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Depression and Insomnia Among Adolescents: A Prospective Perspective

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Abstract

Background—No studies of adolescents have examined the prospective, reciprocal association between insomnia and major depression.

Methods—A two-wave, community-based cohort of 3,134 youths aged 11–17 at baseline. Major depression was assessed using DSM-IV criteria. Three measures of insomnia were used also following DSM-IV: P_1, any symptom of insomnia; P_2, any symptom plus impairment; P_3, P_2 with no comorbid mood, anxiety or substance use disorders.

Results—In general, the association between insomnia and depression was stronger and more consistent for major depression than for symptoms of depression. Baseline insomnia (P_1 and $P_{2)}$ increased subsequent risk of major depression 2–3-fold and P_1 2-fold in multivariate analyses. Major depression increased risk for subsequent insomnia 2–3-fold for P_1 and P_2 2-fold for P_2 in multivariate analyses. Results varied by measure of insomnia used.

Limitations—Only symptoms of insomnia were assessed, so we could not examine the effects of comorbid sleep disorders nor did we have objective or biological measures of disturbed sleep.

We also did not collect data on parental reports of youth depression nor insomnia or sleep problems.

Conclusion—Our results provide the first prospective data on insomnia and major depression among adolescents indicating the two are reciprocally related. More studies are needed examining trajectories of insomnia and major depression in childhood and adolescence.

Keywords

Major Depression; Insomnia; Adolescents; Epidemiology

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Conflict of Interest
There are no potential conflicts of interest for either author. Catherine R. Roberts, Ph.D., the University of Texas School of Medicine (retired) assisted in the design and conduct of the study and collection and management of the data.

INTRODUCTION

Both insomnia and major depression are major public health problems affecting adolescents and young adults. Prevalences of insomnia among adolescents range from 4.4% for point prevalences to 13.4% for past year (Ohayon et al., 2000; Ohayon and Roberts, 2001; Roberts, Roberts and Chan, 2006; 2008) and 10.7% for lifetime (Johnson et al., 2006). Prevalences for major depression range from 2% to 8% for one year and 12% to 18% for lifetime (Lewinsohn et al., 1993; Roberts, Roberts and Xing, 2007; Canino et al., 2004; Costello et al., 2003; Merikangas et al., 2009; Merikangas et al., 2010).

A growing body of research indicates that there is an association between insomnia and major depression. From a diagnostic perspective, this is not surprising. Both insomnia and hypersomnia constitute one of the 9 DSM-IV diagnostic criteria for major depression for both adolescents and adults (American Psychiatric Association, 2000). In the case of insomnia, there also is a diagnostic link with major depression. A diagnostic distinction is made between primary insomnia and insomnia secondary to several psychiatric disorders, including major depression (American Psychiatric Association, 2000).

Insomnia and major depression also appear to be linked epidemiologically. There is literature on the association between insomnia and major depression, particularly among adults (Ford and Kamerow, 1989; Vollrath, 1989; Breslau et al., 1996; Ohayon and Roth, 2003; Riemann and Voderholzer, 2003; Buysee et al., 2008) as well as some data on adolescents (Johnson et al., 2006; Liu et al., 2007; Gillespie et al., 2012). The evidence indicates that insomnia, particularly chronic insomnia, increases subsequent risk of major depression. However, the evidence thus far, albeit limited, suggests that major depression confers less risk for developing insomnia (Ohayon, 2007). However, these conclusions are based on retrospective reports from two prevalence studies (Ohayon and Roth, 2003; Johnson et al., 2006). The latter study focused on youths 13–16 using lifetime reports, and found prior insomnia predicted onset of major depression but not the reverse. While the data suggest an asymetric association, the temporal association is not directly tested. To our knowledge, no study to date has examined the prospective association between insomnia and major depression among adolescents, and none have examined reciprocal effects using data from a cohort study.

Given current DSM-IV diagnostic systems, and data suggesting insomnia and major depression are linked epidemiologically, there are questions about the nature of the link between these two conditions: Are they comorbid disorders? Does insomnia increase the risk for major depression? Does major depression increase the risk of insomnia? Is the association bidirectional or unidirectional? The data are unclear.

Our purpose here is to reexamine the relation between insomnia and major depression in adolescence. That is, we examine whether prior insomnia increases subsequent risk of major depression, and whether the converse also holds as well.

We address these questions using a community-based, two-wave cohort of 4, 175 youths 11–17 at baseline and 3,134 of these youths followed up one year later, Teen Health 2000 (TH2K).

Methods

Sample

The sample was selected from households in the Houston metropolitan area enrolled in two local health maintenance organizations. One youth, aged 11 to 17 years, was sampled from

each eligible household, oversampling for ethnic minority households. Initial recruitment was by telephone contact with parents. A brief screener was administered on ethnic status of the sample youths and to confirm data on age and sex of youths. Every household with a child 11 to 17 years of age was eligible. Because there were proportionately fewer minority subscriber households, sample weights were developed and adjusted by poststratification to reflect the age, ethnic, and sex distribution of the 5-county Houston metropolitan area in 2000. The precision of estimates are thereby improved and sample selection bias reduced to the extent that it is related to demographic composition (Andrews et al., 1973). Thus, the weighted estimates generalize to the population 11 to 17 years of age in a metropolitan area of 4.7 million people.

Data were collected on sample youths and one adult caregiver using computer-assisted personal interviews and self-administered questionnaires. The computerized interview contained the structured psychiatric interview (see below) and demographic data on the youths and the household. Height and weight measures were conducted after the completion of the interviews. The interviews and measurements were conducted by trained, lay interviewers. The interviews took on average 1 to 2 hours, depending on the number of psychiatric problems present. Interviews, questionnaires, and measurements were completed with 4175 youths at baseline, representing 66% of the eligible households. There were no significant differences among ethnic groups in completion rates. Youths and caregivers were followed up approximately 12 months later using the same assessment battery used at baseline. The cohort consisted of 3134 youths plus their caregivers in Wave 2 (75% of Wave 1 dyads). All youths and parents gave written informed consent prior to participation. All study forms and procedures were approved by the University of Texas Health Science Center Committee for Protection of Human Subjects.

Measures

Depression—Data on psychiatric disorders were collected using the youth version of the Diagnostic Interview Schedule for Children, Version 4 (DISC-IV), a highly structured instrument with demonstrated reliability and validity (Shaffer, Fisher, Lucas, Dulcan, and Schwab-Stone, 2000). Interviews were conducted by college-educated, lay interviewer who had been extensively trained using protocols provided by Columbia University. Interviews with the DISC-IV were administered using laptop computers.

Depression is measured using two alternate strategies. First, we examine the association between sleep and major depression using DSM-IV diagnostic criteria (American Psychiatric Association, 2000). The 12-month period prevalence was 1.7%. Then, given that much of the literature has focused on symptoms of depression, we examine disturbed mood in the past 12 months, defined as depressed mood, irritable mood or anhedonia (baseline prevalence was 57.6%).

Sleep—None of the existing psychiatric diagnostic interviews designed for epidemiologic research with children and adolescents have included modules eliciting symptoms of DSM sleep disorders. We inquired about symptoms of disturbed sleep, focusing primarily on symptoms of insomnia, their frequency, and duration.

Our measures attempt to operationalize DSM-IV symptom criteria for a diagnosis of insomnia. That is, we collected data on the symptoms of insomnia specified in the DSM-IV. The insomnia items are trouble falling asleep (DIS), waking up in the middle of the night and finding it hard to go back to sleep (DMS1), waking up frequently but able to go back to sleep (DMS2), waking up very early (EMA), and nonrestorative sleep (NRS). The time referent is the past 4 weeks. The subject could respond “rarely or never, sometimes, often, or almost every day.” The DSM-IV symptom criteria for insomnia include all of these

symptoms, and the symptoms should cause significant distress or impairment. To qualify for a diagnosis of primary insomnia, the symptoms must not occur exclusively during another sleep disorder, occur during another psychiatric disorder, or be due to the effects of alcohol, drugs, or medication. The measures operationalize DSM-IV symptom criteria and thus have content validity. Our rates of insomnia are highly comparable to those reported by Ohayon et al. (2000), demonstrating external validity, and are correlated with other factors consistent with the literature, providing evidence of construct validity.

We define insomnia several ways: P_1 = any symptom of insomnia. P_2 = at least 1 symptom of disturbed sleep with either daytime fatigue or daytime sleepiness (as indicators of impairment). P_3 = P_2 excluding any subject who met the first 2 criteria who also met DSM-IV diagnostic criteria for a mood disorder, an anxiety disorder, or a substance use disorder in the past year. We should note that P3 is not equivalent to a full DSM-IV diagnosis of primary (or secondary) insomnia but approximates such a diagnosis as our measures permit.

Covariates—We include as covariates known correlates of both depression and sleep: age, gender, and family income.

Family income was assessed using total household income in the past year: <$35,000, $35,000 – $64,999, and $65,000 or more.

Age was assessed by age at most recent birthdate: 12 or less, 13 – 15, and 16 or older.

Analyses

First, the relationship between insomnia (P_1, P_2, P_3) and depression (yes, no) at Wave 1 is examined, calculating crude odds ratios and then adjusted odds ratios controlling for age, gender, and family income. Second, insomnia (P_1, P_2, P_3) at Wave 1 is used to predict depression at Wave 2, first examining crude odds ratios and then adjusted odds ratios controlling for the same covariates including depression at baseline. We then repeat this strategy using depression at Wave 1 to predict insomnia (P1, P2, P3) at Wave 2, controlling for insomnia at baseline.

The estimated odds ratios and their 95% confidence limits were calculated using survey logistic regression (Proc Surveylogistic) procedures in SAS V9.1 (SAS Institute, 2004) and Taylor series approximation to compute the standard error of the odds ratio. Lepkowski and Bowles (1996) have indicated that the difference in computing standard error between this method and other repeated replication methods such as the jackknife is very small.

Results

Table 1 presents data on sample characteristics. As can be seen, the sample was diverse in terms of age, ethnicity, family income and marital status of parents. The prevalences at baseline of P_1, P_2, and P_3 were 26.8, 6.7, and 4.7, respectively.

In terms of comorbidity, 56.1% of youths who met criteria for major depression had comorbid P_1 and 21.2% had comorbid P_2, which means 21.2% of youths with major depression had at least 1 symptom of insomnia with daytime impairment (data not shown). Conversely, 3.4% of youths with P_1 and 5.2% with P_2 also met diagnostic criteria for major depression (Wave 1 data). By definition, major depression cannot be associated with primary insomnia (P_3), since a diagnosis of major depression precludes a diagnosis of primary insomnia (American Psychiatric Association, 2000).

Table 2 presents data on the association between insomnia and depression at Wave 1. The association between insomnia and depression is significant. Given the definition of P_3, there is no association between that measure of insomnia and major depression.

Table 3 presents data on baseline insomnia predicting subsequent risk for depression. P_1 predicts both major depression and depressive symptoms. However, when covariates are controlled, P_2 predicts depressive symptoms but not major depression. P_3 does not predict depressive symptoms in multivariate analyses.

Table 4 presents data on depression at baseline predicting subsequent insomnia. In general, the effects are considerably less robust that in Table 2. In multivariate analyses, major depression increases risk only for P_2 while depressive symptoms increases risk only for P_1.

Discussion

Our objective was to reexamine the association between insomnia and depression among adolescent, using data from a 2-wave cohort to directly assess their reciprocal association over time.

At baseline, we found that the P_1 and P_2 measures of insomnia were associated with both major depression and depressive symptoms. Comorbidity between P_1 and P_2 and major depression was moderate.

When we examined risk of future depression among those with insomnia at baseline, we found that P_1 increased the risk of major depression 2-fold, but no effect for P_2. This was surprising, since P_2 is more severe insomnia than P_1. P_1 and P_2 both predicted depressive symptoms. But when depression at baseline was controlled, there was no effect for P_3.

When we examined the reciprocal effects, we found depressive symptoms predicted only P_1. Major depression predicted only P_2. The odds for P_3 was 2.3, indicating a moderate risk, but the confidence interval was quite large, due largely to the low base rates of major depression and P_3 (our indicator of primary insomnia).

Thus, our results are mixed. Only symptoms of insomnia at baseline increased risk of major depression. Major depression only increased risk for P_2. The risk in both cases was about 2-fold, suggesting that the association between major depression and insomnia is bidirectional. The results for symptoms of depression were similar.

How do our results compare to the literature? Previous studies have found that insomnia increases risk of depression, among both adolescents and young adults (Johnson et al., 2006; Liu et al., 2007; Buysse et al., 2008; Gehrman et al., 2011). Previous studies have found risk of insomnia among the depressed either absent or attenuated (Ohayon and Roth, 2003; Johnson et al., 2006; Buysee et al., 2008). However, only one of these studies was based on prospective data and only this study could directly estimate reciprocal effects (Buysse et al., 2008). This study was a 20-year followup of young adults. Thus, our results are the first based on a cohort study of adolescents qua adolescents, and our data paint a more nuanced pattern of associations between insomnia and depression over time.

Limitations

The nature of our study imposed certain limitations on our analyses and interpretations. First and foremost, our structured diagnostic interview did not include modules on DSM-IV insomnia or other sleep disorders. Thus, we were not able to distinguish between primary and secondary sleep disorders, nor were we able to examine the role of comorbid sleep

disorders. Although our measures permitted us to assess Criteria A, B (to a limited degree), D and E, we were not able to assess Criterion C (presence of other sleep disorders). Nonetheless, our symptom criteria capture most of the core research diagnostic criteria for insomnia disorders proposed by the American Academy of Sleep Medicine Work Group, (2004). As noted by the Work Group, there is great diversity in definitions of insomnia in the literature, making comparisons difficult.

This inability to assess comorbid sleep disorders, however, may have little effect on our overall prevalence estimate for insomnia. Based on their analyses of data on adolescents, Ohayon and Roberts (2001) concluded that multiple diagnoses of sleep disorders are a minor issue and affect rates of individual disorders very little. In addition, our measures for B (impairment) were limited to daytime fatigue and daytime sleepiness. We had other indicators of impairment at home, at school, and with peers, as well as a measure of global functioning—the Child Global Assessment Scale—but none of these were specific to sleep.

As noted earlier, our sleep items asked whether subjects had experienced symptoms of insomnia almost every day for the past 4 weeks. Thus, our results are limited in that we were not able to partition our sample into those with acute versus chronic sleep problems. In their epidemiologic study in the United Kingdom, Ohayon et al. (1997) found that the median duration of insomnia symptoms was 24 months. We could not examine whether the association of insomnia and depression differed for those with insomnia of shorter and longer duration, although it might be expected that the association with psychological functioning would be more pronounced for chronic insomnia (Kripke et., 1979).

Another limitation is that we did not have objective data on disturbed sleep. That is, we did not have physiologic studies. Although such data would be useful to have, self-reports and interview-based measures remain the measures of choice in community surveys. Our study was no exception. We should note that there are data suggesting that subjective measures of sleep from children and adolescents are correlated with objective measures of disturbed sleep (Sadeh et al., 1995).

Questions might arise about our sample design. We did not employ an area probability design. To compensate for this design effect, we poststratified our sample to approximate the age, sex, and ethnic composition of the population (Knutson, 2005; Patten et al., 2000; Ohayon, 2002; Roberts, Lewinsohn, and Seeley, 1995; Carkadon, 1990; 2002) of the 5-county metropolitan area in which all of our study households were located. Our wave 2 completion rate was 75%. Data from Table 1 indicate our Wave 1 sample and the baseline data for the Wave 1 – Wave 2 cohort were highly comparable, indicating little bias was introduced by attrition (see also Roberts, Roberts and Chan, 2009.

We also did not interview parents about either sleep disturbance or depression in their adolescent children. Although there is argument that data from multiple informants are desirable, studies have demonstrated considerable discordance in parent-child reports of child functioning (Roberts et al., 2005). We used data only for youths.

Conclusions

We are the first to directly examine the prospective, reciprocal association between insomnia and major depression in adolescents. We find that insomnia has a direct effect on risk for major depression, increasing risk 2 – 3 fold in crude analyses and 2-fold in multivariate analyses, controlling for depression at baseline. Insomnia also increased risk of depressive symptoms, but the effect, while significant, was attenuated compared to major depression.

When we examined the reverse, the results were similar. There was increased risk of insomnia among those with major depression as well as for depressive symptoms.

These results, particularly for major depression, suggest that quantity of sleep, following DSM-IV guidelines (American Psychiatric Association, 2000) increases risk for major depression, which in turn increases risk for decreased sleep. This is not surprising, given the phenomenology of both insomnia and major depression.

Our results extend the available data on insomnia and depression and are the first prospective data on this question for adolescents. Clearly more data are needed on the prospective, reciprocal association between these major public health problems in adolescence. What is needed are studies which examine developmental trajectories of insomnia and depression from childhood through adolescence into adulthood.

Following suggestions by Gruber and Brouillette (2006), future studies should also focus on both objective and subjective measures of disturbed sleep, controlling for comorbid psychiatric disorders, particularly anxiety disorders (see Buysee et al., 2008; Johnson et al., 2006) as well as other sleep disorders such as hypersomnia and nightmares (see Liu et al., 2007; Nadorff et al., 2011).

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Table 1

Unweighted sample characteristics, Teen Health 2000.

Characteristics	Wave I N=4175 %	Wave 2 cohort N=3134 %
Gender of Youth		
Male	51.14	50.77
Female	48.86	49.23
Age of Youth		
16 +	24.91	40.36
Between 13 and 15	48.05	48.63
12 or less	27.04	11.01
Ethnicity of Youth		
European American	35.43	37.01
African American	35.35	34.59
Latino American	24.57	23.64
Other	4.65	4.75
Family Income		
$65,000 +	35.29	40.73
$ 35,000 – $ 64,999	40.71	39.16
< $35,000	24.00	20.11
Parental Marital Status		
Married	75.71	76.10
Others	24.29	23.90
Insomnia		
P_1	26.83 (25.36–28.30)	27.12 (25.42–28.82)
P_2	6.66 (5.84–7.49)	7.03 (6.05–8.01)
P_3	4.70 (4.02–5.39)	4.95 (4.14–5.75)

Depression Symptoms = Either depressed mood, anhedonia, or irritable mood.

P1 = 1 or more insomnia symptoms (nonrestorative sleep; trouble falling asleep; nighttime waking, difficult to sleep again; nighttime waking, but return to sleep; and early morning awakening).

P2 = at least 1 insomnia symptom and daytime fatigue/sleepiness.

P3 = P2 after mood, anxiety, and substance use disorders are excluded.

* Adjusting for age, gender and family income.

† Odds ratios are statistically significant ($p<0.05$).

NA: Major Depression excluded, re P_3.

Table 2

Odds Ratios for the Association Between Insomnia and Depression (Wave 1).

Insomnia at Wave 1	Depression at Wave 1			
	Crude OR, 95% C.I.		Adjusted* OR, 95% C.I.	
	Major Depression	Depression Symptoms	Major Depression	Depression Symptoms
P1	3.25† (1.93–5.47)	1.58† (1.35–1.84)	3.25† (1.89–5.60)	1.54† (1.31–1.82)
P2	3.71† (1.97–6.95)	2.11† (1.57–2.84)	3.32† (1.73–6.37)	2.13† (1.55–2.92)
P3	NA	1.44† (1.05–1.99)	NA	1.51† (1.07–2.14)

Depression Symptoms = Either depressed mood, anhedonia, or irritable mood.

P1 = 1 or more insomnia symptoms (nonrestorative sleep; trouble falling asleep; nighttime waking, difficult to sleep again; nighttime waking, but return to sleep; and early morning awakening).

P2 = at least 1 insomnia symptom and daytime fatigue/sleepiness.

P3 = P2 after mood, anxiety, and substance use disorders are excluded.

* Adjusting for age, gender and family income.

† Odds ratios are statistically significant ($p<0.05$).

NA: Major Depression excluded, re P3.

Table 3

Odds Ratios for the Association Between Insomnia at Wave 1 and Depression at Wave 2.

Insomnia at Wave 1	Depression at Wave 2			
	Crude OR, 95% C.I.		Adjusted* OR, 95% C.I.	
	Major Depression	Depression Symptoms	Major Depression	Depression Symptoms
P1	2.57† (1.33–4.98)	1.63† (1.37–1.94)	2.18† (1.07–4.41)	1.54† (1.28–1.86)
P2	3.27† (1.35–7.88)	1.87† (1.38–2.53)	1.61 (0.61–4.28)	1.54† (1.11–2.13)
P3	NA)	1.43† (1.01–2.01)	NA	1.23 (0.85–1.80)

Depression Symptoms = Either depressed mood, anhedonia, or irritable mood.

P1 = 1 or more insomnia symptoms (nonrestorative sleep; trouble falling asleep; nighttime waking, difficult to sleep again; nighttime waking, but return to sleep; and early morning awakening).

P2 = at least 1 insomnia symptom and daytime fatigue/sleepiness.

P3 = P2 after mood, anxiety, and substance use disorders are excluded.

*Adjusting for age, gender, family income and depression at Wave 1.

†Odds ratios are statistically significant ($p<0.05$).

NA: Major depression excluded, re P3

Table 4

Odds Ratios for the Association Between Depression at Wave 1 and Insomnia at Wave 2.

Depression at Wave 1	Insomnia at Wave 2					
	Crude OR, 95% C.I.			Adjusted* OR, 95% C.I.		
	P1	P2	P3	P1	P2	P3
Major Depression	1.94† (1.06–3.54)	3.41† (1.65–7.06)	2.00 (0.77–5.16)	1.42 (0.77–2.62)	2.31† (1.01–5.28)	2.27 (0.86–5.97)
Depression Symptoms	1.59† (1.33–1.91)	1.81† (1.33–2.46)	1.36 (0.99–1.88)	1.39† (1.14–1.68)	1.31 (0.95–1.82)	1.13 (0.81–1.59)

Depression Symptoms = Either depressed mood, anhedonia, or irritable mood.

P1 = 1 or more insomnia symptoms (nonrestorative sleep; trouble falling asleep; nighttime waking, difficult to sleep again; nighttime waking, but return to sleep; and early morning awakening).

P2 = at least 1 insomnia symptom and daytime fatigue/sleepiness.

P3 = P2 after mood, anxiety, and substance use disorders are excluded.

*Adjusting for age, gender, family income and insomnia at Wave 1.

†Odds ratios are statistically significant ($p<0.05$).