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Quantity, content, and context matter: Associations among social technology use and sleep habits in early adolescents

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Abstract

Purpose—To investigate associations of social technology access and content, bedtime behaviors, parental phone restrictions, and timing and duration of sleep on school nights in early adolescents.

Methods—Adolescents (aged 11–15 years, n = 772) in the Northeast US completed an online survey during or after school in spring 2019.

Results—Quantity of social technology use (e.g. checking social media (SM), problematic internet behaviors, mobile use), content viewed (e.g., emotional or violent videos, risky behaviors), and social context (e.g. bedtime behaviors, starting SM at an early age) were significantly related to later bedtimes and fewer hours of sleep on school nights. Parental rules restricting mobile phone and online use before bed and obtaining a smartphone at a later age were associated with *increased* sleep time and *earlier* bedtime.

Conclusions—Quantity, content, and context of social technology use may affect sleep timing and duration in early adolescents.

Social technologies (ST) such as interactive digital media and social media (SM) provide potential benefits as tools for communication, entertainment, education, and social inclusion and support[1]. 95% of US teens have access to smartphones and 45% report that they are "almost constantly" online[2]. 97% of 13- to 17-year-olds use at least one SM platform[1] such as Snapchat or Instagram. Whether any benefits are realized may depend on the child's age, developmental stage, and personality, as well as the specific content seen and how it is experienced[1]. These technologies also have mental[3] and physical[1] health risks, including a

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negative impact of ST use on sleep, due to factors such as displaced bedtime, disruption of circadian rhythms by the devices' light emission, nighttime smartphone alerts, and increased cognitive arousal[4]. The American Academy of Pediatrics (AAP) has recommended that parents and caregivers turn off screens for children 60 minutes before bedtime[5]. The AAP has also recommended that families create an individualized Family Media Use Plan that can help improve sleep habits[1]. Many adolescents, however, and take devices to bed, use devices in the hour before sleep, and wake to check SM[6]. The apparent prioritization of SM over sleep can result in insufficient and poor quality sleep with subsequent detrimental effects on health and wellbeing[4]. Indeed, the UK Millennium cohort study of adolescents aged 13–15 confirmed that greater SM use is related to poor sleep habits, such as late sleep onset and wake times and frequent sleep disruptions[7]. A longitudinal study of 13 to16 year olds from Australia reported that night-time phone use was positively associated with poor self-esteem, coping, and sleep behaviors.[8]

Quantity of ST use is probably only one factor in sleep disruption; research suggests the need to focus also on content (e.g., *what* are they exposed to online?) and context (e.g., are parents restricting use?)[9]. Evolving social norms and expectations around a person's constant online availability present unique challenges for ST use and sleep, since the enabling of 24/7 accessibility facilitates competition between social interactions and healthy sleep[4,9]. The same amount of time spent on SM may have different impacts depending on how and when the user engages with it[9]. For example, the content displayed by one's online networks, or cognitive factors such as the "fear of missing out"[10] ("FoMO"), can impact adolescents differently depending on their mental health or social status. Of note, girls are more vulnerable to the sleep-mediated associations between frequent SM use and health outcomes than boys[11]. While youth are initiating ST use at younger ages, studies have mostly focused on older adolescents. We have therefore chosen to fill the knowledge gap by investigating associations among ST frequency, content, and context that can affect timing and duration of sleep on a school night in early adolescents aged 11–15 years.

Methods

Participants

Data from this cross-sectional study of 772 6–8th grade students from four Northeast US schools were collected in February to June 2019. Using a combination of validated and self-created items, measures were piloted in 2017–2018 through a different cohort of 700 middle school students; revisions were pre-tested for language and length via phone interview with three students from the target age group. With institutional and school district approvals, parents could opt out of their child's participation before data collection; students provided assent. Schools and teachers received incentives to help with survey administration. Students used school-provided laptops to complete a 40-minute survey during a pre-determined time. Participation rates ranged from 42% in the afterschool programs to 91% in the whole school data collection, which included a 5.7% parental opt-out or absence on the day the survey was administered for the whole school.

Measures

The Qualtrics (Qualtrics Labs, Provo, UT) survey asked questions pertaining to SM, internet, and phone use, content of websites/SM posts, behaviors within one hour of bedtime, bedtime, sleep duration, and phone/screen restrictions (Table 1).

Data analyses.—Two types of linear regression models were used to model the predictors on hours of sleep and bedtime. Single predictor regression models were used to model relationships between SM, internet use, and phone use on sleep duration and bedtime. Multiple predictor regression models were used to separately model content of websites/SM posts, pre-bedtime behaviors, and type of YouTube/internet videos watched on hours of sleep and bedtime (defined in Table 1). We calculated total sleep duration based on hourly increments through self-report ranging from 4 hours or less to 10 hours or more. Each regression model controlled for gender, age, free or reduced-price lunch eligibility, race/ethnicity, and two-parent household.

Results

Fifty percent of the 772 participants were female. Sixth, 7th and 8th graders constituted 33%, 35% and 32%, respectively. Participants self-identified as 57% White, 18% Latinx, 12% Black, 5% Asian, 5% Biracial, and 3% Native American. Free or reduced-price lunch was reported by 24%. 69% lived in a two-parent household. Average age was 12.6 (SD=.1.0; range= 11–15 years) years. On average, participants had a 10pm bedtime (10th & 90th %-ile =9pm & 11pm; range=9pm to 1am or later) and slept 7.5 hours on a typical school night (10th & 90th %-ile =6 hours & 9 hours; range=4 to 10 hours).

More frequently engaging in checking SM, problematic internet behaviors, fear of missing out (FoMO), problematic digital technology use, and watching more emotional or violent videos were significantly related to later bedtimes and fewer hours of sleep on a typical school night (Table 2). Participants who acknowledged losing sleep because they couldn't quit online activities went to bed later and slept less. Seeing posts related to weight was significantly associated with reduced sleep, and seeing messages related to drugs/drinking was significantly related to later bedtime. Other message types, such as hate messages and self-harm, were not significantly related to sleep behaviors. Watching YouTube videos before sleep was related to later bedtime and reduced sleep time; checking SM before bed was related to later bedtime. Parental rules restricting mobile phone and online use before bed and obtaining a smartphone at a later age were associated with *increased* sleep time and *earlier* bedtime. Reading books was the only bedtime behavior associated with an earlier bedtime.

Discussion

Our findings reveal the importance of quantity, content and context of SM use on sleep timing and duration in young adolescents, however, the cross-sectional nature of the study precludes conclusions about the directionality of the findings. We distinguished between types of bedtime behaviors by adding contextual details about a range of screen-based (e.g. games, texting, internet use) and non-screen-based (e.g. book reading, eating snacks)

behaviors and expanded the context of bedtime screen behaviors beyond the existence of bedroom devices and quantity of ST exposure. We could therefore document the type of online content that is associated with later bedtimes and less sleep, including self-described emotionally disturbing or violent content and being exposed to the promotion of risky behaviors. Reading books/kindles was a bedtime behavior that was not associated with later bedtime, suggesting that it might be easier to self-regulate curfews around reading compared to other bedtime screen-related behaviors. This is consistent with the known delaying effect of a screen's blue light on the circadian rhythm[4]. Alternatively, reading books may be associated with adolescents' agency to self-regulate their sleep time by avoiding either the socially interactive components or the algorithmically-generated content that beckons with screen media[12].

Our findings provide evidence that adolescent self-report of personal issues with self-regulation of online content is related to negative sleep outcomes. The specific predictors that we identified should be tested as intervention targets toward healthier sleep habits in early adolescents[13], such as parental phone restrictions, age at SM initiation, or online peer obligations that are magnified with particular social media sites. In addition, asking adolescents at a pediatrician's office whether they can quit being online before bedtime could be an expedient way to determine if a more thorough evaluation of sleep health and ST use is necessary.

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Implications and Contribution

Frequency of social technology use is one known factor influencing healthy early adolescent sleep outcomes. Documenting bedtime habits and specifics of online content that negatively affect sleep outcomes can be initial steps when designing interventions for parents and practitioners to encourage healthier social technology use.

Table 1.

Construct Description, Sample Descriptives and Correlations

Construct and Description	Mean(SD) or Percent	Hours of Sleep (*r*)	Bedtime (*r*)
Social Media and Internet Use			
Frequency of social media: "On a typical school week, how often do you check.... Social Media (like Instagram)"[a]	3.78 (1.92)	−0.18**	0.25**
Problematic internet behaviors (3 items): "How often do you: Lose motivation to do other things that need to get done because of the internet?"; "Feel nervous or anxious when you're NOT online?"; "Become moody or depressed when you're not online?" (Cronbach's alpha=.74)[b]	1.85 (.83)	−0.23**	0.19**
Fear of missing out (3 items): "I get worried when I find out my friends are having fun without me."; "Sometimes, I wonder if I spend too much time keeping up with what is going on."; "When I have a good time it is important to update my status and share the details online." (Cronbach's alpha=.60)[c]	1.61 (.62)	−0.16**	0.19**
Loss of sleep due to internet use: "How often do you: Lose sleep because you can't quit what you're doing online?"[b]	1.81 (1.04)	−0.40**	0.37**
Problematic digital technology use (3 items): "When my mobile phone alerts me to indicate new messages, I cannot resist checking them.", "I often think about calls or messages I might receive on my mobile phone.", "I feel like I use my mobile phone too much." (Cronbach's alpha=.68)[d]	2.61 (1.01)	−0.20**	0.19**
Often watch emotionally disturbing videos: "How often do you watch emotionally disturbing videos on YouTube or the Internet (e.g., scary, tragic)?"[b]	1.75 (1.05)	−0.22**	0.20**
Often watch violent or disturbing videos: "How often do you watch violent or disturbing videos on YouTube or the Internet (e.g., rated R)?"[b]	1.73 (1.10)	−0.25**	0.25**
Websites/Social Media Posts			
Weight messages: "ways to be very thin (such as being anorexic)"[e]	15%	−0.17**	0.14**
Hate messages: "hate messages that attack certain groups or individuals"[e]	20%	−0.10**	0.13**
Drugs/drinking: "sharing experiences of taking drugs or drinking"[e]	17%	−0.18**	0.24**
Self-harm: "ways of physically harming or hurting themselves"[e]	13%	−0.15**	0.17**
Behaviors within 1 hour of sleep			
Watch YouTube videos[f]	2.51 (1.24)	−0.30**	0.32**
Text friends[f]	2.21 (1.17)	−0.25**	0.33**
Check social media[f]	2.26 (1.26)	−0.28**	0.36**
Play online games[f]	1.77 (1.03)	−0.17**	0.20**

Construct and Description	Mean(SD) or Percent	Hours of Sleep (*r*)	Bedtime (*r*)
Read a book/kindle[f]	1.68 (.99)	0.06	−0.16**
Eat a snack or treat[f]	2.15 (1.10)	−0.17**	0.20**
Phone Use and restrictions			
Frequency of text messages: "On a typical school week, how often do you check....Text or Imessages"[a]	3.94 (1.53)	−0.18**	0.21**
Screen restrictions at bedtime: "When are you NOT allowed to use your phone or go online?... At bedtime"[e]	50%	0.22**	−0.27**
Age received smartphone: "How old were you when you first got your own smartphone (with internet)?"[g]	10.40 (1.35)	0.08*	−0.16**

[a]Response scale: 1= Never/Does not apply to 6= More than every hour

[b]Response scale: 1= Never to 5=Very Often

[c]Response scale: 1= Not at all true of me to 4= Extremely true of me

[d]Response scale: 1= Strongly Disagree to 5=Strongly Agree

[e]Response scale: 0=No, 1=Yes

[f]Response scale: 1= Never to 4= Most nights

[g]Response scale: 8= 8 yrs or younger to 14= 14 yrs and older

*p<.05,

**p<.01

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Table 2.

Linear Regression Results

		Hours of Sleep B (SE)	Bedtime B (SE)
Single Predictor Regression Models			
Social Media and Internet Use			
Frequency of social media		−0.09 (0.03)**	0.11(0.02)**
	R^2	0.09	0.11
Problematic Internet Behaviors		−0.45(0.11)**	0.29(0.08)**
	R^2	0.10	0.10
Fear of Missing Out		−0.40(0.12)**	0.38(0.09)**
	R^2	0.10	0.11
Loss of sleep due to internet use		−0.49(0.05)**	0.36(0.04)**
	R^2	0.20	0.19
Problematic Digital Technology Use		−0.24(0.07)**	0.19(0.05)**
	R^2	0.09	0.09
Phone Use			
Frequency of text messages		0.12(0.04)**	0.12(0.03)**
	R^2	0.09	0.10
Screen restrictions at bedtime		0.56(0.10)**	−0.51(0.08)**
	R^2	0.12	0.13
Age received smartphone		0.15(0.04)**	−0.19(0.03)**
	R^2	0.10	0.13
Multiple Predictor Regression Models			
Websites/Social Media Posts			
Weight messages		−0.42(0.15)**	0.13(0.11)
Hate messages		0.04(0.14)	0.06(0.10)
Drugs/drinking		−0.20(0.16)	0.36(0.12)**
Self-harm		−.029(0.18)	0.19(0.13)
	R^2	0.10	0.11
Behaviors within 1 hour of sleep			
Watch YouTube videos		−0.23(0.05)***	0.13(0.04)***
Text friends		0.03(0.07)	0.05(0.05)
Check social media		−0.11(0.07)	0.12(0.05)*
Play online games		−0.03(0.06)	0.03(0.04)
Read a book/kindle		0.09(0.05)	−0.16(0.04)***
Eat a snack or treat		−0.05(0.05)	0.06(0.04)
	R^2	0.16	0.21
Video types			

		Hours of Sleep B (SE)	Bedtime B (SE)
Often watch emotionally disturbing videos		−0.14(0.05) **	0.09(0.04) *
Often watch violent or disturbing videos		−0.28(0.05) ***	0.22(0.04) ***
	R^2	0.15	0.14

* B(SE)= Unstandardized Coefficient (Standard Error);

* p<=.05,

** p<=.01,

*** p<=.001

** All models controlled for age, free/reduced price lunch, gender, two parent household and race/ethnicity.