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Health-Related Outcomes and Sedentary Behaviours in Children

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Abstract

The supra-chiasmatic nucleus develops early in the gestational process, and circadian rhythms can be observed in new-borns. It connects to the retina, part of the eye that is sensitive to light, and to the pineal gland, which secretes what is often referred to as the "sleep hormone", melatonin, which starts rising about few hours before a natural bedtime and signals sleep to the body. While not the only modulating factor of the circadian rhythm, light plays a major role in adjusting and synchronising the body's clock. Light that emits short wavelengths, such as blue and blue-green light, versus longer wavelengths of orange or red light, asserts more of an effect on the circadian photoreceptor.

Keywords: Pineal gland; Melatonin production; Sleep outcomes; Proximal iso-velocity; Synchronising clocks

Introduction

Exposure to light, especially short wavelength light, counteracts the machinery in the pineal gland responsible for producing melatonin, and this suppression of melatonin has been correlated with both the irradiance and duration of exposure to light. Furthermore, melatonin production might be more sensitive to light in children than in adults, and even in pre-versus post-pubertal children and adolescents. While the link to alarm clocks in this sense is clear, what is the link between children and adolescents sleeping behaviours and technology more generally? Many devices today emit short wavelength or blue light [1]. This includes computers, cell phones and tablets, which over time have evolved to have larger and brighter screens. Using one of these self-luminous devices in the evening has been associated with reduced melatonin concentrations [2]. Dosage i.e. time spent engaging with devices and age might impact melatonin production. As mentioned above adolescents might be more sensitive to light than adults, and more time using a device has been associated with a larger reduction in the melatonin response.

Discussion

A systematic review of the literature uncovered few studies from exploring sleep among school-aged children and adolescents, in which 90% of the studies found adverse associations between screen time and sleep outcomes such as delayed timing and shortened duration. It is important to note again here that association, or correlation, does not infer causation. Furthermore, there tend to be issues with measurement error regarding screen time exposure and sleep times. For example, teens are likely to over-report sleep time, and there is little research to validate assessments of youth engagement in screen time using self-report and parent-reported measures [3]. Using validated assessment and objective measures that go beyond self-report tools can help mitigate some of this error. It is important to note also that different types of media use at bedtime might have different implications for sleep [4]. For example, in a cross-sectional study of few year olds in the United Kingdom, difficulty falling asleep was associated with social networking, frequent mobile phone use and video gaming, with those who listened to music showing the greatest effect. The largest reduction in weekday sleep duration in terms of the bedtime use of technologies was observed in those who frequently used social media sites [5]. This was related to a reported almost hour less of sleep. Furthermore, computer use for studying was negatively associated with weekday sleep duration as well, and children who frequently watched television at bedtime were more likely to report symptoms associated with insomnia i.e. early awakening episodes. This was hypothesised to potentially be result from a combination of delayed melatonin release due to exposure to light emission, as well as mental excitation [6]. The findings specifically concerning computer use for studying and the impact on sleep are important to highlight as over adolescents across Organization for Economic Cooperation and Development countries reported browsing the internet for schoolwork outside of school at least once per week, according to proximal iso-velocity surface area data. In addition to the impact of light, there is emerging evidence suggesting that exposure to radiofrequency electromagnetic fields from mobile phones may impact sleep architecture [7]. In a double-blind study in small sample adults that subjected one group to 3 hours of exposure before bedtime, time engaged in slow-wave sleep was slightly diminished and latency to slow-wave sleep was prolonged. The health effects of these patterns are not entirely clear, however reduced slow-wave sleep has been associated with outcomes such as insomnia and burnout. While the reduction in slow-wave sleep in this particular study was low, effects could be cumulative [8]. This needs to be replicated in larger samples, including with children, in order to state whether this is a definitive risk or not. Therefore, implementing limits on when children and adolescents use technology i.e. not in the hours immediately preceding bedtime, or providing children with protective equipment such as blue light-blocking glasses may help prevent sleep disruptions. Evidence suggests that these glasses are effective in mitigating melatonin suppression in teenagers therefore their use for late-night studying or scrolling through social media feeds before bed might be warranted. Research might be warranted in identifying whether activating features on mobile devices such Night Shift or night mode are effective in avoiding disruption in melatonin production [9]. These steps could be incorporated into good sleep hygiene practices, which include behaviours such as avoiding excess or any caffeine, engaging in regular exercise, maintaining a regular sleep schedule and eliminating noise from the sleeping environment. Have you ever wondered why your alarm clock has red numbers instead of blue, green

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or purple? This isn't something that manufacturers happened upon by chance, but is rather based on research regarding human's body clocks, also known as the circadian rhythm, and how different coloured light impacts this circadian clock network of the brain [10]. The circadian rhythm is dependent on an internal clock located in part of the anterior hypothalamus called the supra-chiasmatic nucleus, which plays a role in synchronising clocks in other regions of the body such as the heart and liver, and also directly manages circadian functions. Further to this, as it is often impractical for policy-makers to revert to primary studies, synthesising information through meta-analyses and systematic reviews is an important process in engaging in evidence-based decision making [11]. When formulating guidelines, there are some insights from quality research that can be taken into account. For example, it has been suggested that moderate use of screens, even in excess of many national recommendations or those of the American Academy of Paediatrics, is not associated with problematic outcomes such as delinquency, risky behaviours, reduced grades or mental health problems [12]. Moderate use might even be advantageous for students, the so-called Goldilocks Effect, posing no real risk to mental well-being of adolescents, although this can depend on factors such as type of media used and when it is used. Negative outcomes have been associated with media consumption in excess of 6 hours per day, however the association with mental well-being is small. On the other hand, there are some new challenges faced by researchers and policy-makers as technology evolves and children's habits change [13]. For example, the notion of screen-stacking or media multitasking i.e. using more than one technological device at the same time, is a relatively new and understudied phenomenon that may have implications for children's cognition, behaviour, neural structure and academic outcomes [14]. With more time and research, this could have further implications for guideline development. Some of these factors, including research quality and potential benefits of technology, are not necessarily accounted for in restriction-based guidelines. Despite the proliferation of research on child outcomes resulting from technology use, policy-makers need more in order to make clear and effective guidelines for technology use in children [15]. Some of the main challenges in the available research, as outlined in the above sections, include, Lack of quality research and coherence across research, reanalysis of the same datasets has produced very different results, or results are contested. Reliability of brain science for understanding behavioural issues, challenges in identifying functional relevance of morphological activation patterns, limitations in imaging such as Functional magnetic resonance imaging. Study design issues, reliance on self-report data, small sample sizes and results infer correlation not causation. Chicken and egg dilemma e.g. do behavioural tendencies/problems predict more screen time, or does screen time predict behavioural tendencies? Need for patient-based research much research is done on healthy populations, studying mental illness requires clinical populations. Large focus on negative effects of technology, unbalanced with potential positive outcomes. These issues suggest a need for more high quality research that can elicit reproducible findings on a larger scale. The research on the effects of social media on children is not conclusive. Furthermore, the literature base on Facebook addiction is quite extensive, although caution should be taken when classifying behaviours as addictive or having addictive qualities.

Conclusion

Pathologizing children's behaviour by labelling high use of social media or gaming as addictive can have negative impacts on children, and can overstate risks of harm. Parents and educators should take notice of children excessively engaging with social media to the point that it interferes with daily activities, family time or schoolwork. It is important to note that this paper does not explore content, contact or conduct risks associated with social media use that might have implications for well-being, such as cyber-bullying for example which affects many children around the world.

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Conflict of Interest

None

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