Wearable tech revolutionising sleep monitoring: a new era in sleep health

BY OMURSEN YILDIRIM AND RYAN CHEONG

Restful sleep is crucial for health but conditions like obstructive sleep apnoea (OSA) can significantly disrupt it, leading to fatigue, cardiovascular issues, and other serious health problems. Polysomnography (PSG) remains the gold standard for OSA diagnosis [1], however it is expensive and requires an overnight stay in a sleep lab. Home sleep studies offer a simpler alternative but often involve long referral waiting times due to specialist referrals.

Wearable sleep trackers, including rings, watches and bands, provide an accessible way to monitor sleep patterns and identify potential sleep issues right from the comfort of the patient's home. They have started to transform our health behaviours and habits. Sleep clinics now often see patients equipped with their own sleep data, tracked through smart wearables and displayed on their smartphones. This trend highlights the rapid advancements in consumer technology and its increasing precision, approaching the accuracy of medical-grade diagnostic tools.

Many of these devices rely on accelerometers, tiny sensors that track movement to estimate sleep duration and quality. Some trackers also measure heart rate variability (HRV), provide insights into autonomic nervous system activity, and monitor respiration to detect irregularities alongside blood oxygen saturation levels. Some also record environmental factors such as room temperature and noise levels. Built-in microphones can record sounds like snoring and coughing during sleep. Sophisticated algorithms analyse this data, send the results to an app and offer users insights into their sleep health.

However, there are challenges with using consumer-grade wearables for sleep tracking. These devices sometimes misinterpret wakeful periods as sleep, particularly in patients with insomnia who may lie still for extended periods. This can lead to inaccurate reporting of sleep stages [2]. It's important to remember that no wearable can match the 100% accuracy of a polysomnography test, which uses electrodes to monitor brain waves, muscle activity, and eye movements. Additionally, continuous sleep monitoring can contribute to health anxiety for some individuals. The term 'orthosomnia' was coined by Baron KG et al to describe the anxiety patients experience from their preoccupation with perfecting their wearable sleep data, where 'ortho' means correct and 'somnia' refers to sleep [3]. Imagine waking up feeling refreshed after a good night's sleep, only to have your tracker indicate poor sleep quality. How might this influence your perception of rest despite your subjective experience?

Below, we will compare some of the most popular wearables today, highlighting their features and capabilities in sleep health monitoring.

Samsung Galaxy Watch

Samsung Galaxy watch's BioActive Sensor monitors blood oxygen levels during sleep. Its software then calculates the apnoea-hypopnea index (AHI) by tracking drops in blood oxygen, indicating episodes of partially or fully blocked breathing – a critical marker of sleep apnoea. The Samsung Health Monitor app is the first wearable sleep tracker software with FDA authorisation to detect signs of moderate-to-severe obstructive sleep apnoea in adults aged 22 and older who have not been diagnosed with sleep apnoea [4].

Apple Watch Series

Equipped with a built-in blood oxygen sensor, the Apple Watch can continuously monitor SpO2 levels throughout the night. The watch also tracks HRV and movement. Series 3 and newer watches can track sleep stages. For the watch to detect and track sleeping hours, the user needs to go to the Health app on their phone and set sleep goals, bedtime, and wake-up time because it does not automatically detect sleep. Users often use third-party sleep-tracking apps for more detailed data tracking. The most recent sleep feature, which works with Apple Watch Series 9, 10 and Ultra 2, is now FDA approved for sleep apnoea detection.
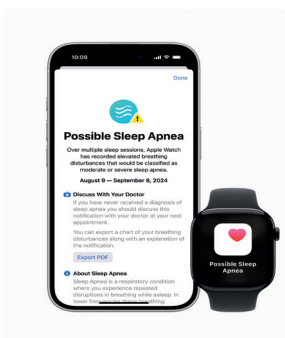
Fitbit Versa 4 and Sense 2

The Fitbit Versa 4 and Sense 2 is equipped with a heart rate and breathing monitor, along with temperature, SpO2, and ECG sensors that work throughout the night. However, accessing advanced features like detailed sleep restlessness and long-term SpO2 trends requires a subscription.

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Garmin Venu 2 Plus

This smartwatch features a pulse ox sensor for continuous blood oxygen monitoring and advanced heart rate tracking at night. Its Body Battery function assesses daily energy levels by analysing sleep quality and activity. The Garmin Connect app provides comprehensive sleep analysis, including detailed breakdowns of sleep stages and oxygen saturation. However, some users report errors in sleep-wakefulness detection.

Withings ScanWatch Nova

The Withings ScanWatch stands out as a health-focused smartwatch featuring a medical-grade SpO2 sensor and an ECG monitor to detect irregular heartbeats. Its battery life is claimed to be a month long. The accompanying Health Mate app offers a sleep score and detailed sleep insights, easily shareable with healthcare professionals. It has the classic look of an analogue watch with a small digital display embedded.

WHOOP Strap 4.0

The WHOOP Strap 4.0, with its screenless design, was initially tailored for elite athletes to optimise their performance. This wearable focuses on health and fitness data, delivering in-depth sleep analysis. It continuously monitors heart rate, respiratory rate, and SpO2 levels alongside HRV, and uses an accelerometer for motion tracking. However, accessing the full range of WHOOP's advanced analytics and personalised insights requires an annual membership.

Oura Ring

The Oura Ring offers comprehensive health insights by monitoring heart rate, blood oxygen levels, sleep stages and overall sleep quality. Its high accuracy in detecting wake-sleep cycles and sleep stages is attributed to combining additional parameters, such as temperature, HRV, and circadian features, with machine learning techniques. This lightweight device, worn on the finger, integrates with third-party apps like Apple Health, Strava, and Google Fit. Users must subscribe to the Oura app to access their data.
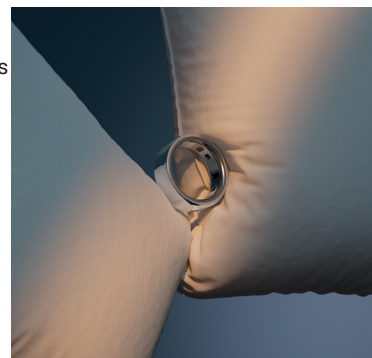
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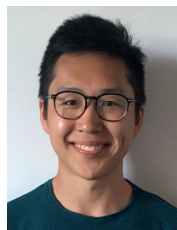
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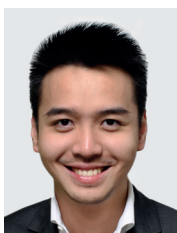
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