Sleep Problems Predict and are Predicted by Generalized Anxiety/Depression and Oppositional Defiant Disorder

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Abstract

Objective—We tested whether sleep problems co-occur with, precede, and/or follow common psychiatric disorders during childhood and adolescence. We also clarified the role of comorbidity, and tested for specificity of associations among sleep problems and psychiatric disorders.

Method—Data came from the Great Smoky Mountains Study, a representative population sample of 1,420 children, assessed 4 to 7 times per person between ages 9 and 16 for major DSM-IV disorders and sleep problems. Sleep-related symptoms were removed from diagnostic criteria when applicable.

Results—Sleep problems during childhood and adolescence were common, with restless sleep and difficulty falling asleep being the most common symptoms. Cross-sectional analyses showed that sleep problems co-occurred with many psychiatric disorders. Longitudinal analyses revealed that sleep problems predicted increases in the prevalence of later generalized anxiety disorder and high generalized anxiety disorder/depression symptoms, and oppositional defiant disorder. In turn, generalized anxiety disorder and/or depression and oppositional defiant disorder predicted increases in sleep problems over time.

Conclusions—Sleep problems both predict and are predicted by a diagnostic cluster that includes oppositional defiant disorder, generalized anxiety disorder and depression. Screening children for sleep problems could offer promising opportunities for reducing the burden from mental illness during the early life course.

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Keywords

Introduction

The relationship between psychiatric disorders and sleep problems is complex. The DSM-IV describes four groups of sleep-related disorders: (1) primary sleep disorders "presumed to arise from endogenous abnormalities in sleep-wake generating or timing mechanisms" (p. 551); (2) sleep disturbance that results from a diagnosable mental disorder; (3) sleep disorder due to a general medical condition; and (4) substance-induced sleep disorder.[1] Here, we use a prospective-longitudinal sample of children and adolescents from the community to test the validity of (2): the DSM's assumption that the causal arrow runs from psychiatric disorders to sleep problems.[2] We also test two additional possibilities: that sleep problems have only concurrent, but no longitudinal associations with mental disorders; and that sleep disturbances predict later psychiatric illness.

Depressive disorders, generalized anxiety disorder and separation anxiety disorder all list sleep problems among their core symptoms; panic disorder includes sleep problems as concomitants but not core criteria. Consequently, research on sleep problems and psychopathology in the early life course has primarily focused on internalizing disorders, with a special emphasis on depression.[3] Sleep problems are not currently part of the diagnostic criteria of externalizing disorders, but have been linked to aggression, attention problems, and substance use in youth (for a review, see [4]). Little is currently known about associations among sleep problems and oppositional defiant disorder, although this disorder is at the intersection of internalizing and externalizing disorders and also tends to precede depression and generalized anxiety disorder.[5, 6]

For testing the assumption of directionality from psychiatric disorders to sleep problems during adolescence, prospective-longitudinal data are needed. Findings of depression[7, 8] and anxiety[8, 9] predicting later insomnia have been reported, but generally, the evidence for the DSM's assumed direction of effect during the adolescent period is limited[4]— in part, because studies were unable to test this prediction (e.g., [10]), but also because they did not find significant predictions (e.g., [3, 11]). More support has been reported for the reverse direction of prediction. In observational community samples, childhood sleep problems predicted later depression/anxiety,[3, 7, 8, 10, 12] and also externalizing problems and substance use (e.g., [13-15]). In clinical samples, sleep abnormalities predicted later depression recurrence.[16]

Thus, few studies have tested predictions from psychiatric disorder to sleep problems during adolescence, and additional challenges limit the conclusions that can be drawn. First, longitudinal studies on sleep problems that include diagnostic measures of both different internalizing and externalizing disorders are rare. Indeed, comorbidity among disorders is often not controlled; thus, limiting possible conclusions about specificity of associations. Linkages between sleep problems and a disorder (e.g., depression) could partially or fully be

accounted for by their joint association with another comorbid disorder (e.g., oppositional defiant disorder). Second, associations between sleep problems and select disorders (e.g., depression, generalized anxiety disorder) could be an artifact of dual measurement of the same sleep problem in both predictor and outcome. Therefore, sleep symptoms must be excluded from the diagnostic criteria for the disorder.[17] Third, studies identifying predictions from childhood/adolescence to sleep problems decades later have documented the long-term importance of sleep for mental health, but more work is needed to understand whether sleep problems already manifest themselves in a range of psychiatric disorders and vice versa over shorter time frames during the early life course. The present study uses parent- and child-reports of eleven DSM-IV sleep problems and common psychiatric disorders of childhood and adolescence to address these challenges.

Methods

Participants

The Great Smoky Mountains Study is a longitudinal study of the development of psychiatric disorders in rural and urban youth.[18, 19] A representative sample of three cohorts of children, age 9, 11, and 13 at intake, was recruited from 11 counties in western North Carolina. Potential participants were selected from the population of some 12,000 children using a household equal probability, accelerated cohort design. All children scoring above a predetermined cut point (the top 25% of the total score) on the externalizing scale of the Child Behavior Checklist (CBCL),[20] plus a 1 - in - 10 random sample of the remaining 75% of the total scores, were recruited for detailed interviews. All subjects were assigned a weight inversely proportional to their probability of selection, and all results presented here are weighted for the sampling procedure; thus, results are representative of the population from which the sample was drawn, and not biased by the oversampling procedure. About 8% of the area residents and the sample are African American, less than 1% are Hispanic, and 3% are American Indian. Of all subjects selected, 80% (*N*=1,420) agreed to participate. Here, we analyzed all assessments from ages 9-16 (*N*=7, *N* =6, and *N*=4 assessments for cohorts 1, 2, and 3, respectively).[19] Across annual assessments, participation rates ranged between 74-94%.

Procedures

A parent (biological mother for 83% of interviews) and the subject were interviewed by trained interviewers separately. Before the interviews began, parent and child signed informed consent forms approved by the Duke University Medical Center Institutional Review Board. Each parent and child received an honorarium for their participation.

Measures

Psychiatric and substance use disorders were assessed using the *Child and Adolescent Psychiatric Assessment*.[21-23] This structured interview enables interviewers to determine whether symptoms, defined in an extensive glossary, are clinically significant, and to code their frequency, duration, severity, and onset. Scoring algorithms generate either symptom scales or diagnoses made using the DSM-IV.[1] The time frame of the *Child and Adolescent Psychiatric Assessment* for assessing psychiatric disorders and also sleep problems is the

three months preceding each interview. Symptoms were coded as present if parent, child, or both reported it, as is standard practice for clinical symptoms. Major depressive disorder, dysthymia, minor depression, generalized anxiety disorder, and separation anxiety disorder have sleep problems listed among the DSM-IV diagnostic criteria. Thus, new algorithms were written to exclude these sleep problems from these disorders (depressive disorders: *insomnia or hypersomnia, fatigue*; generalized anxiety disorder: easy fatigability, trouble falling or staying asleep; separation anxiety disorder: *difficulty falling asleep, nightmares*). Disorders with a prevalence of less than 1% (i.e., post-traumatic stress disorder, panic disorder, agoraphobia, specific phobia, bipolar disorder) were not analyzed separately, but are included in the "any diagnosis" category.

Depression and Generalized Anxiety Disorder

Some have recommended combining depression and generalized anxiety into one "distress disorders" category.[24, 25] Genetic commonalities between these two disorders have also been identified.[26] Studies of sleep and internalizing disorders are inconsistent in their use of anxiety/depression variables: Some combine symptoms of both depression and anxiety disorders into a single category (e.g., [3, 27, 28]); others use two separate categories for depression and anxiety disorders (e.g., [10]), but do not necessarily distinguish among the different anxiety disorders. Consequently, the separate versus joint associations between sleep and depression and generalized anxiety need to be clarified. Therefore, we created several variables reflecting both "pure" generalized anxiety disorder or depression and also comorbidity between the two syndromes. "Any generalized anxiety disorder" and "any depressive disorder" refer to a diagnosis regardless of comorbidity status. "Generalized anxiety disorder without depression" and "depression without generalized anxiety disorder" refer to "pure" disorders. "Depression and/or generalized anxiety disorder" is a combined category referring to all cases with either diagnosis. Finally, children can be highly symptomatic/impaired on the distress dimension, but not meet criteria for either disorder individually.[29] Therefore, a final variable combined the symptoms of both diagnoses into a single scale (excluding sleep-related symptoms). Youth with 3 or more symptoms (4.5% of observations) were treated as high in depression/generalized anxiety disorder symptoms.

Sleep symptoms

The *Child and Adolescent Psychiatric Assessment* asks about 11 sleep problems identified in DSM-IV as associated with psychiatric disorders. Table 1 shows the sleep problems covered, including sample questions (see also http://devepi.duhs.duke.edu/capa.html). Parent and child both reported on 9 sleep problems covering insomnia, hypersomnia, nightmares, restless sleep, tiredness, exhaustion, and failure to feel refreshed after adequate time asleep. Parents only reported on two additional symptoms: whether the child walked in his/her sleep or had night terrors. We used factor analytic techniques to explore the structure of sleep problems. These analyses revealed that a single sleep problems factor best represented all sleep problems assessed. Although the parent-child correlation on the overall number of sleep problems was not high (r=.15, p<.0001), the same sleep problems factor emerged whether parent-only, child-only, or joint (either/or) reports of sleep problems were used. Therefore, we summed the joint (either/or) reports of sleep problems to create the sleep problems scale. However, in order to understand whether there were predictions from

specific sleep problems to specific disorders, we also conducted exploratory follow-up analyses with individual sleep items.

Covariates

Sex, race (American Indian, African American, other) and age (9-16) were included in all models. Pubertal status may affect sleep patterns;[30] therefore, pubertal stage assessed via Tanner stage self-reports was also included in all models.[31] At each assessment youth marked drawings of pubertal indicators (e.g., pubic hair) according to their current developmental stage. "Tanner stage" refers to the five developmental stages derived from this measure, with I = *no pubertal development* to V = *fully developed*.

Analytic strategy

Models predicting the number of sleep problems employed Poisson regression. Models predicting dichotomous diagnostic variables employed logistic regression. These weighted regression models were implemented in a generalized estimating equations framework using SAS PROC GENMOD, specifying the covariance matrix as exchangeable. In both the cross-sectional and longitudinal analyses, two models were tested: Model 1 controlled for age, sex, race, and Tanner stage (and the outcome at the previous assessment in longitudinal models). Model 2 also controlled for comorbidity.

In the longitudinal analyses, psychopathology (and sleep) variables at the current assessment were predicted with sleep (and psychopathology) variables at the previous assessment. For example, current depression was predicted with sleep problems and depression at the previous assessment. In these lagged assessment-to-assessment analyses, subjects with >2 assessments contributed multiple observations. For example, if a subject had four assessments, then they contributed three observations to the lagged longitudinal analyses (assessment 1 predicting assessment 2, assessment 2 predicting assessment 3, and assessment 3 predicting assessment 4). In all analyses, the generalized estimating framework allowed us to capitalizes on multiple observations from each subject while also accounting for both the sampling design and within-person correlations among observations.[19]

Results

Prevalence of Sleep Problems

Sleep problems were fairly common (Table 1): 26.1% of observations had 1+ sleep problems in the past 3 months, 12.4% had 2+ sleep problems. The most common problems were restless sleep and difficulty falling asleep. There was only one individual symptom for which there was a sex difference: girls were more than 3 times as likely than boys to report feeling "tired or weary at least half the time" (girls, 4.1% (95% CI 2.7%, 5.5%); boys, 1.2% (95% CI 0.4%, 2.0%); p<.0001). Analysis by age showed that select sleep problems (insomnia, nightmares, night terrors and somnambulism) were more common in children (aged 9-12), whereas feeling inadequately rested even after sleep was more common in adolescents (13-16).

Concurrent Associations Among Sleep Problems and Psychiatric Disorders

Table 2 shows the mean number of sleep symptoms for youth with and without psychiatric disorders. The mean number of sleep problems in youth with a current diagnosis was three times that of youth with no diagnosis (means ratio 3.7, 95% CI 1.6, 8.3, p<.0001). In Model 1 (which adjusted for sex, age, Tanner stage, and race) all diagnoses except for social phobia, attention deficit hyperactivity disorder, and abuse/dependence of individual substances (alcohol, tobacco, cannabis) were associated with significantly higher levels of concurrent sleep problems. Once comorbidity was taken into account (Model 2), conduct disorder and the overall substance use disorders variable were no longer significantly associated with sleep problems. Depression, generalized anxiety disorder, separation anxiety, and oppositional defiant disorder continued to show strong concurrent associations with sleep problems.

In logistic regression analyses linking individual sleep symptoms to individual diagnoses (results not shown; details available from first author) difficulty falling asleep was associated with all variants of generalized anxiety disorder/depression, social phobia, and oppositional defiant disorder. Exhaustion was also associated with generalized anxiety disorder/depression and oppositional defiant disorder. Hypersomnia was associated with generalized anxiety disorder but not depression, and tiredness during the day was associated with depression but not with generalized anxiety disorder. Restless sleep was more common in youth with social phobia, oppositional defiant disorder, and attention deficit hyperactivity disorder, and nightmares were more common in youth with separation anxiety or attention deficit hyperactivity disorder. Taken together, generalized anxiety disorder and oppositional defiant disorder were associated with the most individual sleep symptoms (three symptoms each), but distinct patterns of specificity between sleep symptoms and psychiatric disorders did not emerge.

Longitudinal Predictions from and to Sleep Problems

Sleep Problems Predicting Psychiatric Disorders—The left half of Table 3 shows results from models predicting current psychiatric disorder from sleep problems at the previous assessment, controlling for past history of psychiatric disorder. In other words, these models assessed whether sleep problems predicted increases in the likelihood of meeting criteria for a psychiatric diagnosis over time. Model 1 controlled for previous psychiatric disorder, sex, race, age, and Tanner stage. Model 2 added other diagnoses to control for comorbidity. Sleep problems predicted increases in anxiety (any generalized anxiety disorder, high generalized anxiety disorder/depression symptoms), and also oppositional defiant disorder. When comorbidity had been taken into account, sleep problems no longer predicted increases in the likelihood of conduct disorder, attention deficit hyperactivity disorder, or substance use disorders.

Follow-up analyses by individual sleep problems showed that difficulty falling asleep, early morning awakening, and exhaustion significantly predicted increases in generalized anxiety disorder/depression. Difficulty falling asleep and wakening in the middle of the night significantly predicted increases in oppositional defiant disorder.

Psychiatric Disorders Predicting Sleep Problems—The right half of Table 3 shows results from longitudinal analyses predicting from past psychiatric disorders to current sleep problems, controlling for past history of sleep problems, without (Model 1) and with (Model 2) controls for comorbidity. Results for Model 2 revealed that a diagnosis of generalized anxiety disorder and/or depression, high generalized anxiety disorder/depression symptoms, and oppositional defiant disorder predicted increases in sleep problems over time. Follow-up analyses by individual sleep problems showed that both difficulty falling asleep and nightmares were predicted by generalized anxiety disorder/depression, as was early morning awakening.

Discussion

Sleep problems have been identified as correlates of common psychiatric disorders of childhood and adolescence.[4] DSM-IV criteria specify that sleep disturbance can be the result of a mental disorder, but longitudinal research during the early life course currently provides more evidence for predictions from sleep problems to psychiatric disorders.[4] The current study tested predictions from sleep problems to psychiatric disorder and vice versa during adolescence while addressing several methodological challenges. Specifically, the study (1) conducted full psychiatric interviews with both parents and adolescents to generate diagnostic data on a range of psychiatric disorders and sleep problems; (2) used repeated measures to assess the direction of effect; (3) dealt with comorbidity in testing which psychiatric disorders were most consistently associated with sleep problems; and (4) removed sleep symptoms from DSM-IV diagnoses. Findings suggested that sleep problems are not only predicted by, but also co-occur with and predict later psychiatric disorders. Once comorbidity was accounted for, most bidirectional longitudinal associations among sleep problems and psychiatric disorders concentrated around a cluster of disorders involving generalized anxiety disorder, depression, and oppositional defiant disorder.

Sleep problems were within the prevalence range reported by other studies of children.[28] Difficulty falling asleep and restless sleep were the most common problems. Sleep problems had been identified as correlates of depression and anxiety in previous research.[22] In our study, generalized anxiety appeared to be the "necessary ingredient" for longitudinal associations between the internalizing distress disorders[25] and sleep disturbance. Indeed, all predictions to or from depression involved the joint depression/generalized anxiety variables. Predictions from sleep problems to anxiety (including generalized anxiety) had been identified in one previous long-term longitudinal study,[10] and linkages between sleep disturbance and generalized anxiety disorder have also been highlighted in work with clinical samples of adolescents.[32, 33] Overall, these findings lend support to the notion that good sleep requires (and perhaps promotes) feelings of security and safety[2]—which may not be sufficiently present in children with generalized anxiety disorder. Furthermore, these findings also support the notion that generalized anxiety disorder and depression may be biologically similar.[26, 34, 35] Analyses of individual sleep symptoms suggested that difficulty falling asleep may be mostly responsible for longitudinal links with generalized anxiety disorder/depression in both directions. Successful treatments for sleep problems, including difficulty falling asleep, have been identified;[36-38] our findings suggest that the application

of such methods in older children could help reduce the risk for generalized anxiety disorder/depression.

This study also identified bidirectional longitudinal associations between oppositional defiant disorder and sleep problems–even when adjusting for comorbidity with generalized anxiety disorder/depression and other externalizing disorders. The literature makes it difficult to disentangle oppositional defiant disorder from attention deficit hyperactivity disorder[39] or other disorders.[40] However, it is possible that some associations between externalizing disorders and sleep disturbance identified in previous research are, in fact, due to comorbidity with oppositional defiant disorder. Past research has reported that generalized anxiety disorder/depression and oppositional defiant disorder are often comorbid with one another,[5] share patterns of comorbidity with other disorders,[41] and that oppositional defiant disorder is, in fact, a developmental precursor of depression and generalized anxiety disorder.[6, 42] Our study adds to the growing body of work identifying joint correlates for this cluster of disorders. One core feature of these three disorders is significant irritability, which may be driven by the child's difficulty in successfully regulating negative emotions,[43] and previous work had reported that children with temperamental tendencies toward being "intense," "touchy," and "easily upset" were more likely to have sleep problems.[44] More work is needed to clarify whether it is indeed irritability that accounts for joint associations of this cluster of psychiatric disorders with sleep problems, what role shared biological and psychosocial underpinnings play in these associations, and also how depression/generalized anxiety versus oppositional defiant disorder uniquely contribute to sleep problems and vice versa.

Limitations of this study include a geographically circumscribed sampling frame (western North Carolina), no children below age 9, a limited number of race/ethnic groups, and only two informants. We also had no "objective," lab-based sleep measures, although findings from such studies have also supported both directions of effect identified here.[2, 4] We also had limited numbers in some diagnostic groups that are likely linked with sleep problems, including bipolar disorder,[45] and no data on select sleep problems (e.g., obstructive sleep apnea) that could play a role in some of the associations observed (e.g., oppositional defiant disorder-sleep problems).[46]

Furthermore, we did not collect information about the number of hours slept; thus, we cannot contribute directly to the literature on the importance of adequate sleep duration.[47, 48] We therefore draw no conclusions about the role of inadequate sleep duration in psychiatric disorders, while recognizing that sleep duration may have been indirectly assessed with symptoms such as *difficulty falling asleep*, or *waking in the middle of the night.* The sleep problems assessed here were consistent with DSM-IV specifications, but it is possible that some sleep problems (e.g., tiredness, exhaustion) could have been consequences of other sleep problems (e.g., difficulty falling asleep). Future work should examine changes in sleep patterns over development; genetics of sleep, depression/generalized anxiety disorder and oppositional defiant disorder; and circadian rhythms and psychopathology. Furthermore, although outside of the scope of the present paper, more work is needed to test whether and how psychosocial risk configurations (e.g., poverty, family chaos) underlie the sleep-psychiatric disorder associations identified here.[49] Finally, although only one sleep problems

factor emerged in our study, future work should keep in mind the possibility of different underlying sleep problems and their specific associations with psychiatric problems.

Despite these limitations, our analyses suggest that the DSM-IV's assumption that the causal arrow runs from psychiatric disorder to sleep problems is not the whole story. In many cases, sleep problems are a risk marker for psychiatric distress one year later, especially for generalized anxiety disorder, depression, and oppositional defiant disorder. Sleep problems are not subject to the same stigma that psychiatric illnesses are subject to. Indeed, sleep problems are asked about in primary care examinations, and also in contexts where children spend most of their time, including home and school. Screening children and adolescents for sleep problems could offer promising opportunities for identifying risk for mental illness, referring children into appropriate services, and reducing the burden from mental illness during the early life course.

Acknowledgments

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Table 1

Sleep problems, with sample questions, 3-month prevalence rates. Number of observation= 6,533[*], age= 9-16.

Sleep problems, with sample questions	*N* of observations	Weighted prevalence: %	95% Confidence Interval
1. Difficulty falling asleep: "*Is it hard to fall asleep when you want to? How long does it take?*"	468	7.0	6.4, 9.3
2. Waking in the middle of the night: "*Once you're off to sleep, do you wake up again in the night? Can you get back to sleep again easily?*"	145	2.2	1.4, 2.9
3. Early morning awakening: "*Do you wake up early in the morning and can't go back to sleep?*"	201	2.9	2.2, 3.6
4. Hypersomnia: "*Do you feel sleepy during the day? More than most people?*"	163	2.1	1.5, 2.6
5. Nightmares: "*Do you have bad dreams or nightmares? Do they wake you?*"	396	5.6	4.5, 6.7
6. Restless sleep: "*Do you sleep soundly/ Do you toss and turn?*"	714	10.8	9.2, 12.5
7. Inadequately rested by sleep: "*Are you fairly well rested when you get up?*"	123	2.6	1.8, 3.4
8. Tiredness: "*Have you been feeling especially tired or weary? How much of the time have you felt like that?*"	135	2.6	1.8, 3.4
9. Fatigability, exhaustion: "*Do you feel exhausted by things that would have been no problem before?*"	118	2.0	1.3, 2.6
10. Somnambulism (parent report): "*Does s/he ever walk in his/her sleep?*"	236	2.9	2.0, 3.7
11. Night terrors (parent report): "*Does s/he ever seem to be having a terrible dream, but doesn't wake up?*"	156	1.8	1.2, 2.4
No sleep problems in past 3 months	4,669	73.9	71.6, 76.2
1 or more sleep problem	1,864	26.1	23.8, 28.4
2 or more sleep problems	906	12.4	11.1, 14.5

[*] Missing sleep data: *N* = 139.

Table 2

Mean number of sleep problems in youth with psychiatric disorders: Cross-sectional analyses.

	N of observations	Mean number of sleep problems (SD)	Model 1[a] Means Ratio (CI)	Model 2[b] Means Ratio (CI)
No current diagnosis	5,682	0.4 (0.9)	NA	NA
Any current diagnosis[c]	990	1.1 (1.3)	**3.7 (1.6, 8.3)**	NA
Any depressive disorder[c]	126	2.3 (1.9)	**4.1 (2.8, 5.9)**	**3.0 (1.8, 4.9)**
Any anxiety disorder[c]	196	2.1 (1.6)	**3.7 (2.8, 4.9)**	**2.8 (1.8, 4.2)**
Any GAD[c]	74	2.4 (1.7)	**4.0 (3.0, 5.3)**	**2.1 (1.3, 3.6)**
GAD w/o depression[c]	35	2.2 (1.3)	**3.2 (2.0, 5.2)**	**2.0 (1.0, 4.0)**
Depression w/o GAD[c]	101	2.3 (1.8)	**3.4 (2.1, 5.7)**	**3.2 (2.0, 5.2)**
Depression or GAD Dx[c]	136	2.3 (1.6)	**3.5 (2.9, 5.3)**	**2.9 (1.9, 4.6)**
3+symptoms (Depression, GAD)	402	1.7 (1.3)	**4.9 (3.3, 7.2)**	**3.9 (2.2, 7.0)**
Separation Anxiety Disorder[c]	91	2.0 (1.5)	**3.5 (2.2, 5.6)**	**2.7 (1.8, 4.1)**
Social phobia	35	2.9 (1.7)	1.7 (0.6, 2.8)	*d*
Conduct disorder	285	0.9 (1.1)	**1.7 (1.2, 2.4)**	1.2 (0.8, 1.9)
Oppositional defiant disorder	466	1.2 (1.2)	**1.9 (1.4, 2.6)**	**1.5 (1.1, 2.0)**
ADHD	113	1.1 (1.0)	1.4 (0.9, 2.1)	*d*
Any substance abuse or dependence	255	0.7 (1.0)	**1.5 (1.1, 2.1)**	1.2 (0.8, 1.8)
Nicotine dependence	167	0.8 (1.0)	1.5 (1.0, 2.3)	~
Alcohol abuse/dependence	64	0.7 (0.8)	1.7 (1.0, 3.0)	~
Cannabis abuse/dependence	98	0.7 (0.9)	1.7 (1.0, 2.9)	~

Boldface results indicate that the means ratio is significant at *p* < .05.

SD = Standard deviation; CI = Confidence Interval; NA = not applicable; GAD = Generalized Anxiety Disorder; ADHD = Attention Deficit Hyperactivity Disorder

Note: Results for specific phobia, agoraphobia, and panic disorder individually are not shown because of their low prevalence, but preliminary analyses suggested that no associations of sleep problems with these disorders would have been identified in Model 2.

[a] Model 1: Means ratios adjusted for sex, age, race, Tanner stage

[b] Model 2: Means ratios adjusted for sex, age, race, Tanner stage and other psychiatric diagnoses

[c] Diagnoses or symptoms scales exclude DSM-IV sleep-related symptoms

[d] Model 2 was not run because results from Model 1 were not significant

Table 3

Left Side: Results from longitudinal logistic regression analyses predicting increases in the likelihood of meeting DSM-IV diagnostic criteria with sleep problems. Right Side: Results from longitudinal Poisson regression analyses predicting increases in sleep problems with psychiatric diagnoses.

Psychiatric Disorder	Sleep Problems → Psychiatric Disorder		Psychiatric Disorder → Sleep Problems	
	Model 1[a]	Model 2[b]	Model 1[a]	Model 2[b]
	Odds Ratio (CI)	Odds Ratio (CI)	Means Ratio (CI)	Means Ratio (CI)
Any diagnosis[c]	**2.0 (1.3, 3.1)**	NA	1.3 (0.6, 2.7)	NA
Depressive disorder[c]	2.6 (0.9, 7.1)	d	1.9 (0.4, 8.6)	~
Anxiety disorder[c]	**3.3 (1.5, 7.3)**	**3.5 (1.3, 9.6)**	2.0 (0.7, 5.9)	~
Any GAD[c]	**11.7 (2.1, 64.4)**	**6.4 (1.6, 25.9)**	**16.3 (2.9, 93.2)**	3.6 (0.6, 22.8)
GAD w/o depression[c]	1.3 (0.3, 5.8)	~	**12.7 (2.9, 56.7)**	4.0 (0.8, 19.3)
Depression w/o GAD[c]	1.9 (0.5, 7.3)	~	2.0 (0.4, 3.0)	~
Depression or GAD	1.6 (0.4, 6.2)	~	**6.5 (1.8, 24.0)**	**4.0 (1.6, 10.0)**
3+symptoms (Depression, GAD)[c]	**2.9 (1.4, 5.7)**	**2.2 (1.1, 4.3)**	**4.0 (1.5, 10.6)**	**3.6 (2.2, 5.8)**
Separation Anxiety Disorder[c]	1.4 (0.5, 4.3)	~	1.0 (0.4, 2.5)	~
Conduct disorder	**2.0 (1.0, 4.1)**	1.4 (0.6, 3.2)	1.3 (0.6, 2.7)	~
Oppositional defiant disorder	**2.5 (1.4, 4.3)**	**2.2 (1.2, 4.1)**	**1.6 (1.0, 2.7)**	**1.9 (1.1, 3.2)**
ADHD	**3.3 (1.3, 8.7)**	1.1 (0.4, 2.7)	1.7 (0.4, 6.7)	~
Any substance abuse or dependence	**2.1 (1.0, 4.2)**	1.6 (0.7, 3.5)	0.7 (0.2, 1.9)	~
Nicotine dependence	1.9 (0.8, 4.6)	~	0.4 (0.1, 1.4)	~
Alcohol abuse/dependence	**4.8 (1.6, 14.5)**	1.4 (0.2, 11.0)	1.2 (0.4, 3.8)	~
Cannabis abuse/dependence	**3.8 (1.4, 10.3)**	2.5 (0.7, 8.9)	2.7 (0.9, 8.3)	~

Boldface results indicate that the means or odds ratio is significant at $p < .05$.

CI = Confidence Interval; NA = not applicable; GAD = Generalized Anxiety Disorder; ADHD = Attention Deficit Hyperactivity Disorder Social phobia was not included in longitudinal analyses because of its low prevalence and non-significant associations with sleep problems in the cross-sectional Model 1.

[a] Model 1: Means/odds ratios adjusted for sex, age, race, and Tanner stage, controlling for past history of the outcome variable.

[b] Model 2: Means/odds ratio adjusted for sex, age, race, and Tanner stage, controlling for past history of outcome variable.

[c]Excluding sleep symptoms

[d]Model 2 was not run because results from Model 1 were not significant