

Sleep and Adolescent Suicidal Behavior

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Study Objectives: Suicide risk begins to increase during adolescence. Adolescents do not get enough sleep and are also at risk for many sleep disturbances. This study examined the association between sleep patterns and sleep problems and adolescent suicidal behavior.

Design and Setting: A questionnaire survey of adolescents attending school was conducted in one prefecture of Shandong Province, People's Republic of China.

Participants: A total of 1,362 adolescents attending school (mean age 14.6 years, 60% males) participated in the survey.

Measurements: Respondents completed a self-administered questionnaire that asked about sleep patterns, sleep problems, suicidal behavior, depressive symptoms, and demographic characteristics of the family and adolescent.

Results: Overall, 19.3% of the sample reported having suicidal ideation, 10.5% having suicide attempts in the past 6 months, 16.9% having insomnia symptoms, 2.3% having taken hypnotic medication, and 48.9% having

experience of nightmares in the past month. Mean night sleep duration was 7.6 hours (SD = 0.8). Logistic regression analyses showed that sleeping less than 8 hours at night (OR = 2.89, 95% confidence interval [CI] = 1.07-7.81) and frequent nightmares (OR = 2.43, 95% CI = 1.76-3.35) were significantly associated with increased risk for suicide attempts after adjustment for age, sex, father's occupation, and depressive symptoms and that nightmares (OR = 1.69, 95% CI = 1.20-2.38) were also significantly related to suicidal ideation.

Conclusion: These findings demonstrate the association between short sleep duration and nightmares and suicidal behavior and highlight the potential role of sleep intervention in the prevention of adolescent suicide.

Key Words: Suicidal ideation; suicide attempts; sleep duration; sleep problems; adolescents

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INTRODUCTION

SUICIDE REPRESENTS A MAJOR WORLDWIDE SOCIAL AND PUBLIC HEALTH PROBLEM WITH ABOUT 1 MILLION DEATHS IN THE WORLD EACH YEAR. Suicide is a leading cause of death for young adults. It is among the top 3 causes of death in the population aged 15 to 34 years.¹ Suicide risk begins to increase during adolescence.² Prevalence rates for suicidal ideation among adolescents have been estimated from 11% for severe suicidal ideation to 75% for any degree of suicidal ideation,³⁻⁵ with an average rate of 20% for suicidal ideation and 8% for suicide attempts during the past year.^{6,7} Suicidal ideation and suicide attempts are associated with increased risk for completed suicide in the future. The risk factors of suicidal behavior found in previous studies, quite similar to those of completed suicide, are multiple in origin, including biologic, cognitive, psychological, social and family factors.⁶

A number of studies have consistently reported that adolescents do not get enough sleep and that their sleep patterns are characterized by staying up late.⁸⁻¹¹ Adolescents are also at increased risk for many sleep disorders, such as insomnia, daytime sleepiness, chronic nightmares, and delayed sleep phase syndrome.¹²⁻¹⁴ Most studies have demonstrated that the way adolescents sleep and their tendency to get insufficient sleep result in negative effects on their ability to think and concentrate in

school, school performance, behavior, and mood during daytime hours and an increased risk for injuries and accidents, drugs and alcohol use, and circadian sleep disorders.^{9-11, 15-17}

Given evidence that suicidal behavior begins to increase during adolescence and that adolescents do not get enough sleep and are at risk for many sleep disturbances, a particular question is whether sleep patterns and sleep disturbances are associated with increased risk for adolescent suicidal behavior. Several recent studies have examined the association between sleep disturbances and suicidality among patients with psychiatric disorders, such as major depression, panic disorder and schizophrenia.¹⁸⁻²² Two prospective studies of adults have reported that poor sleep quality and nightmares are significant predictors of completed suicide.^{23,24} However, there is a virtual absence of information about sleep-suicidality relationships among adolescents. Identifying links between sleep and suicidal behavior among adolescents may therefore be an important step in detecting, treating, or even preventing future suicide.

The data analyzed for the current study came from an epidemiologic survey of mental health problems in a sample of 1,362 adolescents attending school in rural China,^{12,16} where suicide rates are 3 times higher than urban rates.²⁵ The current study was aimed at providing an exploratory examination of the association between sleep and adolescent suicidal behavior (including suicidal ideation and suicide attempts). The specific purposes of the study were (1) to examine the association between sleep duration and suicidal behavior, (2) to examine the association between nightmares and suicidal behavior, and (3) to examine the association between insomnia symptoms and suicidal behavior after controlling for potential confounding effects of demographic variables and depressive symptoms. It was hypothesized that suicidal behavior would be associated with short sleep duration and insomnia symptoms because research has demonstrated the adverse effects of sleep insufficiency and insomnia on behav-

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ioral, emotional, and cognitive functioning among adolescents.¹⁵⁻¹⁷ It was also hypothesized that frequent nightmares would be associated with an increased risk for suicidal behavior among adolescents because one recent epidemiologic study has indicated that nightmares are a significant predictor of suicide in adults.²³

METHOD

Participants and Procedures

This study represents one part of an epidemiologic project on mental health problems among Chinese adolescents, which was carried out in a rural prefecture of Shandong Province, in eastern China. Detailed methods and procedure have been described in previous reports.^{12,16} Briefly, considering the geographic distribution, population size, time and financial constraints, and representatives of the sample, a total of 1,300 students (250 to 300 for each grade) were planned to recruit from 5 or 6 public high schools in this area. According to this plan, the prefecture education committee selected 5 high schools (3 junior and 2 senior), which would represent average high schools of the area. After obtaining permission from the principals of the target schools, half of the classes for each grade in each target school were randomly selected, resulting in a total of 25 classes in the final sample in the survey. All of the students in the target classes on the day of the survey were invited to participate in this study.

After obtaining permission from the principals of the target schools, trained mental health workers administered the questionnaire to the students in their classrooms during regular school hours. All students attending school on the day of the survey gave their consent, even though they were given the option of not participating. Before completing the questionnaire, the students were told to read the instructions carefully and were informed that the survey was anonymous. Interviewers answered questions as needed to ensure that all questionnaires would be completed as accurately as possible. About 45 minutes were required to complete the questionnaire.

The study was approved by the research committee of Shandong Provincial Health Department, People's Republic of China. Consent was obtained from the target schools and students. It is a standard procedure in China to obtain consent from the school, not the parents, since schools in China act in loco parentis.

Measures

A self-administered questionnaire was developed for this study and included items in terms of individual and family demographic information, suicidal behavior, depression, sleep patterns, and sleep problems.

Suicidal Behavior

The questionnaire contained 2 questions concerning suicidal behavior, which were adapted from the Chinese version of the Youth Self-Report of Child Behavior Checklist (YSR).²⁶ The first question represents suicidal ideation: "I think about killing myself." The second question indicates suicide attempts: "I deliberately try to hurt or kill myself." The 2 questions are answered on a 3-point scale: "0" if the problem is not true of him or her,

"1" if the item is somewhat or sometimes true, and "2" if it is very true or often true. Respondents were asked to select the response that described their behaviors at the time they completed the questionnaire or within the past 6 months. The 2 questions have been used in several studies of youth suicide and appear to have acceptable psychometric properties.^{27,28} If a respondent scored 1 or 2 on an item, he or she was considered to have the behavior.

Sleep Patterns and Sleep Problems

There were 7 generalized questions in the questionnaire with regard to sleep patterns and sleep problems. (1) On the average, how many hours do you sleep at night? (2) Do you have difficulty getting to sleep at night? (3) Do you awaken during the night and have trouble getting back to sleep? (4) Do you awaken too early in the morning and have trouble getting back to sleep? (5) How often do you have frightening dreams (nightmares) at night? (6) Do you take any kinds of medications (eg, sleeping pills/tranquilizers) to help you sleep? (7) How often do you go to bed later than 12 o'clock at night? The time frame for the questions was the past month, and the response categories for questions 2 to 4 were (1) *never or rarely*, (2) *sometimes*, and (3) *often*. Questions 2, 3, and 4 were used to estimate insomnia regarding difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS), and early morning awakening (EMA). If a respondent gave an answer of *often* to at least 1 of the 3 questions, he or she was defined as a 'case' of insomnia.

Depressive Symptoms

The YSR of Child Behavior Checklist was used to measure adolescents' depression.²⁶ The YSR depression subscale consists of 16 items that are rated on a 3-point scale: "0" = not true, "1" = somewhat or sometimes true, and "2" = very true or often true. The Chinese YSR has been reported to have satisfactory psychometric properties.²⁹ The Cronbach α with the present sample was 0.81 for the depression subscale. For the purpose of the study, 2 items concerning suicidal behavior were dropped when calculating the total score of the depression subscale.

Demographic Information

Participants were asked individual and family demographic information, including age, sex, grade level, number of persons living in the family and parental age, education and occupation. Father's occupation (farmer/others) was used as an index of the family's social economic status because there are great differences in income and education between farmers and nonfarmers in China.

Statistical Analysis

The main purpose of the analysis was to examine the association between sleep and suicidal ideation and suicide attempts, respectively. Based on their responses to the 2 questions concerning suicidal behavior, all participants were divided into 3 groups: suicidal ideation, suicide attempts, and nonsuicidality. The suicidal-ideation group consisted of adolescents who reported suicidal thought but did not make a suicide attempt ($n = 167$), the suicide—attempts group comprised a total of 143 adolescents

who reported having made suicide attempts, and the nonsuicidal-ity group included a total of 1,052 adolescents who did not report either suicidal ideation or suicide attempts. The suicidal-ideation group was confined to those adolescents who reported suicidal ideation but did not make a suicide attempt to identify sleep factors that were possibly different from those of suicide attempters. A series of logistic regression analyses were performed to examine the association between sleep and suicidal ideation and suicide attempts with those adolescents without suicidality as a reference group. All sleep parameters were initially examined in univariate models. Multivariate logistic regression analyses were followed to control for the potential confounding effects of demographic variables (adolescent's age and sex, and father's occupation) and depressive symptoms because these variables have been shown to be associated with sleep problems and suicidal behavior among adolescents.^{2,6,12,16,30} Statistical tests of the regression estimates or odds ratios (OR) were based on Wald statistics. The OR and their 95% confidence intervals (CI) are presented to show the association.

The 1,362 adolescents of the study were from 25 different classes. To account for the possibility that adolescents within a particular class were more similar than were respondents from different classes or clusters, generalized estimating equation (GEE) techniques were used in the logistic regression analyses. The GEE is a form of regression analysis that adjusts for the effects of clustered sampling.³¹ PROC GENMOD with the "logit link" function in SAS was performed to estimate regression parameters and 95% CI representing the log OR for risk of suicidal ideation or suicide attempts in relation to variables of interest (SAS version 8.2, SAS Inc., Cary, NC). All statistical significance was set at $P < .05$.

Table 1—Demographic Characteristics of Study sample (n = 1,362)

Variables	%
Boys	60.0
Mean age, y (SD)	14.6 (3.4)
Grade level	
7 th	14.7
8 th	20.7
9 th	24.5
10 th	26.1
11 th	14.0
Father's education	
Illiterate or semiliterate	9.0
Primary school	23.1
Middle school	36.1
High school	25.1
Some college or above	6.6
Mother's education	
Illiterate or semiliterate	32.3
Primary school	39.6
Middle school	18.6
High school	8.2
Some college or above	1.2
Father's occupation	
Farmer	80.0
Nonfarmer	20.0
Mother's occupation	
Farmer	83.0
Nonfarmer	17.0

RESULTS

Sample Description

From a total of 1,400 students who were asked to complete a questionnaire, 1,362 questionnaires (97%) were returned usable for statistical analysis. The sample consisted of 816 junior and 546 senior high-school students, 821 boys and 541 girls, had a mean age of 14.6 years (SD = 3.4, range = 12-18). The average family size (including the subject) was 5.8 (SD = 3.0). As shown in Table 1, most of the fathers (80%) and mothers (83%) were farmers. Sixty-eight percent of the fathers and 90% of the mothers had only primary or junior high-school education.

Sleep Duration and Frequencies of Sleep Problems and Suicidal Behavior

Mean night sleep duration of the sample was 7.6 hours (SD = 0.8, median = 8.0, range = 4.0-9.5). As shown in Table 2, approximately 10% of the sample slept less than 7 hours at night, 42% slept less than 8 hours, and only 13% slept 9 hours or more. Sleep duration declined significantly with age ($r = -.191, P < .001$). Of the sample, 16.9% reported insomnia symptoms, including DIS (10.8%), DMS (6.3%), and EMA (2.1%); 22% went to sleep later than 12:00 AM at least once a week; 48.9% had experienced nightmares sometimes or often; and 2.3% had ever taken hypnotic medication during the past month. The χ^2 test indicated that the overall prevalence rate of insomnia was significantly related to

Table 2—Sleep Duration, Sleep Problems, and Suicidal Behavior in Chinese Adolescents (n = 1,362)

	n	%
Sleep duration, h/night		
< 7	135	10.1
7 - 8	430	32.2
8 - 9	595	44.5
≥ 9	177	13.2
Insomnia symptoms		
DIS	146	10.8
DMS	86	6.3
EMA	28	2.1
Any insomnia*	230	16.9
Hypnotic medication use		
Never or rarely	1331	97.7
1-3 nights/month	25	1.8
1-2 nights/week	5	0.4
≥ 3 nights/week	1	0.1
Nightmares		
Never or rarely	700	51.1
Sometimes	570	42.1
Often	92	6.8
Bedtime after 12:00 AM		
Never or rarely	1061	77.9
1-2 nights/wk	260	19.1
≥ 3 nights/wk	41	3.0
Suicidal ideation	263	19.3
Suicide attempts	143	10.5

DIS refers to difficulty initiating sleep; DMS, difficulty maintaining sleep; EMA, early morning awakening.

*The total number (n = 230) is less than the sum of DIS, DMS, and EMA because of the comorbidity of the three insomnia symptoms.

age ($\chi^2 = 21.41$, $df = 6$, $P = .002$), with higher rates in the older adolescents. Female adolescents were more likely than males to report nightmares ($\chi^2 = 20.09$, $df = 2$, $P < .001$). No other sleep variables were associated with age and sex differences.

As many as 19.3% of the sample reported having thought about killing themselves during the past 6 months, 10.5% reported having deliberately tried to hurt or kill themselves, and 7.0% had both suicidal thoughts and suicide attempts. Sex differences were found for suicidal ideation, with female adolescents being more likely to report suicidal ideation than males (22.0% vs 17.5%, $\chi^2 = 4.27$, $P = .039$). Both suicidal ideation ($\chi^2 = 32.78$, $df = 6$, $P < .001$) and suicide attempts ($\chi^2 = 16.30$, $df = 6$, $P = .012$) were significantly associated with increased age.

Association Between Sleep and Suicidal Ideation

Table 3 shows the prevalence rates of suicidal ideation in relation to sleep duration and sleep problems. The OR present the association between sleep variables and suicidal ideation. As shown in Table 3, the prevalence rates of suicidal ideation tended to increase with decreased sleep duration, increasing from 12.4% for adolescents who slept 9 hours or more to 31.1% for those who slept less than 7 hours at night. Univariate logistic regression analysis indicated that sleeping less than 7 hours at night was significantly associated with increased risk for suicidal ideation (OR = 2.43, 95% CI = 1.68-3.52). However, the significance of the association disappeared after adjusting for the effect of depressive symptoms and demographic variables (age, sex, and father's occupation) in the multivariate model. Adolescents

who reported sometimes or often having nightmares were 2 to 3 times more likely to report suicidal ideation than were those who rarely had nightmares. After adjustment for depressive symptoms and demographic variables, the association between nightmares and suicidal ideation remained significant (OR = 1.69, 95% CI = 1.20-2.38). The prevalence rate of suicidal ideation was higher in adolescents who reported insomnia than in those who did not report any insomnia symptoms (30.9% vs 17.0%). In the univariate logistic regression models, suicidal ideation was significantly related to all types of insomnia: DIS (OR = 1.98), DMS (OR = 1.76), and EMA (OR = 3.23). No associations, however, remained significant after adjusting for depressive symptoms and demographic variables. Although those adolescents who went to sleep later and had ever taken hypnotic medication were more likely to report suicidal ideation, the risk (OR) did not reach significant levels ($P > .05$) in either the univariate or multivariate logistic regression model.

Association Between Sleep and Suicide Attempts

Table 4 shows the frequencies of suicide attempts in relation to sleep duration and sleep problems. The prevalence rates of suicide attempts were negatively related to sleep duration. The rate was only 4.4% in adolescents who slept 9 hours or more at night but rose to 20.9% in those who slept less than 7 hours. Multivariate logistic regression analysis indicated that adolescents who slept less than 8 hours at night were approximately 3 times more likely to make a suicide attempt than those who slept 9 hours or more after adjustment for depressive symptoms and

Table 3—Prevalence Rates and Odds Ratios of Suicidal Ideation in Relation to Sleep Duration and Sleep Problems

	%	OR	Crude* 95%CI	Adjusted** OR	95%CI
Sleep duration, h/night					
< 7	31.1	2.43	1.68-3.52	1.27	0.56-2.90
7 - 8	25.1	1.77	0.96-3.27	1.04	0.51-2.10
8 - 9	14.5	0.98	0.54-1.81	0.73	0.38-1.39
≥ 9	12.4	1.00		1.00	
Bedtime after 12:00 AM					
Rarely	17.6	1.00		1.00	
1-2 nights/week	25.4	1.44	0.98-1.95	0.80	0.35-1.82
≥ 3 nights/week	24.4	1.18	0.53-2.60	1.28	0.91-1.80
Nightmares					
Rarely	12.0	1.00		1.00	
Sometimes	26.0	2.21	1.60-3.05	1.69	1.20-2.38
Often	33.7	3.06	1.73-5.41	1.75	0.95-3.23
Insomnia symptoms					
No	17.0	1.00		1.00	
DIS	33.6	1.98	1.27-3.08	1.36	0.84-2.20
DMS	31.4	1.76	1.06-2.92	1.37	0.79-2.35
EMA	42.9	3.23	1.18-8.81	2.15	0.80-5.81
Any insomnia	30.9	1.74	1.20-2.54	1.30	0.85-1.97
Hypnotic medication use					
Never or rarely	19.0	1.00		1.00	
≥ 1 night/month	32.3	1.52	0.48-4.75	1.11	0.29-4.26

OR refers to odds ratio; CI, confidence interval; DIS, difficulty initiating sleep; DMS, difficulty maintaining sleep, EMA, early morning awakening.

*Total subjects for logistic regression analyses ($n = 1,219$) were confined to adolescents who reported suicidal ideation without suicide attempts ($n = 167$) and those who did not report either suicidal ideation or suicide attempts ($n = 1,052$) as a reference group.

†Adjusted for age (years), sex, father's occupation (farmer or nonfarmer), and depressive symptoms.

demographic variables. The OR were almost identical for adolescents who slept 7 to 8 hours at night and those who slept less than 7 hours. Frequent nightmares were also found to be significantly associated with increased risk for suicide attempts. The prevalence rate of suicide attempts was more than 3 times higher in adolescents who reported frequent nightmares than in those who had rarely experienced nightmares. The risk for suicide attempts remained significant after adjustment for depressive symptoms and demographic variables (OR = 2.43, 95% CI = 1.76-3.35). The prevalence rate of suicide attempts was higher in adolescents with insomnia than in those without complaints of insomnia (20.8% vs 10.3%). The prevalence rate was highest among adolescents with EMA (28.6%), followed by DIS (24.2%), and DMS (16.9%). The findings of DIS (OR = 2.78, 95% CI = 1.58-4.90), EMA (OR = 3.49, 95% CI = 2.71-4.49), and any insomnia (OR = 2.30, 95% CI = 1.54-3.43) were significantly related to increased risk for suicide attempts in the univariate models but not in the multivariate model with adjustment for depressive symptoms and demographic variables. Like suicidal ideation, suicide attempts were not significantly related to hypnotic medication use and late bedtime (after 12:00 AM).

DISCUSSION

This report represents one of the first to investigate the association between sleep and suicidal behavior with a large community sample of adolescents from China. Major findings of this study include: (1) adolescents who experienced frequent nightmares were at increased risk for either suicidal ideation or suicide

attempts after adjustment for depressive symptoms and demographic variables; (2) adolescents sleeping less than 8 hours at night were approximately 3 times more likely to make a suicide attempt than those who slept 9 hours or more; and (3) insomnia was associated with increased risk for suicidal behavior, but the significance of the association disappeared after controlling for depressive symptoms and demographic variables.

Nightmares are defined as vivid dreams marked by intensified feelings of dread or terror that awaken the individual, which usually occur during rapid eye movement sleep, and are the most common form of the parasomnias.^{32,33} Occasional nightmares are quite common, with about 85% of individuals reporting at least 1 attack in the past year and 2% to 6% reporting weekly nightmare attacks.³⁴ Recent research suggests that nightmares are more common than previously thought.³⁴⁻³⁶ Numerous studies have shown that individuals who report frequent nightmares score higher than controls on a range of measures of psychopathology.³³⁻³⁵ Previous studies have also demonstrated the association between nightmares and mental disorders, such as major depression, anxiety disorders, and schizophrenia.^{34,37,38} Recent studies have paid attention to the association between nightmares and suicidal behavior. In a study of patients with major depression, Agargun and colleagues demonstrated that frequent nightmares are associated with increased suicide tendency.²⁰ In the only prospective follow-up study in the general population, Tanskanen et al reported a dose-response relationship between frequency of nightmares and completed suicide after adjustment for a number of potential confounding variables.²³ In a cross-sectional study of 1,600 adolescents aged 13 to 16 years, Choquest and Menke

Table 4—Prevalence Rates and Odds Ratios of Suicide Attempts in Relation to Sleep Duration and Sleep Problems

	%	OR	Crude*		Adjusted*†	
			95% CI	OR	95% CI	
Sleep duration, h/night						
< 7	20.9	5.74	2.50-13.18	2.87	1.02-8.10	
7 - 8	16.7	4.34	1.97-9.59	2.89	1.07-7.81	
8 - 9	8.9	2.12	0.95-4.74	1.92	0.73-5.06	
≥ 9	4.4	1.00		1.00		
Bedtime after 12:00 AM						
Rarely	10.7	1.00		1.00		
1-2 nights/week	16.3	1.63	0.89-2.97	1.07	0.38-2.98	
≥ 3 nights/week	19.4	2.02	0.96-4.25	1.17	0.57-2.38	
Nightmares						
Rarely	5.9	1.00		1.00		
Sometimes	18.5	3.58	2.54-5.06	1.46	0.80-2.67	
Often	21.6	4.36	2.46-7.73	2.43	1.76-3.35	
Insomnia symptoms						
No	10.3	1.00		1.00		
DIS	24.2	2.78	1.58-4.90	1.47	0.86-2.52	
DMS	16.9	1.78	0.96-3.30	0.79	0.36-1.76	
EMA	28.6	3.49	2.71-4.49	1.69	0.59-4.88	
Any insomnia	20.8	2.30	1.54-3.43	1.24	0.76-2.02	
Hypnotic medication use						
Never or rarely	11.8	1.00		1.00		
≥ 1 night/month	19.2	1.78	0.54-5.90	0.70	0.15-3.15	

OR refers to odds ratio; CI, confidence interval; DIS, difficulty initiating sleep; DMS, difficulty maintaining sleep, EMA, early morning awakening.

*Total subjects for logistical regression analyses (n = 1,195) were confined to adolescents who reported suicide attempts (n = 143) and those who did not report either suicidal ideation or suicide attempts (n = 1,052) as a reference group.

†Adjusted for age (years), sex, father's occupation (farmer or nonfarmer), and depressive symptoms.

reported that frequent nightmares were more prevalent in adolescents reporting suicidal ideation than in those without suicidal ideation.³⁹ Our results indicated that approximately half of the sample reported having nightmares during the past month and that those adolescents who reported frequent nightmares during the past month were at increased risk for suicidal ideation and suicide attempts after controlling for demographic variables and depressive symptoms. Given the fact that nightmares are associated with increased risk for mental disorders and suicidal behavior, it would be suggested that nightmares be included in routine clinical assessments and that preventive intervention programs of mental disorders or suicide be designed for those adolescents who report frequent nightmares.

Numerous experimental studies in healthy humans have found that sleep deprivation may result in a wide range of psychological or physiologic impairments, such as anxiety, aggressive behavior, daytime sleepiness, lowered cognitive function, and endocrine or immunologic changes.⁴⁰⁻⁴² Three recent epidemiologic studies of sleep duration and mortality consistently demonstrated that both longer sleep duration (eg, 8 hours or more per night) and shorter sleep duration (eg, 4 hours or less per night) are associated with an increased risk for adult mortality.⁴³⁻⁴⁵ The association between sleep duration and mortality is unlikely to be explained by potential confounding factors such as depression, life stress, and physical illness.^{45,46} However, the association and causal mechanisms between sleep duration and psychosocial well-being in the general population is poorly understood.⁴⁶⁻⁴⁸ It is also unclear whether these findings from adults could be generalized to adolescents because sleep need in adolescents is greatly different from that of adults and the role of sleep for adolescents may also be different than that for adults.¹¹ To our knowledge, no studies have investigated the association between sleep duration and suicidal behavior in the literature. The current study indicated that sleeping less than 8 hours at night was significantly associated with increased risk for suicide attempts in adolescents after adjustment for depressive symptoms and demographic variables. The association had no substantial change as adolescents reported sleeping less than 7 hours compared to those who slept 7 to 8 hours a night. Thus, the association cannot be explained by depressive symptoms that are very prevalent among adolescents and a significant risk factor for both short sleep duration and suicide. Sleeping less than 8 hours may be considered a cut-off for suicide risk of adolescents. The association between short sleep duration and suicidal behavior may be due to the negative effects of insufficient sleep on judgment, concentration, and impulse control and the increased risk for fatigue, hopelessness, and mental disorders.^{9-11,15-17} Although further longitudinal studies with objective measures of sleep duration are needed to replicate this finding and to explore the causal link, sleeping less than 8 hours a night should be considered a risk factor for suicidal behavior in screening and prevention programs of adolescent suicide.

Several studies have documented the link between insomnia and suicidality in patients with major depression and panic disorder.^{18,19,21,49} There is evidence that insomnia and poor sleep quality are more common in suicidal patients.²² In a prospective community-based study of aged population, Turvey and colleagues reported that poor sleep quality, including insomnia symptoms and daytime sleepiness, was a significant predictor of late-life suicide.²⁴ However, these previous studies did not control for the

potential effects of the severity of depression when examining the association between insomnia and suicidality, despite the fact that depression has long been recognized as a risk factor for both sleep disturbances and suicidal behavior.^{6,22} Consistent with previous studies, our results indicated that there were strong and significant associations between insomnia symptoms and suicidal ideation and suicide attempts in the univariate models. Unexpectedly, the significant association disappeared after adjustment for the effects of depressive symptoms. This suggests that the insomnia-suicidality associations are perhaps mediated by depressive symptoms. Prospective research is warranted to examine the complicated mechanisms among insomnia, depression, and suicidal behavior.

Several caveats should be considered in the interpretation of these findings. First, this study is cross-sectional in nature, so it is not possible to determine the direction of causality between suicidal behavior and short sleep duration and nightmares. For example, nightmares may increase the risk for suicidal behavior and suicidal behavior because a stressor may also induce nightmares. It is also possible that both nightmares and suicidal behavior are expressions of a third, unidentified, psychopathologic process. Second, all data were assessed by self-report, which may have led to biased reporting of suicidal behavior and sleep. However, given that many suicide attempts may never come to medical attention or result in hospitalization, self-report measures remain a valuable source of information.⁵⁰ Objective measures of sleep duration and sleep problems, such as electroencephalography and actigraphy, are desirable, but self-reports and interviews remain the measures of choice in large-scale epidemiologic studies,^{13,17} and there is evidence that subjective measures of sleep from children and adolescents are correlated with objective measures.⁵¹ Third, no data on sleep latency, sleep-onset time, morning rise time, desired sleep time, and daytime sleepiness were collected in this study. These sleep parameters may provide additional information about sleep duration and its association with suicidal behavior. Fourth, many adolescents may sleep less than 8 hours during weekdays, but they may sleep longer on weekends. Unfortunately, this study had no information of sleep duration on weekends. The association between short sleep duration and suicidal behavior may be underestimated without accounting for the effects of sleep duration on weekends. Fifth, although the confounding effects of demographic variables and depressive symptoms were controlled for when examining the association between sleep and suicidal behavior, other potential confounding variables, such as chronic medical problems and substance abuse, were not taken into account due to lack of information. Finally, although this sample was large, the participants were drawn from 5 high schools in one prefecture of China. Further research is needed to examine whether these findings can be generalized to other groups of adolescents.

Despite these limitations, the current study provides an important step towards increasing our understanding of the association between sleep and suicidal behavior among adolescents. The finding that adolescents who present with complaints of frequent nightmares and sleeping less than 8 hours a night were at higher risk for suicidal behavior highlights the crucial role of sleep in adolescent suicidal behavior. It would be suggested that those adolescents who complain about nightmares, short sleep duration, or sleep disturbances need further psychiatric and sleep assessment for early detection, treatment, and prevention of sui-

cidal behavior among adolescents. On the other hand, prospective longitudinal studies with a comprehensive assessment of sleep are warranted to systematically investigate the possible causal mechanisms among sleep, depression, and suicidal behavior with controlling for all potential confounding variables.

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