

## Sleep Duration and Injury-Related Risk Behaviors Among High School Students — United States, 2007–2013

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Insufficient sleep is common among high school students and has been associated with an increased risk for motor vehicle crashes (1), sports injuries (2), and occupational injuries (3). To evaluate the association between self-reported sleep duration on an average school night and several injury-related risk behaviors (infrequent bicycle helmet use, infrequent seatbelt use, riding with a driver who had been drinking, drinking and driving, and texting while driving) among U.S. high school students, CDC analyzed data from 50,370 high school students (grades 9–12) who participated in the national Youth Risk Behavior Surveys (YRBSs) in 2007, 2009, 2011, or 2013. The likelihood of each of the five risk behaviors was significantly higher for students who reported sleeping  $\leq 7$  hours on an average school night; infrequent seatbelt use, riding with a drinking driver, and drinking and driving were also more likely for students who reported sleeping  $\geq 10$  hours compared with 9 hours on an average school night. Although insufficient sleep directly contributes to injury risk, some of the increased risk associated with insufficient sleep might be caused by engaging in injury-related risk behaviors. Intervention efforts aimed at these behaviors might help reduce injuries resulting from sleepiness, as well as provide opportunities for increasing awareness of the importance of sleep.

The national YRBS monitors health-risk behaviors among students in public and private high schools and is conducted by CDC in the spring of odd-numbered years. Each national YRBS uses an independent, three-stage cluster sample design to obtain a nationally representative sample of students in grades 9–12. The overall response rates\* were 68% in 2007, 71% in 2009, 71% in 2011, and 68% in 2013, and sample sizes ranged from 13,583 (2013) to 16,410 (2009).<sup>†</sup> Students

completed the anonymous, self-administered questionnaires during a single class period.

The combined analytic sample was composed of 50,370 high school students who responded to questions about sleep duration on an average school night ( $\leq 4$  hours, 5 hours, 6 hours, 7 hours, 8 hours, 9 hours,  $\geq 10$  hours); demographic characteristics (sex, grade, and race/ethnicity); and how frequently they used a bicycle helmet (among students who had ridden a bicycle during the past 12 months; responses = never or rarely versus sometimes, most of the time, or always); wore a seatbelt when riding in a car driven by someone else (never or rarely versus sometimes, most of the time, or always); rode in a car or other vehicle with a driver who had been drinking alcohol (i.e., rode with a drinking driver; at least one time during the

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\* Overall response rate = (number of participating schools/number of eligible sampled schools)  $\times$  (number of usable questionnaires/number of eligible students sampled).

<sup>†</sup> Data users manuals (<http://www.cdc.gov/healthyyouth/yrbs/data/index.htm>).



past 30 days versus 0 times); drove a car or other vehicle when they had been drinking alcohol<sup>§</sup> (i.e., drinking and driving; at least one time during the past 30 days versus 0 times); or texted or e-mailed while driving a car or other vehicle<sup>¶</sup> (i.e., texting while driving; at least 1 day during the past 30 days versus 0 days). The percentage reporting insufficient sleep duration ( $\leq 7$  hours according to the *Healthy People 2020* sleep objective for adolescents<sup>\*\*</sup>) and distribution of hours of sleep were calculated by survey year, sex, grade, and race/ethnicity; pairwise t-tests and ANOVA (i.e., linear trend) were used to assess crude significant differences.

Because no differences were found in mean sleep duration or prevalence of insufficient sleep duration by survey year, data from all four survey years were aggregated for subsequent analyses. Aggregating the data from four survey years provided adequate sample size for the calculation of low prevalence risk behaviors among students reporting each category of sleep duration. Unadjusted prevalence of each risk behavior was

<sup>§</sup> In the 2013 survey, for the first time, the response options for this question included "I did not drive a car or other vehicle during the past 30 days." For compatibility with the results for the drinking and driving question in the 2007, 2009, and 2011 surveys, students who responded "I did not drive" on the 2013 survey were counted as 0 times and included in the denominators.

<sup>¶</sup> This question was asked for the first time in the 2011 survey. In the 2013 survey, the response options for this question included "I did not drive a car or other vehicle during the past 30 days." For compatibility with the results for the texting or e-mailing and driving question in the 2011 survey, students who responded "I did not drive" on the 2013 survey were counted as 0 days and included in the denominators.

\*\* <https://www.healthypeople.gov/2020/topics-objectives/topic/sleep-health>.

calculated by sleep duration. Pairwise t-tests were used to assess significant differences compared with 9 hours, the median of the sleep duration recommendation for teens by the National Sleep Foundation (4). Logistic regression analyses were used to calculate adjusted prevalence ratios (APRs) and 95% confidence intervals (CIs) for the likelihood of each injury-related behavior with a referent sleep duration of 9 hours and were adjusted for sex, grade, and race/ethnicity. All analyses accounted for the sampling weights and complex survey design. P-values of  $<0.05$  were defined to be statistically significant.

Reported sleep duration during an average school night was  $\leq 4$  hours for 6.3% of respondents, 5 hours (10.5%), 6 hours (21.9%), 7 hours (30.1%), 8 hours (23.5%), 9 hours (5.8%), and  $\geq 10$  hours (1.8%). Sleep duration varied by sex, grade, and race/ethnicity (Table 1). Female students reported a higher prevalence of insufficient sleep ( $\leq 7$  hours) than did male students (71.3% versus 66.4%,  $p < 0.001$ ). The percentage reporting insufficient sleep ranged from 59.7% of students in 9th grade to 76.6% of students in 12th grade ( $p < 0.001$  for linear trend). Among racial/ethnic groups, the prevalence of insufficient sleep was lowest for American Indian/Alaska Native students (60.3%) and highest for Asian students (75.7%).

Overall, 86.1% of students reported infrequent bicycle helmet use and 8.7% reported infrequent seatbelt use. Twenty-six percent of students reported riding with a drinking driver at least one time during the past 30 days; 8.9% of students reported drinking and driving; and 30.3% reported texting while driving during the past 30 days. Unadjusted prevalence

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TABLE 1. Duration of sleep on an average school night, by selected characteristics—Youth Risk Behavior Surveys, United States, 2007, 2009, 2011, and 2013.

Characteristic	No. <sup>†</sup>	Sleep duration %* (95% CI)							
		≤7 hrs (insufficient sleep)	≤4 hrs	5 hrs	6 hrs	7 hrs	8 hrs	9 hrs	≥10 hrs
<b>Total</b>	<b>50,370</b>	<b>68.8 (68.0–69.6)</b>	<b>6.3 (5.9–6.7)</b>	<b>10.5 (10.1–11.0)</b>	<b>21.9 (21.3–22.4)</b>	<b>30.1 (29.5–30.7)</b>	<b>23.5 (22.9–24.2)</b>	<b>5.8 (5.5–6.2)</b>	<b>1.8 (1.7–2.0)</b>
<b>Survey year</b>									
2007	11,939	69.0 (67.0–70.9)	5.8 (5.3–6.5)	10.0 (9.2–10.9)	22.8 (21.6–24.1)	30.4 (29.4–31.3)	23.5 (21.9–25.3)	5.8 (5.2–6.5)	1.6 (1.3–2.1)
2009	14,477	69.1 (67.5–70.6)	5.5 (4.9–6.1)	10.1 (9.0–11.4)	21.9 (20.9–23.0)	31.6 (30.4–32.9)	23.4 (22.2–24.5)	5.8 (5.3–6.4)	1.7 (1.5–2.1)
2011	11,904	68.6 (67.2–69.9)	6.6 (6.0–7.2)	10.8 (10.0–11.6)	21.7 (20.6–22.7)	29.6 (28.4–30.9)	24.0 (22.9–25.1)	5.7 (5.1–6.4)	1.7 (1.4–2.0)
2013	12,050	68.4 (66.9–69.9)	7.4 (6.6–8.3)	11.3 (10.5–12.2)	21.2 (20.2–22.2)	28.5 (27.5–29.5)	23.2 (22.2–24.2)	6.0 (5.3–6.8)	2.4 (2.0–2.8)
<b>Sex</b>									
Female	25,327	71.3 (70.4–72.1)	6.3 (5.9–6.8)	12.1 (11.5–12.8)	23.8 (23.0–24.6)	29.0 (28.3–29.8)	22.0 (21.3–22.8)	5.1 (4.7–5.5)	1.6 (1.4–1.8)
Male	25,043	66.4 (65.4–67.4)	6.3 (5.8–6.7)	9.0 (8.4–9.6)	20.0 (19.4–20.7)	31.1 (30.2–32.0)	25.0 (24.2–25.8)	6.6 (6.1–7.1)	2.1 (1.8–2.3)
<b>Grade</b>									
9th	12,551	59.7 (58.6–60.8)	5.8 (5.2–6.4)	8.4 (7.7–9.0)	17.2 (16.4–18.0)	28.3 (27.3–29.3)	28.5 (27.5–29.5)	9.1 (8.4–9.9)	2.7 (2.3–3.2)
10th	12,083	67.4 (66.1–68.8)	5.9 (5.3–6.5)	9.7 (8.9–10.6)	20.6 (19.6–21.7)	31.2 (30.0–32.4)	24.7 (23.6–25.8)	5.8 (5.2–6.4)	2.1 (1.8–2.5)
11th	12,784	73.3 (72.0–74.5)	6.8 (6.1–7.4)	11.9 (11.1–12.7)	24.4 (23.4–25.4)	30.2 (29.2–31.3)	21.0 (19.9–22.1)	4.4 (4.0–4.9)	1.3 (1.1–1.6)
12th	12,952	76.6 (75.4–77.8)	6.9 (6.3–7.5)	12.7 (11.9–13.6)	26.3 (25.1–27.5)	30.7 (29.6–31.9)	18.9 (17.9–19.9)	3.4 (3.0–4.0)	1.1 (0.8–1.4)
<b>Race/Ethnicity</b>									
White <sup>§</sup>	22,330	68.3 (67.3–69.4)	5.1 (4.7–5.5)	9.5 (8.9–10.1)	21.6 (20.8–22.3)	32.2 (31.4–33.0)	24.7 (23.8–25.5)	5.6 (5.2–6.1)	1.3 (1.2–1.5)
Black <sup>§</sup>	9,701	71.2 (69.9–72.5)	9.2 (8.5–10.0)	13.9 (12.8–15.2)	23.9 (22.9–24.8)	24.2 (23.1–25.3)	19.9 (18.9–20.9)	5.7 (5.1–6.3)	3.2 (2.8–3.8)
Hispanic	13,452	67.0 (65.5–68.5)	6.7 (6.1–7.4)	10.5 (9.7–11.4)	20.7 (19.8–21.7)	29.1 (28.1–30.1)	23.7 (22.7–24.9)	6.9 (6.3–7.6)	2.3 (2.0–2.7)
American Indian/ Alaska Native <sup>§</sup>	769	60.3 (52.4–67.6)	9.8 (6.7–14.1)	8.9 (6.6–12.0)	18.2 (15.1–21.9)	23.3 (20.1–26.9)	25.9 (21.7–30.7)	8.4 (5.4–12.9)	5.4 (3.8–7.5)
Asian <sup>§</sup>	1,751	75.7 (72.7–78.5)	8.3 (6.4–10.6)	13.2 (11.1–15.6)	26.4 (23.9–29.1)	27.8 (25.2–30.5)	18.1 (15.7–20.7)	4.4 (3.1–6.3)	1.8 (1.1–2.9)
Native Hawaiian/ Pacific Islander <sup>§</sup>	399	68.3 (62.1–73.9)	12.8 (9.0–18.0)	10.8 (7.5–15.2)	20.4 (16.7–24.7)	24.3 (19.3–30.2)	24.2 (19.1–30.1)	5.1 (3.1–8.5)	— <sup>¶</sup>
Multiracial <sup>§</sup>	1,968	72.0 (69.2–74.7)	9.2 (7.6–11.1)	13.3 (11.4–15.5)	22.9 (20.4–25.6)	26.6 (24.1–29.2)	21.0 (18.5–23.6)	4.9 (3.8–6.3)	2.1 (1.4–3.2)

**Abbreviation:** CI = confidence interval.

\* Weighted percentages.

<sup>†</sup> Unweighted n's.

<sup>§</sup> Non-Hispanic.

<sup>¶</sup> Unreliable estimate. Relative standard error ≥0.3.

of all five injury-related risk behaviors varied by sleep duration (Table 2). The likelihood of each of the five risk behaviors was significantly higher (APR >1.0) among students with sleep durations ≤7 hours; infrequent seatbelt use, riding with drinking driver, and drinking and driving were also more likely among students reporting sleeping ≥10 hours compared with 9 hours (Table 3). The likelihood of drinking and driving was also significantly higher among students sleeping 8 hours compared with 9 hours.

## Discussion

Unintentional injuries are the leading cause of death for adolescents, with approximately two thirds of these fatalities related to road traffic crashes (5). Excessive sleepiness, which is most often a result of not getting adequate sleep, has been shown to increase the risk for motor vehicle crashes and other unintentional injury among adolescents (1–3). Although insufficient sleep contributes to injury risk directly by slowing reaction time, impairing ability to pay attention, or causing a driver to fall asleep (6), this study provides evidence that some of the increased risk associated with insufficient sleep might be caused by engaging in injury-related risk behaviors.

In addition to a higher likelihood of engaging in injury-related risk behaviors among students who reported typically sleeping ≤7 hours on school nights, infrequent seatbelt use, riding with a drinking driver, and drinking and driving were also more likely for students sleeping ≥10 hours compared with 9 hours. Although short and long sleep might simply be associated with other adolescent risk behaviors, insufficient sleep might cause persons to take more risks and disregard the possibility of negative consequences (7). However, depression might contribute to both sleep problems and participation in risk behaviors. Sleep problems, including both not sleeping enough and sleeping too much, are common symptoms of depression; one study found that adolescents who reported more depressive symptoms were more likely to engage in several injury-related risk behaviors, including infrequent seatbelt use, infrequent bicycle helmet use, and drinking and driving (8).

The findings in this report are subject to at least two limitations. First, the data were self-reported and the extent of any underreporting or overreporting cannot be determined. However, the survey questions demonstrate good test-retest reliability.<sup>††</sup> Second, the survey is not representative of school-aged youths

<sup>††</sup> <http://www.ncbi.nlm.nih.gov/pubmed/12359379>.

**TABLE 2. Prevalences and 95% confidence intervals (CIs) of unintentional injury risk behaviors among high school students, by sleep duration — Youth Risk Behavior Surveys, United States, 2007, 2009, 2011, and 2013**

Risk behavior	Sleep duration % (95% CI)						
	≤4 hrs	5 hrs	6 hrs	7 hrs	8 hrs	9 hrs	≥10 hrs
Infrequent bicycle helmet use	91.2 (89.2–92.9)*	90.6 (88.8–92.2)*	87.9 (86.3–89.4)*	85.7 (83.9–87.5)*	83.4 (81.2–85.4)	81.7 (79.2–84.0)	82.5 (78.0–86.2)
Infrequent seatbelt use	22.8 (20.6–25.2)*	12.5 (11.2–14.1)*	9.3 (8.3–10.5)*	6.5 (5.6–7.4)	5.9 (5.1–6.8)	5.5 (4.5–6.6)	13.1 (10.6–16.0)*
Rode with a drinking driver	36.8 (34.7–39.0)*	31.5 (29.8–33.3)*	28.2 (26.9–29.4)*	25.1 (23.8–26.3)*	21.4 (20.2–22.7)	19.8 (17.9–21.8)	24.0 (20.5–27.9)*
Drinking and driving	16.6 (14.9–18.4)*	11.2 (10.0–12.5)*	10.1 (9.2–11.1)*	8.3 (7.5–9.2)*	6.7 (6.1–7.4)*	4.7 (3.9–5.7)	9.9 (7.5–12.9)*
Texting while driving	32.7 (29.3–36.3)*	34.8 (31.6–38.1)*	33.4 (31.2–35.7)*	31.5 (28.7–34.5)*	26.1 (23.9–28.4)*	20.9 (17.7–24.4)	24.8 (20.5–29.7)

\* Prevalence significantly different from 9 hours ( $p < 0.05$ ).

**TABLE 3. Adjusted prevalence ratios (APRs)\* and 95% confidence intervals (CIs) for unintentional injury risk behaviors among high school students, by sleep duration — Youth Risk Behavior Surveys, United States, 2007, 2009, 2011, and 2013**

Risk behavior	Sleep duration APR (95% CI)						
	≤4 hrs	5 hrs	6 hrs	7 hrs	8 hrs	9 hrs	≥10 hrs
Infrequent bicycle helmet use	1.12 (1.08–1.15)	1.11 (1.07–1.15)	1.08 (1.05–1.11)	1.06 (1.02–1.09)	1.02 (1.00–1.06)	1.00 (Ref)	0.99 (0.94–1.05)
Infrequent seatbelt use	4.50 (3.66–5.54)	2.60 (2.10–3.22)	1.92 (1.60–2.31)	1.28 (1.06–1.54)	1.13 (0.95–1.36)	1.00 (Ref)	2.38 (1.82–3.11)
Rode with a drinking driver	1.84 (1.64–2.06)	1.58 (1.41–1.77)	1.42 (1.27–1.58)	1.27 (1.15–1.40)	1.09 (0.98–1.20)	1.00 (Ref)	1.20 (1.01–1.42)
Drinking and driving	3.14 (2.52–3.92)	2.10 (1.71–2.58)	1.84 (1.49–2.27)	1.51 (1.27–1.81)	1.32 (1.06–1.64)	1.00 (Ref)	2.19 (1.60–3.00)
Texting while driving	1.26 (1.05–1.51)	1.29 (1.11–1.49)	1.22 (1.05–1.41)	1.19 (1.03–1.37)	1.10 (0.95–1.27)	1.00 (Ref)	1.24 (1.00–1.55)

\* Adjusted for sex, grade, and race/ethnicity.

who do not attend school. Nationwide, in 2012, approximately 3% of persons aged 16–17 years were not enrolled in a high school program and had not completed high school.<sup>§§</sup>

The National Sleep Foundation recommends that adolescents aged 14–17 years sleep 8–10 hours per night (4). To help ensure that adolescents get adequate sleep, they can practice good sleep hygiene (i.e., habits that promote good sleep). These habits include going to bed and getting up at the same time each day both during the school week and weekends, minimizing light exposure in the evenings, and keeping computers and other electronic devices, such as computers, video games, and cell phones, out of the bedroom.<sup>¶¶</sup> Parents can help by setting bedtimes and limiting when (only before a set time or “media curfew”) and where (not in their bedrooms) their teenagers can use electronic devices. Early school start times contribute to insufficient sleep among adolescents. Delaying school start times has been proposed as a means of allowing adolescents to get adequate sleep (9). Some students naturally need more sleep than their peers, but waking up and feeling unrested in spite of adequate sleep might be an indication of a problem such as poor sleep quality or an underlying health condition. Poor sleep quality might result from poor sleep hygiene, a bad sleep environment (e.g., too warm, too noisy, or cell phones in the bedroom), or a sleep disorder. In addition, long sleep durations might be a symptom of depression.

§§ <http://nces.ed.gov/pubs2015/2015015.pdf>.

¶¶ More tips for good sleep are available from the National Sleep Foundation (<https://sleepfoundation.org/sleep-tools-tips/healthy-sleep-tips>).

Various resources are available to address injury-related risk behaviors. Public health practitioners can refer to systematic reviews of interventions included in The Community Guide (<http://www.thecommunityguide.org/mvoi/index.html>). Some evidence exists that health care providers, in collaboration with health educators, might be able to change adolescent injury-related behavior through screening and brief counseling, followed by a visit by a health educator (9,10). Information for parents of teen drivers on what they can do to encourage safe driving by their teens is available at <http://www.cdc.gov/parentsarethekey/parents/index.html>.

### Summary

#### What is already known about this topic?

Insufficient sleep is common among high school students and is associated with an increased risk for unintentional injury from drowsy driving crashes and other causes.

#### What is added by this report?

Students who reported sleeping ≤7 hours on school nights were more likely to report several injury-related risk behaviors (infrequent bicycle helmet use, infrequent seatbelt use, riding with a driver who had been drinking, drinking and driving, and texting while driving) compared with students who sleep 9 hours.

#### What are the implications for public health practice?

High school faculty and administrators, as well as parents of high school students, should be made aware of the increased likelihood for risky behavioral choices among students who do not get enough sleep.

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