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Adolescent Sleep and Technology Use Rules: Results from the California Health Interview Survey

Jennifer M. Bowers, Anne Moyer

Stony Brook University

Abstract

Objectives: This study reports on adolescent sleep, technology use rules in the home, and their potential association using the 2017 California Health Interview Survey (CHIS).

Methods: CHIS cross-sectional, representative survey data was collected between June-December 2017 via telephone. Weekday bedtimes, rise times, and nightly time in bed in the past week, as well as whether technology use rules were implemented at home were examined among 448 adolescent residents of California ($M_{age} = 14.5$, range = 12-17; 48% female).

Results: The average weekday nightly time in bed was 9.04 hours among 12-13-year-olds and 7.89 hours among 14-17-year-olds. The majority reported having technology use rules and those who did spent 35 more minutes in bed. Although a significant relationship was found between having technology use rules and earlier bedtime, one was not found for time in bed, when controlling for demographics.

Conclusions: Many California adolescents do not meet recommended sleep guidelines. Yet, technology use rules appear to be associated with earlier bedtime. Results have implications for policy-making and adolescent sleep interventions.

Keywords

adolescents; sleep; technology; California; parenting

Sleep is an essential aspect of adolescent physical and mental health¹, yet many adolescents do not meet National Sleep Foundation (NSF) recommendations that children ages 6-13 should sleep for 9 to 11 hours per night and teenagers ages 14-17 should sleep for 8 to 10 hours per night². Several factors may explain insufficient and poorly timed sleep in adolescents, culminating in a “perfect storm”³, including factors associated with later bedtimes such as homework⁴, a lack of parent-set bedtimes^{5,6}, and technology use^{7,8}; factors that contribute to earlier rise times such as early school start times^{9,10}; as well as the sleep/wake homeostatic processes and circadian rhythms that shift around puberty such that adolescents prefer later bedtimes and waketimes³. Although biological factors cannot be intervened upon, several others can, and technology use is of recent interest for studying adolescent sleep.

Numerous studies show consistent relationships between technology use and poor sleep outcomes; technology use appears to interfere with both sleep onset and duration, especially when used at night or when present in the bedroom⁷. Although causal relationships are not confirmed, several mechanisms may explain this association: time is displaced that would have been spent sleeping, light can effect alertness, and psychological and physical arousal may increase⁸. New research shows the relationship to be bidirectional as well, with young people perhaps using technology when experiencing difficulty sleeping¹¹. Therefore, parents may implement rules curbing media use before bedtime¹²; a recent survey indicated that about 75% of parents implemented rules about technology before sleep, with parents of younger children enforcing more rules⁶. However, the use and benefits of such rules has not been studied extensively.

The aims of this study are to report on adolescent sleep, technology use rules, and their potential association using the largest state health survey in the US, the 2017 California Health Interview Survey (CHIS). Until this point, the CHIS had not included measures of sleep; this study is the first to report representative sleep data for California adolescents. An important conversation is ongoing about adolescent sleep health in the US and in California; the California governor recently vetoed a bill that would have implemented an 8:30AM or later start time for most middle and high schools¹³ as recommended by the American Academy of Pediatrics¹⁴, and policy conversations about the sleep needs for California adolescents continue. Current descriptive data about adolescent sleep is therefore important to inform policymakers and families.

Methods

The California Health Interview Survey

Data were obtained from the adolescent sub-sample of the 2017 CHIS, a telephone-administered health survey representative of California's noninstitutionalized population. CHIS 2017 data were collected between June and December using a multi-stage sampling design. Sleep and technology questions were only directed to adolescents. Random-digit dialing methodology was most often used to reach landline and cellphone numbers of adults (ages 18+), and available adolescents (ages 12-17) were consented and interviewed separately and independently before or after adult interviews. Geographical stratification of 58 counties was used, and survey weights, based on state population estimates and projections from the California Department of Finance, are used in this study to make the reported data representative of the 2017 California adolescent population¹⁵. Further information about CHIS methodology is available elsewhere¹⁵. SAS 9.4 programming was used for data analysis.

Measures

Age, race/ethnicity, gender, and school attendance were among the demographics and background assessed. Participant ages were divided into two groups based on NSF sleep recommendations: ages 6-13 and 14-17. Weeknight bedtime was measured using the item, "During the past week, on nights when you had school the next day, what time did you usually go to bed?". Weekday rise time was measured using the item, "During the past week,

on school days, what time did you usually get up?”. These items were reported as clock time (e.g., 9:25 PM), then total time in bed on weeknights was reported in the data by subtracting the time difference between each participant’s bedtime and rise time, and reported in total hours (e.g., 7.5 hours). Having technology use rules was measured using the item, “Do you have rules in your home about when you are supposed to turn off or put away computers, phones or other electronics, such as during meal times or a specific time at night?” for which response options were *yes* or *no*.

Analytical Approach

Means and standard deviations were used to describe the sample’s demographic data. Means, standard errors, and weighted percentages were used to report descriptive data on sleep and technology use rules. Chi-square was used to test for differences in technology use rules by age group and gender. Linear regression was used to test for differences in continuous sleep outcomes by technology use rules, and age and gender were used as covariates. Alpha was set to .05. Sampling weights (80 replicate weights) were applied using the jackknife method of variance estimation. Therefore, denominator degrees of freedom (DDF) for F-test analyses are 79. SAS 9.4 survey procedures were used for all analyses to account for sample weighting.

Results

The total sample size was 448, with a mean age of 14.49 years old ($SD = 1.68$, range = 12-17); 145 participants were in the younger age group of 12-13-years-old, and 303 were 14-17-years-old. Forty-eight percent were female, 48% were non-Hispanic White, 34% were Hispanic, 7% were non-Hispanic Asian, and 4% identified another race, consistent with the makeup of race/ethnicity in California. Gender differences were not found across age groups, $X^2(1) = 2.10$, $p = 0.15$. Eighty-two percent attended school in the last week, 9% did not, 9% indicated they were on vacation, and less than 1% were homeschooled. Sensitivity analyses that sought to determine any influence of school attendance are reported.

Table 1 reports outcome data, including by age and gender. The average weekday bedtime was about 10:01PM (SE = 4.60). The average weekday rise time was about 6:19 AM (SE = 3.17). The average weeknight time in bed in the overall sample was 8.29 hours (SE = 0.08), 9.04 hours in the younger group (SE = 0.11), and 7.89 hours in the older group (SE = 0.11). A large portion (37.21%) of the younger group did not report enough time in bed to meet the NSF minimum recommendation of 9 hours of sleep, and a large portion (39.32%) of the older group also reported fewer than their respective minimum recommendation of 8 hours. Those who did not attend school in the past week reported rising two minutes earlier (6:17AM vs. 6:19 AM), going to bed 15 minutes earlier (9:46 PM vs. 10:01 PM) and thus spending 13 minutes more in bed on average compared to those who attended school.

The majority of the overall sample reported having technology use rules (70.20%, SE = 3.86), as well as the younger group (76.37%, SE = 7.19), and the older group (66.82%, SE = 4.56). A Chi-square test did not show significant differences in technology use rules by age groups, $X^2(1) = 1.34$, $p = 0.25$, or school attendance, $X^2(1) = .77$ $p = .38$; however, males were more likely than females to report having such rules, $X^2(1) = 5.57$ $p = .02$ (see Table

1). Among those reporting having technology use rules, total sleep time was 8.47 hours, and among those reporting not having such rules, it was 7.89 hours (a difference of 35 minutes per night).

Table 2 presents regression analysis results. Linear regression indicated a significant relationship between having technology use rules and earlier weekday bedtime, controlling for age and gender. Age was also significantly related to technology use rules in the model, however gender was not. Linear regression indicated a non-significant relationship between having technology use rules and increased weekday total time in bed when controlling for age and gender. Age was significantly related to technology use rules in the model, but gender was not. Sensitivity analyses involved running these models excluding those who did not attend school in the past week; no meaningful differences were found among any variable or model estimate.

Discussion

This study found that many (about 40% or more of) California adolescents report time in bed that falls short of NSF minimum recommendations for sleep durations in the past week. On average, younger adolescents ages 12-13 only narrowly reported time in bed that matches sleep duration minimums, with an average of 9.04 hours in bed, and older adolescents ages 14-17 did not, with an average of 7.89 hours. Time in bed reported among other adolescent samples indicate similar averages of 7.5-8.25 hours¹⁶¹⁷. Most, including younger and older adolescents alike, reported having rules in the home about putting away technology at certain times for any specific scenario. Having such technology use rules was associated with earlier weekday bedtimes when controlling for age and gender. Younger age explained large amounts of variance in both earlier bedtimes and increased total time in bed, independent of technology use rules. Technology use rules and gender also contributed to explaining total time in bed but were non-significant predictors; descriptive data indicates that female participants rose earlier and went to bed later than males. Males also were more likely to report having technology use rules in the home. Adolescents in this study reporting having technology use rules averaged 35 additional minutes in bed on school nights compared to those without; this much additional time may be clinically relevant among adolescents, a group that does not sleep adequate amounts on average. These results suggest that implementing parental rules about putting away technology at a certain time (including, but not necessarily at bedtime) may promote improved sleep outcomes for adolescents and inform interventions. However, further study is needed to determine the effectiveness of psychoeducational interventions for adolescent sleep outcomes, beyond the effectiveness of reduced nighttime media use, as was the challenge of one recent intervention¹⁸

Limitations to this study include its cross-sectional design, which only allows for associations and not causal inferences. Further research in this area should more specifically examine technology use rules to understand the extent to which rules are being followed; the question in this survey did not get at this directly and did not necessarily refer specifically to bedtime rules (only as one example). Factors such as parent-set bedtimes and parenting style may partially explain sleep patterns of adolescents but were not measured in the study. Sleep was self-reported and thus is subject to potential reporting biases as well as differing

interpretations of the items. Subjective, self-report measures of sleep typically overestimate sleep durations, especially among those with shorter durations¹⁹. However, self-report measures are more common and practical, and the specific and recent recall period of the past week may promote accuracy. Finally, although this study captures sleep opportunity that can provide insight for how many adolescents reported insufficient sleep based on their time in bed (about 40%), it is unclear how many of the remaining 60% may or may not get sufficient sleep during this total time in bed. Time in bed includes shuteye latency, especially for those using technology before sleeping²⁰.

This study is the first to report sleep wake patterns from the CHIS, one of the largest national health surveys and the largest state health survey in the US. The relationship between technology use rules and earlier bedtimes may be informative starting points for families and interventions. The descriptive sleep data reported in this study support the contention that the average California adolescent does not meet recommended sleep guidelines. Although the school start time bill was vetoed in late 2018, California State Senator Portantino plans to “bring this important public health issue back [this] year” and Governor Brown encouraged local communities to consider the issue of adolescent sleep¹³. Research and policy about sleep is important for adolescents everywhere. Because California is often a role model for US state-level public health policy for adolescents, such as indoor tanning bans²¹, it is important to consider current, representative data to inform policy for this state and adolescents broadly.

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References

1. Shochat T, Cohen-Zion M, Tzischinsky O: Functional consequences of inadequate sleep in adolescents: A systematic review. *Sleep Med Rev* 2014;18(1):75–87. doi: 10.1016/j.smrv.2013.03.005 [PubMed: 23806891]
2. Hirshkowitz M, Whiton K, Albert SM, et al.: National Sleep Foundation’s sleep time duration recommendations: Methodology and results summary. *Sleep Health* 2015;1(1):40–43. doi: 10.1016/j.sleh.2014.12.010 [PubMed: 29073412]
3. Crowley SJ, Wolfson AR, Tarokh L, et al.: An update on adolescent sleep: New evidence informing the perfect storm model. *J Adolesc* 2018;67:55–65. doi: 10.1016/j.adolescence.2018.06.001 [PubMed: 29908393]
4. Carskadon MA: Factors influencing sleep patterns of adolescents, in *Adolescent Sleep Patterns: Biological, Social, and Psychological Influences*. Edited by Carskadon MA. New York, NY, US, Cambridge University Press, 2002, pp. 4–26.
5. Short MA, Gradisar M, Wright H, et al.: Time for bed: Parent-set bedtimes associated with improved sleep and daytime functioning in adolescents. *Sleep* 2011;34(6):797–800. doi: 10.5665/SLEEP.1052 [PubMed: 21629368]
6. Buxton OM, Chang AM, Spilsbury JC, et al.: Sleep in the modern family: Protective family routines for child and adolescent sleep. *Sleep Health* 2015;1(1):15–27. [PubMed: 26779564]
7. Cain N, Gradisar M: Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep Medicine* 2010;11(8):735–42. doi: 10.1016/j.sleep.2010.02.006 [PubMed: 20673649]
8. Hale L, Guan S: Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Medicine Rev* 2015;21:50–58. doi: 10.1016/j.smrv.2014.07.007

9. Bowers JM, Moyer A: Effects of school start time on students' sleep duration, daytime sleepiness, and attendance: a meta-analysis. *Sleep Health* 2017;3(6):423–31. doi: 10.1016/j.sleh.2017.08.004 [PubMed: 29157635]
10. Minges KE, Redeker NS: Delayed school start times and adolescent sleep: A systematic review of the experimental evidence. *Sleep Med Rev* 2016;28:86–95. doi: 10.1016/j.smrv.2015.06.002 [PubMed: 26545246]
11. Mazzer K, Bauducco S, Linton SJ, et al.: Longitudinal associations between time spent using technology and sleep duration among adolescents. *J Adolesc* 2018;66:112–19. doi: 10.1016/j.adolescence.2018.05.004 [PubMed: 29842997]
12. Hale L, Kirschen GW, LeBourgeois MK, et al.: Youth screen media habits and sleep: Sleep-friendly screen behavior recommendations for clinicians, educators, and parents. *Child Adolesc Psychiatr Clin N Am* 2018;27(2):229–45. doi: 10.1016/j.chc.2017.11.014 [PubMed: 29502749]
13. Harrington T: Rejecting one-size-fits-all approach, California governor vetoes later school start time bill [EdSource]. 9 20, 2018 Available at: <https://edsource.org/2018/rejecting-one-size-fits-all-approach-california-governor-vetoes-later-school-start-time-bill/602602>
14. American Academy of Pediatrics: Let them sleep: AAP recommends delaying start times of middle and high schools to combat teen sleep deprivation [AAP website]. 8 25, 2014 Available at: <https://www.aap.org/en-us/about-the-aap/aap-press-room/pages/let-them-sleep-aap-recommends-delaying-start-times-of-middle-and-high-schools-to-combat-teen-sleep-deprivation.aspx>
15. Dutwin D, Sherr S, Goyle A, et al.: CHIS 2017 Methodology Report, 2018 Available at: www.chis.ucla.edu
16. Hysing M, Pallesen S, Stormark KM, Lundervold AJ, Sivertsen B: Sleep patterns and insomnia among adolescents: a population-based study. *J Sleep Res* 2013;22: 549–556. doi:10.1111/jsr.12055 [PubMed: 23611716]
17. Knutson KL, Lauderdale DS: Sociodemographic and behavioral predictors of bed time and wake time among US adolescents aged 15 to 17 years." *J Ped* 2009;154(3): 426–430.
18. Das-Friebel A, Perkinson-Gloor N, Brand S, et al.: A pilot cluster-randomised study to increase sleep duration by decreasing electronic media use at night and caffeine consumption in adolescents. *Sleep Med* 2018; doi: 10.1016/j.sleep.2018.11.010
19. Lauderdale DS, Knutson KL, Yan LL, et al.: Self-reported and measured sleep duration: how similar are they? *Epidemiol* 2008;19(6): 838–845.
20. Exelmans L, Van den Bulck J: Bedtime, shuteye time and electronic media: Sleep displacement is a two-step process. *J Sleep Res* 2017;26(3): 364–370. [PubMed: 28271575]
21. Mayer JE, Swetter SM, Guild S, et al.: The impact of indoor tanning legislation: Newspaper coverage of the risks of indoor tanning before and after the California indoor tanning ban for minors. *J Cancer Educ* 2015;30(1):124–9. doi: 10.1007/s13187-014-0672-4 [PubMed: 24882438]

Table 1

Sleep and Technology Rules Outcomes by Age and Gender (N = 448)

	Weekday Rise Time (SE, min.)	Weeknight Bedtime (SE, min.)	Time in Bed, hrs. (SE, min.)	Technology Rules % (SE)
All (<i>N</i> = 448)	6:19 AM (3.17)	10:01 PM (4.60)	8.29 (.08)	70.20 (3.86)
95% C.I.	6:13 AM - 6:25 AM	9:52 PM - 10:10PM	8.13 - 8.46	
Range	4:00 AM - 11:00 AM	7:00 PM - 5:00AM	4.0 - 11.0	
Age Groups				
12-13 (<i>n</i> = 145)	6:25 AM (5.83)	9:22 PM (7.73)	9.04 (.11)	76.37 (7.19)
14-17 (<i>n</i> = 303)	6:16 AM (3.98)	10:23 PM (6.65)	7.89 (.11)	66.82 (4.56)
Gender				
Female (<i>n</i> = 216)	6:14 AM (5.09)	10:10 PM (8.00)	8.08 (.14)	60.94 (5.90)
Male (<i>n</i> = 232)	6:23 AM (4.46)	9:53 PM (7.08)	8.50 (.12)	79.05 (4.97)

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Table 2

Summary of Regression Analyses for Variables Predicting Adolescents Bedtime and Total Time in Bed (N = 448)

Variable	Bedtime					Time in Bed						
	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>p</i>	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>p</i>		
Technology Rules	28.89	10.75	.18	2.69	.009	.32	.18	.12	1.77	.08		
Age	17.25	2.96	.39	5.82	<.0001	-.32	.04	-.42	-7.13	<.0001		
Gender (Female)	8.76	11.42	.06	.77	.44	.31	.18	.12	1.71	.09		
<i>R</i> ²					.22					.24		
<i>F</i>					41.77	<.0001					45.72	<.001

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