



Presence of Small Screens in Bedrooms Is Associated With Shorter Sleep Duration and Later Bedtimes in Children With Obesity

Michael P. Duggan, BS; Elsie M. Taveras, MD, MPH; Monica W. Gerber, MPH; Christine M. Horan, MPH; Nicolas M. Oreskovic, MD, MPH

From the Division of General Academic Pediatrics (MP Duggan, EM Taveras, MW Gerber, CM Horan, NM Oreskovic), Massachusetts General Hospital for Children; Department of Pediatrics (EM Taveras, NM Oreskovic), Harvard Medical School; and Department of Nutrition (EM Taveras), Harvard T. H. Chan School of Public Health (EM Taveras), Boston, Mass

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Address correspondence to Nicolas M. Oreskovic, Division of General Academic Pediatrics, Department of Pediatrics, Massachusetts General Hospital for Children, 125 Nashua Street, Suite 860, Boston, MA 02114 (e-mail: noreskovic@partners.org).

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ABSTRACT

BACKGROUND: The presence of small screens in the sleep environment has been associated with shorter sleep duration and later bedtimes in children of normal weight, but the role these devices play in the sleep environment of overweight children is unclear. We sought to examine the association of small screen presence in the sleep environment with sleep behaviors among school-age children with obesity.

METHODS: We surveyed 526 parents of children ages 6 to 12 years old with a body mass index ≥ 95 th percentile who were participating in a randomized trial to treat childhood obesity. Twelve months after enrollment, parents were asked how frequently their child slept with or near a small screen (defined as a cellphone, smartphone, or texting/chat-capable device). We used multivariable linear regression to examine associations of the presence of small screens with sleep duration, waketime, and bedtime.

RESULTS: Compared with children who rarely/never slept with a small screen in their bedroom, children who did so 1 day or more per week had shorter sleep durations and later bedtimes. After we adjusted for television presence in the bedroom, small screen presence was still associated with shorter sleep duration (-9.9 minutes; $P = .02$) and later weekday (8.8 minutes; $P = .03$) and weekend (12.0 minutes; $P = .03$) bedtimes.

CONCLUSIONS: Children with obesity and a small screen present in their sleep environment have shorter sleep durations and later bedtimes than children who rarely/never sleep with a small screen. Pediatricians should consider inquiring about small screens in the bedroom when counseling on healthy sleep and weight management habits.

KEYWORDS: obesity; pediatrics; screen time; sleep; smartphone

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WHAT'S NEW

This study examined the association between having a small screen in the sleep environment and sleep characteristics among children who are overweight and obese. Pediatricians should consider asking children and parents about small screens when counseling on obesity.

INSUFFICIENT SLEEP DURATION and poor sleep quality among adolescents have been associated with various negative health outcomes, including increased risk for obesity, poor mental health, poor academic performance, injuries, and decreased alertness.^{1,2} The American Academy of Sleep Medicine recommends that children 6 to 12 years old sleep 9 to 12 hours each night for optimal health.³ Over the last decade, mean sleep duration among adolescents has decreased in the United States.⁴

Studies have shown that children with a television (TV) in the bedroom have delayed bedtimes and shorter sleep duration.^{5,6} Children with a TV in their bedroom are also at increased risk of having a high body mass index (BMI), adverse cardiometabolic risk, high visceral adiposity, and high serum triglyceride levels.⁷

Although most studies on the associations between screen time and sleep in youth have tended to focus on TVs and to a lesser extent computers, newer forms of media technology are increasingly available and accessed by children.^{1,8,9} Small screens, such as smartphones and tablets, increasingly are used by school-aged children, with one study finding that more than one half of fifth graders currently own a smartphone, and another study noting that more than 60% of 4-year-old children have access to their own tablet.^{10,11} Small screens increasingly are present in the bedroom and have been found to impact

the quantity and quality of sleep in adolescents.^{1,8,9} Studies that have examined the association between small screens in the sleep environment and sleep duration, bedtime, and sleep quality have demonstrated that small screen presence is associated with shorter sleep duration, perceived insufficient rest, and suboptimal sleep quality and efficiency.^{1,8,9} Small screens may have a greater ability to alter sleep patterns than TVs since they can disrupt circadian rhythms, given the close proximity in which they are held to the face of the user.¹ Colors emitted from electronic screens have been shown to stimulate photoreceptors in the retina, with certain wavelengths in turn suppressing the release of melatonin, a hormone involved in regulating sleep–wake cycles.^{12,13} Children with small screen devices in their sleep environment may thus have a more difficult time falling asleep than children without electronic devices in their bedroom.

In this study, we examined the presence of small screens in the sleep environment among children with obesity. Better understanding the relationship between the use of small screens and sleep duration in this high-risk population may provide new opportunities to intervene and improve weight management. We hypothesized that the presence of small screens in the sleep environment would be associated with a decrease in total sleep time and later bedtimes among 6- to 12-year-old children with obesity.

METHODS

PARTICIPANTS AND SETTING

The Study of Technology to Accelerate Research was a pediatric obesity management intervention in Eastern Massachusetts that enrolled 549 school-aged children with a BMI \geq 95th percentile. Details regarding recruitment and study design have been published elsewhere.¹⁴ One year after enrollment, parents were asked to complete a survey that included questions about the presence of small screens in the sleep environment, sleep duration, and bed and wake times. Between October 2012 and September 2013, 526 (95.8%) parents completed the survey.

MEASURES

SLEEP

Primary outcomes of this study were mean calculated sleep duration (hours/night) based on parent-reported bedtime and waketime of child. We asked parents open-ended questions to report their children's usual bedtimes and waketimes over the past month separately for weeknights and weekend nights. We then calculated mean sleep duration per night for a usual week based on reported bedtime and waketimes.¹⁴

SMALL SCREENS

To measure the presence of small screens in the sleep environment, we asked parents: How often does your child sleep with a cell phone, smartphone, or any other device that can send or receive chats or text messages near where he/she sleeps, such as in their bed or next to

their bed? Answer options were: Every day of the week; Most days, that is 4-6 days a week; A few days, that is 1-3 days a week; Rarely, less than once a week; Never; or Not applicable. We dichotomized responses for this analysis as: \geq 1 day/week versus rarely/never.

STATISTICAL ANALYSIS

We calculated means and standard deviations for continuous variables and percentages for categorical variables. To measure the strength of the association of small screen presence in the sleep environment with average sleep duration (hours/night), waketimes, and bedtimes, we used multivariable linear regression and calculated 95% confidence intervals (CIs). Models were adjusted for age, sex, race/ethnicity, and household income. In a separate model, we further adjusted for the presence of TV in the bedroom since TV presence has been shown to influence sleep behavior in children.^{2,8}

RESULTS

Children were a mean (standard deviation) age of 10.7 (1.9) years, evenly distributed by sex, and one half of the sample was white (Table 1). After 1 year in the obesity intervention study, nearly all (99.2%) children possessed BMI \geq 85th percentile. In total, 83.2% of children possessed a BMI $>$ 95th percentile and 16.0% of participants had a BMI $<$ 95th percentile but greater than or equal to the 85th percentile. The remainder of the sample (0.8%) had a BMI $<$ 85th percentile. More than one quarter (27.6%) of parents reported that their child slept with or near a small screen a few days to every day per week.

Table 1. Descriptive Characteristics of 526 Children Enrolled in Study of Technology to Accelerate Research at 1-Year Follow-up

Child Characteristics	Mean \pm SD or %
Female, %	46.8
Age, y	10.7 \pm 1.9
Race or ethnicity, %	
Hispanic	14.3
White, non-Hispanic	51.5
Black, non-Hispanic	21.2
Asian, non-Hispanic	4.8
Other, non-Hispanic	8.2
Weight status, %	
Normal weight (BMI $<$ 85th percentile)	0.8
Overweight (BMI \geq 85th percentile to $<$ 95th percentile)	16.0
Obesity (BMI \geq 95th percentile)	83.2
Annual household income (\leq 50k)	31.4
Screens in child sleep environment, %	
Ever sleeps near small screen (every day/most days/a few days)	27.6
TV in bedroom	40.0
Sleep behaviors, mean \pm SD	
Average weekly sleep duration, hh:mm	9:53 \pm 0:45
Average weekday bedtime, hh:mm PM	8:57 \pm 0:44
Average weekend bedtime, hh:mm PM	9:52 \pm 1:00
Average weekday waketime, hh:mm AM	6:39 \pm 0:38
Average weekend waketime, hh:mm AM	8:10 \pm 1:16

SD indicates standard deviation; BMI, body mass index; TV, television; hh, hours; and mm, minutes.

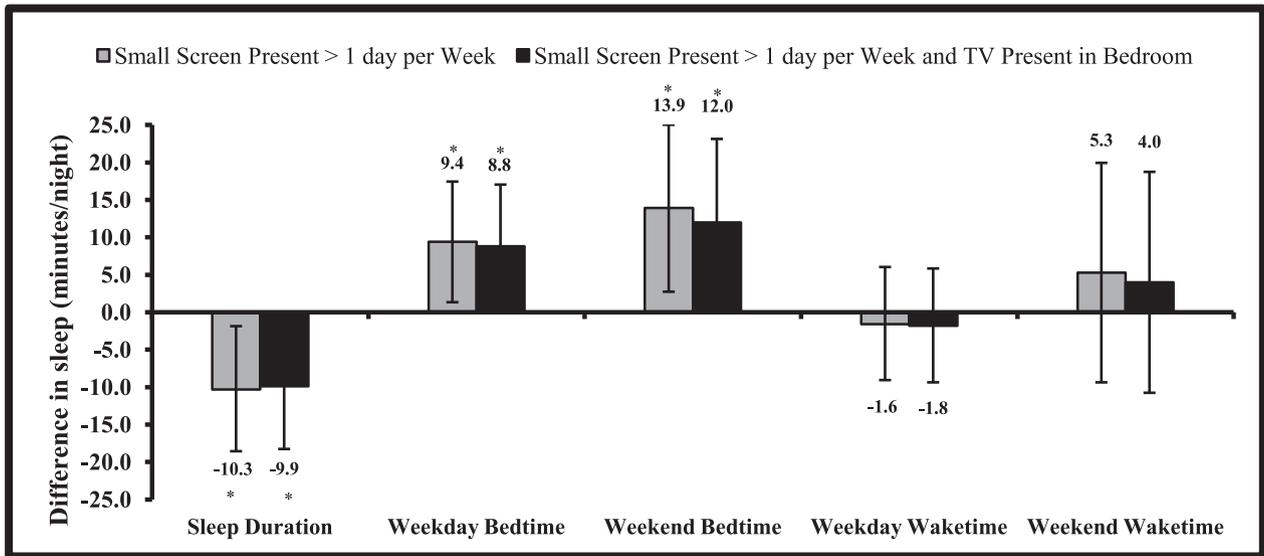


Figure. Associations of small screen and television (TV) presence in child's sleeping environment with sleep behaviors (N = 526).

The Figure and Table 2 present the results of multivariable models. Compared with children whose parents reported they rarely or never slept with a small screen in their bedroom, children whose parents reported they slept with a small screen a few days to every day had shorter sleep duration (−10.3 minutes; 95% CI, −18.6, −1.9, $P = .02$), and later bedtimes on weekdays (9.4 minutes; 95% CI, 1.3–17.4, $P = .02$), and weekends (13.9 minutes; 95% CI, 2.7–25.0, $P = 0.01$). After we adjusted our model for the presence of a TV in the bedroom, small screen presence was still associated with shorter sleep duration (−9.9 minutes; 95% CI, −18.3, −1.5, $P = .02$), and later bedtimes on weekdays (8.8 minutes; 95% CI, 0.7–17.0, $P = .03$) and weekends (12.0 minutes; 95% CI, 0.9–23.1, $P = .03$). Small screens were not associated with waketimes. Adjusting for child BMI also had no effect on these associations.

DISCUSSION

Children with overweight or obesity who slept with a cell phone, smartphone, or other similar device in their bedroom once per week or more were more likely to go to

bed at a later time and sleep less, regardless of having a TV in the bedroom. We found that on average, the presence of these small screens in the bedroom was associated with a 10-minute decrease in sleep time per night. This magnitude of sleep deficit remained nearly the same after we adjusted for the co-presence of TVs, suggesting that small screens present an independent risk for poor sleep hygiene. In addition, children with a device in their room were more likely to go to bed later on both weekdays and weekends.

These findings extend those in previous studies examining the relationship between media and/or electronic device presence in the sleep environment and sleep deprivation.^{8-9,15} These studies showed that allowing children to bring an electronic device into their bedroom can have an adverse effect on sleep duration, efficiency, and quality when using a device immediately before bed.^{8,9,15} One pathway for shorter sleep duration associated with small screens use likely includes melatonin suppression, resulting in sleep onset delay.^{12,13} Screen time shortly before bed also is associated with a reduction of time in rapid-eye movement sleep, which can lead to morning sleepiness.¹³

Table 2. Associations of Small Screen and TV Presence in Child's Sleeping Environment With Sleep Behaviors (N = 526)

	Sleep Duration, min	Weekday Bedtime, min	Weekend Bedtime, min	Weekday Waketime, min	Weekend Waketime, min
Model 1*					
Presence of small screen in sleep environment, 1 day/week or more [‡]	-10.3 [†] (-18.6, -1.9)	9.4 [†] (1.3, 17.4)	13.9 [†] (2.7, 25.0)	-1.6 (-9.1, 6.0)	5.3 (-9.4, 19.9)
Model 2[§]					
Presence of small screen in sleep environment, 1 day/week or more [‡]	-9.9 [†] (-18.3, -1.5)	8.8 [†] (0.7, 17.0)	12.0 [†] (0.9, 23.1)	-1.8 (-9.4, 5.8)	4.0 (-10.8, 18.7)

Values are shown as β (95% confidence interval).

*Results from multivariable linear regression models, adjusted for age, sex, race/ethnicity, and household income.

† $P < .05$.

‡Reference group reported never or rarely used small screens in their sleep environment.

§Additionally adjusted for presence of TV in bedroom.

As small screens continue to become more prevalent and accessible to children,^{10,11} recognizing the possible harms associated with having these devices in children's sleep environment will be of importance. Even a modest difference in children's sleep duration can have significant effects on mood and behavior.^{16,17} Two recent randomized control studies found that participants whose school start time was delayed by 15 to 25 minutes reported longer sleep durations, greater daytime attentiveness, decreased daytime sleepiness, and had fewer emotional problems than their peers attending schools at earlier start times.^{16,17}

Shorter sleep duration and later bedtimes also have been shown to be associated with increased risk of weight gain and being overweight among children and adolescents.^{5,18} This association is complex and may be due in part to increased caloric intake, daytime sleepiness resulting in decreased physical activity levels, and hormonal dysregulation.^{19,20} Lack of sleep has been shown to correlate strongly with increased ghrelin levels and decreased leptin levels, leading to increased hunger and less satiety.^{8,20} This hormone imbalance may lead individuals to overeat or choose calorie-dense foods, behaviors unhelpful to achieving a healthier weight.

A healthy sleeping routine is important for child growth and development, but particularly for children who may already be at risk for negative health outcomes, such as overweight and obesity. The American Academy of Pediatrics recommends removing all screens from the sleep environment and keeping the bedroom a "media-free" space.²¹ Parents can establish household rules to keep small screens out of bedrooms and implement bedtime routines such as reading a book before sleep in lieu of use of electronics.¹⁶ Our study provides additional evidence to reinforce maintaining media-free bedrooms.

This study has several limitations. The data on small screen presence in the bedroom as well as bedtimes and waketimes were parent-reported. Parent-reported sleep data are prone to social desirability bias. In several studies assessing sleep in both school-aged children and adolescents, parents significantly idealized their child's sleep hygiene, overestimating their average sleep duration as well as reporting earlier bedtimes and later wake-up times than actigraphy measurement.^{22,23} In addition, because the sleep data were parent-reported, only the device presence in the bedroom, and not their usage, was able to be assessed in this analysis. Another study limitation is that we did not inquire about, and thus were unable to assess, differences in daytime sleep behaviors such as drowsiness, naps, and fatigue between the children with a small screen present once or more per week and those without a device present. This study's cross-sectional design means we cannot infer causality. The data were from a larger obesity intervention study, which may therefore underestimate the true association between small screen presence and sleep behaviors among the general population of children with overweight or obesity who have not received any weight management counseling.

To our knowledge, this is the first study to examine the presence of small screens in the sleep environment specifically in children with overweight or obesity. Our findings extend those from previous studies among all children—both healthy weight and overweight—that screen presence in the sleeping environment is associated with alterations in sleep duration and bedtime. These results add to the growing literature on the associations of screen time and BMI.^{1,8-9,15}

In the future, similar studies assessing small screen use in the sleep environment could further inquire about the activities that children use on their devices. This could include questions regarding whether the device has access to the internet, texting capabilities, or certain social media applications. In addition, future research should be directed at examining the relationship between children's bedtime small screen use and daytime behaviors such as fatigue, naps, and school performance. Future research studies also should use device applications and operating systems that now measure device usage, which would assist in increasing the accuracy of assessing screen time use of smartphone users.

In conclusion, this study found that children with overweight or obesity who have a small screen present in their sleep environment have shorter sleep durations and later bedtimes compared with children with overweight or obesity who never or rarely sleep with a small screen. As the age at which children in the United States gain access to a smartphone continues to decrease, and the prevalence of smartphone use among children continues to increase, much remains to be learned about the impact of smartphone ownership on children's health and health behaviors.¹⁰ As part of weight management and healthy sleep habits counseling for children with overweight and obesity, pediatricians should consider inquiring about small screen presence in the bedroom and recommend media-free bedrooms.

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