Dose-dependent Relationships between Sleep Duration and Unsafe Behaviors among United States High School Students

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Introduction

Youth in America are sleeping less than ever before. More than 70% of high school students average <8 hours of sleep,[1] falling short of the 8-10 hours that adolescents need for optimal health.[2] Insufficient sleep negatively impacts learning and development and acutely alters judgment, particularly among youth.[3] We estimated associations between sleep duration and adolescent personal safety risk-taking behaviors in United States high school students.

Methods

We utilized data from high school students who responded to the Youth Risk Behavior Survey (YRBS) between 2007 and 2015.[4] The study was exempt from Institutional Review Board review. The YRBS is administered biannually to a nationally representative sample of students of all ages enrolled in grades 9-12 at public and private schools. Sleep duration on an "average" school night was categorized as 8 hrs, 7 hrs, 6 hrs, or <6 hrs. Personal safety risk-taking behaviors were examined individually and as composite categories. We weighted all analyses to account for the complex survey design and controlled for age, sex, race, and year of survey in weighted logistic regression models to test the association between sleep duration and each outcome of interest.

Results

The dataset included 67,615 surveys. Most participants (99%) were 14 years old. Approximately half were female (49%), most identified as white (58%), while 18% identified as hispanic or latino, 13% black or African American, and 8% other race or

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ethnicity. Grade of school was approximately balanced. 9th grade students had the highest representation (27%) and 12th grade students the lowest (23%). Each survey year contributed a similar amount of data (minimum 18% and maximum 22%).

Only 30% reported averaging 8 hours of sleep. The proportion who reported <8 hours increased from 69% to 73% from 2007-2015. Shorter sleep duration was associated with increased odds of risk-taking behaviors in a dose-dependent manner (Figure 1), with fewer hours of average sleep associated with increased odds of all selected unsafe behaviors (Table 1). Insufficient sleep increased the odds of risk-taking while driving, use of alcohol, tobacco and other drugs, risky sexual activity, and aggressive behaviors. The strongest associations were related to mood and self-harm. Those who slept less than 6 hours were more than 3 times as likely to report considering suicide, a plan to attempt suicide, or attempting suicide; and more than four times as likely to report an attempted suicide that resulted in treatment.

Discussion

We found significantly increased odds of reported unsafe behaviors among youth who reported insufficient sleep. These behaviors are common precursors to accidents and suicides, which are the leading causes of death among teenagers.[5] Insufficient sleep has pervasive consequences that may underlie adolescent public health concerns, including mental health, substance abuse, and motor vehicle crashes. Prior reports have documented that high school students who slept <8 hours were at increased risk of adverse health behaviors.[6] Our study adds to this literature by using a larger, updated dataset collected over an 8-year interval; by incorporating more granular sleep information; and by examining a wider array of risk-taking behaviors. The data were collected via self-report and may be subject to social desirability and recall bias. The cross-sectional design precludes examination of a bidirectional relationship, which may exist for some behaviors. We controlled for multiple potential confounders, but residual confounding may persist due to imprecise or unmeasured confounders.

These data have important implications for the health and safety of high school students nationally. We observed a significant burden of insufficient sleep and a consistent dose-dependent relationship between sleep duration and unsafe behaviors. Future efforts should seek to promote healthy sleep habits and remove barriers to sufficient sleep in this vulnerable population.

Acknowledgements

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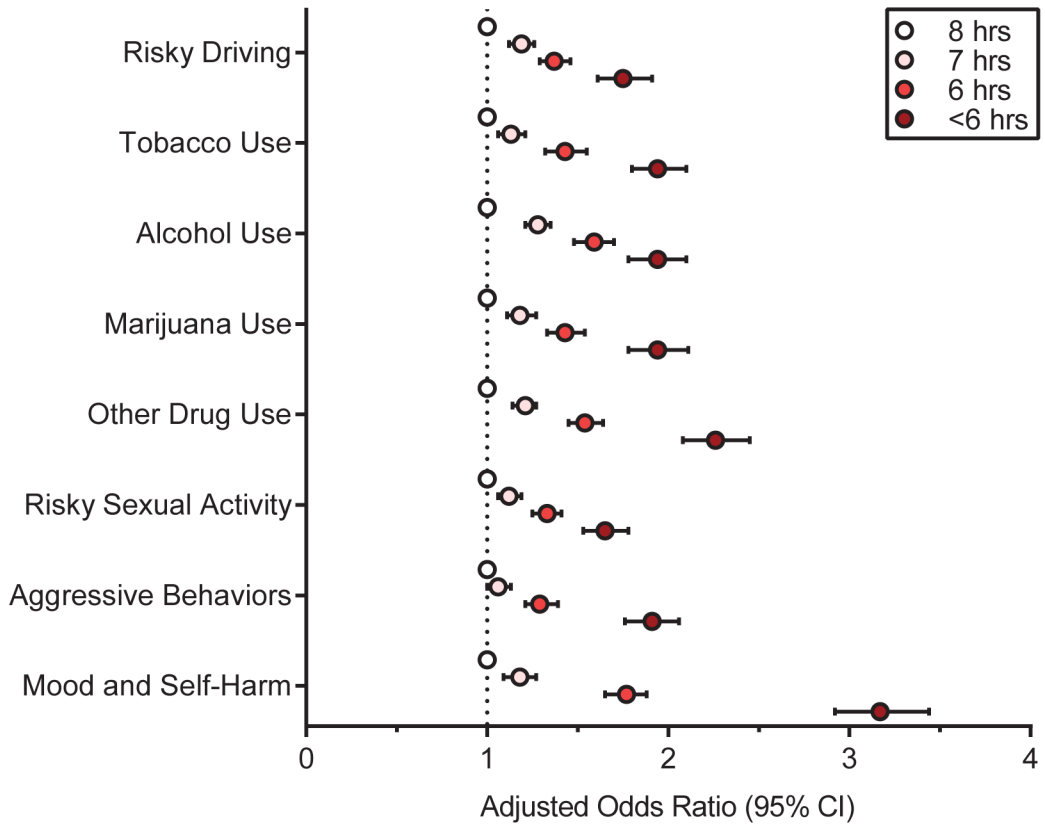
Figure 1. Adjusted association between sleep duration and risk-taking behaviors.
Estimated odds ratios are from weighted logistic regression models adjusted for age, sex, race, and year of survey.

Table 1.

The prevalence of each selected risk-taking behavior in the past 30 days and their adjusted association with sleep duration.

Description	Prevalence n=67,615	7 hrs* n=20,266 (30.0%)	6 hrs* n=14,900 (22.0%)	<6 hrs* n=11,912 (17.6%)
Risky Driving	35.5%	1.19 (1.12-1.26)	1.37 (1.29-1.46)	1.75 (1.61-1.91) [†]
Rarely or never wore a seat belt	8.2%	1.04 (0.93-1.18)	1.56 (1.39-1.75)	2.98 (2.65-3.34) [†]
Texted or emailed while driving (among drivers)	41.7%	1.30 (1.14-1.49)	1.32 (1.17-1.49)	1.29 (1.12-1.50) [†]
Rode with a driver who had been drinking alcohol	24.6%	1.19 (1.12-1.26)	1.41 (1.31-1.51)	1.79 (1.66-1.93) [†]
Drove after drinking alcohol (among drivers)	8.8%	1.04 (0.84-1.30)	1.27 (1.03-1.56)	1.98 (1.62-2.42) [†]
Tobacco Use	26.6%	1.13 (1.06-1.21)	1.43 (1.32-1.55)	1.94 (1.80-2.10) [†]
Alcohol Use	38.9%	1.28 (1.21-1.35)	1.61 (1.50-1.74)	2.01 (1.84-2.19) [†]
Marijuana Use	21.9%	1.18 (1.11-1.27)	1.43 (1.33-1.54)	1.94 (1.78-2.11) [†]
Other Drug Use [a]	24.9%	1.17 (1.10-1.25)	1.51 (1.41-1.62)	2.34 (2.16-2.52) [†]
Risky Sexual Activity	37.0%	1.12 (1.06-1.19)	1.33 (1.25-1.41)	1.65 (1.53-1.78) [†]
Currently sexually active	33.4%	1.11 (1.05-1.19)	1.30 (1.23-1.38)	1.59 (1.48-1.71) [†]
Sexually active, have used alcohol or drugs before sex	21.9%	1.04 (0.92-1.18)	1.17 (1.04-1.32)	1.91 (1.69-2.17) [†]
Sexually active, withdrawal method of birth control	5.1%	1.15 (1.00-1.33)	1.63 (1.44-1.85)	1.85 (1.61-2.14) [†]
Sexually active, no method of birth control	5.8%	1.04 (0.91-1.19)	1.31 (1.15-1.49)	1.94 (1.72-2.19) [†]
History of sexual intercourse with four or more persons [b]	13.9%	1.03 (0.95-1.11)	1.32 (1.21-1.45)	1.99 (1.81-2.20) [†]
Aggressive Behaviors	36.1%	1.06 (1.00-1.13)	1.29 (1.21-1.39)	1.91 (1.76-2.06) [†]
Carried a weapon	17.3%	0.96 (0.89-1.04)	1.16 (1.06-1.26)	1.95 (1.77-2.14) [†]
Carried a gun	5.3%	0.79 (0.68-0.92)	1.03 (0.89-1.18)	1.73 (1.54-1.96) [†]
In physical fight	29.1%	1.09 (1.03-1.16)	1.37 (1.28-1.46)	1.97 (1.81-2.15) [†]
Mood and Self-Harm	34.3%	1.18 (1.09-1.27)	1.77 (1.65-1.88)	3.17 (2.92-3.44) [†]
Felt sad or hopeless	28.5%	1.16 (1.07-1.25)	1.74 (1.62-1.86)	3.11 (2.87-3.37) [†]
Seriously considered suicide	15.9%	1.15 (1.05-1.26)	1.73 (1.58-1.89)	3.12 (2.85-3.41) [†]
Made plan about how to attempt suicide	12.6%	1.10 (1.01-1.21)	1.63 (1.50-1.77)	3.17 (2.87-3.51) [†]
Attempted suicide	7.4%	0.98 (0.87-1.10)	1.48 (1.31-1.68)	3.39 (3.00-3.82) [†]
Attempted suicide and required treatment	2.3%	1.05 (0.85-1.30)	1.29 (1.05-1.58)	4.24 (3.53-5.10) [†]

[*] Participants reporting 8 hrs sleep (n=20,538 (30.3%)) are the referent category for all comparisons.

[†] P-value <0.0001.

[a] Reported ever using cocaine, inhalants, heroin, methamphetamines, ecstasy, synthetic marijuana, steroids without a prescription, prescription drugs without a prescription, or injecting an illegal drug.

[b] Lifetime history.