

# Sleeping smart: Can smart watches and devices really measure your sleep?

by Sleep Technician Melissa Cava

*Fitness trackers have become a popular accessory and as the market for these devices has grown, the design and additional features have become more elaborate. One such example is 'sleep tracking' where a device or associated app suggests it can monitor the quality and quantity of the wearers' sleep. But how capable are these devices at actually measuring sleep quality?*

To answer this question, first we need to address some fundamental questions:

## What is sleep and how do we measure it?

Sleep is a physiological state. In simple terms this means the body functions differently when you are asleep compared to when you are awake: e.g. your muscles have altered activity; metabolism and hormone production changes; and respiration (or breathing) becomes slower and more rhythmic. All these changes are controlled by your brain and we use your brain to measure your sleep.

We do this through the use of electroencephalography (EEG): tiny placed electrodes stuck to your scalp, measuring tiny changes in brain wave activity. It is non-invasive, we don't need to shave your hair, we just stick sensors on your head and measure tiny electrical fluctuations naturally being produced by your brain cells (neurons). To step back and address the question what is sleep, it is defined by the specific brain wave activity we see on an EEG.

## What do we see on an EEG during sleep?

Contrary to popular belief, the brain is quite active during sleep: your brain activity is constantly changing and continuously does so in a cyclic manner through 5 different sleep stages. During a sleep study we measure chin (muscle) activity and eye movements in addition to EEG. Together these signals allow us to distinguish between the different sleep stages, as well as pick up any disruptions to your sleep (known as arousals). A sleep study also records other signals such as body movements, sound, respiration and cardiac measures. These help further pinpoint what could be causing any disruptions to your sleep. From your sleep study, an average of 1,000 pages of data (epochs) are collected, analysed, and reported. And with this study, in conjunction with a history and examination, comes a diagnosis – of which there are 65 current well-defined Sleep Disorders (ICSD-3).

## How does a fitness tracking device measure sleep?

This is a good question and one that has been difficult to answer. Even researchers who have tried to review the evidence found a '*critical lack of basic information about the devices*' (1). In other words, to date, none of the devices have been successfully validated in comparison to laboratory based sleep studies (2). Generally they claim their sleep statistics are based on position, movement and cardiac sensors; their basic rationale being that you lie down and move less when asleep and your heart rate varies between sleep stages. These characteristics are to some extent true but the evidence would suggest insufficient at determining sleep quality and quantity alone for a number of reasons:

- Heart rate variability occurs during wake and sleep and, although is associated with certain sleep stages, has never been shown to be a substitute measure of sleep.
- Heart rate sensors in these wrist-worn devices have poor sensitivity (3)
- Heart rate variability also occurs in response to abnormal sleep behaviour that the device is not equipped to measure (such as sleep apnoea and parasomnias\*).



**BURNSIDE  
HOSPITAL**

**Burnside War Memorial Hospital**  
120 Kensington Road  
Toorak Gardens SA 5065

Reception (08) 8202 7222  
Facsimile (08) 8364 0038

mail@burnsidehospital.asn.au  
burnsidehospital.asn.au

- Subtle movements (e.g. leg twitches) can still be quite detrimental to your sleep quality but may be missed by a wrist-worn device.
- Movements may be non-specific to the wearer (i.e. may be your partner's, pet or child's movements) thus giving a wearer a false movement measure.

Even with such recordings by consumer sleep-tracking devices, the ultimate goal of diagnosing and treating any sleep disturbance needs to be addressed. Sleep trackers currently aren't able to diagnose, explain the implications, offer treatment, or allow follow up.

### Are these devices or apps useful for sleep tracking?

The strongest argument for consumer sleep tracking devices is they should only be used as a guide. The user instructions never claim they are a substitute for medical advice or a replacement for diagnostic sleep studies. The issue is some consumers may misunderstand this and believe they do provide valid data regarding their sleep. As a guide, I think sleep tracking is a positive thing: it increases public awareness and encourages people to become more proactive in improving their sleep and overall health.

### So, is there really any harm to using this function?

If consumers accept these devices cannot measure sleep as accurately or successfully as a proper sleep study, then the harm is likely to be minimal. However, perception of sleep can have a profound impact on daytime functioning. In other words if you are led to believe you slept badly (even if this is not the case) you will potentially still suffer symptoms of sleep deprivation (4) e.g.: deterioration in thought processes, slower reaction times and impaired mood during the day. This could have direct implications for workplace safety and driving. On the other hand, sleep tracking devices may also underestimate how fragmented or abnormal your sleep is. This could give a person false reassurance that there is no problem and prevent them from seeking medical advice. I have interacted with a number of people who felt their GP or specialist's referral was unwarranted because the sleep tracker said their sleep was fine, only to find out they had a severe sleep disorder.

### Take home message

Sleep trackers are not a replacement for sleep studies or expert medical advice and mostly they don't claim to be so. Sleep is defined by brain wave activity and fitness trackers do not measure brain activity. The measures they do use are limited and potentially misleading on their own (without EEG).

If you are worried about your quality of sleep, or have unexplained sleepiness or fatigue, visit your GP and request a referral for a sleep study\*\*. Properly diagnosing the problem behind poor sleep is the first step in determining how to improve your sleep and consequently your quality and quantity of life.

*By Melissa Cava*

\* For more information regarding these, and other sleep disorders, fact sheets can be found on the [Sleep Health Foundation's](#) website.

\*\* [Click here for the Burnside Sleep Centre](#) website

#### References:

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