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## Youth Screen Media Habits and Sleep: Sleep-Friendly Screen Behavior Recommendations for Clinicians, Educators, and Parents

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## Youth screen media habits and sleep: sleep-friendly screen-behavior recommendations for clinicians, educators, and parents

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## Summary

With the widespread use of portable electronic devices and the normalization of screen media devices in the bedroom, insufficient sleep has become commonplace, affecting 30% of toddlers, preschoolers, and school-age children and the majority of adolescents.<sup>1,2</sup> In a recent literature review of studies investigating the link between youth screen media use and sleep, 90% of included studies found an association between screen media use and delayed bedtime and/or decreased total sleep time.<sup>3</sup> Proposed mechanisms include displacement of time that would have been spent sleeping, psychological stimulation and light exposure, and increased physiological alertness.<sup>3</sup> This pervasive phenomenon of pediatric sleep loss has widespread implications due to the associations between insufficient sleep and increased risk of childhood obesity<sup>4</sup>, disrupted psychological well-being<sup>5</sup> and impaired cognitive/academic functioning<sup>6</sup>. There is a clear need for more basic, translational, and clinical research examining the effects of screen media on sleep loss and health consequences in children and adolescents in order to educate and motivate clinicians, teachers, parents and youth themselves to foster healthy sleep habits.

## Keywords

youth; screen media habits; sleep; screen-behavior recommendations

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## Introduction

The widespread use of portable electronic devices and the normalization of screen media devices in the bedroom is accompanied by a high prevalence of insufficient sleep, affecting a majority of adolescents, and 30% of toddlers, preschoolers, and school-age children.<sup>1,2</sup> Three-fourths of American children and adolescents report the presence of at least one screen-media device in their bedroom, with roughly 60% reporting regular use of these devices during the hour before bedtime.<sup>7,8</sup>

Parents, educators, and clinicians express concern about whether excessive use of screen media among young people affects sleep and wellbeing. In this article, we provide an overview of the current science on screens and sleep, with a focus on recommendations to reduce the potentially problematic influence of screen time on pediatric sleep. We then review how impaired sleep in pediatric populations may lead to a range of adverse behaviors, physical health problems and well-being outcomes. We begin with a summary of the two consensus statements on child and adolescent sleep needs. Then we summarize the range of screen habits among youth, focusing on screen habits at bedtime. Next, we review current literature on evidence of the effects of youth screen habits on sleep, and the mechanisms by which screen habits may impact sleep. We conclude with evidence-based

strategies to improve sleep through *sleep-friendly screen-behavior* recommendations and other take-home messages for families and practitioners.

### **Sleep requirements for children and adolescents**

Two independent sleep associations – the National Sleep Foundation (NSF) and American Academy of Sleep Medicine (AASM) – each convened teams of sleep researchers and other experts to establish consensus to guide health care providers and the public about sleep duration requirements across the lifespan, based on the best available evidence. Both groups used a modified RAND/UCLA Appropriateness Method<sup>9</sup> to arrive at their recommendations. For the pediatric population, the NSF panel recommended that newborns (0–3 months) obtain 14–17 hours of sleep daily, infants (4–11 months) obtain 12–15 hours, toddlers (1–2 years) obtain 11–14 hours, preschoolers (3–5 years) obtain 10–13 hours, school-aged children (6–13 years) obtain 9–11 hours, and teenagers (14–17 years) obtain 8–10 hours.<sup>10</sup> The AASM recommendations were identical to those of the NSF, except the former suggested that infants aged 4–12 months obtain 12–16 hours of sleep per day (including naps) and children aged 6–12 obtain 9–12 hours.<sup>11</sup>

### **Consequences of insufficient sleep for cognitive, psychological and physical wellbeing**

Sleep problems in early life predict a greater likelihood of later development of psychopathology in childhood and adolescence.<sup>12</sup> In a large study ( $N= 32,662$ ), short sleep duration ( < 10h/night by maternal report) and nocturnal awakenings ( > 3/night) in toddlers were associated with development of behavioral and emotional problems at age 5.<sup>13</sup> Sleep problems at age 4 have been found to predict a greater incidence of behavioral and emotional problems emerging by mid-adolescence.<sup>14</sup> In experimental studies, toddler napping appears to be important for self-regulation. A challenging puzzle task following 5 days of regular napping (compared to non-napping) elicited fewer perseverative behaviors, and less negative self-appraisals.<sup>15</sup> Imposing sleep restriction on healthy teens rapidly degrades mood and emotion regulation<sup>16</sup>, as with adults. A large cross-sectional study of adolescents identified associations between short sleep duration and emotional problems, peer conflict, and suicidal ideation.<sup>17</sup> In a meta-analysis of longitudinal and intervention studies, adolescent sleep problems appear to precede the emergence of depression.<sup>18</sup> Although more work on the modifiable aspects of sleep duration, sleep quality, and regularity of sleep timing are needed, current literature suggests that each of these factors is important for psychological health. These relationships may be bi-directional, as sleep and psychological problems influence one another throughout development,<sup>19</sup> suggesting a resonance phenomenon or a vicious cycle that may be exacerbated by excessive screen media habits. Williams and colleagues have proposed a Developmental Cascade Model, supported by longitudinal data on children, to explain the reciprocal interactions of sleep and emotion and attention self-regulation.<sup>20</sup>

Beyond emotional and behavioral problems, a meta-analysis of cross-sectional studies revealed that short sleep duration was reliably associated with weight gain, adiposity, and obesity risk in both children and adults.<sup>4</sup> Infants obtaining less than 12 hours of sleep/day,

measured by maternal report, were more likely to be overweight at age 3 and have higher levels of adiposity.<sup>21</sup> In a longitudinal study of children age 1 to age 7, sleep duration was associated with greater BMI increases, fat mass, and waist-to-hip ratio.<sup>22</sup> In a controlled, laboratory-based experimental study, 3-year old children exposed to acute sleep restriction (skipping a nap and bedtime delayed ~2.3 hours) consumed greater amounts of carbohydrate and fat and more total calories<sup>23</sup>, which may explain the elevated risk of obesity caused by insufficient sleep. A recent review identified sleep as among the socioeconomic, family, environmental, and behavioral factors contributing to childhood obesity.<sup>24</sup>

In a longitudinal study of children in 3<sup>rd</sup> grade, bedtimes after 8pm were associated with greater odds of increased adiposity measured at 6<sup>th</sup> grade. As with children, insufficient sleep in adolescence has been shown to promote dietary behaviors that lead to obesity<sup>25</sup>, with additional effects mediated via decreased physical activity and neuroendocrine changes that bolster fat storage. More evidence is needed, particularly in interventions that counteract the effects of screen-media consumption leading to insufficient quantity or inadequate quality sleep, that in turn influence weight gain in childhood. However, the “weight” of available evidence suggests that obesity may be a sleep loss-related outcome of excessive screen-media consumption.

### **What are the bedtime screen habits of infants, children, and adolescents?**

Although the scientific and clinical communities continue to express concern regarding the negative impacts of screen media on sleep, electronics in the bedroom and screen time use around bedtime remain common among youth.<sup>26–28</sup> A large-scale, nationally representative sample of American parents in 2013<sup>26</sup> revealed that about one third (36%) of young children had TVs in their bedrooms, including 16% of children under 2 years of age, 37% of 2- to 4-year-olds, and 45% of 5- to 8-year-olds. Additionally, among parents of infants and young children who allowed a bedroom TV, 22% did so to help their child fall asleep, 14% did so to get their child to fall asleep in his/her own room, and 4% did so because their child slept in a family room containing a TV.<sup>26</sup> The presence of a TV in the bedroom varies by cultural, socioeconomic and structural factors. Data from a 2016 nationally representative study of over 2,600 US youth indicated that 47% of tweens and 57% of teens have TVs in their bedrooms.<sup>27</sup> Media devices in the bedroom were more common in lower-income youth (68% versus 37%). The authors speculated that the higher rate of media in the bedrooms of lower-income tweens and teens may be the result of more frequent room sharing, sleeping in a multi-purposed room, or differing family preferences. Parent-report data from the 2014 *Sleep in America* poll by the NSF revealed that 75% of youth keep at least one type of electronic device in their bedroom. The poll also found that the 28% of school-aged children and 57% of teenagers who leave an electronic device on in their bedroom after bedtime obtained less total sleep and had lower sleep quality.<sup>7</sup>

About 50% of parents endorse the belief that watching TV helps their infant, toddler, or preschooler ‘wind down’ in the evening.<sup>28</sup> Likewise, multiple studies documented that adolescents report using media at bedtime to “help” them fall asleep.<sup>29</sup> There is a current programming trend toward developing calming shows and apps aimed at helping children relax before bedtime and transition to sleep. To our knowledge, no published research exists

on the effectiveness of such content. Such evidence should be a minimum requirement for these approaches to be recommended.

Importantly, over the past decade, the landscape of screen media devices has changed markedly, dramatically altering children and adolescents engage with their environment. Data from large national US samples in 2011 and 2013 show an increase in ownership of tablet devices in young children (age 0–8) from 8% to 40% and an increase in access to mobile “smart” devices at home from 52% to 75%.<sup>26</sup> Another report indicated that, from 2011 to 2013, the percentage of children under 2 years of age who had used a mobile device rose from 10% to 38%.<sup>26</sup>

## **Screen media, especially near bedtime, is adversely associated with sleep time and quantity**

In relation to a growing interest in the association between screen time and sleep patterns, data from over 60 associated studies have been examined in two systematic literature reviews<sup>3,30</sup> and two related meta-analyses<sup>31,32</sup>. In the time since those articles were published, at least a dozen more studies have surfaced (e.g., see<sup>6,8,33–42</sup>), from a wide-range of cultural contexts including Thailand,<sup>37</sup> Saudi Arabia,<sup>40</sup> and Norway.<sup>8</sup>

The vast majority of these studies indicate that the extent of screen time among children and adolescents is associated with delayed bedtime and shorter total sleep time<sup>43–45</sup>. Several studies also found associations between screen time and reduced sleep quality,<sup>46,47</sup> longer sleep onset latency,<sup>48</sup> and increased daytime tiredness.<sup>49,50</sup> One recent study found that electronic media use accounted for 30% of all variance in adolescent sleep efficiency, as measured by actigraphy.<sup>34</sup> Most studies examined total daily screen time as a predictor, but even greater effects on sleep have been documented in evening media use in the bedroom (i.e., in the 1–2 hours before bedtime<sup>51,52</sup>) and in use of violent media at any time.<sup>53,54</sup>

One meta-analysis investigated the association between portable screen-based media devices and sleep outcomes.<sup>32</sup> Merging results from 20 studies and over 125,000 youth, the authors consistently found that bedtime media usage is associated with insufficient sleep duration (OR=2.17,  $p<.001$ ), poor sleep quality (OR=1.46,  $p<.01$ ) and excessive daytime sleepiness (OR=2.72,  $p<.01$ ). This meta-analysis found that the mere presence of a portable screen-based media device in the bedroom has adverse associations with sleep outcomes. In one study of 600 preschoolers, those with a TV in their bedroom watched twice as much evening TV (about 28 versus 13 minutes, respectively) and watched more shows with violent/scary or ‘mature’ content (29% versus 13%).<sup>53</sup> Most related studies focused on typically-developing children, but results of studies on children with ADHD and Autism Spectrum Disorders show similar patterns. One such study found that exposure to violent programming within 30 minutes before bedtime was associated with longer sleep latency and shorter sleep duration.<sup>54</sup>

Negative associations with sleep have been found with use of a range of screen media devices, including television, computers, video games, and mobile devices such as smartphones and tablets.<sup>29,51,52,55–65</sup> However, there are mixed results regarding whether

the type, size, or interactivity level of the screen affects sleep outcomes. In a study of 2,048 children in grades four and seven, having either a TV or small screen device near where they sleep – as well as more daily screen time – was associated with obtaining less sleep.<sup>6</sup> The rise in interactive media options may increase the impact of media use on sleep, as some studies have found that interactive screen media use (e.g. video games and mobile devices) may have a greater impact on sleep than passive use, such as watching television.<sup>6,45,66–71</sup> One recent meta-analysis found no association between television watching and sleep duration,<sup>31</sup> but did find that computer use is associated with shorter total sleep duration. Another study shows that use of interactive screen-media increases the odds of nighttime awakenings and daytime tiredness,<sup>41</sup> but other studies examining the effects of video game use on sleep have shown more modest effects.<sup>68,72</sup> One study compared 1 hour of bedtime tablet use with three different lighting profiles and found minimal differences in the impact on sleep and next-day functioning.<sup>73</sup> However, longer durations of bright screen use (between 1.5–5 hours) have shown to increase alertness before sleep.<sup>74–77</sup>

## **Mechanisms through which screens affect sleep**

Since many of the existing studies are observational and cross-sectional, causality is difficult to discern. Several potential mechanisms, along with supporting evidence, are briefly discussed below: time displacement, psychological stimulation from content, and the alerting and circadian effects of light.

### **Time displacement of sleep**

Screen media use can lead to behavioral bedtime delay, as children or adolescents postpone bedtime to prolong screen entertainment.<sup>66,78,79</sup> Using a screen-based device displaces time that would otherwise have been spent sleeping. This time-displacement mechanism is particularly powerful when screens are used at night, when sleep is most likely the activity being directly offset.

### **Psychological stimulation from media content disrupting sleep**

Research has found mixed results regarding the effect of screen media use on psychological, emotional, and/or physiological arousal, but this relationship likely mediates some effect of screen media use on sleep.<sup>80–83</sup> Video games, particularly violent games, are often thrilling for enthusiasts, typically simulating life-or-death experiences requiring players' full attention to succeed. Violent videogame play before bed increase arousal compared to nonviolent gameplay. However, arousal is a likely mediator of sleep problems even in non-violent media use.<sup>46</sup> In another controlled experiment, playing an “exciting” video game was associated with increased heart rate, slightly delayed sleep-onset, and decreased REM sleep, further suggesting that the effect of screen use on sleep is mediated via arousal.<sup>61</sup>

### **Effects of light-emitting screens on child and adolescent sleep**

Exposure to the light emitted by screens in the evening hours before and/or during bedtime is another likely mechanism by which use of screen media negatively impacts sleep. Screen-based light may affect sleep via several pathways:

1. increasing arousal and reducing sleepiness at bedtime,
2. disrupting sleep architecture as assessed by polysomnographic (PSG) recording, and
3. delaying the circadian rhythm and subsequently postponing sleep-onset, which results in shortened sleep duration unless wake-time is also delayed.

Studies of young adults demonstrated that evening use of light-emitting devices increases alertness and decreases sleepiness before bedtime, as determined by cognitive performance, self-reported scales and waking EEG measures.<sup>74,76,84</sup> These studies also showed that this light suppresses blood levels of the sleep-promoting hormone melatonin, which normally increases in the hours before bedtime.<sup>74,76,77,84</sup> Similar results were found in an experimental study of adolescents, in which exposure to LED screens before bedtime decreased self-reported sleepiness and melatonin levels.<sup>75</sup> Exposure to non-screen artificial light in the evening also increases alertness (quelling underlying sleep drive) and suppresses melatonin levels, delaying sleep onset. The light emitted from screen media devices includes greater short-wavelength light in the blue light range, which has been shown to induce stronger melatonin-suppressing responses<sup>85</sup>. In fact, in the aforementioned study of adolescents<sup>75</sup>, both subjective alertness and melatonin suppression were significantly attenuated when study participants wore glasses that filtered out short-wavelength light.

Few studies have directly measured the effects of light from screens on polysomnographic (PSG) measures of sleep.<sup>73,75,76</sup> One such study in young adults found that exposure to light-emitting devices before bedtime caused a phase delay of melatonin release and modestly increased the time to fall asleep and reduced the duration of REM sleep<sup>76</sup>. It is impossible to determine whether longer sleep latency or reduced REM sleep duration was due to decreased sleepiness before bedtime, suppression of melatonin, a phase delay of the circadian clock, or a combination of these factors. Other published reports, including a study of adolescents,<sup>73</sup> found no significant changes on subsequent PSG with evening exposure to light-emitting devices.<sup>73,75</sup>

Although limited research documents the effects of light from digital media on sleep, the results are particularly applicable to youth, who may be more sensitive to light than adults.<sup>86</sup> One study<sup>87</sup> found that the magnitude of melatonin suppression induced by moderately bright indoor light levels in the evening was twice as much in primary school children as in adults. This difference could be related to pupil diameter, which is significantly larger in children than adults. Another study<sup>88</sup> found that children showed significantly greater melatonin suppression compared to adolescents in response to varying degrees of evening light exposure. Taken together, these results suggest that the light from screen media use around bedtime adversely affects sleep, particularly in younger children. Furthermore, these findings indicate the need for further research on the effect of screen media devices on sleep, especially in youth.

## Internet and video game addiction and sleep

There is growing concern that technology habits can become uncontrollable and excessive to the point of interference with normal daily functioning. For example, the Diagnostic and

Statistical Manual V (DSM-V) recognizes one type of technology addiction, internet gaming disorder, as a “condition for further study”.<sup>89</sup> More broadly, the concept of internet and video game addiction (IVGA), has gained traction in the psychological and psychiatric communities, due in part to the disorder’s deleterious effects on sleep. IVGA is classified as an inability of internet users to limit excessive internet use, with ensuing psychosocial dysfunction.<sup>90</sup> A recent systematic literature review and other studies show a particularly strong association between use of massively multiplayer online role-playing games (MMORPGs) and poor sleep quality.<sup>91–93</sup> IVGA has been associated with subjective insomnia and insufficient sleep among afflicted adolescents.<sup>91</sup> Existing literature on this association remains limited and causality is unproven, but there appears to be a strong association between IVGA and sleep problems.

### **Moderating factors**

New evidence suggests some young people are particularly susceptible to the ill effects of screen media on sleep quality. As early as 2009, researchers documented individual differences in teenagers’ heart rate variability (HRV) when playing violent video games.<sup>83</sup> A subsequent study<sup>46</sup> demonstrated that adolescents’ level of gaming experience moderated the effect between their videogame use, HRV, and sleep. Inexperienced gamers reported poorer sleep after playing a violent video game, in contrast to experienced gamers who reported poorer sleep after a nonviolent videogame. Physiological trait differences can also amplify technology exposure effects by directly delaying bedtimes.<sup>52</sup> An experimental laboratory study by Reynolds and colleagues<sup>79</sup> revealed that adolescents who perceived fewer consequences from risk-taking were more likely to end daily video gaming sessions at a later time, thus delaying sleep onset, compared with their peers. Smith et al.<sup>94</sup> found that adolescents who self-reported higher trait flow (the ability to easily immerse oneself into an activity) were also more likely to delay bedtime via extended periods of evening gaming. Their follow-up laboratory study replicated this effect, but only for videogames that were both challenging and enjoyable (i.e. when game difficulty was set to “hard” instead of “easy”). Similarly, poor self-control in combination with unstructured television viewing has been associated with delayed bedtimes in adults, a finding supported in a follow-up study.<sup>95</sup> This emerging research suggests that identifying predisposing individual traits and characteristics of the technology use helps discern youth whose technology habits are most likely to delay sleep onset.

### **Interventions, policies and strategies designed to improve child and adolescent sleep**

The American Academy of Pediatrics (AAP) issued a Statement of Endorsement in support of the American Academy of Sleep Medicine (AASM) guidelines, which recommends that screen-based devices not be allowed in children’s bedrooms and be turned off 30 minutes before bedtime.<sup>96</sup> These are commonly suggested approaches, but modifying media content may be another effective means of protecting sleep. A randomized trial found that a harm-reduction intervention, which attempted to change the media exposure of preschool children

away from violent and towards educational and prosocial content, significantly decreased odds of sleep problems across follow-up at 6, 12, and 18 months, compared with controls.<sup>97</sup>

Experimental studies seeking to evaluate interventions to improve sleep outcomes in children and adolescents are sparse, and have typically incorporated multifaceted sleep hygiene programs that address multiple elements in addition to screen media before bed. Nevertheless, existing literature suggests that limiting screen time during the 30 to 60 minutes before bedtime may yield modest benefits in terms of “lights out time” as well as sleep quality and duration. A one-week program, consisting of classes teaching sleep physiology, biological significance, and consequences of sleep deprivation, resulted in more regular bedtimes and shorter sleep-onset latency among 58 adolescents (mean 16 years old), but no benefit on sleep quality or daytime sleepiness.<sup>98</sup> Another investigation assessed the utility the FERRET (Food, Emotions, Routine, Restrict, Environment and Timing) sleep hygiene program among 22 adolescents (mean 13 years old). FERRET instructed adolescents to comply with three rules for each of the domains of the acronym (e.g. Restrict: No electronic media at least 30 minutes before bed, no exercise 3 hours before bed, no other activities in bed except for sleep).<sup>99</sup> This program significantly improved scores on the Adolescent Sleep Hygiene Scale (ASHS), Pittsburgh Sleep Quality Index (PSQI), and Sleep Disturbance Scale for Children (SDSC), although objective sleep duration did not change significantly. A targeted intervention of mobile phone restriction in the hour before bed among 63 adolescents (mean 16 years old) resulted in “lights out” 17 minutes earlier and a total sleep time increase of 19 minutes per night.<sup>100</sup> However, the authors reported a low 26% recruitment rate, highlighting the difficulty of implementing such a regimented screen-limiting schedule in teens. In another study, limiting screen media around bedtime for healthy adolescents with good sleep did not significantly impact sleep outcomes. In a study of high school athletes (mean 17 years) whose baseline consisted of sufficient sleep (e.g. total sleep time, 7:49 weekdays, 9:11 weekends), a strict “no electronic media” rule after 10:00 pm resulted in no benefit in terms of total sleep time, sleep quality, or daytime functioning.<sup>101</sup> In sum, limited existing research suggests that sleep hygiene interventions may be practically challenging to achieve but yield benefits to those children and adolescents with insufficient sleep. Larger, multi-site studies are urgently needed given the increasing intrusion of evening screen media use in of the lives of modern youth, including gaming, social media, and homework.

## Clinician’s perspective

Clinicians can help families improve their sleep health and screen media habits by encouraging parenting marked by high levels of warmth and support, as well as limits that are clearly communicated, consistently applied appropriate to the child’s behavior and context, and allow for developmentally appropriate autonomy(i.e. an authoritative parenting style).<sup>102,103</sup> (See Box 1) All parents should begin instilling family bedtime routines and healthy sleep habits early in life, and adjust these routines as youth mature (See Box 2). If the youth health behaviors and habits become part of the child’s own daily routine, she will be better able to take charge of her own sleep health behaviors when this becomes appropriate in later years. For younger children, these routines mean establishing household rules related to screens and sleep early on. For older children and adolescents, they involve

open conversation about the core reasons for behaviors. This proactive and engaged parenting style promotes cooperation and parent-child shared goals for children's health and well-being, and aims to help children develop self-regulation skills, and eventually increasing autonomy to govern their own behavior.

### Box 1

#### Sleep-friendly screen-behavior recommendations for clinicians and educators

- Talk with families about the importance of adequate sleep.
- Recommend building healthy sleep habits starting as young as possible.
- Teach families about the negative effects of evening use of light-emitting screens on sleep.
- Encourage regular bedtimes that allow adequate time for sleep, and regular bedtime routines in the hour before bed, consisting of calming activities and avoidance of screen media.
- Advise families to restrict all screen devices from bedrooms, including TVs, video games, computers, tablets, and cell phones. Encourage parents to be good role models by following these rules themselves.
- Consider insufficient sleep as a contributing factor for youth exhibiting mood, academic, or behavioral problems.
- Inspire children of all ages to develop autonomy and self-regulatory skills to maintain healthy screen media habits.

### Box 2

#### Sleep-friendly screen-behavior recommendations for parents

- **Establish screen media habits for your children which enable healthy sleep.**<sup>3,7,113</sup>
  - **Plan a bedtime that allows for adequate sleep.**
  - **Avoid screen media in the hour before bedtime and at nighttime.**
  - **Replace evening screen time with calm activities for your children** (*reading, coloring, conversation, etc.*).
  - **Keep all screen devices (TVs, video games, computers, tablets, and smartphones) out of bedrooms.**
  - **Avoid passive background media:** *Children may be affected by screen media even when they are not actively engaged.*
  - **Content matters: Avoid violent and/or scary media,** *which can negatively affect your children's sleep.*

- **Family rules/routines are most effective when applied to all children in the household.**
- **Establish other healthy sleep practices for your child and yourself.**<sup>112,114,115</sup>
  - **Set and abide by regular bedtimes every day, including weekends, allowing the child sufficient sleep duration for his/her age.**<sup>10</sup>
  - **Bedtime should follow a predictable routine** (e.g.: brush teeth, read a story, lights out).
  - **Bedrooms should be cool (65–70 degrees), comfortable, dark, and quiet.**
  - **Avoid evening intake of chocolate or beverages that interfere with sleep** (soda, tea, coffee, energy drinks).
  - **Include physical exercise into the daily routine, and spend time outdoors during sunlight hours when possible.**
- **Be a healthy sleep role model by prioritizing your own sleep.**
  - **Improve your own sleep-related behaviors** (e.g., reduce screen time before bedtime, establish a regular bedtime, etc.)<sup>114</sup> to improve your health and well-being<sup>116</sup>
  - **Turn off electronic media devices in the evening throughout the household and charge all mobile devices in a central location outside bedrooms.**
  - **Parents who are overtired are less well able to parent effectively, including being proactive in orchestrating child routines and dealing effectively and calmly with daily hassles that are part of everyday life.**
- **Parent your child with clear communication, awareness, and fair, consistent, developmentally appropriate rules.**<sup>117</sup>
  - **Talk with your child or teen early and often about the importance of adequate sleep for optimal health.**
  - **Be aware of how much time your child or teen spends engaging in screen media, including before and after bedtime.**<sup>76</sup>
  - **Pay attention to your child or teen’s mood and behavior at home, and discuss concerns you may have. Mood impairment is often caused by inadequate sleep.**
  - **Establish and enforce appropriate media and sleep rules for your children as early in their lives as possible; consistently point out after-effects of failing to follow those rules** (e.g., being

*tired and cranky the next day after playing games too late) to develop your child's understanding of the effects of inadequate sleep.*

- **Work with teens to jointly develop healthy sleep routines that also allow them to meet obligations** (*e.g., homework or sports*) and are consistent with the guidelines above. *Developing autonomy and ability to self-regulate is important for teens, as is consistency.*

*Adapted from* Lemola S, Perkinson-Gloor N, Brand S, et al. Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. *J Youth Adolesc* 44(2): 405–418; and Mindell JA, Owens JA. *A Clinical Guide to Pediatric Sleep: Diagnosis and Management of Sleep Problems*, 2<sup>nd</sup> edition. Philadelphia: Lippincott Williams & Wilkins; 2015; with permission.

Examples from health psychology provide accessible guidance. A teen with a healthy diet does not typically result from the rigid imposition of a such a diet after a lifetime of unhealthy foods, but with a healthy and balanced eating habits instilled from a young age. A healthy “screen media diet” may be a resonant and useful concept for many children, parents, educators, and clinicians. It is difficult for parents who smoke to mandate a no-smoking policy. Role modeling and a health-risk prevention approach is far more likely to be effective than a secondary prevention approach (e.g smoking cessation). Successful parenting ideally starts early and sets appropriate norms and boundaries while maintaining parental warmth, rather than holding off on setting boundaries until a problem develops requiring discipline. Encouraging the development of age-appropriate autonomy will help teenagers to develop a sense of responsibility for maintaining a healthy lifestyle.

For teenagers presenting with excessive screen time, a few clinical pearls may help families to follow the recommendations laid out in Box 1 and 2, below. First, one must always focus on the chief complaint, what brought the patient to seek help in the first place. In cases of excessive nighttime screen media use, children and adolescents are often seen in the clinician's office for poor academic performance or lack of concentration in school. Upon taking a careful history, the clinician often discovers a significant lack of sleep, often attributable to patients staying up late while using mobile devices, computers, or videogames. Clinicians must discover the underlying factors (e.g., social or family stress) which drive the patient to use the screens in the late hours. Addressing such factors directly may be essential to motivating families to achieve healthier screen habits.

The clinicians should then work with families to reduce evening and nighttime screen media use via structural and behavioral modifications in order to improve sleep health (See Box 2). Many adolescents are reluctant to change their health behaviors,<sup>104</sup> yet providing them with education about the positive benefits of sufficient sleep as well as the negative consequences of poor sleep can help motivate such change.<sup>105–109</sup> For example, pointing out that a change in sleep habits may improve concentration, daytime alertness, and academic performance

may motivate youth to modify nighttime habits. Discussing the negative repercussions of inadequate sleep on qualities that are important to the patient, such as body weight or athletic performance, may likewise motivate the patient to reduce nighttime screen media use and establish other healthy bedtime habits. Perhaps most importantly, parents and children should remove screen-based devices from the bedroom to ensure that they are not used at night.

Changing bedtime screen media use habits in our young patients is challenging. However, several tools and strategies increase our chances of success, with the goal of promoting healthy sleep habits that children and adolescents will continue to follow throughout their lives.

## Recommendations for clinicians, educators, and parents

Based on our current understanding of clinical practice and sleep health research, we have developed *sleep-friendly screen-behavior* recommendations for clinicians and educators (see Box 1) and for parents (see Box 2) to help minimize the adverse effects of screen-based media on the sleep of children and adolescents.

## Future directions

Research indicates that screen-based media represents a threat to the sleep quality of youth, many of whom already have insufficient sleep. However, very few studies demonstrate easy-to-implement and effective interventions. Future research should develop, implement, and evaluate sustainable interventions that minimize the adverse effects of evening screen use on sleep. For example, a means of reducing fear of missing out from social media and other screen-based activities may significantly improve the sleep of adolescents.<sup>110,111</sup> There is a clear need for more basic, translational, and clinical research into the effects of screen-based media on sleep and related health consequences among children and adolescents, in order to educate and motivate parents, clinicians, teachers, and youth to foster healthy sleep habits.

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### Key points

- Use of screen media by youth, throughout the day and in the period before bedtime, is associated with shorter total sleep time and delayed sleep onset in over five dozen studies from around the world. Access to a screen-media device in the bedroom at night is associated with shorter sleep duration, later bedtime, and poorer sleep quality.
- The currently-supported mechanisms underlying the relationship between screen media habits and sleep outcomes include (1) displacement of time spent sleeping by time spent using screens, (2) psychological stimulation from screen-media content, and (3) alerting and circadian effects of exposure to light from screens.
- Clinicians, educators, and parents should prioritize the need of youth to get sufficient sleep through maintaining regular and consistent bedtime routines. In addition, youth and parents should practice *sleep-friendly screen behaviors*: restricting exposure to digital media in the hour before bedtime, turning devices off during the night, and keeping devices out of bedrooms. Modifying media content to reduce psychological stimulation (e.g., limiting violent or scary media) may also reduce adverse impact on sleep.
- There is a clear need for more basic, translational, and clinical research examining the effects of screen media on sleep and related health and health behavior consequences among children and adolescents in order to educate and motivate clinicians, teachers, parents and youth to maintain healthy sleep habits.