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Sleep and Technology: Friends or Foes

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Globally we are getting less sleep than ever before, with associated risks for individuals ranging from short-term decreases in cognitive functioning, to chronic health conditions such as depression and dementia (Perez-Pozuelo et al., 2020). Economic costs are also significant, with reduced sleep contributing to healthcare costs and work absences (Hafner et al., 2017). It is unsurprising then that the consumer sleep tech industry is growing exponentially and is predicted to be worth $40.6 billion (USD) by 2027 (Global Market Insights). The potential of sleep tech is wide ranging, and provides exciting opportunities for innovative developments that can enhance the wellbeing of people around the world.

What is sleep tech?

In an industry that is growing by around 12% annually (Global Markets Insights), consumer sleep technology forms part of a digital health revolution, where innovative devices are continuously being created (De Zambotti et al., 2019). Tech that shows promise includes wireless EEG devices, ultrasound sensors to detect breathing patterns, and artificial intelligence that uses data modelling to collate and categorise sensor data to identify sleep problems and make recommendations (Perez-Pozuelo et al., 2020). For the majority of us sleep tech constitutes the increasingly popular sleep apps and wearable devices e.g. Fitbits, which are developing at an impressive rate. Current sleep wearables include multiple sensors that record a range of signals such as heart rate and skin temperature, and are increasingly accurate in monitoring sleep (De Zambotti et al., 2019). With increases in connectivity wearables are increasingly able to sync to apps which use algorithms to monitor and evaluate sleep for individuals.

Does it work?

Wearable devices have consistently lacked accuracy in measuring sleep (De Zambotti et al., 2019), but the technology is improving all the time. Multi-sensor models combine information from many sources and are increasingly able to detect sleep/wake stages. Whilst newer models have dramatically improved accuracy for the majority of users, this research has largely failed so far to consider demographic or environmental factors such as age, gender, stress exposure, alcohol use etc., all of which are known to impact sleep (De Zambotti et al., 2019). Most sleep apps have fallen short when compared to clinic-standard measurements of sleep (Ong & Gillespie, 2016), which is unsurprising given that only around 30% contain empirical evidence supporting their claims (Lee-Tobin et al., 2017).

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Sleep technology is progressing at an astounding rate, and whilst the evidence for efficacy (or lack of) is accumulating, the research moves at a slower pace to the industry. Evidence supporting specific devices may only be available when the model is no longer available (De Zambotti et al., 2019).

Consumer sleep technology falls largely outside the remit of regulatory bodies, for example the Food and Drug Administration in the US regulates "medical" sleep tech but not "wellness" sleep tech. Consequently companies can overstate the efficacy of their devices. To date consumer sleep tech creators, researchers and regulatory bodies have worked independently of each other, but promising collaborations are beginning which may lead to consumer-grade sleep tech which is more reliable and evidence-based. For example in 2017 the FDA introduced a certification pilot for digital health technologies, in which large names such as Apple, Fitbit and Samsung were selected to participate (Dunn et al., 2018).

Sleep tech for wellness

Sleep tech has the potential to help individuals manage and improve their own sleep, and with increases in connectivity and multi-functionality, devices can motivate and encourage individuals towards self-improvement (Khosla et al., 2018). However, increased use of sleep technology comes with a range of potential risks.

Given the limited accuracy of consumer sleep technology and the lack of accessible information about efficacy, there is potential for people to change their sleep habits based on misinformation and misinterpretation. Additionally there is a risk that individuals may self-diagnose sleep disorders where there are none (Lee-Tobin et al., 2017), or delay seeking professional advice when needed (De Zambotti et al., 2019).

Screen time has consistently been linked to poor sleep and as such time spent using sleep apps may in fact have a detrimental impact on sleep (Jakobsson et al., 2018). Bright light from screens can suppress the sleep-promoting hormone melatonin (Park et al., 2020). However some research suggests that people who are naturally night-owls, may be using technology late at night because they have a natural preference for staying up late (Cain & Gradisar, 2010). Tech use at bedtime may also be a means of coping with existing sleep problems for some (Tavernier & Willoughby, 2014).

As consumer sleep technology gathers increasingly detailed information about users' sleep, a new phenomena termed "orthosomnia" (Baron et al., 2017) has been described whereby individuals can become preoccupied with measuring their sleep, which conversely leads to poorer sleep. There is also the risk that for individuals already concerned about sleep, detailed information may exacerbate sleep-related anxiety, which can impact sleep (De Zambotti et al., 2019). As sleep technology develops it is clear that the psychological responses to such tech will need to be investigated.

Sleep tech for disordered sleep

With apps capturing detailed information e.g. sleep quality, bedtime routines, and habits impacting sleep such as caffeine intake, clinicians are increasingly able to incorporate such information into their assessments and intervention (Ong & Gillespie, 2016). There is potential for this technology to revolutionise patient-doctor interactions (Khosla et al., 2018). Sleep tech information is beginning to be integrated into electronic health records (Dunn et al., 2018), and the evolution of telehealth is increasing access to therapeutic sleep interventions such as digital Cognitive-Behavioural Therapy for Insomnia (Luik et al., 2019; Vedaa et al., 2020).

Sleep tech and "Big Data"

Consumer sleep technology generates huge amounts of data from millions of people around the world providing massive potential for population-based research into sleep (De Zambotti et al., 2019). Having previously relied on clinic-based technology and self-report measures, researchers can now map sleep across geographical regions, genders, ages, and more at little cost (Walch et al., 2016). Tech companies and researchers are increasingly collaborating, which will enable such large scale data collection still further (Hagheyegh et al., 2019).

Conclusion

Sleep tech has the potential to be truly personalised and empowering, but the implications also reach far beyond the individual. With appropriate regulation and effective collaboration between stakeholders, the digitization of sleep could revolutionise the sleep experiences of millions of people, having a massive impact on global health trends and economies. My advice to consumers of sleep tech is to be aware of both the potential and the risk and continue watching this exciting space.

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