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Journal of Adolescent Health ■ (2010) 1–3

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 JOURNAL OF  
 ADOLESCENT  
 HEALTH
 

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## Adolescent health brief

# Prevalence of Insufficient, Borderline, and Optimal Hours of Sleep Among High School Students – United States, 2007

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Manuscript received July 1, 2009; manuscript accepted October 22, 2009

**Abstract**

We describe the prevalence of insufficient, borderline, and optimal sleep hours among U.S. high school students on an average school night. Most students (68.9%) reported insufficient sleep, whereas few (7.6%) reported optimal sleep. The prevalence of insufficient sleep was highest among female, black, and students of grades 11 and 12. © 2010 Society for Adolescent Medicine. All rights reserved.

EQ1 **Keywords:**

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Sleep is necessary for physical and mental health and is particularly important during adolescence, a phase of rapid biologic growth and development [1]. Although no formally accepted sleep guidelines exist, the National Sleep Foundation defines sleep hours for adolescents to be insufficient if <8 per night, borderline if 8 per night, and optimal if ≥9 per night [2]. According to the 2006 Sleep in America poll [2], more than half of adolescents are getting insufficient sleep on school nights; therefore, many adolescents are at risk for negative consequences of insufficient sleep, including daytime sleepiness [3,4], drowsy driving [1,3], depressed mood [1,3,5], headaches [5], and poor school performance [6]. Data from the 2006 Sleep in America poll, however, are limited by a low response rate (27%) and potential for reporting bias because telephone interviews were conducted first with a parent followed by the adolescent.

The Institute of Medicine convened an expert panel to examine the health effects of sleep deprivation and identify

gaps in the public health response. The panel recommended additional sleep pattern surveillance [7], specifically calling for the inclusion of sleep questions on the Centers for Disease Control and Prevention's Youth Risk Behavior Survey (YRBS). The YRBS was developed in 1990 to monitor the prevalence of priority health risk behaviors among high school students. In 2007, a sleep duration question was added to the national YRBS. This study describes the prevalence of insufficient, borderline, and optimal sleep on an average school night among U.S. high school students.

**Methods**

For the 2007 national YRBS, a three-stage cluster design was used to obtain a representative sample of students of 9th–12th grade attending U.S. public and private schools. Sampling strategies have been reported elsewhere [8]. Student participation was anonymous and voluntary. Local parental permission procedures were followed. Centers for Disease Control and Prevention's Institutional Review Board approved the survey. During spring 2007, students completed the self-administered questionnaire during a regular class period. Data from 14,041 students were available for analysis. The school response rate was 81%, student response rate was 84%, and overall response rate was 68%. A weighting factor

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Table 1

Prevalence of insufficient, borderline, and optimal sleep on an average school night among high school students, by gender, race/ethnicity, and grade (United States – 2007)

	Insufficient $\leq 7$ h		Borderline (8 h)		Optimal $\geq 9$ h	
	%	95% CI	%	95% CI	%	95% CI
Overall	68.9	(66.9–70.9)	23.5	(21.8–25.3)	7.6	(6.8–8.4)
Sex						
Female	71.3	(69.2–73.2)	22.5 <sup>M</sup>	(20.5–24.6)	6.3 <sup>M</sup>	(5.5–7.1)
Male	66.6 <sup>F</sup>	(64.1–69.1)	24.5	(22.6–26.6)	8.8	(7.7–10.1)
Race/Ethnicity						
White, non-Hispanic	69.2	(66.3–71.9)	24.4	(21.8–27.2)	6.5 <sup>H</sup>	(5.7–7.3)
Black, non-Hispanic	71.2	(68.9–73.4)	20.6 <sup>W, H</sup>	(18.8–22.6)	8.2	(6.7–9.9)
Hispanic	65.6 <sup>B</sup>	(61.3–69.6)	23.8	(21.3–26.4)	10.6	(8.7–12.9)
Grade						
9th	57.7 <sup>10,11,12</sup>	(54.8–60.5)	29.7	(27.1–32.5)	12.5	(10.5–15.0)
10th	67.6 <sup>11,12</sup>	(64.8–70.2)	25.4 <sup>9</sup>	(23.0–27.9)	7.1 <sup>9</sup>	(5.8–8.5)
11th	75.1	(72.4–77.7)	19.5 <sup>9,10</sup>	(17.2–22.0)	5.4 <sup>9,10</sup>	(4.6–6.3)
12th	78.2	(75.2–81.0)	17.7 <sup>9,10</sup>	(15.4–20.4)	4.0 <sup>9,10,11</sup>	(3.1–5.2)

F = female; M = male; W = white, non-Hispanic; B = black, non-Hispanic; H = Hispanic.

9 = 9th grade; 10 = 10th grade; 11 = 11th grade; 12 = 12th grade. The subgroups (denoted by a superscript) have a higher prevalence of insufficient, borderline, or optimal sleep hours than the row subgroup according to pairwise *t*-test at  $p < .05$ .

was applied to each student record to adjust for nonresponse and oversampling of black and Hispanic students.

Sleep duration was assessed by the question, “On an average school night, how many hours of sleep do you get?” Response options included “4 or less hours,” “5 hours,” “6 hours,” “7 hours,” “8 hours,” “9 hours,” and “10 or more hours.” Responses were collapsed into three categories: insufficient ( $< 8$  hours); borderline (8 hours); and optimal ( $\geq 9$  hours). Student demographic characteristics included sex, grade, and race/ethnicity (non-Hispanic white, non-Hispanic black, or Hispanic). Data are presented only for non-Hispanic black, non-Hispanic white, and Hispanic students. The numbers of students from other racial/ethnic subgroups were too small for meaningful analysis.

The final sample for this study included 12,154 students who responded to the sleep question. Analyses were performed on weighted data using SUDAAN to account for the complex sample design. Prevalence and 95% confidence intervals of the sleep categories were calculated for students overall and by sex, race/ethnicity, and grade. Pairwise differences were determined using *t*-tests, with  $p < .05$  considered significant.

## Results

Nationwide, 68.9% of students reported insufficient sleep on an average school night (Table 1). Among all students, students getting insufficient sleep comprised the 5.9% of students who reported sleeping  $\leq 4$  hours, 10% who reported sleeping 5 hours, 22.8% who reported sleeping 6 hours, and 30.2% who reported sleeping 7 hours on an average school night. The prevalence of insufficient sleep was higher among female (71.3%) than male (66.6%) students and higher among black (71.2%) than Hispanic (65.6%) students. The prevalence of insufficient sleep was lowest among students of ninth grade (57.7%) and highest among those of 12th

grade (78.2%). All pairwise comparisons by grade were statistically different except for students of 11th grade (75.1%) versus those of 12th grade (78.2%).

Nearly one-quarter (23.5%) of students nationwide reported borderline sleep on an average school night. The prevalence of borderline sleep was higher among male (24.5%) than female (22.5%) students, higher among white (24.4%) and Hispanic (23.8%) than black (20.6%) students. The prevalence of borderline sleep was lowest among students of 12th grade (17.7%) and highest among those of ninth grade (29.7%). All pairwise comparisons by grade were statistically different except for students of 11th grade (19.5%) versus those of 12th grade (17.7%).

Nationwide, 7.6% of students reported optimal hours of sleep on an average school night. The prevalence of optimal sleep was higher among male (8.8%) than female (6.3%) students, higher among Hispanic (10.6%) than white (6.5%) students, and lowest among students of 12th grade (4.0%) and highest among those of ninth grade (12.5%). All pairwise comparisons by grade were statistically significant.

## Discussion

On an average school night, most of high school students are getting insufficient sleep, while few students are getting optimal sleep, a finding consistent with the 2006 Sleep in America poll [2]. Female students, students in 11th and 12th grades, and black students have the highest risk for insufficient sleep.

These data apply only to youth who attend school and are not representative of all persons in this age group. Nationwide, in 2006, approximately 3.9% of persons aged 16–17 years were not enrolled in a high school program and had not completed high school [9]. The data are based on self-report and may be subject to associated biases.

Too many adolescents are getting insufficient sleep on school nights, and public health efforts are needed to promote optimal sleep. A variety of factors contribute to total sleep time, including employment status [7], social interaction [7], caffeine consumption [4], sleeping disorders [7], and school start times [10]. Adolescents who have a set bedtime before 10 pm on school nights, sufficient sleep on weekends, and consistent wake and sleep times on weekends and weeknights are most likely to get optimal sleep [2]. Delaying school start times is a demonstrated strategy to promote sufficient sleep among adolescents [10]. Nationally endorsed evidence-based sleep duration guidelines are needed to inform public health programs and policy and increase awareness about the importance of sleep.

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