ORIGINAL ARTICLES

Sleep Patterns and Mental Health Correlates in US Adolescents

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Objective To investigate systematically the associations of sleep patterns with a range of mental disorders and other outcomes among a nationally representative sample of US adolescents.

Study design Using the National Comorbidity Survey Adolescent Supplement, a nationally representative cross-sectional survey of 10 123 US adolescents 13-18 years of age, we assessed associations between adolescent-reported sleep patterns (tertiles of weeknight bedtime, weeknight sleep duration, weekend bedtime delay, and weekend oversleep) and past-year mental disorders based on the *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition*, smoking, injury, suicidality, and perceived mental and physical health, assessed via direct diagnostic interview.

Results The average weeknight bedtime was at 22:37 and sleep duration was 7.72 hours. Average weekend bedtime delay was 1.81 hours and average weekend oversleep was 1.17 hours. Later weeknight bedtime, shorter weeknight sleep duration, greater weekend bedtime delay, and both short and long periods of weekend oversleep were associated with increased odds of mood, anxiety, substance use, and behavioral disorders, as well as suicidality, tobacco smoking, and poor perceived mental and physical health. ORs ranged from 1.27 to 2.15. The only outcomes not associated with any sleep patterns were past-year injury and eating disorder.

Conclusions Suboptimal sleep patterns were associated with an array of mental disorders and other health-related outcomes among adolescents. Abnormal sleep patterns may serve as markers of prodromal or untreated mental disorders among adolescents, and may provide opportunities for prevention and intervention in mental disorders. *(J Pediatr 2017;182:137-43).*

Sleep plays a critical role in growth, development, and health in adolescents.[1,2] The National Sleep Foundation has recommended that adolescents 14-17 years of age should receive 8-10 hours of sleep.[3] Recommendations for school-aged children (ages 6-13) are slightly longer (9-11 hours), and those for young adults (ages 18-25) are slightly shorter (7-9 hours). Sleep duration and bedtime in adolescents are influenced by multiple factors, the best documented of which are age, sex, and ethnicity.[4-7] In a recent meta-analysis, Olds et al[8] reported that average nightly time in bed decreased by 13.6 and 14.4 minutes with each year of age among adolescent boys and girls, respectively, and that US adolescents slept less than those in Europe and Australia. In addition, some studies indicate that sleep duration among American adolescents has decreased in recent decades. Using nationally representative samples from 1991 to 2012, Keyes et al[9] found that the proportion of adolescents in the US obtaining at least 7 hours of sleep nightly decreased across this period, across age, sex, and race groups. Findings that young people receive inadequate sleep raise concerns about potential physical and mental health consequences.

Sleep loss and its consequences have drawn attention in both public and academic domains. Insufficient sleep, which is common in adolescents, has been associated with adverse consequences, including mood disturbances,[10] other mental and physical health outcomes,[11] increased risk of injuries,[12] and poor school performance.[13] Previous studies have shown that short sleep duration is associated with several mental disorders in children and adolescents, including behavior disorders,[14,15] substance abuse,[16] mood disorders,[17] and suicidality.[18] In addition, we have reported that symptoms of insomnia have been associated with various mental disorders among adolescents.[19] However, several aspects of the association between sleep patterns and mental health are unclear. First, no previous studies have investigated systematically the association of sleep duration with a range of mental disorders based on the *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition* (DSM-IV) among adolescents. Estimation of associations with disorders would provide an indicator of the potential public health impact of sleep patterns on states with defined levels of severity and impairment. Second, studies have indicated that sleep

DSM-IV	*Diagnostic and Statistical Manual of Mental Disorders, 4th Edition*
NCS-A	National Comorbidity Survey Adolescent Supplement
PSAQ	Parent self-administered questionnaire

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pattern variability, that is, variability in bedtimes and sleep duration between weekdays and weekends, is associated with poorer perceived mental and physical health.[10,13,20] However, these studies have not used operational diagnostic criteria to assess associations with clinically relevant mental disorders. Third, to our knowledge, no studies of the associations of sleep patterns with mental disorders have used nationally representative samples.

In light of these knowledge gaps, this study aimed to describe the distribution of sleep patterns (weeknight bedtime, weeknight sleep duration, weekend bedtime delay, and weekend oversleep) among a nationally representative sample of US adolescents, both overall and by sociodemographic characteristics, and estimate associations between atypical sleep patterns and mental disorders, suicidality, injury, tobacco smoking, and perceived mental and physical health.

Methods

The National Comorbidity Survey Adolescent Supplement (NCS-A) is a nationally representative, face-to-face survey of adolescents residing in households in the continental US. A total of 10 123 adolescents, aged 13-18 years, participated in this study with a response rate of 82.9%. Details about the design, sampling, and measure have been published elsewhere.[21,22] In brief, the NCS-A is a national probability sample including both household and school subsamples. Adolescents participated in in-depth personal interviews conducted from 2001 to 2004 that assessed personal characteristics, sociodemographics, physical health conditions, and DSM-IV mental disorders. Written informed consent was obtained from parents (except for adolescents who were emancipated minors) and adolescents. The study was approved by the institutional review boards at the University of Michigan and Harvard University at the time of initial data collection.

Sleep Pattern Measures and Sociodemographic Correlates

Respondents were asked about their sleep patterns, including bedtime and sleep duration on weekdays and weekends, during in-person interviews. Bedtime and sleep duration were collected by asking usual sleeping habits without reference to a specific time frame: (1) "What time do you usually go to bed on weeknights/weekend nights?" and (2) "How many hours of sleep do you usually get on weeknights/weekend nights?" Participants responded in military time. Adolescents that reported a bedtime between 06:00 and 18:00 or sleep duration of greater than 14 hours were considered outliers and excluded from the current study.[4,23] There were 91 outliers for weekday bedtime (0.9%), 165 for weekend bedtime (1.6%), 7 for weekday sleep duration (0.07%), and 33 for weekend sleep duration (0.3%).

Weekday bedtime, weekday sleep duration, weekend bedtime delay (weekend bedtime – weekday bedtime), and weekend oversleep (weekend sleep duration – weekday sleep duration) were classified into tertiles. Sociodemographic characteristics were reported by adolescents and included age (in years), sex, and race/ethnicity (Hispanic, non-Hispanic black, non-Hispanic white, and "other").

Assessment of Mental Health Correlates

A modification of the fully structured World Health Organization Composite International Diagnostic Interview was used to assess DSM-IV disorders by lay interviewers, who were professionals at the Institute for Social Research and had completed a 2-day general interviewer training and a 5-day additional training specific to the NCS-A. Details about the interviewer training and field quality control have been published elsewhere.[21] In addition, behavioral disorders, including attention-deficit/hyperactivity disorder, conduct disorder, and oppositional defiant disorder, measured by parent report using a parent self-administered questionnaire (PSAQ), were included. Because parents are much more accurate reporters than adolescents in attention-deficit/hyperactivity disorder,[24] attention-deficit/hyperactivity disorder was defined by parent report, whereas the other behavioral disorders were defined by endorsement by either the parent or adolescent at symptom level. Analyses of behavioral disorders were restricted to the subsample of adolescents with available parent reports. Definitions of all psychiatric disorders adhered to DSM-IV criteria, except the definition of oppositional defiant disorder, which was modified to enhance clinical validity based on a clinical reappraisal subsample.[25] The diagnoses of DSM-IV disorders in the past 12 months were used in the current study. The 12-month prevalence rates of mental disorders in the NCS-A have been published previously.[26] Five categories of mental disorders were included into the final analyses: mood (major depressive disorder, dysthymia, bipolar I, and bipolar II), anxiety (agoraphobia, generalized anxiety disorder, social phobia, specific phobia, panic disorder, post-traumatic stress disorder, separation anxiety disorder), substance use (alcohol abuse or dependence, drug abuse or dependence), eating disorders (anorexia, bulimia, binge eating), and behavior disorders (conduct disorder, oppositional defiant disorder). Suicidality included any suicidal thoughts, plans, or attempts in the past 12 months.

Lifetime tobacco smoking was assessed by a positive response to the question, "Are you a current smoker, ex-smoker, or have you never smoked?" and/or "Was there ever a time in your life lasting at least 2 months when you smoked at least once per week?" Past-year injury was assessed by the question, "In the past 12 months did you have an accident, injury, or poisoning that required medical attention?" Perceived physical and mental health were assessed by the question "How would you rate your overall physical (mental) health – excellent, very good, good, fair, or poor?" and were coded to indicate fair or poor perceived health.

Statistical Analyses

Analytic sample sizes were 10 003 for weekday bedtime (6417 in PSAQ subsample), 10 072 for weekday sleep duration (6449 in PSAQ subsample), 9748 for weekend bedtime delay (6252 in PSAQ subsample), and 9965 for weekend oversleep (6381 in PSAQ subsample). To account for complex sampling design features of the NCS-A and obtain unbiased