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THE IMPACT OF GADGET USE ON ADOLESCENTS' SLEEP QUALITY

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Abstract
The intensive use of gadgets among adolescents is strongly suspected to be a major factor contributing to the decline in sleep quality. This study aims to analyze the correlation between the duration of gadget use at night and adolescents' sleep quality. The method employed is a literature review of relevant scientific journals. Data analysis was conducted qualitatively using a thematic synthesis technique to identify patterns and relationships between variables from existing findings. The results reveal a consistent positive relationship between the intensity of gadget use, particularly during pre-sleep hours, and the decrease in adolescents' sleep quality and duration. Psychostimulant content, such as social media and online games, significantly contributes to heightened cognitive arousal (hyperarousal) and anxiety, which further hinders adolescents from falling asleep. It is concluded that excessive gadget use negatively affects adolescents' sleep through two primary mechanisms: the inhibition of melatonin production by blue light and the increase in cognitive arousal caused by digital content.

Keywords: adolescents, blue light, gadget use, hyperarousal, sleep quality

Introduction

Over the past decade, advancements in digital technology have significantly altered adolescent lifestyles, embedding devices into the very fabric of daily routines (Twenge, 2017). Computers, tablets, and smartphones have become essential tools for learning, communication, and entertainment. However, despite their utility, excessive use, particularly before bedtime, disrupts adolescents' circadian rhythms and sleep quality. Research indicates that approximately 90% of adolescents use electronic devices at least one hour before sleep, which is associated with reduced sleep duration and total sleep time (Hysing et al., 2015). Blue light emitted by digital screens has the biological potential to suppress melatonin, a hormone that regulates sleep-wake cycles (Cajochen et al., 2011). Even brief exposure to blue light at night can shift circadian phases and prolong sleep latency, a finding supported by controlled laboratory studies (Wood et al., 2013).

Beyond physiological effects, the interactive and emotionally charged nature of digital content can lead to cognitive hyperarousal, characterized by increased mental and emotional activity that impedes pre-sleep relaxation (Exelmans & Van den Bulck, 2016). This condition causes adolescents to experience difficulty sleeping. Adolescents are particularly vulnerable due to a natural tendency towards delayed sleep phases, and gadget use exacerbates this propensity (Touitou et al., 2017). Furthermore, the constant need for social connectivity fosters a fear of

missing out (FoMO) and compulsive checking behaviors, both contributing to chronic sleep disturbances (Scott & Woods, 2018). The displacement of traditional pre-sleep activities by screen time further reduces the opportunity for wind-down routines (Bartel et al., 2015).

Therefore, this study aims to synthesize empirical findings on the impact of gadget use on adolescent sleep quality. It places particular emphasis on physiological and psychosocial components, as well as scientifically grounded preventive measures. Lifestyle changes driven by technological development not only affect how adolescents interact with the external world but also alter their daily patterns, including sleep activities. Dependence on gadgets creates new, hard-to-control habits, such as repeatedly checking messages or social media late into the night (Gradisar et al., 2013). Adolescents often feel social pressure to stay connected with peers, leading to increasingly shorter and poorer quality sleep (Vernon et al., 2018). This disrupts the body's physiological balance, which requires adequate rest for regeneration and energy recovery.

Poor sleep quality during adolescence can have broad implications for physical and psychological development. Sleep deprivation impairs concentration, reduces critical thinking abilities, and diminishes learning motivation (Dewald-Kaufmann et al., 2013). Furthermore, fatigue from insufficient sleep can trigger stress and increase the risk of emotional disorders such as irritability and anxiety (Lemola et al., 2015). Long-term, irregular sleep patterns can disrupt metabolism, weaken the immune system, and increase obesity risk (Cappuccio et al., 2008). Consequently, research on the relationship between gadget use and adolescent sleep quality is crucial for understanding the root of the problem and identifying realistic solutions. A systematic review and meta-analysis by Carter et al. (2016) confirms a strong association between access to or use of media devices and inadequate sleep quantity and quality.

This literature review seeks to fill a gap by synthesizing the most recent evidence and providing a holistic view that integrates findings from diverse cultural contexts, including Indonesia, to offer a more globally relevant perspective. Adolescents undergo significant neurological development that makes them particularly susceptible to sleep disruptions (Giedd, 2015). The delayed circadian rhythm typical of this age group, combined with early school start times, creates a perfect storm for sleep deprivation (Owens et al., 2014). When compounded by excessive gadget use, this biological predisposition can lead to severe consequences for cognitive development and mental health. The portability of modern devices means that sleep environments are no longer protected spaces for rest but have become extensions of the digital social world, blurring the boundaries between wakefulness and sleep (Exelmans & Van den Bulck, 2016). Importantly, emerging experimental research indicates that interventions targeting evening screen exposure can be effective, with studies showing that reducing screen time in the evening significantly improves sleep onset in adolescents.

Method

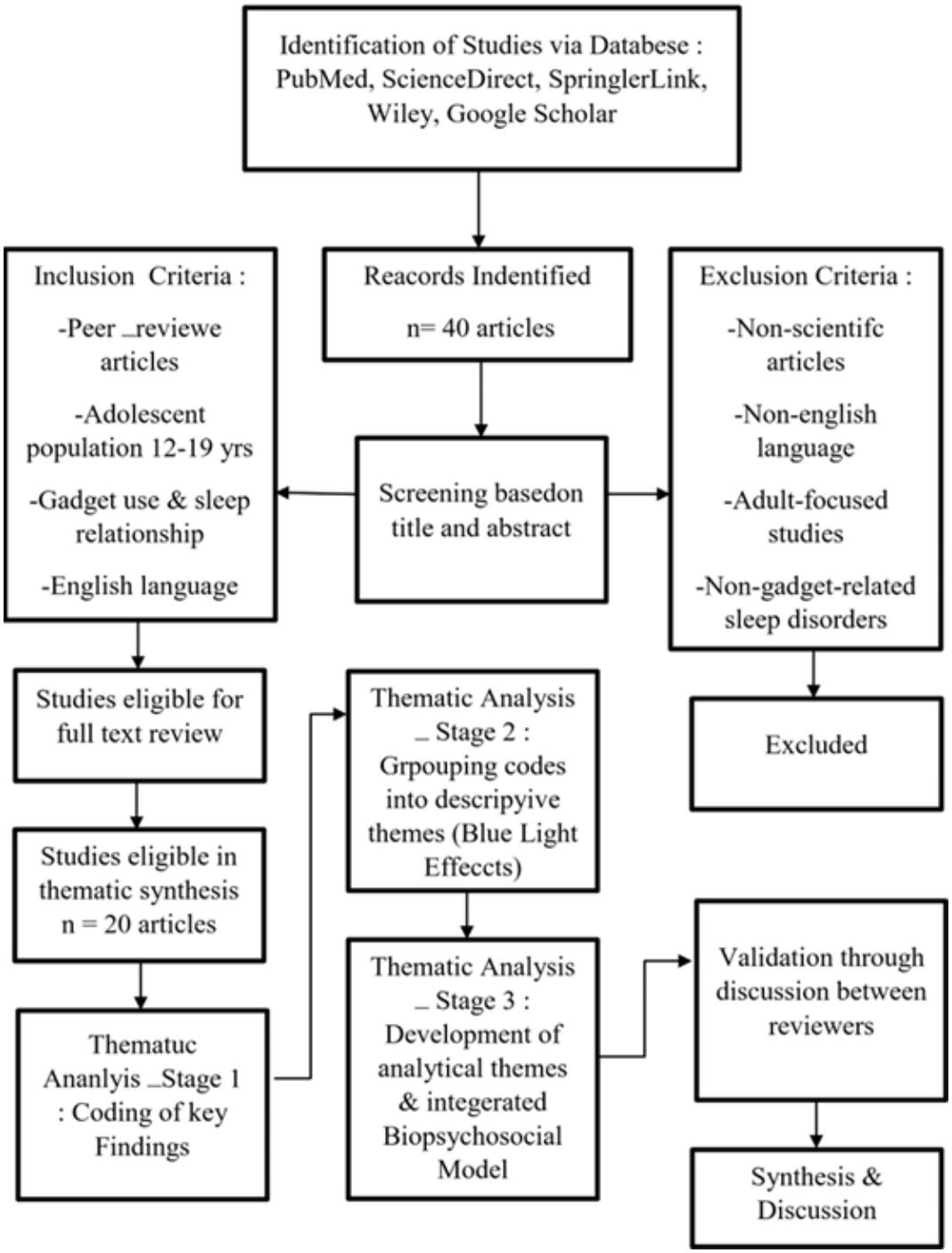

Figure 1. Methodology Flowchart

This research examines literature on the subject and integrates quantitative and qualitative findings from prominent international journals published between 2010 and 2025. The primary goal was to identify consistent themes, mechanisms, and patterns related to adolescent gadget use and sleep quality. Using a combination of keywords including "gadget use," "screen time," "mobile phone use," "sleep

disturbance," "melatonin," "blue light," "adolescent," and "teenager," article searches were conducted via PubMed, ScienceDirect, SpringerLink, Wiley Online Library, and Google Scholar databases.

Inclusion criteria consisted of peer-reviewed scientific articles focusing on adolescents aged 12 to 19 years that discussed the relationship between gadget use and sleep-related factors such as duration, latency, efficiency, or quality. Exclusion criteria encompassed non-scientific articles, articles not in English, and studies focusing on adults or sleep disorders unrelated to gadgets. Data from selected articles were analyzed thematically based on research design, sample size, sleep quality measurement tools, duration of gadget exposure, and main outcomes. The results were used to identify related patterns, biological and psychological mechanisms, and intervention methods.

In the literature review process, the authors selected approximately forty scientific articles relevant to the research topic. Of these, only twenty articles met the eligibility criteria based on their focus on adolescent populations, methodological clarity, and relevance of findings to the research variables. Each article was carefully analyzed to identify common themes and differing findings. A thematic approach was used to highlight recurring factors, such as pre-sleep gadget use duration, types of digital activities, and their impact on sleep quality.

Analysis was conducted stepwise by comparing findings across studies to identify general patterns. Validation was achieved through discussion between the two reviewers to enhance objectivity.

Although qualitative, this method provides a sufficiently clear picture of the relationship between the studied variables, even if it cannot directly establish causality. Furthermore, the thematic synthesis was conducted in three iterative stages: first, the coding of key findings from each article; second, the grouping of these codes into descriptive themes (e.g., "blue light effects," "social media anxiety"); and finally, the development of analytical themes that interpret and explain the relationships between these descriptive themes, leading to the integrated biopsychosocial model presented in the discussion.

To ensure methodological rigor, the quality of included studies was assessed using standardized critical appraisal tools. For cross-sectional studies, we evaluated sample representativeness, measurement validity, and appropriate statistical analysis. For experimental studies, we examined randomization procedures, blinding, and control of confounding variables. This quality assessment revealed that while most studies demonstrated strong methodological approaches, some relied exclusively on self-reported data for both gadget use and sleep outcomes, potentially introducing recall bias. Nevertheless, the consistency of findings across different methodological approaches strengthens the overall conclusions. The search strategy was also limited to articles published in English, which may have excluded relevant studies in other languages, though our inclusion of Indonesian research through English-language databases helped mitigate this limitation for the specific context of interest.

Findings and Discussion

This review synthesizes empirical evidence to examine the multifaceted relationship between gadget use and adolescent sleep quality. The findings are

organized thematically, addressing the strength of the association, underlying mechanisms, moderating factors, and potential interventions.

Dose-Response Relationship and Correlation Strength

Numerous studies indicate a strong correlation between the intensity of gadget use and poorer sleep quality, demonstrating a clear dose-response relationship. A long-term study in Norway found that adolescents using electronic devices for more than four hours daily had double the risk of insomnia (Hysing et al., 2015). This pattern is consistent across various studies, with evidence suggesting that for every additional hour of screen time beyond a baseline, adolescents experience a significant increase in the likelihood of developing clinical insomnia symptoms (Hale & Guan, 2015). The relationship demonstrates a non-linear trajectory, with the most severe sleep disturbances observed in heavy users, particularly when use extends into the pre-sleep period (Bartel et al., 2015). This threshold effect highlights critical intervention points, indicating that interventions targeting the heaviest users could yield the most significant public health benefits (Carter et al., 2016). Research conducted in Indonesia corroborates this global pattern, reporting that 84.8% of adolescents with high gadget usage experienced poor sleep quality (Ivana et al., 2021). The consistency of these findings across diverse methodologies strengthens the causal inference about screen time's detrimental role (Carter et al., 2016).

Physiological and Neurological Mechanisms

The biological pathways linking screen time to sleep disruption are well-established. Through retinal photoreceptors, exposure to blue light (wavelength 460–480 nm) suppresses melatonin secretion (Cajochen et al., 2011). Experimental research has demonstrated that evening blue light exposure increases alertness and delays sleep onset (Chang et al., 2015). Furthermore, reading from an e-reader before bed was found to reduce melatonin levels by up to fifty-five percent compared to reading a printed book, directly disrupting circadian rhythms (Touitou et al., 2017). This suppression is dose-dependent, with greater exposure leading to more pronounced delays in melatonin onset (Chang et al., 2015). Adolescent brains show heightened sensitivity to these effects, creating a neurodevelopmental susceptibility where technology use directly conflicts with biological sleep needs (Giedd, 2015).

Psychosocial and Behavioral Drivers

Beyond physiology, the interactive nature of digital content contributes to cognitive hyperarousal. Activities such as gaming or social media use heighten mental activation, impeding the relaxation necessary for sleep onset (Vernon et al., 2018). The Fear of Missing Out (FoMO) induces social anxiety, prompting adolescents to stay connected online, resulting in sleep fragmentation (Alt, 2015). This combination of psychological stimulation and biological disruption reinforces late-night habits within a biopsychosocial model (Gradisar et al., 2013). The type of content is a critical moderator; interactive activities like competitive gaming cause greater arousal than passive watching (King et al., 2013). Social media platforms, with their algorithmically curated feeds, exacerbate FoMO and an

"always-on" mentality, while online games create compelling social and reward-based pressures to delay sleep, effectively displacing sleep time.

Moderating Factors: Content, Context, and Culture

The impact of gadget use is not uniform but moderated by several factors. The type of digital activity plays a significant role, with interactive content being more detrimental than passive consumption (Bartel et al., 2015). Environmental and familial contexts are equally crucial. Adolescents with clear parental rules and supervision regarding gadget use demonstrate better sleep outcomes (Vernon et al., 2018). Conversely, a lack of control and parental modeling of poor digital habits normalizes disruptive behavior. Cross-cultural research reveals significant variations. In collectivist cultures like Indonesia, family interdependence may offer some protective oversight, while in individualistic Western societies, private device use in bedrooms leads to more pronounced disruptions (Scott & Woods, 2018). Demographic differences also emerge, with females showing greater vulnerability to social media-related sleep disturbances and males to impacts from gaming (Lemola et al., 2015). These moderating factors explain why universal screen time limits may be less effective than tailored interventions (Bartel et al., 2015).

Consequences and Long-Term Implications

The consequences of gadget-induced sleep deprivation are profound and multi-domain. Acutely, it impairs concentration, memory consolidation, and academic performance (Dewald-Kaufmann et al., 2013). Emotionally, it leads to increased irritability, stress, and emotional instability, which can create a vicious cycle of poor sleep and worsened mood (Lemola et al., 2015). The long-term developmental implications are severe. Persistent sleep disruption during adolescence can alter neural architecture, affecting prefrontal cortex maturation and executive function (Giedd, 2015). Longitudinal studies link technology-related sleep problems to a significantly higher risk of anxiety and depressive disorders in early adulthood (Lemola et al., 2015). Metabolically, sleep deprivation dysregulates appetite hormones, increasing the risk of obesity and establishing lifelong health vulnerabilities (Cappuccio et al., 2008). These wide-ranging impacts underscore sleep's foundational role in adolescent health.

Interventions and Implementation Challenges

Several interventions have demonstrated efficacy. Research indicates that reducing screen time one hour before bed or using blue-light-filtering glasses can increase sleep duration. Preventive efforts through school-based digital literacy programs and family-centered rules (e.g., digital curfews, charging stations outside bedrooms) are essential components (Owens et al., 2014). However, significant implementation barriers persist. Adolescent resistance driven by peer pressure and identity formation, the educational necessity of devices, inconsistent parental enforcement, and the rapid evolution of digital platforms all complicate intervention (Twenge, 2017). A multi-stakeholder approach is necessary, combining technical solutions (e.g., robust night modes), behavioral strategies, educational components, and public health campaigns that engage adolescents as partners in designing solutions for healthy digital habits.

Conclusion

In conclusion, the synthesis of evidence presented in this review unequivocally demonstrates that excessive and poorly timed gadget use constitutes a major disruptor of adolescent sleep. The negative impact is mediated through a powerful convergence of physiological pathways, primarily blue light exposure that suppresses melatonin and delays circadian rhythms, and potent psychosocial drivers, such as cognitive hyperarousal from interactive content and the anxiety fueled by Fear of Missing Out. This disruption manifests in reduced sleep duration, poorer sleep quality, and increased sleep onset latency, creating a cascade of detrimental effects. These consequences critically impair daytime functioning, undermining academic achievement, emotional stability, and cognitive performance, while also establishing long-term risks for mental health disorders, metabolic issues, and compromised neurological development. Mitigating this pervasive issue demands a systematic and multilayered intervention strategy that extends beyond individual responsibility.

Success hinges on the integrated efforts of adolescents themselves, families, educational institutions, technology designers, and public health authorities. Effective measures include the consistent enforcement of pre-sleep digital curfews, the adoption of built-in device features that minimize blue light and interruptions, and the implementation of comprehensive digital literacy and sleep hygiene education programs within school curricula. Ultimately, fostering an environment—both at home and in society—that values and protects sleep as a non-negotiable pillar of health is paramount. By equipping adolescents with the knowledge, tools, and supportive structures to manage their digital lives mindfully, we can safeguard their sleep, thereby nurturing their resilience, well-being, and capacity to thrive in an increasingly connected world.

References

Alt, D. (2015). College students' academic motivation, media engagement and fear of missing out. *Computers in Human Behavior*, *49*, 111–119. https://doi.org/10.1016/j.chb.2015.02.038

Bartel, K., Gradisar, M., & Williamson, P. (2015). Protective and risk factors for adolescent sleep: A meta-analytic review. *Sleep Medicine Reviews*, *21*, 72–85. https://doi.org/10.1016/j.smrv.2014.08.002

Cajochen, C., Frey, S., Anders, D., Späti, J., Bues, M., Pross, A., & Stefani, O. (2011). Evening exposure to a light-emitting diodes (LED)-backlit computer screen affects circadian physiology and cognitive performance. *Journal of Applied Physiology*, *110*(5), 1432–1438. https://doi.org/10.1152/japplphysiol.00165.2011

Cappuccio, F. P., Taggart, F. M., Kandala, N. B., Currie, A., Peile, E., Stranges, S., & Miller, M. A. (2008). Meta-analysis of short sleep duration and obesity in children and adults. *Sleep*, *31*(5), 619–626. https://doi.org/10.1093/sleep/31.5.619

Carter, B., Rees, P., Hale, L., Bhattacharjee, D., & Paradkar, M. S. (2016). Association between portable screen-based media device access or use and sleep outcomes: A systematic review and meta-analysis. *JAMA Pediatrics*, *170*(12), 1202–1208. https://doi.org/10.1001/jamapediatrics.2016.2341

Chang, A. M., Aeschbach, D., Duffy, J. F., & Czeisler, C. A. (2015). Evening use of lightemitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proceedings of the National Academy of Sciences*, *112*(4), 1232–1237. https://doi.org/10.1073/pnas.1418490112

Dewald-Kaufmann, J. F., Oort, F. J., & Meijer, A. M. (2013). The effects of sleep extension on sleep and cognitive performance in adolescents with chronic sleep reduction: An experimental study. Sleep Medicine, 14(6), 510–517. https://doi.org/10.1016/j.sleep.2013.01.012

Exelmans, L., & Van den Bulck, J. (2016). Bedtime mobile phone use and sleep in adults. *Social Science & Medicine*, *148*, 93–101. https://doi.org/10.1016/j.socscimed.2015.11.037

Giedd, J. N. (2015). Risky teen behavior is driven by an imbalance in brain development. *Scientific American*, *312*(6), 32–37. https://doi.org/10.1038/scientificamerican0615-32

Gradisar, M., Wolfson, A. R., Harvey, A. G., Hale, L., Rosenberg, R., & Czeisler, C. A. (2013). The sleep and technology use of Americans: Findings from the National Sleep Foundation's 2011 Sleep in America poll. *Journal of Clinical Sleep Medicine*, *9*, 1291–1299. https://doi.org/10.1016/j.sleh.2015.10.004

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Medicine Reviews*, *21*, 50–58. https://doi.org/10.1016/j.smrv.2014.07.007

Hysing, M., Pallesen, S., Stormark, K. M., Jakobsen, R., Lundervold, A. J., & Sivertsen, B. (2015). Sleep and use of electronic devices in adolescence: Results from a large population-based study. BMJ Open, 5(1), e006748. https://doi.org/10.1136/bmjopen2014-006748

Ivana, I., Murniati, & Putri, N. R. I. A. T. (2021). The relationship between gadget usage and adolescent sleep quality. *Journal of Public Health for Tropical and Coastal Region, 4*(1), 23-27. https://doi.org/10.14710/jphtcr.v4i1.10776

King, D. L., Gradisar, M., Drummond, A., Lovato, N., Wessel, J., Micic, G., Douglas, P., & Delfabbro, P. (2013). The impact of prolonged violent video-gaming on adolescent sleep: An experimental study. *Journal of Sleep Research*, *22*(2), 137–143. https://doi.org/10.1111/j.1365-2869.2012.01060.x

Lemola, S., Perkinson-Gloor, N., Brand, S., Dewald-Kaufmann, J. F., & Grob, A. (2015). Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. *Journal of Youth and Adolescence*, *44*(2), 405–418. https://doi.org/10.1007/s10964-014-0176-x

Owens, J. A., Au, R., Carskadon, M., Millman, R., Wolfson, A., Braverman, P. K., Adelman, W. P., Breuner, C. C., Levine, D. A., Marcell, A. V., Murray, P. J., O'Brien, R. F., Devore, C. D., Allison, M., Ancona, R., Barnett, S. E., Gunther, R., Holmes, B., Lamont, J. H., … Young, T. (2014). School start times for adolescents. *Pediatrics*, *134*(3), 642–649. https://doi.org/10.1542/peds.2014-1697

Scott, H., & Woods, H. C. (2018). Fear of missing out and sleep: Cognitive behavioural factors in adolescents' nighttime social media use. *Journal of Adolescence*, *68*(1), 61–69. https://doi.org/10.1016/j.adolescence.2018.07.009

Touitou, Y., Touitou, D., & Reinberg, A. (2017). Disruption of adolescents' circadian clock: The vicious circle of media use, exposure to light at night, sleep loss and risk behaviors. *Journal of Physiology-Paris*, *110*(4), 467–479. https://doi.org/10.1016/j.jphysparis.2017.05.001

Twenge, J. M. (2017*). iGen: Why today's super-connected kids are growing up less rebellious, more tolerant, less happy—and completely unprepared for adulthood*. Atria Books.

Vernon, L., Modecki, K. L., & Barber, B. L. (2018). Mobile phones in the bedroom: Trajectories of sleep habits and subsequent adolescent psychosocial development. *Child Development*, *89*(1), 66–77. https://doi.org/10.1111/cdev.12836

Wood, B., Rea, M. S., Plitnick, B., & Figueiro, M. G. (2013). Light level and duration of exposure determine the impact of self-luminous tablets on melatonin suppression. *Applied Ergonomics*, *44*(2), 237–240. https://doi.org/10.1016/j.apergo.2012.07.008