Adolescent Insomnia as a Risk Factor for Early Adult Depression and Substance Abuse

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Study Objective*:* To evaluate the association between adolescent insomnia and mental health during adolescence and young adulthood.
Design: Cross-sectional and prospective study.
Settings: School and in home.
Participants: Nationally based population sample of 4494 adolescents, 12 to 18 years old at baseline (mean = 15.83 years), with 3582 young adults, 18 to 25 years old (mean = 21.25 years) at 6- to 7-year follow-up.
Measures: Self-report measures of mental health.
Results: Insomnia symptoms were reported by 9.4% of the adolescents. Cross-sectionally, adolescent insomnia symptoms were associated with use of alcohol, cannabis, and drugs other than cannabis; depression; suicide ideation; and suicide attempts (all P values < 0.01) after controlling for sex. Prospectively, insomnia symptoms during adolescence were a significant risk factor for depression diagnosis (odds ratio = 2.3) in young adulthood after controlling for sex and baseline depression.
Conclusion: This study is the first to longitudinally evaluate insomnia symptoms during adolescence as a risk factor for mental health problems in young adulthood. The findings indicate that insomnia is a prevalent problem for adolescents and argue for future treatment-outcome studies to evaluate the efficacy and effectiveness of various insomnia interventions in this age group.
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ADOLESCENTS AND YOUNG ADULTS EXPERIENCE SUBSTANTIAL CHANGES IN THEIR PHYSIOLOGIC, COGNITIVE, AND PSYCHOLOGICAL FUNCTIONING that make them more susceptible to sleep and psychological problems. An estimated 10.7% of adolescents in the general population experience insomnia.[1] Studies in adults have found that insomnia is associated with and a risk factor for psychological problems.[2-4] Little research has explored the relationship between insomnia and mental health during adolescence and young adulthood. Cross-sectionally, the current study provided prevalence and correlate data, and, prospectively, the study evaluated *adolescent* insomnia symptoms as a risk factor for psychopathology in *young adulthood*.

Adolescents experience changes in their central neuroendocrine regulation, which alter their physiologic, cognitive, and emotional functioning.[5] Opposing societal demands, such as early school-start times and an increase in the significance of social roles coincide with these physiologic changes. These incongruous demands may explain why adolescents are prone to sleep problems,[6] such as delayed phase sleep syndrome and insomnia and, subsequently, to the development of mental health problems. The multiple changes that adolescents experience can be very stressful, and serve as precipitating factors that activate a diathesis (ie, biological or psychological predisposition) for other problems (eg, depression, insomnia).

Previous research has indicated that insomnia is a risk factor for psychological problems in adults.[3,7-15] For instance, people with chronic insomnia were more likely to develop major depression,[7,8,11] alcohol abuse or dependence, or illicit drug abuse and dependence[7,10,11] and to commit suicide.[9,12,13]

Substantially less research has evaluated insomnia and psychological disorders in adolescents. Cross-sectional studies have found that adolescents with insomnia experience more depressive symptoms[16,17] and suicide ideations and attempts[18-21] and are more likely to use alcohol, cigarettes, illicit drugs, or a combination of these substances.[22,23] Prospective studies have found that adolescents with insomnia are more likely to develop and maintain depression than are adolescents without insomnia.[24,25] No prospective studies have specifically evaluated insomnia as a risk factor for suicidal behaviors or alcohol or substance use.

The present study hypothesized that (1) adolescents with insomnia symptoms (Insomnia group) would have significantly higher occurrences of mental health problems than adolescents without insomnia symptoms (No insomnia group) at baseline and (2) adolescents with insomnia symptoms would be significantly more likely to develop mental health problems than adolescents without insomnia, 6 to 7 years later.

METHOD

Procedures

The present study used archival data from a National Longitudinal Study of Adolescent Health (Add Health).[26] Add Health collected data from a nationally representative sample of adolescents in the United States from 1994 to 2002. The sample was determined by a systematic, stratified, random-selection, process performed by Quality Education Data, Inc. One hundred forty-five US. middle, junior, and high schools were selected to participate based on size, school type, census region, level of urbanization, percentage of European American stu-

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Table 1—Demographic Information

	Total Sample		Insomnia group		No insomnia group	
	%	no.	%	no.	%	no.
Baseline (n = 4494)						
Sex[a]						
Female	52.4	2355	57.8	244	51.8	2111
Male	47.6	2139	42.2	178	48.2	1961
Age, y[b] (15.83 ± 1.46)						
Ethnicity						
Caucasian	59.1	2657	60.4	255	59.	2402
African American	21.1	950	21.1	89	21.1	861
Latino	4.4	199	4.5	19	4.4	180
Asian	3.1	140	2.8	12	3.1	128
Native American	0.6	25	0.2	1	0.6	24
Other[c]	11.6	523	10.9	46	11.7	477
Grade						
7	18.8	846	19.9	84	18.7	762
8	19.5	878	22.3	94	19.3	784
9	21.1	948	21.3	90	21.1	858
10	21.5	964	19.9	84	21.6	880
11	18.4	828	16.1	68	18.7	760
12	0.7	30	0.5	2	0.7	28
Follow-up (n = 3582)						
Sex[d]						
Female	54.4	1950	59.2	197	54	1753
Male	45.6	1632	40.8	136	46	1496
Age, y[b] (21.25 ± 1.49)						

[a]Significant interaction with insomnia, P = 0.019.
[b]Data are expressed as mean ± SD.
[c]*Other race* encompassed all multiple responders and students who marked "Other"
[d]Significant interaction with insomnia, P = 0.011.

dents, percentage of African American students, grade span, and curriculum.

The baseline phase was a cross-sectional data collection from 1994 to 1995 and was used for all cross-sectional analyses. The longitudinal data was collected 6 to 7 years later (2000-2001), and the period from baseline to this follow-up was used for the analyses of incidence. All participants, students, and parents signed informed consent forms, and researchers provided the schools with passive or active consent forms for the release of information. Add Health provides a more detailed description of the stratification process.[27]

Participants

Of the 6514 adolescents included in the public-use data set, 4494 provided data on sex, ethnicity, grade, and insomnia status usable for statistical analysis. As shown in Table 1, the sample consisted of 52.4% females (mean age = 15.83 years, SD = 1.46). Of the 4494 adolescents, 9.4% met criteria for insomnia symptoms at baseline. Table 1 contains insomnia-symptom status by demographic breakdown. Longitudinal data had a drop-out rate of 20.3%, which resulted in a total sample size of 3582 for analyses of incidence. At follow-up, the sample consisted of 54.4% females (mean age = 21.25 years, SD = 1.49). The overall refusal rate was 0.1% for all questions. Statistical analyses were conducted using SPSS 13.0 for Windows (SPSS, Inc., Chicago, IL).

Measures

This school-based, longitudinal study utilized various measures to gather information pertaining to the health-related behaviors of adolescents and health-related outcomes upon reaching young adulthood.[27] ADD Health used several instruments to obtain information about the adolescents at baseline. The current analyses used data from the baseline in-home interview, which was administered face to face with an interviewer and a laptop that prompted structured questions. More sensitive questions were input directly by the adolescent. The longitudinal data used in the current analysis came from the follow-up in-home interview. The entire data set, including both baseline and follow-up data, contained information about health-related variables such as height, weight, pubertal development, mental health status, and chronic and disabling conditions. Students who marked *Legitimate skip* or *Not applicable* were coded as *No*. The definition for *Legitimate skip* indicated that the student previously answered a question that served as a *No* for the subsequent question or questions, and, by definition, *Not appl*icable means *No*.

Insomnia symptoms was operationally defined by responses to the question, *Please tell me how often you have had each of the following conditions in the past 12 months. . . trouble falling asleep or staying asleep*. The Insomnia group was defined as adolescents who marked *Almost every day* or *Every day*. The No insomnia group was defined as adolescents who marked *Never*, *Just a few times*, or *About once a week*.

This definition approximated the frequency requirement and exceeded the duration requirement recommended by Lichstein, Durrence, Taylor, Bush, and Riedel.[28] The conservative tact of excluding adolescents from the Insomnia group who endorsed *Just a few times* was taken because of the difficulty in determining how many days *a few times* meant. Follow-up insomnia symptoms could not be assessed because no questions regarding insomnia symptoms were asked at follow-up.

All dependent variables were dichotomized because they could not be analyzed as continuous dependent variables due to large discrepancies in group sizes, open-ended answers (eg, 10+ times), and violations of several assumptions of analyses, such as nonnormal distribution (ie, skewed and/or kurtotic data). For instance, 4390 were classified as nonusers of cocaine versus 20 who marked *1*, 6 marked *2*, 4 marked *3*, 5 marked *4*, 2 marked *5*, 1 marked *7 to 10 times*, 2 marked *11 to 14 times*, 3 marked *15 to 30 times*, and 7 marked *33 or more times*. Binge drinking was quantified as drinking 5 or more alcoholic beverages in a row. Several who used drugs other than cannabis were polled in the baseline and follow-up in-home interviews; however, due to low affirmative response rates, all noncannabis drugs were combined into 1 category if an individual endorsed 1 or more. Baseline non–cannabis-drug categories were exact correlates to follow-up noncannabis categories with 1 exception—at follow-up, a question asked about crystal meth use in place of the baseline question about inhalant use. At baseline, adolescents were asked how often they felt depressed during the previous week. Adolescents who marked *Often* or *Everyday* were classified as having Depressive symptoms, and those who marked *Never Rarely*, or *Occasionally* as having No depressive symptoms. At follow-up, participants were asked if they had been previously diagnosed with depression, with an answer of *yes* indicating depression and *no* indicating no depression. Suicide-ideation status was based on whether or not a participant endorsed having thoughts of suicide over the past year. Suicide-attempts status was based on attempts made over the past year, with 1 or more attempts indicating endorsement.

RESULTS

Confound Variable Analyses

A series of χ^2 tests for independence and independent t tests were performed to compare Insomnia group with No insomnia group at baseline on demographic variables (ie, age, ethnicity, sex). Significant differences suggest the variable is a confound and should be included in further analyses. The χ^2 tests and t tests indicated that the prevalence rate of insomnia symptoms was significantly related to sex ($\chi^2_{1, 4494} = 5.48$, $P = 0.019$) but not ethnicity ($\chi^2_{5, 4494} = 1.32$, $P = 0.93$) or age ($t_{4492} = 0.351$, $P = 0.725$). Specifically, more females than males (10.4% vs 8.3%, respectively) experienced insomnia symptoms at baseline (Table 1). All future analyses included sex and sex-insomnia interaction in the model.

Continuers Versus Noncontinuers Analyses

Several χ^2 analyses were run comparing the 2 groups on baseline measures to ensure that participants who completed both baseline and follow-up assessments (Continuers) were similar to those who dropped out before the follow-up assessment (Noncontinuers). Analyses of study continuers versus noncontinuers indicated similar group membership (eg, Insomnia group versus No insomnia group, depression versus no depression). For the baseline Insomnia group, the frequency of continuers versus noncontinuers was similar for alcohol use (30.7% vs 38.6%), cannabis use (18.2% vs 18.6%), drug use other than cannabis (7.2% vs 7.9%), depressive symptoms (21.1% vs 23.6%), suicide ideation (27.6% vs 19.5%), and suicide attempts (10.8% vs 7.9%). Similarly, in the baseline No insomnia group, the frequency of continuers was similar to that of noncontinuers for alcohol use (20.7% vs 27.1%), cannabis use (10.6% vs 15%), drug use other than cannabis (3.9% vs 4.6%), depression (7.4% vs 9.3%), suicide ideation (11.5% vs. 11.8%), and suicide attempts (2.8% vs 3.5%).

Cross-Sectional Analyses

A series of binary, logistic, backward, stepwise regression analyses were performed on the baseline data with insomnia status, sex, and sex-by-insomnia as the independent variables and baseline psychopathology (ie, alcohol use, cannabis use, drug use other than cannabis, depressive symptoms, suicide ideation, and suicide attempts) as the dependent variables (Table 3). Nonsignificant factors were dropped from the final model. The Insomnia group was significantly more likely to use alcohol, cannabis, and drugs other than cannabis and to have depressive symptoms and suicide ideation ($P < 0.001$, except noncannabis, $P = 0.002$). Follow-up analysis of the insomnia-by-sex interaction indicated that females with insomnia were 2.31 to 5.5 times more likely to have attempted suicide during the past year than were females without insomnia ($P < 0.001$); however, insomnia was not a significant risk factor for males.

Incidence Analyses

A second series of binary, backward, stepwise logistic regressions were performed with baseline insomnia status, sex, and sex-by-insomnia as the independent variables and follow-up psychopathology (ie, alcohol use, illicit drug use, depression diagnosis, suicide ideation, and suicide attempt) as dependent variables. Data were excluded from each analysis if participants endorsed the corresponding mental health problem at baseline to evaluate incidence. For example, data were not included in analyses of incident depression if baseline depression was endorsed. For cannabis use and drug use other than cannabis, participants were excluded if they endorsed either at baseline. For suicide ideation and attempts, data were excluded if participants endorsed depression, suicide ideation, or suicide attempts at baseline. This enabled a more accurate picture of the new onset of each mental health disorder. Nonsignificant factors were dropped from the final model. As shown in Table 3, findings indicated that the Insomnia group was 1.54 to 3.01 times more likely to develop depression ($P < 0.001$) and 1.24 to 6.55 times more likely to have attempted suicide ($P = 0.014$) than the no insomnia group at follow-up. There was significant sex main effect for depression, alcohol use, cannabis use, and drug use other than cannabis. Males were significantly more likely to

Table 2—Cross-Sectional Odds Ratios for Insomnia Group vs No Insomnia Group

	no.	% Insomnia group	% No insomnia group	Unadjusted OR (CI)	Adjusted OR (CI)
Alcohol use	4487	32.4	22	1.7 (1.37-2.11)[d]	1.73 (1.39-2.15)[ad]
Cannabis use	4422	18.3	11.5	1.72 (1.32-2.25)[d]	1.75 (1.34-2.29)[ad]
Drug use other than cannabis	4494	7.3	4.1	1.88 (1.26-2.79)[e]	1.91 (1.29-2.85)[ae]
Depressive symptoms	4487	54.3	31.9	3.27 (2.53-4.24)[d]	3.18 (2.45-4.14)[ad]
Suicide ideation	4457	25.9	11.6	2.68 (2.11-3.4)[d]	2.1 (1.63-2.71)[abd]
Suicide attempts	4484	10.2	2.9	3.77 (2.62-5.42)[d]	1.76 (.77-4.03)[abc]

Insomnia group refers to adolescents with insomnia symptoms; No insomnia group, adolescents without insomnia symptoms; OR, odds ratio; CI, 95% confidence interval.
Adjusted for [a]sex, [b]depression, [c]sex-by-insomnia symptom status.
[d]$P < 0.001$, [e]$P < 0.01$.

Table 3—Incidence Odds Ratios for Insomnia Group vs No Insomnia Group

	no.	Insomnia group, %	No insomnia group, %	Predictor[a]	OR (CI)[a]	Predictor[b]	OR (CI)[b]
Alcohol use	3571	48.2	50.6	Sex	2 (1.6-2.51)[c]	Sex	2.14 (1.81-2.54)[c]
Cannabis use	3570	25.1	22.5	Sex	1.66 (1.4-1.99)[c]	Sex	1.65 (1.32-2.05)[c]
Drug use other than cannabis	3582	8.4	6.7	Sex	1.66 (1.21-2.28)[d]	Sex	1.61 (1.09-2.37)[f]
Depression	3578	22.9	10.2	Sex	0.47 (0.37-0.6)[c]	Sex	0.45 (0.32-0.62)[c]
				Insomnia	2.15 (1.54-3.01)[c]	Insomnia	2.2 (1.34-3.58)[d]
Suicide ideation	3546	9.7	6.4	—	—	—	—
Suicide attempts	3581	3	1.4	Insomnia	2.85 (1.24-6.55)[e]	—	—

Insomnia group refers to adolescents with insomnia symptoms; No insomnia group, adolescents without insomnia symptoms; OR, odds ratio; CI, 95% confidence interval.
[a]Incidence rating with no endorsement of same baseline variable.
[b]Incidence rating with no endorsement of any baseline variable.
[c]$P < 0.001$, [d]$P = 0.002$, [e]$P = 0.014$, [f]$P = 0.017$

endorse alcohol use ($P < 0.001$), cannabis use ($P < 0.001$), and drug use other than cannabis ($P = 0.017$). Females were twice as likely to develop depression at follow-up ($P < 0.001$).

A third series of more stringent, binary, backward, stepwise logistic regressions were performed for each dependent variable from the follow-up data with insomnia, sex, and sex-by-insomnia as the independent variables. Data were excluded from analyses if participants endorsed any mental health problem at baseline. These analyses evaluated the role of baseline insomnia without other mental disorders potentially contributing. Nonsignificant factors were dropped from the final model. As shown in Table 3, the Insomnia group was 1.34 to 3.58 times more likely than the no insomnia group to experience depression ($P = 0.002$). As with the previous analyses, a significant sex main effect was found for depression, alcohol use, cannabis use, and drug use other than cannabis (refer to Table 3).

DISCUSSION

The current findings corroborate those of previous studies that showed an association between adolescent insomnia and mental health problems (ie, alcohol and/or substance use, and/or depression, and/or suicide thoughts/attempts).[16,18,20,22,23] Specifically, at baseline, the Insomnia group was more likely to use alcohol, cannabis, drug use other than cannabis and was more likely to suffer from depression, suicide thoughts, and suicide attempts (Table 2). The Insomnia group also had a greater risk of developing new incidences of depression and suicide attempts after excluding data from participants who suffered from these specific psychopathologies at baseline (Table 3). When excluding data from participants who endorsed any mental health problem at baseline, the Insomnia group was significantly more likely to develop incident depression (Table 3). In addition, sex differences emerged for alcohol use, cannabis use, drug use other than cannabis, and depression.

This study is the first to look at insomnia in adolescents both in association with mental health problems during adolescence and as a risk factor for mental health problems in young adulthood. This study is also one of the few to utilize criteria for insomnia symptoms based on both duration and frequency. Both the cross-sectional and incidence analyses provide strong support for an association between insomnia and mental health problems. The diathesis stress model may explain the role insomnia has in the development, and in some instances perpetuation, of other mental health problems. This model would suggest that the presence of insomnia not only increases the risk of the development of mental health problems, but might also increase the severity.

The current study had several limitations. First, the methods were not able to realistically control for the presence of all occult sleep problems or potential alternative diagnoses (eg, delayed sleep phase syndrome) due to the lack of a thorough sleep history or polysomnography at baseline or at follow-

up. Adolescents, specifically postpubescent adolescents, are particularly prone to the development of delayed sleep phase syndrome.[29] In addition, the similarity in presenting symptoms between insomnia and delayed sleep phase syndrome make the differentiation particularly difficult. Therefore, caution is warranted when interpreting the results of the current study. Second, the current study did not take into account possible comorbid medical conditions, which could increase the presence of the mental health problems. A third limitation is the inherent reciprocal nature of insomnia and mental health problems, which is more specific to the cross-sectional data obtained during adolescence. The inclusion of prospective data attempted to address this limitation. The fourth limitation is an overarching inherent fault associated with most, if not all, archival datasets in epidemiologic studies—the dataset was not created specifically for the current study. For instance, insomnia symptoms were not assessed at follow-up. In conjunction, the fifth limitation is the definition used in the current study. The dataset utilized did not allow for the inclusion of a daytime complaint, sleep-onset latency, or duration of wake time after sleep onset. Despite these caveats, insomnia symptoms during adolescence appear to play a role in the initiation of mental health problems during young adulthood. A sixth limitation is the use depression questions that were not drawn from validated questionnaires and, therefore, may lack sensitivity.

The information from this study has various implications. First, this information can potentially provide parents, educators, and mentors with a sign of a risk factor for the development of mental health problems. Second, the evidence suggests that it may be very difficult to determine whether insomnia is caused by another disorder or is simply comorbid with that disorder. However, it does appear that insomnia can become a self-sustaining independent disorder that responds to specific treatments.[30] These findings suggest that adolescents with insomnia can benefit from therapeutic interventions for insomnia (eg, cognitive behavior therapy for insomnia) independent of any other treatment for comorbid psychiatric problems.

More treatment-outcome studies are needed in adolescents with insomnia, in part to determine if traditional insomnia treatments work in this population. Long-term follow-up of adolescents who choose to participate could be done to determine if those who have their insomnia treated are at a reduced risk for developing mental health problems. Such outcome studies would provide much more information as to the role insomnia plays in the development of these problems.

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