



Sleep Deprivation among Rhode Island High School Students

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Sleep is an essential component in adolescent health, well-being and development.¹ As children develop and mature into teenage years, biological changes alter circadian rhythms and the urge to fall asleep decreases, resulting in later sleep onsets.² Practical factors of teenage sleep deprivation include school responsibilities, family commitments, after-school jobs, extracurricular activities, and social media. Lack of sleep has been associated with an increased risk for injuries, hypertension, obesity and depression.^{3,4} Guidelines from the American Academy of Sleep Medicine (AASM) recommend teens ages 13–18 years receive 8–10 hours of sleep per night.⁵ The purpose of this study was to measure the burden of inadequate sleep among RI high school students and to assess demographic, environmental and health factors associated with lack of sleep.

METHODS

Data are from the 2019 Rhode Island High School Youth Risk Behavior Survey (YRBS). The YRBS is a biennial national survey of public high school students conducted by the Rhode Island Department of Health (RIDOH) and the Centers for Disease Control and Prevention (CDC) and is designed to monitor health risk behaviors related to major causes of morbidity and mortality among youth. YRBS employs a two-stage, cluster sample design to produce a representative sample of students.⁶ Schools within the state are selected with probability proportional to school enrollment size and then classes from a required subject or period within each school are randomly selected. A weight is applied to each record to adjust for student non-response and to obtain population estimates and a distribution of students by grade, sex, and race/ethnicity that approximates that of the state public high school population. Based on standards set by the CDC, a school and student response rate of 60% is considered sufficient to obtain a valid weighted sample. In 2019 the combined response rate of schools and students in Rhode Island was 66%. In total there were 1,613 high school students from 21 public high schools who completed the YRBS. This sample is representative of 44,052 students statewide. More information on the RI YRBS is available on the RIDOH website.⁷

Sleep was assessed with the question, “On an average school night, how many hours of sleep do you get?” Based on guidelines from the AASM, 8 or more hours of sleep per

night was defined as recommended sleep. We measured the prevalence of inadequate sleep and then conducted chi square analyses to examine differences in sleep based on demographic characteristics. Demographic characteristics of interest were sex, grade in school, race/ethnicity, sexual identity, socioeconomic status (SES), and disability. Hunger was used as proxy for SES and was assessed with the question, “During the past 30 days, how often did you go hungry because there was not enough food in your home: Never, Rarely, Sometimes, Most of the time, Always”. Those answering sometimes/most of the time/always were defined as going hungry. Disability was defined as any physical or learning disability, emotional problem, or long-term health problem.

Next, we conducted chi square analyses to examine the association between health and environmental factors and sleep. For purposes of these analyses we further classified amount of sleep into three categories: 5 hours or less, 6-7 hours, or 8 or more hours. Social environmental measures of interest included hunger and feeling safe in one’s neighborhood (“How often do you feel safe and secure in your neighborhood? – Never, Rarely, Sometimes, Most of the time, or Always” – where those who answered sometimes/rarely/never were defined as feeling unsafe). We also examined obesity, feelings of sadness/hopelessness (“During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?”), daily exercise, use of electronics, and current use of alcohol, e-vapor products, and marijuana. Body Mass Index (BMI) was calculated based on self-reported height and weight and obesity was defined as a BMI \geq 95th percentile for age and sex. Current substance use was defined as use within the last 30 days.

To further assess the association between modifiable or treatable risk factors and inadequate sleep we conducted two multivariable logistic regression analyses. The first model was a multivariable binary logistic regression model estimating the odds of receiving less than recommended (<8 hours) sleep. The second model was a multivariable multinomial logistic regression using the three-level variable for sleep to separately estimate the odds of receiving 5 hours of sleep or less, and 6–7 hours of sleep compared to the recommended 8 hours of sleep. Both models included modifiable and/or potentially treatable risk factors of e-cigarette use,

alcohol use, marijuana use, use of electronics, lack of exercise, obesity, and sadness/hopelessness and adjusted for the demographic characteristics sex, grade, race/ethnicity, sexual identity, disability, hunger, and neighborhood safety.

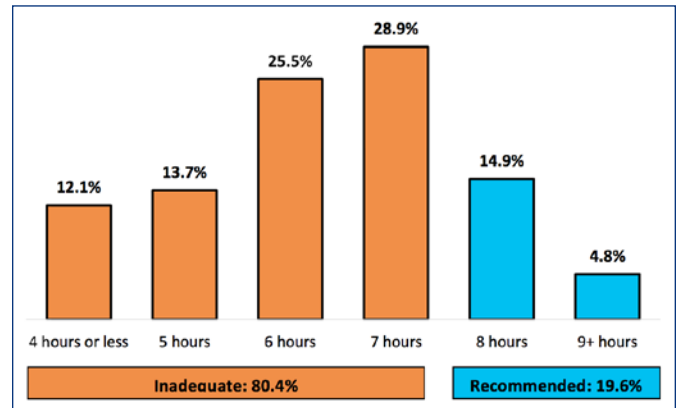
RESULTS

Overall, about 4 in 5 Rhode Island high school students (80.4%) receive less than the recommended amount of sleep on the average school night (Figure 1). Specifically, more than 1 in 4 students (26%) get 5 hours or less of sleep (Figure 1). Analysis of demographic factors found that prevalence of inadequate sleep increased each academic year, ranging from 73% among 9th graders to 86% among 12th graders (Table 1). Additionally, students who reported they at least sometimes went hungry in the past month; identified as lesbian, gay, or bisexual; and reported having a disability, were more likely than comparison groups to receive less than the recommended amount of sleep.

Analysis of health and environmental measures found many measures were significantly associated with sleep (Table 2). These differences were particularly apparent when examining prevalence of getting 5 hours of sleep or less. More than 40% of students who felt unsafe in their neighborhood reported getting 5 or less hours of sleep, compared to 22% of those who felt safe. Those who exercise daily were more likely than those who did not exercise to report 8 or more hours of sleep (29.1% vs. 17.1%) and less likely to report receiving 5 hours of sleep or less (18.7% vs 27.9%). Hunger, obesity, sadness/hopelessness, electronics use, and use of alcohol, marijuana and e-cigarettes were also significantly associated with sleep.

Multivariable analysis estimating odds of receiving less than 8 hours of sleep found that those who did not exercise [Adjusted Odds Ratio [AOR] = 2.20; 95% Confidence Interval [CI] = 1.38-3.51] were more likely to receive inadequate sleep while those who were obese were less likely to receive inadequate sleep (Table 3). None of the other modifiable factors assessed were significant. Results of the multinomial model indicated feeling sad/hopeless, e-cigarette use, use of electronics 5+hr/day and lack of daily exercise, were significantly associated with odds of receiving 5 or fewer hours of sleep (compared to 8 hours of sleep). Only lack of daily exercise was significantly associated with odds of receiving 6–7 hours of sleep (compared to 8 hours of sleep).

Figure 1. Average number of hours of sleep on a school night, among RI high school students



Source: 2019 RI YRBS

Table 1. Hours of sleep per school night among Rhode Island high school students, by selected demographics, 2019

	Inadequate Sleep (<8 hours)			Recommended Sleep (8+ hours)		
	Unweighted n	Weighted n	Weighted %	Unweighted n	Weighted n	Weighted %
Sex						
Female	610	17,038	81.3%	161	3,907	18.7%
Male	594	16,962	79.1%	177	4,482	20.9%
Grade*						
9th	395	8,132	72.6%	150	3,072	27.4%
10th	311	8,532	80.4%	81	2,074	19.6%
11th	272	8,552	83.2%	66	1,721	16.8%
12th	221	8,670	85.9%	36	1,419	14.1%
Race/Ethnicity						
White, Non-Hispanic	603	19,745	80.5%	160	4,782	19.5%
Black, Non-Hispanic	85	2,744	80.2%	24	680^	19.8%
Other, Non-Hispanic	118	2,599	85.5%	28	440	14.4%
Hispanic	382	8,389	80.2%	113	2,075	19.8%
Sexual Identity*						
Straight	996	28,352	80.0%	281	7,098	20.0%
Gay/Lesbian/Bisexual	150	4,219	87.9%	22	580^	12.1%
Went hungry*						
Yes	235	6,026	84.0%	47	1,146	16.0%
No	955	27,574	80.0%	285	7,085	20.4%
Disability*						
Yes	274	7,917	84.6%	50	1,438	15.4%
No	925	26,012	79.1%	284	6,888	20.9%

Source: 2019 RI YRBS

^Relative standard error>20%, estimate may be unstable, interpret with caution

*p<.05

Table 2. Health factors and the average hours of sleep per school night among RI high school students

	5 hours or less N = 11,506 25.9%	6–7 hours N = 23,362 54.5%	8+ hours N = 8,389 19.6%
Body Mass Index*			
Obese	28.1%	47.6%	24.3%
Not obese	24.7%	56.5%	18.8%
Went Hungry*			
Yes	38.8%	45.2%	16.0%
No	23.0%	56.6%	20.4%
Feel Safe in Neighborhood*			
Always/Most of the time	22.4%	57.9%	19.8%
Never/Rarely/Sometimes	41.6%	40.0%	18.4%
Felt Sad/Hopeless*			
Yes	38.4%	47.2%	14.3%
No	19.8%	58.0%	22.2%
Exercise 1 Hr Everyday*			
Yes	18.7%	52.2%	29.1%
No	27.9%	55.0%	17.1%
Use Electronics 5+ Hr/Day*			
Yes	32.9%	48.3%	18.7%
No	24.1%	55.9%	20.0%
Alcohol Use*			
Yes	33.6%	52.7%	13.7%
No	22.6%	55.4%	21.9%
E-Vapor Product Use*			
Yes	30.4%	56.5%	13.1%
No	23.3%	54.4%	22.4%
Marijuana Use*			
Yes	33.2%	54.2%	12.6%
No	23.1%	55.0%	21.9%

Source: 2019 RI YRBS

*p<.05

DISCUSSION

Results of the 2019 YRBS indicate that insufficient sleep is common among RI public high school students. The distribution of sleep duration on an average school night resembled a bell-shaped curve, with four out of five high school students reporting less than 8 hours of sleep, and 1 in 4 students (25.9%) with sleep duration of 5 hours or less. High school seniors, and students who identify as lesbian, gay, or bisexual were more likely to report inadequate sleep.

Several health-risk behaviors were associated with inadequate sleep. Students who felt unsafe in their neighborhood, and experienced food insecurity, two measures of social environment, had higher rates of inadequate sleep. The finding

Table 3. Adjusted odds of inadequate sleep by modifiable/treatable risk factors among RI high school students

	Model 1	Model 2	
	<8 hours of sleep Adjusted odds ratio (AOR)	5 hours of sleep or less AOR	6–7 hours of sleep AOR
Sadness/hopelessness	1.32 [0.77–2.27]	1.94 [1.07–3.53]	1.12 [0.63–1.97]
E-cigarette use	1.47 [0.96–2.26]	1.59 [1.10–2.30]	1.44 [0.87–2.38]
Alcohol use	1.16 [0.66–2.03]	1.23 [0.60–2.53]	1.12 [0.64–1.96]
Marijuana use	1.11 [0.68–1.82]	1.17 [0.75–1.84]	1.09 [0.62–1.92]
Electronics use (5+ hr/day)	1.19 [0.80–1.78]	1.67 [1.23–2.26]	1.02 [0.63–1.64]
Do not exercise 1hr/day	2.20 [1.38–3.51]	2.06 [1.16–3.67]	2.25 [1.43–3.52]
Obesity	0.66 [0.45–0.98]	0.70 [0.45–1.08]	0.65 [0.41–1.03]

Source: 2019 RI YRBS

Note: Statistically significant results are bolded**Model 1:** multivariable logistic regression model**Model 2:** multivariable multinomial logistic regression model

Both models adjusted for demographic characteristics of sex, race/ethnicity, grade, disability, sexual orientation, hunger, and neighborhood safety.

that obese students were less likely to have inadequate sleep conflicts with findings from some other studies.⁸ Reasons for this discrepancy are unclear, but the relationship between sleep and obesity is complex and influenced by a variety of factors. Rhode Island students who engaged in daily exercise had the highest prevalence of sufficient sleep compared to the other health factors examined. These findings on daily physical activity are consistent with a prior analysis.⁹

Sleep is an important determinant of health and well-being. Studies have found inadequate sleep is associated with problems with weight, decision-making, academic and job performance and numerous other health issues.^{10–12} In 2017, nationwide approximately 25% of high school students got at least eight hours of sleep per night. Healthy People 2020 identified sleep as a focus area with a specific objective to increase the proportion of students in grades 9–12 who get sufficient sleep to $\geq 33.2\%$.

Solutions to addressing insufficient sleep among teens can be complex. At the systematic level, the American Academy of Pediatrics recommends local advocacy for delayed school start times.¹³ On the clinician level, pediatricians can play an important role by discussing the consequences of inadequate sleep with parents. Pediatricians can also counsel families on healthy sleep practices and provide recommendations, such as establishing a consistent sleep schedule, setting a media curfew to limit use of electronic devices,

and encouraging physical activity.¹⁴ Furthermore, medical facilities can help make sleep hygiene information more readily available in their office and/or website.

There were several limitations to this study. First, data are self-reported and prone to recall bias. Secondly, data are cross-sectional and therefore we cannot ascertain causality or the temporality of the relationship between sleep and other variables. Furthermore, we only measured the self-reported average hours of sleep per school night; a more comprehensive study of sleep would involve measures of sleep quality. Despite these limitations, this study provides important information on the burden of inadequate sleep among Rhode Island high school students.

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