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Adolescent Sleep, Risk Behaviors, and Depressive Symptoms: Are They Linked?

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Abstract

Objective—To explore how weekday and weekend sleep patterns are related to adolescent substance use, depressive symptoms, and school truancy.

Methods—Self-report surveys of 242 youth (93.4% white, mean age 16.4 years).

Results—Longer weekday sleep duration was inversely associated with depressive symptoms, past month alcohol use, and drunkenness. Later weekend bedtime and wake-times, compared to those of weekdays, were associated with increased substance use and truancy.

Conclusions—Weekday sleep duration appears to be protective for substance use, depression and school truancy for teenagers. However, inconsistent sleep patterns between weekdays and weekends were associated with a range of markers for adolescent risk.

Keywords

adolescents; sleep; risk behaviors; depressive symptoms

Sleep may be particularly important during adolescence as this is a period of increased brain maturation.¹ Average sleep duration varies between pre-adolescents and adolescents, but optimal sleep time, in both groups, appears to be about 9 hours.^{2,3} However, research suggests that adolescents typically do not get enough sleep, especially during the school week.^{4,5} According to a 2006 report by the National Sleep Federation, only 20% of adolescents report getting 9 hours of sleep, and almost half report sleeping less than 8 hours on school nights.⁶

One 6-year longitudinal study found that when pre-adolescents (varying in baseline age from 10 to 12) were allowed to sleep up to 10 hours, the amount they slept averaged 9.2 hours, and this sleep time did not vary across pubertal stage.^{2,3} Additional research in the area has reported similar findings.⁷ However, in transitioning to the teenage years, adolescents have been found to stay up later at night and sleep later in the morning than pre-

adolescents.^{3,8} Though previous research has shown that teenagers may compensate for sleep lost during the weekday on the weekends,^{5,7,9} this may not be enough.

If adolescents are going to sleep later but still need to get up earlier for school, they may be running up a sleep debt, potentially putting them at risk for a multitude of negative outcomes^{4,5}; and different facets of “sleep” may have a unique impact on adolescent health, including sleep problems, sleep duration, and sleep patterns. *Sleep problems* refer to having trouble falling or staying asleep; *sleep duration* refers to the length of sleep; and *sleep patterns* refer to the times youth go to sleep and wake up and the consistency of those patterns across weekdays and weekends.

Significant associations between adolescent risk behaviors, such as substance use, and overall sleep problems have been illustrated in both cross-sectional and longitudinal research.^{10,11} Previous research has indicated that adolescents engaging in substance use (eg, tobacco, alcohol, marijuana and other illicit drugs) may have as much as 3.2 times greater risk for sleep problems, compared to adolescents not engaging in substance use behaviors,^{10,11} and this relationship may be stronger among girls.¹⁰ Given that these associations were significant even after exploring mediating pathways of sleep problems on substance use, the authors concluded that sleep problems in early childhood appear to be “a marker of an independent contributor to early substance involvement.”¹¹(p.583)

There are also many adverse consequences of inadequate sleep duration. Adolescents who sleep less are more likely to have academic problems.³ Short night sleep, particularly on school nights, has also been associated with increased levels of depressive mood, daytime sleepiness, and problematic sleep behavior.^{3,12,13} It has been suggested that depression may lead to short sleep durations and irregular sleep schedules¹⁴ and sleep loss may, in turn, cause depression,^{1,4,15} illustrating the complex nature of these relationships. Furthermore, there is some evidence to suggest that less sleep may be associated with increased alcohol use rates among youth.¹²

Finally, research has also suggested that sleep patterns, or the times youth go to sleep and wake up and the weekday/weekend consistency of those patterns, may also influence risk behaviors and depression. Youth who have a greater weekend delay (ie, greater difference between weekday and weekend bedtimes) have been found to be more likely to engage in tobacco use, alcohol use, and marijuana use.¹² In addition, girls with larger weekend delays reported increased depressed mood.³ These relationships between sleep patterns and risk behaviors may reflect youth who are more likely to be out with friends and have less parental supervision on weekends, providing more opportunity for risky behavior.

Although studies have explored the relationship between sleep problems and risk behaviors,^{10–12} fewer have explored how sleep duration influences risky behaviors and depression and how these associations may vary by weekday versus weekend sleep duration.¹² Because adolescents tend to make up for lost weekday sleep on the weekends, combining weekday and weekend sleep may mask important associations between sleep and risky behaviors. Also, little research to date has explored the association between sleep patterns and risk behaviors¹² and depression.³ Although research has begun in this area, there are still gaps in our knowledge and also a need to further document existing research findings. In particular, it is important to understand how differences in the amount of sleep on the weekdays and weekends, as well as inconsistent sleep and wake times, may be associated with engagement in risky behavior and depressive symptoms. Sleep patterns may be important as it is particularly difficult for adolescents to adjust their sleep schedules from weekends to weekdays as their circadian timing systems adjust much more readily to delays in sleep than to advances in their wake times.¹ Therefore, adolescents with delayed weekend bed and

wake times, as compared to weekdays, may take several days to adjust to the earlier school bed and wake times,¹ thereby putting them at much greater risk for sleep loss during the week and perpetuating a cycle of inconsistent sleep patterns and sleep loss. Additionally, though previous work has documented significant gender differences in sleep^{13,16,17} and prevalence of risk behaviors,¹⁸ what little research that has explored gender-based differences in the impact of sleep on risk behaviors has been inconsistent.^{10,12}

Sleep may be associated with these risk factors because adolescents who are not receiving enough sleep may be more likely to have trouble coping with day-to-day tasks and challenges due to a diminished capacity from lack of sleep. Because these adolescents are already taxed due to lack of sleep, they may be more likely to engage in risky behaviors such as substance use and truancy. Previous research suggests that sleep loss among youth has been associated with lower mood control¹ and that inadequate sleep can result in problems with attention, increased irritability, difficulty regulating impulses and emotions.^{1, 19} Research also shows that a lack of self-control, a form of coping, including both behavioral and emotional self-control, is related to substance use among youth.^{20,21} Difficulties with emotion regulation have also been associated with an increased risk for depression.²² Therefore, it is particularly important to determine if there is a direct effect of sleep on these risk behaviors as well. As suggested by Yap and colleagues, “This developmentally normative ‘mismatch’ between strong affective and behavioral impulses, and the adolescents’ still limited capacity to regulate them, and reduced adult monitoring, means that early- to middle adolescence is a period of heightened vulnerability to problems associated with poor regulation of affect and behavior.”²²(p. 184)

Therefore, the purpose of this study is to explore how weekday and weekend sleep duration and sleep patterns among adolescents are related to levels of risk behaviors, including substance use, school truancy, and depressive symptoms. We hypothesize that decreased sleep duration and larger sleep duration differences between weekdays and weekends will be related to increased levels of risky behaviors and depressive symptoms. Additionally, we hypothesize that a larger weekend delay and weekend oversleep (ie, a later time to bed and later wake-time on weekends compared to weekdays) will be associated with increased risk behaviors and depressive symptoms. We will also explore how the relationships between sleep and risk factors may vary by gender.

METHODS

Participants

From 2006 to 2007, 349 youth aged 10–16 (and one of their parents) were recruited from within the 7-county metropolitan area of Minneapolis-St Paul, Minnesota, to participate in a study of factors related to the development of overweight in youth. Youth were invited to participate regardless of weight status but were required to participate with one adult with whom they spent a significant amount of time (eg, a parent/guardian or other relative or adult who cares for him or her on a regular basis). Youth were recruited from (1) an existing cohort of youth participating in the Minnesota Adolescent Community Cohort (MACC) Tobacco Study,²³ (2) a Minnesota Department of Motor Vehicle (DMV) list restricted to the 7-county metro area, and (3) a convenience sample drawn from local communities. A total of 26% of the youth were recruited from the MACC cohort, 49% were recruited from the DMV sample, and 25% were recruited from the convenience sample. The recruitment rate was 18% and 6% for the MACC and DMV samples, respectively. A recruitment rate cannot be calculated for the convenience sample because the denominator is unknown.

The youth sample was primarily white (93.4%), approximately half were male, and nearly 80% of the sample lived with both parents. Census data from the Minneapolis-St Paul area

(Twin Cities) indicates that 86.1% of youth under the age of 18 in the metro area are white; however, the difference in racial distributions between our sample and the census data was not significantly different. Although nearly 80% of our sample lives with both parents, this proportion is much higher than the population in the Twin Cities where about 41% of youth under 18 live with both parents.

Given the very low prevalence of risk behaviors among junior high and middle school students in this sample (ranging from 0% engaging in past month drunkenness and marijuana use to 3.8% for ever smoking), the participants in this analysis were limited to those who were in high school (9th–11th grades) (n=242). See Table 1 for demographic information. The Institutional Review Board of the University of Minnesota approved this study. The present study is a secondary data analysis of data from the larger study.

Measures

Youth completed a self-report survey that included questions on sleep patterns, substance use, and other risk behaviors as part of a larger survey to assess a broad range of adolescent health behaviors. Youth completed the confidential survey in a separate room from their parents. Each survey was identified only by the adolescent's identification number.

Sleep Measures

Sleep duration was assessed by asking the youth what time they usually went to bed in the evening (ie, turned out the lights in order to go to sleep) and "usually got out of bed in the morning" on a typical weekday and weekend. These items, adapted from the Night Eating Diagnostic Scale,²⁴ were used to compute weekday and weekend sleep duration. For this study we added the additional description of "turned out the lights in order to go to sleep" to the questions taken from the Night Eating Diagnostic Scale. Similar sleep questions have been used successfully with adolescents in previous studies^{16,17,25} and have been shown to be significantly correlated with measures of sleep using both diary and sleep actigraphy measures.²⁶

Sleep pattern variables were also calculated from the usual bedtime and wake-time questions. Weekend delay between weekdays and weekends was calculated by subtracting the time the adolescent went to sleep on the weekdays from the time he or she went to sleep on the weekends. This weekend-delay variable represented the bedtime shift from weekdays to weekends with a larger number indicating a later bedtime on weekends. Weekend oversleep between weekdays and weekends was calculated by subtracting the time the adolescent woke up on the weekdays from the time he or she woke up on the weekends. This weekend-oversleep variable then represented the wake-time shift from weekdays to weekends with a larger number indicating a later wake-time on weekends. The sleep-duration-difference variable was calculated by subtracting weekday sleep duration from weekend sleep duration to represent the difference between sleep duration on the weekends and weekdays with a larger number indicating a greater difference between hours of sleep on the weekends and weekdays (with a more positive number indicating more sleep on the weekends).

Risk Behavior and School Truancy Measures

Several adolescent risk behaviors were assessed including substance use, school truancy, and depressive symptoms. Substance use questions assessed ever and current smoking status, past month alcohol and marijuana use, and past month drunkenness.²⁷ Each risk behavior was included as a single item measure. Two questions assessed ever smoking and current smoking. The ever-smoked question asked if the student had ever smoked a cigarette with the 3 response options including "never," "yes, but only a puff," and "yes, more than

once.” The response options were recoded to 0 = never and 1 = ever trying a cigarette. The current smoking asked how much the student currently smoked with 10 response options ranging from “I don’t smoke” to “a pack or more each day.” The response options were recoded to 0, which included “I don’t smoke” and “not in the last 12 months” and 1 which included all other responses.

To assess alcohol use, students also completed 2 questions about past month alcohol use and past month drunkenness. The first question asked how many times in the past month they had alcohol to drink, including beer, wine, and liquor, but not including sips, with response options ranging from 0 to 40 or more. The response options were recoded to 0 and 1 (using alcohol at least once in the past month). The second question asked how many times in the past month they have “gotten really drunk” from drinking alcoholic beverages. Response options ranged from 0 to 10 or more times. This variable was also recoded to 0 and 1 (gotten drunk at least once in the past month). To assess marijuana use, students were asked to report the number of times they used marijuana, with response options ranging from 0 to 40 or more times, which was recoded to 0 and 1 (used marijuana at least once in the past month). Past month school truancy was assessed with one question, adapted from the Global School-based Health Survey,²⁸ in which students were asked how many days they skipped classes or school without permission in the past month. The response options ranged from 0 days to 10 or more days. This variable was recoded to 0 and 1 (skipped class at least once in the past month).

Depression Measure

Past year depressive symptoms were also assessed. Depressive symptoms were measured using the 6-item Kandel-Davies scale.²⁹ These questions asked the students to respond “not at all,” “somewhat,” or “very much” to questions that ranged from the extent to which, in the past 12 months, they felt bothered or troubled by feeling too tired to do things; feeling hopeless about the future; and feeling sad, unhappy, or depressed. The Cronbach alpha for this scale was 0.78.

Covariate Measures

Height and weight were objectively measured and transformed into BMI z-scores using national reference data.³⁰ BMI z-score was included as a control variable due to previous documented associations with sleep,^{31–33} substance use,³⁴ and depression.³⁴ Parent’s highest level of education represented the highest level of education for the parents who resided in the house (assessed on the parent survey). Pubertal development was measured with the 5-item self-report Pubertal Development Scale.³⁵ Pubertal development has been associated with both sleep^{1,8} and risk behaviors.^{36,37} Gender and school grade were also included as covariates due to differences in the prevalence of risk behaviors^{38,39} as well as sleep^{3,17} by both of these variables.

Analysis

Using these cross-sectional data, logistic regression analyses using PROC LOGISTIC in SAS (version 9.1)⁴⁰ were conducted to assess how sleep characteristics (ie, weekday and weekend sleep duration, weekend delay, weekend oversleep, and sleep duration difference) were associated with substance use and school truancy. Because depression symptoms were measured on a continuum not using a cut point, linear regression analyses, using PROC GLM, were used to assess how sleep characteristics were associated with depression. Interactions were tested to determine if the relationship between sleep and risk behaviors was modified by gender. All analyses controlled for gender, school grade, body mass index (BMI) z-score, pubertal development, and parent’s highest level of education. In addition to adjusting for gender, school grade, BMI z-score, pubertal development, parent’s education,

weekend delay and oversleep models were also adjusted for weekend and weekday sleep duration.

Missing data represented less than 0.01% of observations for each variable included here and observations with missing data were excluded from models. Therefore, although the total sample size was 242, individual models vary slightly in sample size.

RESULTS

Descriptive Statistics: Outcomes and Exposures

Average sleep duration was 7.7 hours on weekdays and 9.3 hours on weekends (Table 2). However, daily hours of sleep ranged from 4.8 to 10 on weekdays and 4 to 13 hours on weekends. The average weekend delay (in hours) between weekdays and weekends was 1.7 hours and ranged from -1 (one hour earlier on weekends as compared to weekdays) to 7 (7 hours later on weekends compared to weekdays). The average weekend oversleep (in hours) between weekdays and weekends was 3.3 and ranged from -0.25 to 8.5 hours. The average sleep duration difference (in hours) between weekdays and weekends was -1.6 (ie, 1.6 fewer hours of sleep on the weekdays as compared to weekends) and ranged from -0.6 to 2.3 hours.

The prevalence of risk behaviors varied from 6.2% for past month marijuana use to 26.1% for past month alcohol use (Table 2). On average students skipped 1.2 days of school in the past month, and the average depressive symptoms score was 16.2 out of 30 (Table 2). Kendal and Davies found that the mean depressive symptom score for a clinical adolescent sample was 21.8.²⁹

Associations Between Sleep Duration and Adolescent Risk

The results of the logistic regression analyses indicated that odds of past month alcohol use and past month drunkenness were significantly associated with average weekday sleep, with increased hours of sleep on the weekdays associated with decreased odds of alcohol use and instances of drunkenness (Table 3). Results of the linear regression indicate that depressive symptoms were also significantly negatively associated with average weekday sleep, with fewer hours of sleep on the weekdays associated with increased depressive symptoms. Ever smoking, current smoking, past month marijuana use, and school truancy were not significantly associated with weekday sleep. Weekend sleep duration was not associated with any of the risk behaviors or depressive symptoms.

Gender interactions were explored for all models with a significant exposure variable (ie, past month alcohol use, past month drunkenness, and depressive symptoms) (data not shown). There was a statistically significant gender interaction in the relationship between past month alcohol use and weekday sleep ($P=0.03$). In gender-stratified models, the relationship between weekday sleep and past month alcohol use was no longer significant for girls ($OR=0.997$ ($CI=0.63, 1.59$), $P=0.99$). However for boys, the relationship remained significant ($OR=0.39$ ($CI=0.22, 0.70$), $P=0.001$), with fewer hours of weekday sleep associated with increased past month alcohol use. Significant gender interactions were not found for depressive symptoms or past month drunkenness (data not shown).

Associations Between Differential Weekday/weekend Sleep Patterns and Adolescent Risk

The models examining the odds of risk behaviors with weekend delay found that the likelihood of engaging in the risk behaviors (ever smoked, current smoking, past month alcohol use, past month drunkenness, past month marijuana use, school truancy) significantly increased with a delayed bedtime on weekends as compared to weekdays (ie, a

greater weekend delay score) (Table 4). Similar results were found for weekend oversleep, with the odds of each risk behavior (substance use behaviors and school truancy) significantly increased with a delayed wake-time on weekends as compared to weekdays (Table 4). No significant relationship was found between weekend delay or oversleep and depressive symptoms. Sleep duration difference was not significantly associated with risk behaviors or depressive symptoms (Table 4).

Gender interactions were again explored for all models with a significant exposure variable (ie, all risk behaviors for bedtime and weekend oversleep) (data not shown). Significant gender interactions were found between weekend delay and past month alcohol use ($P=0.02$) and school truancy ($P=0.05$), as well as weekend oversleep and school truancy ($P=0.007$). The gender-stratified models found that for past month alcohol use the relationship with weekend delay remained significant for girls (OR=2.26 (CI=1.23, 4.16), $P=0.008$) but was no longer significant among boys (OR=1.38 (CI=0.88, 2.18), $P=0.16$). For weekend delay and school truancy, the relationship was no longer significant for girls but remained significant for boys (girls (OR=1.05 (CI=0.55, 2.01), $P=0.88$; boys (OR=4.05 (CI=1.75, 9.38), $P=0.001$). In the stratified models for weekend oversleep, the relationship with school truancy was no longer significant among girls (OR=1.06 (CI=0.56, 2.02), $P=0.86$) whereas it remained significant among boys (OR=4.06 (CI=1.76, 9.36), $P=0.001$).

DISCUSSION

The results of this study suggest that youth who sleep less on weekdays are more likely to have increased depressive symptoms and report past month alcohol use and past month drunkenness, compared to youth who report longer sleep durations on weekdays. Additionally, youth with greater weekend delays and weekend oversleeps appear to be more likely to engage in substance use behaviors. Consistent with previous work,¹² weekend sleep duration was not associated with the risk behaviors. The lack of association may be due to the fact that adolescents may compensate for lost weekday sleep on the weekends, sleeping later in the day.^{5,9} However, whereas weekend sleep duration was not associated with substance use behaviors or depressive symptoms, those adolescents who slept later on the weekends as compared to the weekdays were more likely to engage in substance use behaviors.

To our knowledge, this is among the first studies of its kind to examine the relationship between risky behaviors and measures of weekday and weekend sleep duration, weekend sleep delays and oversleeps, and sleep duration differences. Similar to O'Brien and Mindell,¹² this study found that a greater weekend sleep delay was associated with greater risk for alcohol use; however this study also found associations between school truancy and weekend sleep delay and oversleeps. Previous research has also found stronger associations between risk behaviors and sleep problems for girls.¹⁰ In contrast, although other work has shown that girls sleep later and longer on the weekends than boys do,¹⁶ our findings are, to our knowledge, the first to indicate that the relationships between weekday sleep duration, weekend delay and weekend oversleeps and risk behaviors were stronger for boys than for girls.

Future studies are needed to more fully examine the relationships among sleep duration, sleep patterns, risky behaviors, and depressive symptoms, possible gender differences, and particularly, the causal mechanisms through which these associations occur. Although this cross-sectional analysis allows us to gain insights into the associations between sleep and risk factors, it does not shed light on the temporality of the associations between sleep and risk factors. Regarding our findings that show a relationship between weekday sleep duration, risk behaviors and depressive symptoms, it may be that youth are losing sleep if

they are depressed or engaging in risky behaviors such as alcohol use, but it is equally plausible that distress caused by lack of sleep is contributing to depressive symptoms and that substance use occurs as a way to cope with the distress. The importance of patterning of sleep on the weekends suggests that youth may be engaging in risky behaviors on weekends later in the evenings when there is no curfew or when parents relax their curfew. However, we do not know the causal relationship between risky behaviors, depression, and later sleep initiation on weekends.

Family- and parental-level characteristics may be a particularly important target for future research in this area. For example, factors such as parental monitoring may be related to both sleep and engagement in risky behaviors as parents who monitor their children less may have children who are more likely to set their own bedtimes, which may lead to reduced sleep during the week. Parental monitoring may differ during the weekdays and weekends. Additionally, it has been shown that lower levels of parental monitoring are associated with higher levels of alcohol use.^{41–45} It is also plausible that parenting factors may be antecedents to both sleep patterns and engagement in risky behaviors and that more involved and engaged parenting may reduce the risk for problems in both of these areas. This research suggests a clear difference in the influence of sleep factors during the week and weekends. It suggests that parents need to be made aware of the need to monitor their adolescent's bedtime even during the weekend; having a curfew on the weekend is likely as important as getting enough sleep during the school week for adolescent risk behaviors and depression risk. Future research is needed to more fully explore the relationships among parenting, sleep, and engagement in risk behaviors.

Future studies should also explore the effects of work schedules, extracurricular activities, and social activities as possible covariates in the relationship between adolescent sleep issues and risk behaviors^{1,4} as these activities may combine to create environments conducive to neglecting sleep, as well as explain some differences in weekday and weekend bedtime and weekend oversleeps. In addition, the relationships between externalizing and internalizing behaviors (ie, such as violence and depression) and sleep duration may need to be examined as previous research has found that the association between cigarette and alcohol use and sleep problems was reduced after controlling for these behaviors¹⁰ though the evidence supporting a mediating effect of these behaviors has not been entirely consistent.¹¹ Finally, it is crucial to explore the tracking of sleep habits and patterns throughout adolescence into early adulthood¹ as sleep patterns may be related to tracking of risk-taking behavior as well,^{46–48} and persistent unhealthy sleep patterns could exacerbate later risk of substance abuse and dependence.

Despite the interesting contributions of this work, there are limitations to this study. As previously described, this is a cross-sectional study. Future longitudinal studies are needed to explore the temporal association between sleep, risk behaviors, and depression. This study is also limited in its generalizability as the participants are mostly white and of middle to upper socioeconomic status. Studies are needed with more diverse populations to determine if there are racial/ethnic and socioeconomic differences in the relationships between sleep and risk behaviors. Additional research examining high-risk youth in elementary and middle school to explore how sleep may influence the onset of risk behaviors as well as how it may exacerbate these risk behaviors once they have begun is also needed. An additional limitation to the generalizability of the study is that almost 80% of our youth lived in 2-parent families. Youth in 2-parent families may be more likely to have parental oversight of bedtimes and activities due to the presence of 2 parents. Future research should explore how family structure may moderate the relationship between sleep and risk behaviors. Another limitation is possible endogeneity between the measure of time to sleep and the item on the Kandel-Davies depression scale that asks if the adolescent has had trouble falling asleep or

staying asleep. However, this endogeneity is likely limited as the time to sleep is only one component of the sleep-duration variable. Our inclusion of numerous analyses may create a problem of multiple comparisons, and thus p-values should be interpreted cautiously. Finally, the youth surveys were not anonymous, which may have contributed to underreporting of substance use; however, the surveys were confidential and youth were assured no one but the researchers would see their answers.

In conclusion, adequate sleep during the school week appears to be associated with lower risk behaviors and lower levels of depression in youth. However, this research suggests that parents need to pay attention not only to sleep patterns and amount of sleep that their teens get during the school week, but they also need to be alert that late bedtimes and rising times on weekends may be signaling risk-taking behaviors. Setting weekend curfews may help reduce a variety of risk behaviors. Given the demands of adolescence and the importance of this developmental period, it is critical that we better understand how lack of sleep, in addition to changing sleep patterns, may influence risk behaviors and the health of adolescents.

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Table 1

Descriptive Demographic Characteristics of the Study Sample (n=242)

| | |
|---|----------|
| Age, years | 16.4 |
| Mean Body Mass Index Z-Score | 0.29 |
| Mean Body Mass Index Percentile | 58.3 |
| | <u>%</u> |
| Gender | |
| Male | 48.8 |
| Grade Level | |
| 9th grade | 19.8 |
| 10th grade | 23.1 |
| 11th grade | 57.0 |
| School Type | |
| Public | 84.7 |
| Private | 13.6 |
| Home schooled | 1.7 |
| Race/ethnicity | |
| White | 93.4 |
| African American | 1.2 |
| Asian | 0.4 |
| Mixed ^a | 5.0 |
| Family Structure | |
| Mother and father together | 79.3 |
| Mother and father equally, but separate | 2.9 |
| Parent and step-parent | 4.6 |
| Mother mostly | 11.6 |
| Other | 1.6 |
| Parent Education | |
| Less than HS | 0.0 |
| HS or GED | 3.3 |
| Some college | 18.4 |
| College degree | 33.1 |
| Training beyond college | 45.2 |

Note.

^a More than one race/ethnicity indicated

Table 2

Prevalence of Behaviors Among Adolescents (n=242)

| | Estimate | SD |
|---|-------------------|-----|
| Sleep | | |
| Average Weekday Sleep (hours/day) | 7.7 | 0.9 |
| Average Weekend Sleep (hours/day) | 9.3 | 1.4 |
| Average Weekend Delay in Hours (weekday to weekend) | 1.7 | 1.0 |
| Average Weekend Oversleep in Hours (weekday to weekend) | 3.3 | 1.5 |
| Average Sleep Duration Difference in Hours (weekday to weekend) | -1.6 | 1.5 |
| Risk Behaviors | | |
| % Ever smoked | 24.8 | |
| % Current smoking | 11.2 | |
| % Past month alcohol use | 26.1 | |
| % Past month drunkenness | 8.7 | |
| % Past month marijuana use | 6.2 | |
| Average days skipped in the past month | 1.2 | 0.5 |
| Average depressive symptoms score | 16.2 ^a | 4.3 |

Note.

^aRange 10–30

Table 3

Cross-sectional Association Between Sleep Duration and Risk Behaviors and Depressive Symptoms (n=242)

| | Odds Ratio ^a | CI | P-value |
|---------------------------|-------------------------------|------------|----------------|
| Weekday Sleep | | | |
| Ever smoked | 0.92 | 0.65, 1.31 | 0.65 |
| Current smoking | 0.73 | 0.45, 1.18 | 0.19 |
| Past month alcohol use | 0.71 | 0.51, 0.99 | 0.04 |
| Past month drunkenness | 0.60 | 0.36, 0.97 | 0.04 |
| Past month marijuana use | 0.72 | 0.38, 1.34 | 0.30 |
| Past month skipped school | 0.80 | 0.51, 1.25 | 0.33 |
| | β Estimate^a | SE | P-value |
| Depressive symptoms | -0.76 | 0.30 | 0.01 |
| Weekend Sleep | | | |
| Ever smoked | 0.97 | 0.79, 1.20 | 0.80 |
| Current smoking | 0.98 | 0.73, 1.33 | 0.91 |
| Past month alcohol use | 0.98 | 0.79, 1.20 | 0.82 |
| Past month drunkenness | 0.98 | 0.71, 1.34 | 0.89 |
| Past month marijuana use | 1.10 | 0.73, 1.63 | 0.68 |
| Past month skipped school | 0.84 | 0.63, 1.11 | 0.22 |
| | β Estimate^a | SE | P-value |
| Depressive symptoms | -0.07 | 0.19 | 0.72 |

Note.

^a adjusted for gender, school grade, SES, BMI z-score, pubertal development, and parent's education

Table 4

Cross-sectional Association Between Sleep Patterns and Risk Behaviors and Depressive Symptoms (n=242)

| | Odds Ratio | CI | P-value |
|--|-------------------------------|------------|----------------|
| Weekend Delay | | | |
| Ever smoked | 2.23 | 1.51, 3.30 | <0.0001 |
| Current smoking | 2.38 | 1.45, 3.90 | 0.0006 |
| Past month alcohol use | 1.65 | 1.17, 2.32 | 0.004 |
| Past month drunkenness | 2.56 | 1.53, 4.27 | 0.0003 |
| Past month marijuana use | 2.59 | 1.44, 4.66 | 0.002 |
| Past month skipped school | 2.04 | 1.31, 3.20 | 0.002 |
| | β Estimate^a | SE | P-value |
| Depressive symptoms | 0.35 | 0.30 | 0.24 |
| Weekend oversleep | | | |
| Ever smoked | 2.20 | 1.49, 3.25 | <0.0001 |
| Current smoking | 2.36 | 1.45, 3.85 | 0.0006 |
| Past month alcohol use | 1.65 | 1.17, 2.32 | 0.004 |
| Past month drunkenness | 2.53 | 1.52, 4.21 | 0.0004 |
| Past month marijuana use | 2.60 | 1.45, 4.67 | 0.001 |
| Past month skipped school | 2.05 | 1.31, 3.21 | 0.002 |
| | β Estimate^a | SE | P-value |
| Depressive symptoms | 0.38 | 0.30 | 0.21 |
| Sleep Duration Difference^b | | | |
| Ever smoked | 1.00 | 0.82, 1.23 | 0.98 |
| Current smoking | 1.10 | 0.83, 1.46 | 0.52 |
| Past month alcohol use | 1.10 | 0.91, 1.34 | 0.32 |
| Past month drunkenness | 1.18 | 0.87, 1.59 | 0.28 |
| Past month marijuana use | 1.20 | 0.83, 1.72 | 0.33 |
| Past month skipped school | 0.92 | 0.70, 1.21 | 0.56 |
| | β Estimate^b | SE | P-value |
| Depressive symptoms | 0.19 | 0.18 | 0.29 |

Note.

^a Adjusted for gender, school grade, SES, BMI z-score, pubertal development, parent's education, weekend sleep duration, and weekday sleep duration

^b Adjusted for gender, school grade, SES, BMI z-score, pubertal development, parent's education