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Prevalence and Correlates of Hypersomnolence Symptoms in US Teens

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Abstract

Objective: Recent attention to pervasive sleep deficits in U.S. adolescents has focused on sleep patterns and insomnia, but there are limited data on the prevalence and correlates of hypersomnolence symptoms.

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Ms. He served as the statistical expert for this research.

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Method: The sample included 6,483 adolescents ages 13–18 years who were interviewed directly and had parent reports in the National Comorbidity Survey Replication Adolescent Supplement (NCS-A), a nationally representative sample of US youth. Information on sleep patterns/symptoms that were collected in the interview was used to determine the population prevalence of DSM-5 criterion-A defined hypersomnolence and component symptoms. Logistic regression analyses were used to examine associations between sleepiness and sub-symptoms of hypersomnolence with weekday/weekend bedtime, sleep duration, mental disorders and psychotropic medication use.

Results: 41.5% of US adolescents reported feeling sleepy during the daytime and 11.7% met criteria for hypersomnolence. The prevalence of hypersomnolence varied depending on age ($p<0.001$) and was more common in adolescent girls (OR=1.40; 95% CI=1.09–1.78). Excessive sleepiness and hypersomnolence symptoms were associated with reduced sleep duration and delayed bedtimes on weekdays and weekends. Hypersomnolence was significantly associated with insomnia (OR=2.45; 95% CI=1.87–3.21) and mental disorders (OR=1.99; 95% CI=1.42–2.77). After accounting for insomnia, hypersomnolence was no longer associated with use of psychotropic medication (OR=1.61; CI=0.97–2.66).

Conclusion: Among adolescents with adequate sleep duration, we found that 11.7% still report symptoms of hypersomnolence. The strong association between hypersomnolence with insomnia suggests that sleep disorders in adolescents may fluctuate between over- and under-sleeping. Potential mechanisms underpinning the strong associations between sleep disturbances and mental disorders should be further pursued and may provide insight into prevention efforts.

Keywords

Hypersomnia; sleepiness; adolescents; sleep disturbance; insomnia

Introduction

Sleepiness and inadequate sleep in U.S. teens are associated with deterioration in school performance, health and safety^{1,2} and are significant public health concerns. Sleepiness in adolescents and young adults contributes to motor vehicle accidents, the leading cause of mortality in these age groups³. Improving sleep health, reducing sleepiness and increasing sleep opportunity are important areas for intervention to improve overall adolescent health and wellbeing¹. However, most community-based research on sleep in adolescents has focused on inadequate sleep time, and there are very limited data on the prevalence and correlates of sleepiness and hypersomnolence in U.S. adolescents.

The Diagnostic Statistical Manual- 5th Edition (DSM-5) defines hypersomnolence as symptoms of excessive sleepiness associated with lapses into sleep, feeling unrefreshed despite adequate sleep time and difficulty waking in the morning which occur despite adequate nighttime sleep⁴. A previous study that examined somnolence in a single school district in the U.S. revealed that as many as 45% of teenagers complained of sleepiness during the day and 16% noted falling asleep in class⁵. Similarly, 51% of U.S. teens reported sleepiness or tiredness during the daytime in an online survey conducted by the National Sleep Foundation⁶. However, these studies did not examine the influence of sleep duration,

psychiatric comorbidity and psychotropic medication use. Additionally, the impact of inadequate nighttime sleep duration on excessive sleepiness and other symptoms of hypersomnolence is under explored in samples of community dwelling adolescents.

Previous analyses of the National Comorbidity Survey Replication Adolescent Supplement (NCS-A), a nationally representative population based sample showed that the average sleep duration of U.S. adolescents is less than even the minimum recommended 8 hours of sleep each night⁷, primarily due to later weekday bedtimes⁸. In turn, later bedtimes and shorter sleep durations are associated with significant psychiatric comorbidity⁸. However, the prevalence of sleepiness, hypersomnolence and its component sub-symptoms and their association with mental disorders, psychotropic medication use, sleep duration and insomnia in the NCS-A has not been previously explored.

In the current study, we utilized data from the NCS-A to examine 1) the association between excessive sleepiness and other component symptoms of hypersomnolence defined in accordance with DSM-5 criterion A with weekday and weekend bedtime/sleep duration 2) determine the population prevalence and associated socio-demographic characteristics of hypersomnolence among those with adequate nighttime sleep duration in a representative sample of adolescents; and 3) examine the association of hypersomnolence with insomnia, mental disorders and psychotropic medication use.

Methods

Sample:

The NCS-A was a face-to-face computer assisted interview of adolescents that was supplemented by a self-administered questionnaire (SAQ) mailed to a biological parent/guardian⁹. The NCS-A included a nationally representative sample of 10,123 adolescents aged 13 to 18 years who were living in the continental U.S. and was carried out between February 2001 and January 2004. It included dual household and school subsamples with a combined response rate of 82.9%. The response to the parent/guardian SAQ was 83.3%. The analytical sample of this study included information from 6,483 adolescents who had data from both the adolescent interview and SAQ.

Measures:

Self-reported information on sleep related questions including sleep duration and sleep disturbance was collected in the interview section of the Chronic Conditions in the adolescent in person interview. The possible contribution to hypersomnolence from inadequate sleep time was assessed utilizing the data from self-reported total sleep duration and bedtime on weekdays and weekends. The NCS-A did not include any objective measures of sleep time.

While the DSM-5 requires a main sleep period lasting at least 7 hours before hypersomnolence can be diagnosed, the American Academy of Sleep Medicine consensus guidelines recommend that teenagers obtain at least 8 hours of sleep each night¹⁰. The National Sleep Foundation expert panel recommendations suggest that 13-year-olds obtain at least 9 hours of sleep¹¹. In the current study, 13 and 14 year-olds obtaining less than 9 hours

of sleep and 15–17 year-olds obtaining less than 8 hours of sleep per weekday were considered to be obtaining inadequate sleep¹⁰.

In this study hypersomnolence was defined in accordance with the DSM-5 Criterion A, with modifications. Subjects who endorsed problems with feeling sleepy during the daytime for at least 2 weeks were considered to have “daytime sleepiness.” Respondents with adequate nighttime sleep duration who had one or more of the following sub-symptoms, at least sometimes or often, in conjunction with a complaint of daytime sleepiness, a) a tendency to fall asleep during the daytime; b) not feeling rested upon awakening; or c) difficulty waking in the morning, were considered to have “hypersomnolence”.

“Insomnia” was defined as 1) difficulty getting to sleep, 2) staying asleep or 3) waking too soon. DSM-5 criteria B through F which include frequency specifiers that the complaints occur at least three times per week for three months, result in significant impairment or distress and are not better explained by other sleep or medical disorders were not part of the hypersomnolence and insomnia definitions used in this study.

Socio-demographic information on age, sex, race/ethnicity, parent education, and urbanicity was obtained during adolescent interview. The parent/guardian indicated the marital status of parents and family income which was normed against federal poverty levels. Self-reported height and weight were used to calculate sex-specific body mass index (BMI) for age according to Center for Disease Control (CDC) guidelines. Duration of symptoms was ascertained based on self-report of length of problems with daytime sleepiness and/or insomnia. Adolescents were administered the modified World Health Organization Composite International Diagnostic Interview (WHO-CIDI) Version 3.0. This instrument collected information required by the Diagnostic and Statistical Manual of Mental Disorders- IV Edition (DSM-IV) criteria for the following five major classes: mood disorder (major depressive disorder and dysthymia, bipolar I/II), anxiety disorders (panic disorder, agoraphobia, social phobia, specific phobia, generalized anxiety disorder, posttraumatic stress disorder, and separation anxiety disorder); attention-deficit/hyperactivity disorder (ADHD) and other behavior disorders (oppositional defiant disorder and conduct disorder); eating disorders (anorexia, bulimia, binge eating), and substance use disorders (alcohol or drug abuse/dependence, nicotine dependence). The diagnostic information was based on adolescent reports for anxiety, mood, eating, and substance use disorders, parent reports for ADHD, and both adolescent and parent reports combined at symptom level using the ‘or’ rule for other behavior disorders.

Psychotropic medication use was ascertained from the Pharmacoepidemiology section of the adolescent interview. We examined antidepressants, antipsychotics and stimulant medications (methylphenidate, amphetamines and mixed amphetamine salts) that had sufficient frequency for meaningful analyses.

Statistical Analysis:

The rates of sleepiness and sub-symptoms of hypersomnolence (symptoms a, b and c described above) in adolescents with and without adequate sleep duration were estimated. The prevalence of hypersomnolence as defined above was calculated. The association

between daytime sleepiness and the number of sub-symptoms of hypersomnolence with insomnia, sleep duration and bedtime on weekdays and weekends were examined. For these analyses sleep duration and bedtime were ordinally divided into four groups: sleep durations < 7 hours, 7–8 hours, 8–9 hours, > 9 hours and bedtimes before 10 p.m., 10–11 p.m., 11 p.m.–12 a.m. and after 12 a.m. Logistic regression analyses controlling for age and sex, where sleep patterns were treated as independent variables, were performed. The associations between past year hypersomnolence and various demographic characteristics were calculated utilizing odds ratios (ORs) where demographic characteristics were treated as exposures of interest and hypersomnolence was considered a dichotomous outcome. Separate logistic regression analyses were used to examine the associations between hypersomnolence and DSM-IV mental disorders and psychotropic medication use, in which hypersomnolence status was treated as the main exposure of interest. These models were analyzed progressively to adjust for 1) demographic characteristics 2) other 12-month DSM-IV mental disorders and 3) insomnia.

All statistical analyses were completed with the SAS version 9.3 and SUDAAN version 11 using the Taylor series linearization method to take into account the complex survey design and sample weighting. The Taylor series design-based variance-covariance matrices were used for variance estimates and 95% confidence intervals (CIs). The design-adjusted Wald χ^2 tests were used to examine differences by hypersomnolence status. All statistical significance was based on two-sided tests evaluated at the 0.05 level of significance.

Results

Prevalence of hypersomnolence symptoms and sleep patterns

A significant proportion of adolescents reported feeling excessively sleepy during the daytime (41.5%; SE=1.1). Sleepiness was much more common in adolescents who were not obtaining an adequate duration of sleep at night time, compared to those had an adequate duration of sleep (45.5% (SE=1.3) versus. 36.2% (SE=1.4); $p<.001$) (See figure 1).

Daytime sleepiness (OR= 6.07; 95% CI=5.31 – 6.93) and sub-symptoms of hypersomnolence (OR= 5.46; 95% CI=4.60 – 6.48) were much more common in teens who reported symptoms of insomnia. A total of 69% of subjects reporting sleepiness also reported insomnia. Daytime sleepiness and sub-symptoms of hypersomnolence were more frequent among teens reporting sleep durations of 8 hours and bedtimes later than 11 p.m. on weekdays as well as in those reporting sleep durations of 7 hours or less and bedtimes later than 12 a.m. on weekends (Table 1).

Prevalence of hypersomnolence and its socio-demographic correlates

The prevalence of hypersomnolence and its socio-demographic correlates are outlined in table 2. The overall prevalence of hypersomnolence defined in accordance with DSM-5 criterion A i.e. in those with adequate sleep duration was 11.7% (SE=0.7). The prevalence was 5.0% (SE=0.5) after excluding those with insomnia. Among adolescents with hypersomnolence, symptoms lasted for a median of 4.6 weeks (SE=1.1).

Hypersomnolence was more prevalent in adolescent girls compared to boys (OR=1.40; 95% CI=1.09 – 1.78). The prevalence of hypersomnolence varied by age group in both boys and girls, with teens between the ages of 15–16 years endorsing the highest rates of hypersomnolence (OR=3.20; 95% CI=2.13 – 4.81), followed by 17–18 year-olds (OR=2.43; 95% CI=1.49 – 3.96) (Figure 2). Race, family income, urbanicity, parental education, BMI and marital status were not associated with hypersomnolence.

Hypersomnolence, insomnia and mental disorders

The prevalence of various mental disorders by hypersomnolence status, with hypersomnolence defined in accordance with DSM-5 criterion A (daytime sleepiness plus at least one other subsymptom, despite adequate sleep duration), is detailed in table 3. After accounting for demographic characteristics and insomnia, hypersomnolence was significantly associated with having a mental disorder (OR=1.99; 95% CI=1.42 – 2.77). Among individual mental disorders, anxiety, behavior, eating and mood disorders were significantly associated with hypersomnolence after adjusting for demographic characteristics and other DSM-IV disorders. However after further adjustment for insomnia, only behavior (OR=1.69; 95% CI=1.21 – 2.36) and eating disorders (OR=2.20; 95% CI=1.32 – 3.66) were associated with hypersomnolence. These associations were unchanged after additional analyses accounting for BMI (results not shown).

Hypersomnolence was also significantly associated with insomnia after accounting for demographic characteristics and other DSM-IV disorders (OR=2.45; 95% CI=1.87 – 3.21).

Hypersomnolence and prescription medication use

Overall, 6.2% of adolescents reported the use of psychotropic medication(s) in our sample. Adolescents with hypersomnolence were more likely to report using psychotropic medication after adjustment for demographic characteristics and other DSM-IV disorders (OR= 1.69; CI=1.01 – 2.83)(table 3). After further analyses accounting for the presence of insomnia, use of psychotropic medication was no different among those with and without hypersomnolence (OR= 1.61; CI=0.97 – 2.66).

Discussion

In this large nationally representative sample of 6,483 adolescents aged 13 to 18 years, 41.5% of teenagers reported sleepiness during the daytime and 11.7 % met criteria for hypersomnolence per the DSM-5 criterion A. Hypersomnolence was more common in adolescent girls and prevalence rates varied depending on age. Hypersomnolence was significantly associated with insomnia and mental disorders. These results indicate that daytime sleepiness and hypersomnolence are common in U.S. teenagers and that inadequate sleep duration and delayed bedtime increase the risk of daytime sleepiness and other subsymptoms of hypersomnolence, i.e. having a tendency to fall asleep during the daytime, not feeling rested upon awakening and having difficulty waking in the morning.

Our finding that daytime sleepiness is reported by the nearly half of U.S. adolescents confirm the high prevalence of sleepiness in adolescents from previous telephone⁶ and local surveys⁵, in the first large nationally representative sample of U.S. adolescents. Up to 51%

of youth ages 11–17 years reported feeling tired or sleepy during the day in a telephone survey by the National Sleep Foundation⁶ and 45.7% of 13–15 year-olds in a small survey of a single school district in Colorado reported daytime sleepiness⁵. Additionally, our study further examined the specific DSM-5 symptoms for hypersomnolence, as well as the association between hypersomnolence and insomnia. This study is among the first to report rates of hypersomnolence in an adolescent population and a significant number of teenagers met criteria for hypersomnolence as defined by the DSM-5 criterion A after excluding those with inadequate sleep duration.

The American Academy of Sleep Medicine consensus statement recommends that teenagers obtain between 8–10 hours of sleep each night. However, concerns have been raised that 8 hours of sleep is likely inadequate for 13 and 14 year olds¹², who require more sleep than older teenagers, especially on weekdays¹³. In this study we chose a cut off of 9 hours of sleep for 13 and 14 year-olds and 8 hours of sleep for 15 to 17 year-olds on weekdays in order to define adequate sleep duration. A critical finding from our study was that obtaining less than 8 hours of sleep on weekdays and bedtimes later than 11 p.m. on weekdays, and obtaining less than 7 hours of sleep and bedtimes later than 12 a.m. on weekends, were associated with excessive sleepiness and hypersomnolence sub-symptoms in teens.

Earlier school start times have been shown to result in inadequate sleep duration and daytime sleepiness in adolescents; even moderate delays in start times have been found to result in an increase in sleep duration, reduction in sleepiness/fatigue and improvement in mood without a significant change in bedtime^{14–16}. These findings add impetus to the argument that inadequate sleep duration on school nights has a negative impact on alertness in the adolescent age group. Previous data from the NCS-A has shown that a delay in school start times, until 8 a.m. or later is associated with increased nighttime sleep duration⁸. Thus, concerted efforts toward delaying school start times and allowing for greater sleep opportunity could potentially help mitigate the risk of sleepiness in teenagers.

Other potential causes for excessive sleepiness in teenagers who report adequate sleep include central disorders of hypersomnolence such as narcolepsy and idiopathic hypersomnia and sleep-related breathing disorders. While the incidence of narcolepsy peaks in the teens, it is a relatively rare disorder¹⁷. On the other hand, sleep-related breathing disorders are more common and prevalence rates of up to 5.7% have been reported in this age group¹⁸. Although the NCS-A did not have adequate data to rule out these causes of hypersomnolence we were able to control for BMI, a significant risk factor for sleep-related breathing disorders. Adolescents with excessive sleepiness should be screened for these disorders. Another potential explanation for excessive sleepiness, particularly in older adolescents, could be circadian rhythm sleep-wake disorders¹⁹. These disorders, especially delayed sleep-wake phase disorder, are common in this age group, and could present both as excessive sleepiness and insomnia. The effects of delayed sleep-wake phase disorder could be compounded by early school start times. The NCS-A did not assess circadian rhythm sleep-wake disorders, so this explanation cannot be ruled out.

Older adolescents exhibited higher rates of hypersomnolence compared to younger adolescents in our sample. This confirms findings of greater sleepiness in older adolescents

based on objective assessment with the mean sleep latency test (MSLT), which demonstrated that pre-pubertal and early pubertal adolescents had a higher mean sleep latency compared to mid and late pubertal adolescents, indicating that older adolescents tend to be sleepier^{20,21}. These studies did not report sex differences in objective sleepiness. Another potential cause for excessive sleepiness, particularly in older adolescents, could be circadian rhythm sleep-wake disorders. These disorders, especially delayed sleep-wake phase disorder, are common in this age group, and could present both as excessive sleepiness and insomnia. The effects of delayed sleep-wake phase disorder could be compounded by early school start times. The NCS-A did not collect information about circadian preferences and the role of circadian rhythm sleep-wake disorders as a potential confounder cannot be ruled out.

We also found that adolescent females reported greater rates of hypersomnolence than males. In this particular population, menarche and associated hormonal changes could potentially influence sleep architecture, circadian preference and daytime sleepiness²². The female predominance of excessive daytime sleepiness has been previously reported in studies of Korean high school students²³, and a Finnish study of 11, 13 and 15 year olds²⁴. Thus, overall, there appear to be sex differences with an increased propensity for hypersomnolence/sleepiness among adolescent girls. While few studies have examined the association between hypersomnolence and other demographic characteristics in adolescents, a previous study in adults reported an increased prevalence of hypersomnolence in Black individuals and those with a lower household income²⁵. In our study there was no association between hypersomnolence and ethnicity, parental education, family income and urbanicity.

Our finding of a strong association between insomnia and hypersomnolence symptoms has not been previously reported in adolescents; however, a previous study showed that this association was evident in adults from the general population²⁵. Although our finding may be in part attributable to the structure of the diagnostic probes for sleep conditions, co-occurrence of excessive sleepiness and insomnia should be pursued in future studies. While hypersomnolence has been described in adolescents with depression and shown to be associated with heavy episodic drinking as well as alcohol-related adverse outcomes, the association between hypersomnolence and other mental disorders in adolescents has not been previously well delineated²⁶. In our study, after adjustment for demographic characteristics, hypersomnolence was associated with increased risk of all major classes of mental disorders except substance use disorders. Previous studies in adults have revealed a strong association between hypersomnolence and depressive disorders. However, these studies did not account for the presence of insomnia^{25,27}. Studies in children and adolescents have reported an increased association between excessive sleepiness and depressive symptoms but these studies utilized rudimentary and inconsistent definitions of hypersomnolence²⁸. In this study, after accounting for insomnia, and other mental disorders, hypersomnolence was associated with having any mental disorder and specifically with having only behavior and eating disorders. These associations persisted after further analyses accounting for BMI.

Studies in children with narcolepsy indicate that they have higher rates of ADHD compared to healthy controls. However, ADHD symptoms were not associated with self-reported

daytime sleepiness in this cohort²⁹. Children with ADHD and daytime sleepiness may have higher rates of emotional and behavior problems³⁰. Further analyses in our sample showed that hypersomnolence was not significantly associated with ADHD but with oppositional defiant and conduct disorders. Thus, hypersomnolence could potentially be an independent treatment target, similar to insomnia, in youth with oppositional defiant and conduct disorders.

As reported previously in this study, about 6.2% of adolescents reported receiving prescription medication(s) in our sample. This is similar to reports from other general population surveys^{31,32}. Although antidepressants have been shown to be associated with hypersomnolence in adults, they were not associated with an increased rate of hypersomnolence in our cohort of adolescents²⁵. In our sample, youth using any psychotropic medications were not at increased risk for hypersomnolence after analyses accounting for insomnia. Thus, data from our study indicate that prescription medications may be unlikely to influence the symptoms of hypersomnolence in adolescents.

Strengths of our study include the use of a large, nationally representative sample of US adolescents, relatively high response rates, comprehensive assessment of sleep patterns on both weekdays and weekends and systematic in-person evaluation of DSM-IV disorders. However, our study needs to be viewed in light of some limitations. First, our interview did not include the full criteria for the diagnosis of DSM-5 Hypersomnia that requires direct clinical assessment. Second, there was overlap in the interview items covering insomnia and hypersomnia so we could not distinguish the actual source of daytime sleepiness. Third, the data are cross-sectional so we could not discriminate between mental disorders preceding or postdating sleep problems. Fourth, we relied on subjective assessments of sleep duration which could potentially overestimate sleep times³³. These data were collected prior to the significant growth in the use of technology devices by adolescents which could further reduce sleep duration/quality and conceivably promote daytime sleepiness and hypersomnolence³⁴.

Close to half of U.S. teenagers report feeling sleepy during the day and one in nine adolescents meets criteria for hypersomnolence. After adjusting for insomnia and other confounders, hypersomnolence was associated with aggregate mental disorders but not with psychotropic medication use. These findings, in conjunction with other evidence on the adverse consequences of sleep disturbances on school performance and other health-related outcomes in teens, highlight the importance of promoting adequate sleep at both the societal and individual level in youth.

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Figure 1.

Distribution of Adequate Sleep Duration and Hypersomnolence Symptoms in the National Co-morbidity Survey Adolescent Supplement (n=6,483) Note:^a Adequate sleep duration was defined as self-reported weekday sleep duration of > 9 hours if aged 13– 14 years or >8 hours if aged 15 years or older ^b Three sub-symptoms included 1) falling asleep 2) non-restorative or unrefreshing sleep and 3) difficulty awakening ^c Hypersomnolence was defined as daytime sleepiness with at least one of the three subsymptoms in adolescents with adequate sleep

Figure 2.

Prevalence of Hypersomnolence by Age and Sex Note: Prevalence of hypersomnolence was significantly different by sex ($p=0.011$). There were differences across age groups in both males ($p<0.001$) and females ($p=0.001$)

Table 1

Past-Year Hypersomnolence Symptoms and Sleep Patterns, National Comorbidity Survey Replication Adolescent Supplement (NCS-A) (n=6,483)

Sleep patterns	n	The leading symptom		Number of sub-symptoms ^d endorsed, besides the leading symptom					
		% (SE)	OR (95% CI) ^b	+ none % (SE)	+ any one % (SE)	+ any two % (SE)	+ all three % (SE)	OR (95% CI) ^c	
Total	6,483	41.5 (1.1)	-	67.5 (1.0)	14.8 (0.7)	11.2 (0.6)	6.6 (0.4)	-	
Insomnia	2,124	69.4 (1.3)	6.07 (5.31 – 6.93)	41.7 (1.5)	24.5 (1.3)	20.6 (1.3)	13.3 (1.0)	5.46 (4.60 – 6.48)	
	4,359	27.4 (1.2)	Reference	80.6 (1.0)	9.8(0.7)	6.5(0.7)	3.1 (0.5)	Reference	
Weekday sleep duration	1,008	61.0 (1.9)	3.21 (2.40 – 4.28)	47.1 (2.3)	18.6 (1.7)	21.9 (2.7)	12.4 (1.0)	3.09 (2.18 – 4.40)	
	1,636	43.0 (2.0)	1.51 (1.19 – 1.92)	66.1 (2.1)	15.3 (1.7)	10.7 (1.1)	8.0(0.9)	1.38 (1.07 – 1.78)	
	3,207	36.1 (1.5)	1.21 (0.95 – 1.54)	73.4 (1.2)	14.1(1.0)	8.4(0.8)	4.1 (0.6)	1.02 (0.78 – 1.33)	
	525	30.8 (2.3)	Reference	76.0 (2.3)	9.2(1.9)	8.9(1.9)	5.9 (1.7)	Reference	
Weekend sleep duration	771	50.4 (2.9)	1.53 (1.17 – 2.00)	60.0 (2.7)	17.6 (2.3)	15.5 (2.1)	6.9 (1.2)	1.32 (1.08 – 1.62)	
	555	42.2 (3.5)	1.06 (0.78 – 1.43)	66.6 (3.3)	15.5 (2.2)	10.3 (2.2)	7.6 (1.5)	0.99 (0.73 – 1.35)	
	2,303	39.7 (2.1)	0.95 (0.76 – 1.18)	70.4 (2.2)	14.5 (1.7)	8.4(1.0)	6.6(0.7)	0.82 (0.65 – 1.04)	
	2,739	40.1(1.4)	Reference	67.5 (1.2)	14.0 (1.2)	12.3 (1.3)	6.2(0.7)	Reference	
Weekday bedtime	1,370	34.6 (2.2)	Reference	73.5 (2.3)	13.3 (1.8)	7.5(1.0)	5.7 (1.1)	Reference	
	2,578	39.6 (1.7)	1.18 (0.93 – 1.50)	70.5 (1.3)	13.3 (0.7)	11.1 (0.9)	5.1 (0.7)	1.09 (0.84 – 1.42)	
	1,937	45.0 (1.7)	1.48 (1.13 – 1.94)	63.1 (1.7)	17.2 (1.3)	11.8 (1.3)	8.0(0.9)	1.53 (1.14 – 2.06)	
	444	55.6 (4.5)	2.43 (1.53 – 3.84)	54.3 (4.5)	14.4 (2.4)	20.1(2.7)	11.3 (2.1)	2.57 (1.72 – 3.83)	
Weekend bedtime	164	31.2 (6.7)	Reference	73.9 (6.2)	11.8 (3.2)	8.0 (3.4)	6.3(3.8)	Reference	
	653	30.3 (3.2)	0.91 (0.42 – 1.97)	78.6 (2.8)	10.5 (1.7)	6.8 (1.6)	4.1 (0.9)	0.73 (0.32 – 1.63)	
	2,536	35.9 (1.6)	1.12 (0.61 – 2.05)	72.9 (1.3)	12.2 (0.7)	9.4(0.7)	5.5(0.8)	0.95 (0.51 – 1.77)	
	2,806	50.1(1.7)	2.01 (1.14 – 3.55)	59.5 (1.6)	18.3 (1.3)	13.8 (1.0)	8.4(0.8)	1.68 (0.91 – 3.12)	

Note: % standard error indicates prevalence. Odds ratio (OR) with 95% CI was based on logistic regression models using sleep pattern variables as independent variables (one at a time) controlling for age and sex

^a the leading symptom of hypersomnolence is daytime sleepiness; three sub-symptoms included falling asleep daytime, non-restorative or unrefreshed sleep, and difficulty waking

^b PROC RLOGIST daytime sleepiness as dependent variable, treated as dichotomous variable

^c PROC MULTLOG number of sub-symptoms as dependent variable, treated as ordinal variable (0,1,2,3), using CUMLOGIT as link function

Table 2.

Past-Year Hypersomnolence by Demographic Characteristics, National Comorbidity Survey Replication Adolescent Supplement (NCS-A) (n=6,483)

Characteristics		Hypersomnolence		
		n	%(SE)	OR (95% CI)
Total		6,483	11.7 (0.7)	-
Sex	Female	3,333	13.5 (1.0)	1.40 (1.09 – 1.78)
	Male	3,150	10.1 (0.8)	Reference
Age Group	13–14 yrs	2,611	5.7 (0.9)	Reference
	15–16 yrs	2,528	16.3 (1.3)	3.20 (2.13 – 4.81)
	17–18 yrs	1,344	12.9 (1.8)	2.43 (1.49 – 3.96)
Race/Ethnicity	Hispanic	758	11.0 (1.6)	0.93 (0.60 – 1.45)
	Non-Hispanic Black	1,097	12.5 (2.0)	1.07 (0.69 – 1.65)
	Other	371	11.7 (2.6)	1.00 (0.57 – 1.76)
	Non-Hispanic White	4,257	11.7 (1.0)	Reference
Family Income	Low	925	10.2 (1.4)	0.76 (0.55 – 1.04)
	Low average	1,218	10.8 (1.2)	0.81 (0.59 – 1.10)
	High average	2,139	11.7 (1.3)	0.89 (0.66 – 1.19)
	High	2,201	13.0 (1.0)	Reference
Urbanicity	Metropolitan	2,645	13.1 (0.8)	1.20 (0.77 – 1.85)
	Other urban	2,242	10.4 (1.2)	0.93 (0.59 – 1.46)
	Rural	1,596	11.2 (2.0)	Reference
Parental Education	Less than high school	746	8.7 (2.1)	0.75 (0.45 – 1.25)
	High school grad	1,852	12.7 (1.4)	1.14 (0.86 – 1.51)
	Some college	1,364	12.8 (1.7)	1.14 (0.80 – 1.64)
	College grad +	2,521	11.4 (0.9)	Reference
Parental marital status	Married/Cohabiting	4,602	11.5 (0.7)	Reference
	Previously married	1,009	14.0 (2.0)	1.25 (0.89 – 1.76)
	Never married	308	7.9 (2.6)	0.66 (0.33 – 1.34)
	Unknown	564	11.6 (1.7)	1.01 (0.71 – 1.44)
Body mass index ^a	Underweight	137	6.2 (2.4)	0.47 (0.19 – 1.15)
	Normal	4,309	12.3 (1.0)	Reference
	Overweight	972	10.1 (1.8)	0.80 (0.48 – 1.34)
	Obese	821	12.7 (1.7)	1.03 (0.71 – 1.49)

Note: % standard error indicates prevalence. Odds ratio (OR) with 95% CI indicates unadjusted OR based on logistic regression models using demographic characteristics as exposure of interest and dichotomous hypersomnolence as outcome. Family income was assessed relative to the federal poverty line, which was categorized as low income (less than 1.5 times the poverty line), low-average income (1.5–3.0 times the poverty line), high-average income (3.0–6.0 times the poverty line), and high income (greater than 6.0 times the poverty line).

^a unknown body mass index (n=244) were excluded

Table 3.

Past-Year *DSM-IV* Mental Disorders and Psychotropic Medication Use by Hypersomnolence Status, National Comorbidity Survey Replication Adolescent Supplement (NCS-A) (n=6,483)

OUTCOME	n	% (SE)	Hypersomnolence		Reference (Hypersomnolence = No)		
			No	Yes	OR (95% CI) ^a	OR (95% CI) ^b	OR (95% CI) ^c
			% (SE)	% (SE)			
Past-year DSM-IV disorder							
Anxiety	1,188	19.7 (0.8)	18.2 (0.8)	30.8 (2.4)	2.04 (1.54 – 2.71)	1.67 (1.22 – 2.28)	1.39 (0.98 – 1.97)
Behavior	959	15.5 (0.9)	14.1 (0.9)	25.7 (3.0)	2.28 (1.71 – 3.04)	1.87 (1.35 – 2.58)	1.69 (1.21 – 2.36)
Eating	191	3.2 (0.5)	2.6 (0.5)	7.4 (1.1)	3.01 (1.78 – 5.07)	2.32 (1.36 – 3.95)	2.20 (1.32 – 3.66)
Mood	673	10.1 (0.8)	9.0 (0.7)	18.5 (2.3)	2.08 (1.57 – 2.75)	1.42 (1.02 – 1.98)	1.18 (0.84 – 1.66)
Substance use	684	10.9 (0.7)	10.0 (0.7)	17.6 (2.6)	1.67 (1.13 – 2.47)	1.13 (0.69 – 1.85)	1.04 (0.64 – 1.70)
Any Mental Disorder	2,452	38.8 (1.1)	36.0 (1.0)	59.4 (3.3)	2.55 (1.90 – 3.42)	2.55 (1.90 – 3.42)	1.99 (1.42 – 2.77)
Use of medication in past-year							
Antidepressant	232	3.7 (0.3)	3.4 (0.3)	5.9 (1.4)	1.63 (0.92 – 2.89)	1.05 (0.58 – 1.91)	1.02 (0.58 – 1.78)
Antipsychotic	36	0.5 (0.1)	0.4 (0.1)	1.5 (0.6)	5.51 (2.04 – 14.88)	3.83 (1.44 – 10.21)	3.71 (1.17 – 11.77)
Stimulant	155	2.8 (0.4)	2.2 (0.3)	7.2 (2.1)	4.28 (2.23 – 8.21)	3.02 (1.64 – 5.56)	2.78 (1.52 – 5.09)
Any medication	403	6.6 (0.5)	5.7 (0.5)	13.0 (2.3)	2.51 (1.57 – 4.01)	1.69 (1.01 – 2.83)	1.61 (0.97 – 2.66)

NOTE: % standard error indicates prevalence. Odds ratio (OR) with 95% CI was based on logistic regression models using dichotomous hypersomnolence as exposure of interest, DSM-IV disorders and medications as outcomes entering models one at a time; Anxiety = any of agoraphobia, generalized anxiety disorder, social phobia, specific phobia, panic disorder, posttraumatic stress disorder, separation anxiety disorder; Behavior = any of attention deficit hyperactivity disorder, conduct disorder, oppositional defiant disorder; Eating = any of anorexia, bulimia, binge eating; Mood = any of major depressive disorder, dysthymia, bipolar I or II; Substance use = any of alcohol abuse/dependence, drug abuse/dependence, nicotine dependence; Any medication included antidepressant, antipsychotic, stimulant, mood stabilizer/anticonvulsant, sedative/Z drug, Benzo, Non-Benzo, and Barbiturate

^a adjusted for demographic characteristics (age and sex)

^b additionally adjusted for past year DSM-IV disorders

^c additionally adjusted for insomnia