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How Long Teenagers Sleep and Their Mental Health: Findings from the 2023 National Youth Risk Behavior Survey

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Abstract. It is believed that sleep may impact adolescents' mental health, but data reflecting this in American high school students has been lacking. Data from the 2023 Youth Risk Behavior Survey, which is nationally representative of students in grades 9–12, was used to examine the relationship between sleep on a typical school night and mental health. Sleep was categorized into 7 levels and dichotomized into less than 8 hours and at least 8 hours. Mental health was assessed using feelings of sadness/hopelessness in the past 12 months and self-reported mental health in the past 30 days. Odds ratios were calculated with weighted logistic regression adjusting for sex, grade and race/ethnicity. Interactions with sex and grade were tested. Out of 17,266 students, 40.4% reported sadness/hopelessness and 28.9% reported poor mental health. There was a U-shape curve, with students who slept around 8 hours having the least sadness/hopelessness and poor mental health. Students who slept 4 hours or less had increased odds of sadness/hopelessness compared to 8 hours (adjusted odds ratio [aOR] 4.86; 95% CI 3.80–6.23) and poor mental health (aOR 5.02; 95% CI 3.61–6.98). Sex and grade did not substantially change this relationship. These findings suggest that healthy sleep should be considered when working to improve adolescents' mental health.

Keywords: Sleep duration, Mental health, Adolescents, Youth Risk Behavior Survey, Cross-sectional study

1. Introduction

Adolescents develop sleep habits and may experience poor mental health, which can impact them as adults. It is recommended that those ages 13 to 18 receive 8–10 hours of sleep every 24 hours to maintain health and wakefulness [1]. However, data shows that a large percentage of high school students are not receiving this recommended amount of sleep on school nights. As of 2015, 72.7% of high school students were sleeping less than 8 hours on a typical school night [2], and data from other cycles shows similar numbers [3]. There have been many cross-sectional studies that have shown poor mental health when teens don't get enough sleep. Some of these include depressive symptoms, sadness/hopelessness and suicidal ideation and attempts [4, 5]. Sleep is a modifiable behavior that can be addressed at the population level, which has made it a popular topic of study in America [3, 6].

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The Youth Risk Behavior Survey (YRBS) is done by the Centers for Disease Control and Prevention (CDC) to monitor high school students' health-related behaviors and mental health. According to the 2023 YRBS, 39.7% of students reported feeling so sad or hopeless for most days that it interfered with daily activities and 28.5% stated they had poor mental health most or all of the time in the last 30 days [6]. By learning which modifiable behaviors are associated with poor mental health, changes can be implemented in the school setting and beyond to improve the mental health of students [3, 6].

Previous studies have looked at this topic in four categories. First, there is data that describes the prevalence of sleep duration in American high school students and shows a trend of students not getting enough sleep over time [3]. Second, many studies have looked at how lack of sleep may harm students' mental health. A meta-analysis that included a dose-response curve showed a strong curvilinear relationship with suicidality and sleep duration, where students who slept around 8–9 hours had the least risk [4]. Another meta-analysis of 23 studies showed that students who did not get enough sleep were at an increased risk for depressive symptoms. Not many studies supported sleep duration being caused by depression [7]. The 2021 Florida YRBS, which was representative of the state of Florida, also found that students who did not sleep enough had higher depressive symptoms and suicidal ideation/behavior [5]. Other countries have also shown that not getting enough sleep can lead to poor mental health [8]. Although there are many different study designs, measurements and samples, the evidence consistently shows that less sleep is associated with worse mental health. Third, demographics seem to play a role. According to the 2023 YRBS, students' mental health and suicide risk varied by sex and grade. Females fared worse across all measurements [6], which was also found in a population-based study [8]. Finally, sleep has been determined as something that can be intervened on through policy, such as changing school start times [3, 9, 10]. By delaying start time at two schools by 50–65 minutes, students gained an average of 40 minutes of sleep each night [11].

Although we know that there is a relationship between sleep and mental health in adolescents, there are still gaps. By looking at multiple YRBS cycles from 2011 to 2023, we saw that there were lower amounts of poor mental health when students were sleeping around 8–9 hours [12]. How sleep affects mental health when controlling for demographics is unknown with recent nationally representative data. Also, since these are cross-sectional studies, we do not know if sleep comes before poor mental health or the other way around. With the pandemic affecting students' sleep and mental health, it would be interesting to look at more recent data. Therefore, the purpose of this study was to see how sleep duration on a typical school night may affect adolescents' feelings of sadness/hopelessness in the past 12 months and poor mental health in the past 30 days. We also wanted to see if there was any difference by sex and grade. This information can help clarify how sleep and mental health among students might be improved.

2. Methods

2.1. Data source and study population

We used data from the 2023 national Youth Risk Behavior Survey (YRBS). The YRBS is a school-based survey that is completed every other year by the CDC to assess students' health behaviors [13, 14]. Data was collected in the spring of 2023. Students in grades 9–12 were representative of all 50 states and the District of Columbia that attended public, Catholic or private schools [13, 14]. Students took the survey on tablets and it consisted of 107 questions about students' health behaviors [14]. Out of 311 schools, 155 completed the survey (response rate 49.8%), and after data cleaning

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20,103 student responses were usable (student response rate 71.0%). The overall response rate was 35.4% [13]. Survey weights accounted for non-response at the school and student level as well as the intentional oversample of Black and Hispanic students. The weights were scaled so the student sample size and grade level represented the U.S. population [13]. Students participated voluntarily and anonymously. IRB approval was obtained by the CDC [14].

Students who responded to both the sleep question and the feelings of sadness/hopelessness question were included in the final sample (n = 17,266). We also looked at students who responded to the question of poor mental health in the past 30 days (n = 14,790). Students that reported an ungraded or other grade (n = 39) and those that were missing a covariate were excluded from the multivariable models. There were 16,830 students with complete data. Depending on the outcome used in the model and missing values, the number of students would vary. Data from the 2023 National YRBS is publicly available through the CDC [13].

2.2. Measures

Sleep duration. Students were asked how many hours of sleep they typically get on a school night as part of the YRBS. There were 7 categories to choose from: 4 or less, 5, 6, 7, 8, 9 and 10 or more hours [13]. We used all 7 categories to see what the trend was between sleep and mental health. Then we created a new variable of students who slept less than 8 hours and at least 8 hours. It is recommended that children between the ages of 13 to 18 receive 8 to 10 hours of sleep per 24-hour period [1].

Mental health outcomes. We used two measurements to look at mental health. The primary outcome was if a student reported they had felt sad or hopeless for most days for 2 weeks or more in the past 12 months. Students responded yes or no to this question on the YRBS [13]. This is the question used by YRBS to assess depressive symptoms among high school students [6]. We also used the question about students' mental health over the past 30 days. If they responded "most of the time" or "always", we grouped them together and called it poor mental health. This is how the YRBS presents their data as well [6].

2.3. Covariates

Covariates that we chose to adjust for are known to be related to sleep and/or mental health in adolescents: sex (female/male), grade (9th–12th grade) and race/ethnicity (White non-Hispanic, Hispanic, Black non-Hispanic, Asian non-Hispanic and other/multiracial). We also thought that sex and grade could act as effect modifiers because there have been disparities in students' mental health by these groups [6, 8]. Age was used as a covariate. Since students in schools will always have a grade that matches their age, we decided to use grade as the main covariate and ran age as a sensitivity analysis.

2.4. Statistical analysis

We weighted our estimates to represent students in the U.S. and used Taylor series linearization with the survey package in R to calculate variances due to our stratified, clustered design with unequal probabilities of selection [15]. We calculated weighted percentages and 95% confidence intervals (CI) for the overall sample and each sleep category for the outcomes. We also calculated odds ratios (OR) using survey-weighted logistic regression comparing each sleep duration to 8 hours. We chose 8 hours as the referent category because studies have found this is where the lowest amount of poor

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mental health occurs and it falls within the recommended amount of sleep [1, 4]. We calculated unadjusted and adjusted models for the sleep variables. To see if sleep had an effect on mental health by sex and grade, we tested the multiplicative interaction between sleep and these variables with a Wald F test. We also calculated adjusted ORs for the dichotomized sleep variable (less than 8 hours vs at least 8 hours) by each category of sex and grade. We kept sleep as a categorical variable because previous studies showed it had a non-linear relationship with mental health [4]. We also wanted to see what was happening across all of the sleep categories. A p-value of <0.05 was considered significant. No imputation was done, but because the outcomes had less than 10% missing values, the results can be applied to those who answered these questions. All analysis was done in R version 4.5.2 with the survey package version 4.4.8 [15].

3. Results

3.1. Sample characteristics

Of the 17,266 students in the sample, 48.1% were female and most were juniors (23.7%). There were 48.7% who were White non-Hispanic and 6.1% who were other or multiple races (Table 1). 23.2% of the sample slept at least 8 hours on a typical school night and only 8.8% slept 4 or less. 28.7% reported sleeping 7 hours. Overall, 40.4% of students reported sadness/hopelessness and 28.9% reported poor mental health. These numbers are similar to the total sample of those surveyed (39.7% sadness/hopelessness and 28.5% poor mental health).

Table 1. Weighted sample characteristics of U.S. high school students (2023 national YRBS; n = 17,266)

Characteristic	Weighted %
Sex	
Female	48.1
Male	51.9
Grade	
9th	26.6
10th	25.8
11th	23.7
12th	23.9
Race/ethnicity	
White, non-Hispanic	48.7
Hispanic	27.5
Black, non-Hispanic	13.8
Asian, non-Hispanic	3.9
Other or multiracial	6.1
Sleep duration on a school night	
4 or less	8.8
5	14.3
6	25.0
7	28.7
8	17.6

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Table 1. (continued)

9	4.1
10 or more	1.5
Sadness/hopelessness in past 12 months	40.4
Poor mental health past 30 days	28.9

Values represent weighted values that reflect the U.S. population. Values may not add up to 100% due to rounding. Only students who responded to the sleep and sadness/hopelessness questions were used.

3.2. Sleep duration and mental health outcomes

Figures 1 and 2 show that students who slept 8–9 hours had the least sadness/hopelessness and poor mental health. Figure 1 shows that the percent of sadness/hopelessness was 60.7% (95% CI 56.8–64.6) when students slept 4 or less hours and decreased until it reached 25.8% (95% CI 22.7–29.0) when they slept 8 hours. It then increased to 27.7% (95% CI 22.1–33.4) at 9 hours and 34.5% (95% CI 24.4–44.6) when they slept 10 or more hours. All sleep categories in between showed a gradual decrease in sadness/hopelessness (Table 2). There was a larger percentage of students who reported sadness/hopelessness when they slept less than 8 hours vs those who slept at least 8 hours (44.6% [95% CI 42.4–46.7] vs 26.7% [24.1–29.4]). Poor mental health had a similar pattern (Figure 2, Table 2). When students slept 4 or less hours, they were more likely to have poor mental health (49.6% [95% CI 43.0–56.2]), which decreased to 17.8% (95% CI 15.6–20.0) at 8 hours. Similar to sadness/hopelessness, students who slept at least 10 hours had an increase in poor mental health (29.7% [95% CI 19.4–40.0]). Of the students who slept 4 or less hours, 42.7% also reported sadness/hopelessness, vs those who slept 8 hours at 11.4%.

Table 2. Percentage (95% CI) of students with sadness/hopelessness and poor mental health by sleep on a typical school night (2023 national YRBS)

Hours of sleep	Sadness/hopelessness			Poor mental health		
	Overall	Female	Male	Overall	Female	Male
4 or less	60.7 (56.8–64.6)	77.2 (70.9–83.4)	45.3 (40.1–50.4)	49.6 (43.0–56.2)	66.5 (55.7–77.2)	33.6 (28.9–38.2)
5	57.0 (53.6–60.4)	66.9 (62.4–71.4)	45.4 (40.7–50.0)	40.0 (35.8–44.2)	50.6 (44.0–57.1)	28.0 (23.4–32.6)
6	43.5 (40.0–46.9)	54.9 (50.8–59.0)	32.4 (28.6–36.2)	32.2 (29.0–35.5)	41.7 (37.0–46.4)	22.7 (19.5–26.0)
7	34.4 (31.8–37.1)	47.8 (44.9–50.7)	22.8 (19.8–25.8)	22.7 (20.7–24.7)	32.7 (29.9–35.5)	14.0 (11.8–16.2)
8	25.8 (22.7–29.0)	38.3 (33.2–43.4)	15.7 (13.4–18.0)	17.8 (15.6–20.0)	25.8 (22.0–29.7)	11.4 (8.6–14.2)
9	27.7 (22.1–33.4)	40.4 (32.7–48.2)	16.1 (9.8–22.3)	16.2 (10.9–21.5)	24.0 (16.1–31.9)	9.0 (4.3–13.8)
10 or more	34.5 (24.4–44.6)	47.1 (32.1–62.2)	22.5 (11.4–33.6)	29.7 (19.4–40.0)	35.6 (21.2–50.0)	23.5 (12.5–34.6)

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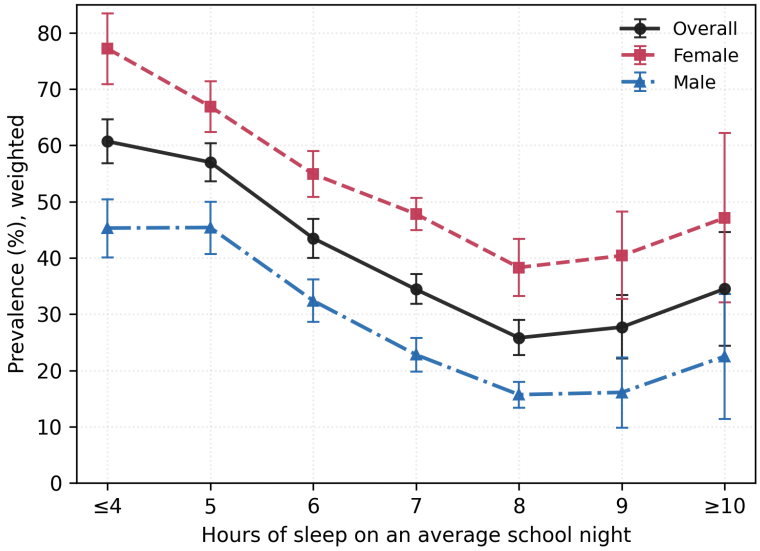


Figure 1. Prevalence of students who had sadness/hopelessness in the past year by sleep on a school night (2023 national YRBS) (picture credit: original)

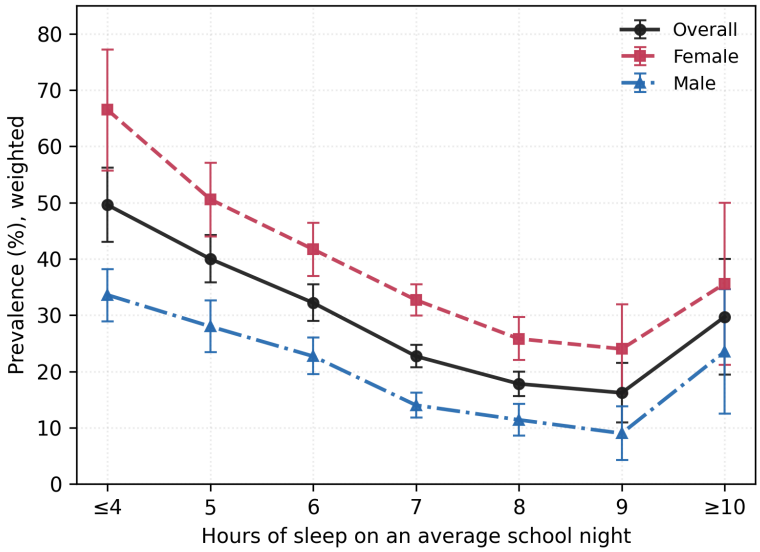


Figure 2. Prevalence of students who had poor mental health in the past 30 days by sleep on a school night (2023 national YRBS) (picture credit: original)

3.3. Multivariable models

After adjusting for the covariates, students who slept less were at a higher risk of sadness/hopelessness (Table 3). Students who slept 4 or less hours were at 4.86 times (95% CI 3.80–6.23) the risk of sadness/hopelessness when compared to students who slept 8 hours. Those who slept 5 hours had a 3.94 (3.19–4.87) increased risk and those who slept 7 hours had a 1.52 (1.22–1.90) increased risk. Students who slept 9 hours had similar risks as those who slept 8 hours. Although not statistically significant, we saw that students who slept at least 10 hours were also at a higher risk. When we looked at poor mental health, there were similar ORs for most of the sleep categories. We saw the highest risk at 4 or less hours of sleep with an OR of 5.02 (3.61–6.98). Males

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had a lower risk of sadness/hopelessness than females (OR 0.34 [95% CI 0.30–0.38]). Students who were Asian had lower odds than those who were White (OR 0.59 [95% CI 0.44–0.79]). We ran a model with age instead of grade and saw that the results stayed consistent (OR 4.85 [3.81–6.17] for those who slept 4 or less hours).

Table 3. Adjusted ORs (95% CI) for students with sadness/hopelessness and poor mental health by hours of sleep on a school night (2023 national YRBS)

Exposure	Adjusted OR (95% CI)	p
Adjusted ORs for sadness/hopelessness		
4 or less hours	4.86 (3.80–6.23)	<0.001
5 hours	3.94 (3.19–4.87)	<0.001
6 hours	2.25 (1.87–2.70)	<0.001
7 hours	1.52 (1.22–1.90)	<0.001
9 hours	1.04 (0.75–1.44)	0.82
10 or more hours	1.46 (0.91–2.36)	0.11
Less than 8 hours	2.27 (1.92–2.63)	<0.001
Male	0.34 (0.30–0.38)	<0.001
Asian	0.59 (0.44–0.79)	<0.001
Sensitivity analysis		
Age instead of grade	4.85 (3.81–6.17)	<0.001
Models by subgroups: less than 8 hours		
Female	2.08 (1.72–2.56)	<0.001
Male	2.50 (2.04–3.13)	<0.001
9th grade	2.70 (2.00–3.57)	<0.001
10th grade	2.13 (1.69–2.70)	<0.001
11th grade	1.96 (1.49–2.56)	<0.001
12th grade	2.27 (1.64–3.13)	<0.001
Adjusted ORs for poor mental health		
4 or less hours	5.02 (3.61–6.98)	<0.001
5 hours	3.11 (2.49–3.88)	<0.001
6 hours	2.21 (1.80–2.71)	<0.001
7 hours	1.35 (1.11–1.64)	0.003
9 hours	0.87 (0.55–1.39)	0.55
10 or more hours	1.82 (1.06–3.14)	0.03
Male	0.35 (0.30–0.41)	<0.001

3.4. Subgroup analysis

There were higher percentages of females reporting sadness/hopelessness across all of the sleep categories. There was also a U-shaped relationship for males and females, with those who slept 8 hours having the least sadness/hopelessness (Table 2, Figure 1). We ran the interaction term and found that sleep did not have an impact on sadness/hopelessness by sex (Wald F test p = 0.19).

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When we ran a model with only those who slept less than 8 hours, we saw that there was still a higher risk of sadness/hopelessness for both females (OR 2.08 [1.72–2.56]) and males (OR 2.50 [2.00–3.13]).

We looked at how sadness/hopelessness may vary by grade and saw that all grades had similar prevalence rates (Table 4). Students did not vary in sleep duration and their risk of sadness/hopelessness by grade (interaction p = 0.14). All of the students who slept less than 8 hours had a higher percentage of sadness/hopelessness compared to those who slept 8 or more hours. There was a range of 15.0 percentage points to 23.2 percentage points across grade levels (Table 4). Due to the small number of students in the 10 or more category for each grade, please use with caution.

Table 4. Percentage of students with sadness/hopelessness in the past 12 months by sleep on a school night by grade (2023 national YRBS)

Hours of sleep	9th grade	10th grade	11th grade	12th grade
4 or less	68.0 (59.3–76.6)	61.4 (54.7–68.2)	57.7 (50.3–65.2)	54.9 (48.1–61.6)
5	59.1 (51.6–66.6)	60.5 (54.6–66.5)	58.4 (51.1–65.6)	51.0 (45.3–56.6)
6	50.3 (44.6–56.0)	42.0 (36.5–47.6)	41.5 (37.6–45.3)	41.1 (35.3–46.8)
7	35.5 (30.8–40.2)	33.0 (28.5–37.5)	33.8 (28.9–38.7)	35.0 (30.1–40.0)
8	22.7 (18.9–26.4)	27.8 (23.2–32.4)	29.6 (23.3–35.9)	24.2 (17.2–31.2)
9	28.9 (20.8–37.1)	23.8 (15.7–32.0)	24.7 (14.8–34.5)	32.0 (16.0–47.9)
10 or more	31.5 (17.4–45.5)	34.3 (14.4–54.2)	26.7 (7.1–46.3)	53.2 (26.9–79.5)
Less than 8 hours	47.8 (43.8–51.9)	44.2 (41.5–46.9)	43.7 (40.1–47.2)	42.4 (38.7–46.1)
At least 8 hours	24.6 (21.1–28.2)	27.4 (23.0–31.9)	28.7 (23.3–34.1)	26.7 (20.8–32.5)
Total	40.6 (37.5–43.8)	40.5 (37.8–43.2)	40.5 (37.2–43.9)	39.6 (36.2–42.9)

3.5. Summary of results

Table 3 shows the results for all of the models we ran. When we adjusted for the covariates, there was an increase in odds of sadness/hopelessness when students slept less than 8 hours. With the binary variable of sleep less than 8 hours, there was also an increase in odds of sadness/hopelessness. We saw consistent results when we replaced grade with age. Students who were males and all of the grades were at a higher risk for sadness/hopelessness than the referent group. However, when we looked at if sleep had a different effect on sadness/hopelessness by sex and grade, we found that it did not. Poor mental health also had an increased odds when students slept less than 8 hours. There was also a slight increase for students who slept at least 10 hours, adjusted for sex, grade and race.

4. Conclusion

Using the 2023 U.S. National Youth Risk Behavior Survey, we found that students who slept less on a typical school night were at an increased risk of sadness/hopelessness and poor mental health in the past 30 days. There was a U-shaped curve for the outcomes, with students who slept around 8 hours having the lowest risk of both outcomes. Some of the estimates were also higher for students who slept at least 10 hours. Students who slept 4 or less hours had 4.86 (3.80–6.23) and 5.02 (3.61–

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6.98) times the odds of sadness/hopelessness and poor mental health compared to those who slept 8 hours.

We know that students vary in their mental health by demographic groups. Most students that were female and all students who slept less than 8 hours had higher amounts of sadness/hopelessness. When we replaced grade with age, we saw similar results, so we know that there are different factors that can affect students' mental health.

We should continue to encourage students to sleep healthy amounts to improve their mental health. There are many limitations to this study that we must consider. Because the data was cross-sectional, we cannot assume that there is a causal relationship. Students self-reported their sleep duration and mental health, which could bias the results. There could also be unmeasured confounders that we did not adjust for. We had a small sample size of students who slept at least 10 hours. More research needs to be done with follow-up measurements and objective measurement of sleep to see what happens over time. Schools can use interventions to increase sleep and provide resources for families to promote good sleep for their children.

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