at the sleep phases specifically, Somnofy accurately detected light sleep in 75 percent of time periods, deep sleep in 74 percent and REM in 78 percent of time periods compared to PSG. The overall average disagreement was 1 minute for light sleep, 12 minutes for deep sleep and 11 minutes for REM sleep compared to how much the manual PSG scores agreed.

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