

SLEEP TRACKERS: FROM SIMPLE ACTIGRAPHY TO SMART WATCHES, WHAT ADVICE CAN WE GIVE?

By Rui de Sousa, RPSGT

In today's self-help, consumer centric, health conscious, latest-and-greatest marketplace, we are inundated with various gadgets, apps, advice from gurus and doodads that claim to make our aches go away, to help us sleep better, to help us lose weight, to make us happier, thinner, richer or live the rest of our lives with wrinkle-free skin. It is the equivalent of the wild, wild west and the snake oil salesmen rule the roost. And yet, is there any validity to some of these claims? Can the myriad of "sleep trackers," actually deliver on their promises? Are they worth the cost of the plastic that they are built around?

Does this sound familiar? You are setting up your patient. They are on the chair in front of you. You start measuring their head and you casually ask, "So, why are you here? What brings you to the sleep lab tonight?" Usually, they answer with "Well, my wife made me come here... because I snore." What follows is a long list of all their sleep (and inevitably non-sleep) related complaints. And once in a while, we get "but the app that I downloaded (or the gadget I just bought) tells me that I sleep just fine."

Ahhhhh... that latest piece of software or technology that promises to make our jobs obsolete. The "sleep tracker" or "activity monitors." We are seeing more and more people wearing them. Curiosity about our personal sleep has always been high. After all, by definition, our own sleep is something we cannot directly observe. And inevitably, the question is asked... "So, just how good are these gadgets? Did I just waste my money?" What do you say? Is there any advice or talking points we can cover with our patients?

Before tackling those questions, what exactly are we talking about? Are these sleep trackers all the same, or are there tangible differences between different ones? To start, we can divide Sleep Trackers into two parts, 1. Physical Gadgets and 2. Software Apps.

THE GADGETS

The gadgets can be further divided according to the technology they use. Most make the use of a built-in accelerometer to record or plot movement. Known as actigraphy, this is a long-established way of estimating sleep-wake activity. Although professional or research grade actigraphy costs thousands of dollars, these consumer

grade units that can cost under \$200 are typically nearly as accurate. Validity studies comparing consumer grade actigraphy with research quality units show typically quite high concordance. So, the question isn't whether these consumer products are effectively measuring activity, but whether actigraphy itself is a valid way to measure, estimate or infer sleep stages and other sleep metrics claimed by their manufacturers or assumed by our patients.

These consumer products also employ other technology. Position sensors are incorporated in some units to give data on sleep position. Pulse sensors can sense the heart beating. Some even have a built-in SpO2 monitor. Others claim they can even measure blood pressure. Still others use microphone technology to listen to, and analyze (or just record) breathing sounds. These gadgets are dedicated and purposely built (for example, the FitBit, Jawbone, OuraRing, etc.).

THE SOFTWARE APPS:

These apps integrate the robust technology incorporated in higher end smart phones and smart watches. After the data is collected, the software interprets that data to tell you how well you have slept. There is incredible variability in these apps, not just on how well the algorithms are written, but which technology is used. Some bare-bone apps will just use the microphone to record snoring sounds. While some fully featured apps might recruit the accelerometer on a smart phone or a linked smart watch, pair it with the microphone on the smart phone, and incorporate client-entered data on daily behaviors (à la sleep diaries) and then process all that data to infer sleep metrics. Many apps will also give advice on how to improve your sleep or to better stay awake.

Without a doubt, these are very technologically advanced apps and software, and when used in the right context, are a great source of information about our sleep-wake cycles. The problem arises when the claims from some manufactures, or the assumptions from some patients, infer much more than the data shows. For example, some sleep trackers claim to stage your sleep, from a simple sleep vs wake, to a detailed histogram showing Awake, Light Sleep, Deep Sleep and REM stages. Some claim to be able to "sense" or diagnose sleep disorders, or even treat them. Using a combination of sensors, accelerometer, pulse, position, SpO2 and snore recording, some companies will promise you the moon – a sleep lab quality analysis of your sleep.

So now that we are all on the same page as to what these gadgets are, and what they can do, how shall we answer the patient's original question? Are these gadgets worth the time and money? Do they really "work"? Are they accurate? The answer all depends on what the patient wants to learn from the information.



RUI DE SOUSA, RPSGT

Rui de Sousa is a sleep technologist with over 20 years of experience helping patients in the greater Toronto area. Rui is heavily involved in educating both new and practicing sleep technologists. He has contributed to a medical textbook, articles in local newspapers, on sleep related blogs, and a sleep related magazine.

A QUESTION OF VALIDITY

Patients have to understand that these consumer gadgets cannot tell you what stage of sleep you are in. They can estimate, they can infer, but they cannot claim to know what stage of sleep you were in. Sleep stages are defined by changes in the EEG record, in frequency, amplitude and morphology, in combination with eye movement and chin EMG. So, by definition, without these recordings, one cannot reliably interpret sleep stages from the dataset. My first piece of advice is to be highly wary of any gadget company or app that tells you otherwise. Even in research, actigraphy itself infers only sleep vs wake. It will not attempt to determine stages of sleep. In fact, whereas actigraphy has been shown to be reliable in differentiating between sleep and wake periods for normal healthy adults, as soon as a sleep disorder is introduced, the identification of sleep periods becomes less reliable. Actigraphy is great when estimating the total sleep time but loses accuracy when there is fragmented sleep.

Some sleep trackers tackle only a single variable, or a few narrow and well defined parameters. These simpler sleep trackers are likely more accurate, but the information they provide is also limited in scope and usefulness. For example, there is an app that just records snoring and body movement. It makes no assumptions other than general sleep vs wake. There is another app that focuses on napping only. Using motion sensing and an alarm timer (which you set), it targets naps of appropriate duration (20-30 minutes), starting when you fall asleep, as defined by a reduction in movement. How many times have we set the timer to ring within 30 minutes, only to take 25 minutes to fall asleep, resulting in a 5-minute nap. This app attempts to address this problem, and this problem only. When we stop moving around, the count-down starts.

I would be wary of any over-reach type claims by gadget makers, assigning too much weight or validity to the data collected that cannot be fully backed up scientifically. For example, there is an app that records only sound but can somehow differentiate between light sleep, deep sleep, and awake. It will even know if there are two people in the same room. Some apps also claim to sense obstructive apnea and will vibrate to wake up the sleeper so as to induce them to turn on their side. As a rule, I would be very wary of any gadget or app that claims to diagnose or correct ANY sleep disorder. I would make it very clear to my patient that only the polysomnogram can truly diagnose sleep apnea or determine stages of sleep.

PROPER CONTEXT

However, if patients understand the inherent limits associated with this technology, then the information they get can be helpful if used in the correct context. Although sleep-stage information is probably more often wrong than right, uncomplicated sleep-wake information

would likely have a higher degree of accuracy. Keeping in mind that valid and reliable data cannot be assured by the use of these gadgets, or apps, one can still use their information to delineate trends on how their diurnal activities impact their nocturnal period. This is especially helpful when used in conjunction with a sleep-diary type app. For example, one can see how five cups of coffee, or a two-hour nap, in the middle of the day might impact their sleep at night. They can track the effects of their lifestyle choices on their nocturnal sleep. What effect does staying up late, drinking that third glass of wine, or exercising have on their sleep?

Some apps also assess sleep behavior and offer advice or hints to improve sleep or alertness, from tips on sleep hygiene to exercise videos to stay alert, to types of foods and drinks that could help improve sleep. Some advice, of course, is better than others, and an overall general recommendation cannot be given at this time. It depends on the app, the source and accuracy of the advice, and how that information is presented. The point is, some of that information is good and if used as general advice, can be beneficial to the patient. For example, one gadget maker's website states, "You sleep a bit better on nights after a run. It's subtle, but you spend five fewer minutes being restless/awake on those nights." Another potential insight could be: "Starting your day at a regular time helps lock in a stable circadian rhythm. This week you did a great job by having a consistent wake-up time!"

These apps are also useful to the sleep lab or the sleep professional, if used in the correct context. One can regard these as an updated and modernized version of the sleep diary, with built-in actigraphy. It gives the medical professional a little more information on the patient's daily activity. It can also be used to very roughly estimate the overall effectiveness of therapy. For example, if a patient undergoes light therapy to reset their circadian clock every morning, these gadgets or apps can help glean conclusions as to the therapy's efficacy.

CONCLUSION

Giving people more tools to interest them in their sleep health is always a good thing, and in the proper context, these gadgets or apps can be useful in tracking general trends in someone's sleep pattern. However, we could and should remind our patients, as always, that any questions they may have would be best answered by their sleep physician, rather than blindly following whatever advice they find online or in their gadget/app.

Consumer gadgets researched for this article:

Fitbit brand of activity monitors; Oura Ring; Apple Watch; Google Watch.