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Prevalence and Correlates of Sleep Disturbance and Depression Among Chinese Adolescents

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Keywords: Prevalence, Sleep disturbance, depression, risk factors, Chinese adolescents

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Strengths and limitations of this study:

There has been a lack of epidemiological research about both sleep disturbance and depressive mood among Chinese adolescents

The results of the study show the prevalence of students' reported poor sleep quality is more prevalent than the prevalence of depression reported in China.

There is an association between sleep disturbance and depression.

The study demonstrates that an adolescent's family, school, and psychosocial factors influence their sleep qualities and depressive mood.

The sample size limits the conclusions that can be drawn from the multivariate analysis; however, this was a secondary objective of the study.

ABSTRACT

Study objective: To investigate the prevalence and the risk factors of sleep disturbance and depression among Chinese adolescents, and to examine the association of the two problems.

Design: Cross sectional survey research

Participants: A total of 3,485 school students in junior high school and senior high school from the sampled schools in Guangdong, and a stratified cluster random sampling strategy was used to select the schools.

Main outcome measures: A self-administered questionnaire was used. *The Pittsburgh sleep quality index (PSQI)* was used to assess sleep quality, and *the Center for Epidemiology Scale for Depression* (*CES-D*) was used to identify whether individuals had a depressive mood.

Results: In total, the mean PSQI global score was 8.69 (± 2.40) points, and 43.6% of the total sample was thought to have poor sleep quality (collectively known as sleep disturbance). The mean CES-D score of students was 15.23 (± 9.36) points, and 6.7% of the students had depression according the CES-D. Additionally, the results revealed that the girls, the 14-18 year age group, and the older than 19 years age group were all more likely to suffer from sleep disturbance, and the students who had depression were 3.17 times more likely to suffer from sleep disturbance than those who did not have the depression. Factors that were determined to be both correlated with sleep disturbance and depression having a poor relationship with teachers, feeling lonely, suicide-ideation, running away from home.

Conclusion: Sleep disturbance was determined to be more prevalent among Chinese adolescents than having depression. School factors, family factors, and psychosocial adjustment were both correlated with sleep disturbance and depression, and there was an association between the students with sleep disturbances and depression.

INTRODUCTION

Sleep plays very important roles in the development of adolescents; it not only impacts physical growth, behavior, and emotional development but it also affects learning and attention.[1] Adolescence is a period of immense behavioral, psychological and social changes and challenges. Sleep is essential, accounting for approximately 40% of a child's typical day.[2] Previous studies have estimated that a large amount (estimated prevalence of 25%-40%) of adolescents have sleep problems.[3] In Western countries, estimates of the prevalence of sleep problems for adolescents range from 11% to 30%.[4] It is well known that poor sleep quality (collectively known as sleep disturbance) in the teenage years has adverse effects on developmental processes, psychosocial function, and general ability. For example, insomnia is a disease characterized by poor sleep quality; epidemiology studies have indicated that insomnia is linked to behavioral and emotional problems, such as depression and poor social competence.[5] Prospective studies have found that adolescents with insomnia are more likely to develop and maintain depression than are adolescents without insomnia.[6] In addition, the sleep problems of adolescents are not only influenced by biological and psychological factors but also by cultural and social factors.[7] People suffering from sleep disturbances have lower self-rated health, more physical and mental health complaints, such as depression, and more absences from school or work due to sickness.[8] Previous studies have differing results about the sleep disturbances between the two genders,[9] and a study in Taiwan reported that women scored 1.25 points higher than men on the insomnia inventory.[10] In a study by Liu, the prevalence of sleep disturbance varies with age and grade level among adolescents, and adolescents from incomplete families were more likely to have poorer sleep quality when compared with their peers.[11] In addition, a school environment is very important for the sleep quality and mental status of adolescents.[12] It has been reported that the prevalence of sleep problems in children and adolescents with depression ranges from 66% to 90%.[3] Recently, many researchers reported that sleep disturbance can be a sign of depression, and depression can likewise be a sign of sleep disturbance.[13] It has also been reported that sleep disturbance and depressed are closely related, and insufficient sleep may result in depression.[14]

Although we concluded that sleep quality and mental health are universal phenomenon, it is clear that sleep behavior and mental problems in adolescents vary according to ethnic and socio-cultural backgrounds.[15] Thus, different cultural backgrounds and genetic characteristics may result in different sleep/mental problems among adolescents. Previous studies about sleep quality and

depression have rarely focused on adolescents in mainland China; it is unknown whether sleep disturbances and depression and their correlates occur in Chinese adolescents as they do in Western adolescents. Therefore, we conducted this cross-sectional study in China to investigate the sleep quality and depression of adolescents, to estimate the prevalence of sleep disturbance and depression, and to examine the relationship between potentially influential factors and their involvement in sleep disturbance and depression

METHODS

Study design and participants

A cross-sectional study was conducted and based on a province-wide sample to investigate the sleep quality and depression of adolescents, to estimate the prevalence of sleep disturbance and depression, and to examine the relationship between potentially influential factors and their involvement in sleep quality and depression. The participants were middle school students from Guangdong, China. Guangdong is known as an immigrant province, with more than half of the population migrating from other provinces; therefore, the sample from Guangdong has a certain degree of representativeness. The schools were divided into three categories: junior high schools, senior high schools, and vocational schools. A stratified cluster random sampling method was used to randomly select participants among the three types of schools. Six junior high schools, four senior high schools, and two vocational schools were selected. Next, two classes were randomly selected from each grade in these schools. All available students within the grade were surveyed; those not surveyed were absent or refused to participate and consisted of less than 1% of the student population. All the participants were fully informed of the purpose of the survey and were invited to participate voluntarily. Written consent letters were obtained from the school, each participating student and one of the student's parents. A rigorously anonymous method for collection of the self-report questionnaires was guaranteed. The questionnaires were administered by research assistants in the classrooms without the presence of the teachers. It is important to stress that the questions of this questionnaire were based on an instrument proposed by the WHO and adapted to the realities of China, and the findings of a number of investigations indicate that such data can be extremely useful.[16-18]

Measures

Independent variable

Socio-demographic variables: Age, grade, gender and so on.

Family factors: Living arrangement, family economic status, family relationship, and parental caring. Living arrangements were assessed by asking who lived in the student's primary home. Family economic status was measured by asking the student's perception of their family's current economic status (rated from below average to above average). Family relationships were assessed by asking the students, with the responses coded on a 3-point scale ranging from below average to above average. Parental caring was assessed by asking, "Are you satisfied with the love you receive from your father, mother, or both of them, based on a 4-point scale from dissatisfaction to satisfaction?"

School factors: Classmate relations and teacher-classmate relations were also assessed based on the student's self-rating about their relationships with classmates and teachers, ranging from poor to good. Academic achievements were captured by a single item asking about a personal appraisal of students' performances relative to that of their classmates (responses were coded as "above average", "average", and "below average").

Psychosocial adjustment: Feeling lonely was assessed by asking, "During the past 12 months, how often did you feel lonely per week?" Response options ranged from 1 (never) to 4 (over 4 days). Suicide-ideation status was based on whether a participant had endorsed thoughts of suicide over the past year. Suicide-attempt status was based on attempts made over the past year, with 1 or more attempts indicating endorsement. A student's attempt to hurt themselves was assessed by asking, "During the past 12 months, did you ever hurt yourself on purpose?" Responses were categorized into 4 groups: never, considered, planned, and attempted. Running away from home was assessed by asking, "During the past 12 months, did you run away from home without your parents' permission for more than 24 hours?" Response options were 1) never, 2) considered, 3) attempted, or 4) have run away from home one time or more.

Dependent variables

We used *the Pittsburgh sleep quality index (PSQI)* to assess sleep quality and disturbances over a 1-month time interval; the sum of the scores for these seven components yields one global score with a range of 0-21 points in which higher scores indicate worse sleep quality.[17] The Chinese version of this test, which has been shown to be valid and reliable, is also commonly used. In China, a PSQI

global score of above 7 points indicates poor sleep quality collectively known as *sleep disturbance*; a higher score indicates a greater reduction in sleep quality.[19]

Depression is one type of common mental disorders;[20] in our study, *the Center for Epidemiology Scale for Depression* (*CES-D*) was used to identify whether individuals had a depressive mood. The respondents were asked to rate the frequency, over the past week, of 20 symptoms of depression by choosing one of four response options ranging from "rarely or none of the time" to "most or all of the time".[21] The scores range from 0 to 60, with a score greater than 28 indicating "Depression". For the CES-D survey, those who failed to answer at least 17 of the 20 items were discarded.

Statistical analysis

All data were entered by two investigators independently using EpiData 3.1, and the statistical analyses were conducted using SPSS 21.0 and SAS 9.2. Descriptive analyses were used to describe demographic characteristics and the prevalence of sleep disturbances and depression among adolescents. Categorical and continuous data were reported in the form of proportions and means (SD). Chi-squared tests were used to test the difference between the categorical variables referred to above. Multivariate logistic regression models included the significant variables that had been tested by univariate analyses or that have been widely reported in the literature; these were used to screen for the risk factors for sleep disturbance/ depression according to the odds ratios (ORs) and 95% confidence intervals (95% CIs). An OR>1 with a $P<0.05$ was reported as a risk factor. Considering that our study using a multi-stage sampling, students were grouped into classes; therefore, differences might not segregate independently. Thus, a multi-level analysis was performed to select possible factors that might influence students' sleep disturbances and depression. The CLMMIX procedure in SAS was used to fit the two-level logistic regression mixed models in which classes were treated as clusters. All statistical tests were two-sided with a P value less than 0.05 considered significant.

RESULTS

Demographic information

A total of 3,485 participants were involved in this analysis. *Table 1* provides the basic demographic information for the sample involved in this study. The proportion of male students was 53.9%, and the male-to-female ratio was approximately 1.2:1. The students ranged in age from 9 to 21 years old, and

the mean age of the students was 15.7 (±1.90) years; the most common age group was 14-18 years old. The junior group of students represented 49.8% of the sample, while the senior group of students comprised 50.2% of the sample. Regarding the family factors, a total of 88.9% of students lived with both biological parents, whereas 4.6% lived in single-parent families. A total of 15.4% of students thought of their family relationships as average, and 77.1% of students were satisfied with both of their parents' love. A subset of students (29.9%) reported that their current economic status was above average, whereas 9.4% reported that their economic status was below average. Regarding school factors, 29.1% of the students appraised themselves as average in their academic achievement, while 28.7% of students rated themselves as below average. Additionally, 42.9% of the students thought their academic pressure was above average. A total of 7.5% of participants reported poor relationships with their teachers, and 4.1% had poor relations with their classmates. Regarding the psychosocial factors, 13.8% of students felt lonely more than 4 days per week. A total of 3.5% of students often had suicide-ideation, and 1.9% of students had attempted suicide often. In addition, 2.8% of participants often hurt themselves on purpose, and 3.7% of participants had run away from home more than once.

Univariate Analysis for Sleep disturbance and Depression

According to the PSQI, the mean PSQI global score was 8.69 (± 2.40) points, and 43.6% of the total sample was thought to have sleep disturbances (had a global score higher than 8 points). In addition, 6.7% of the students had depression, according the CES-D. The mean CES-D score of students was 15.23 (± 9.36) points. As shown in *Table 2*, without adjustment for other variables, sleep disturbances and depression groups were correlated with gender, family economic status, family relationships, parental caring, academic pressure, relationships with teachers or classmates, feeling lonely, suicide-ideation, suicide-attempt, hurting themselves on purpose, and running away from home. Only age, grade, and depression were significantly correlated with having a sleep disturbance, while only living arrangements and sleep disturbances were significantly correlated with depression.

Multilevel Logistic Regression Analysis: Sleep disturbance

The final logistic regression model for sleep disturbance is presented in *Table 3*. Eight of the original variables remained in the final model: gender, age, habit of sleep duration after lunch, family relationships, relationships with teachers, feeling lonely, suicide-ideation, running away from home,

and depression. The results revealed that the girls, the 14-18 year age group, and the older than 19 years age group were all more likely to suffer from sleep disturbance. Taking frequent or occasional naps after lunch was a risk factor for sleep disturbance compared with the group that rarely or never had the habit of sleep duration after lunch. Students with average family relationships (OR=1.34, 95% CI=1.08-1.67) and below average family relationships (OR=1.27, 95% CI=0.90-1.81) had a higher probability of sleep disturbance. Likewise, students with average or poor relationships with teachers were more troubled with sleep disturbances. In addition, students feeling lonely 1-4 days a week (OR=1.69, 95% CI=1.38-2.07) or over 4 days a week (OR=3.30, 95% CI=2.42-4.50) had a higher probability of sleep disturbances. Having occasional or frequent suicide-ideations were risk factors for sleep disturbance, and students who considered running away from home (OR=1.43, 95% CI=1.19-1.73) and attempted running away from home (OR=2.38, 95% CI=1.23-4.62) were also risk factors for sleep disturbance compared to students who had never considered running away from home. Finally, students who had depression were 3.17 times more likely to suffer from sleep disturbance than those who did not have the depression.

Multilevel Logistic Regression Analysis: Depression

The final model for depression in *Table 4* showed many correlations. Having average relationships with teachers (OR=3.10, 95% CI=1.83-5.25) or poor relationships with teachers (OR=1.55, 95% CI=1.11-2.16) were risk factors for having depression. Students who felt lonely 1-4 days a week (OR=1.77, 95% CI=1.01-3.08) and over 4 days a week (OR=3.83, 95% CI=2.10-7.00) also had a higher probability of having depression. Likewise, students occasionally or sometimes having suicide-ideation had a higher probability of having depression. Considering running away from home (OR=2.91, 95% CI=1.99-4.25), planning to run away from home (OR=3.71, 95% CI=1.98-6.93), and attempting to run away from home (OR=4.63, 95% CI=2.48-8.63) were also risk factors for depression compared to students who never considered running away from home. Students with sleep disturbances were also more likely to have depression (OR=3.35, 95% CI=2.31-4.87).

DISCUSSION

Similar studies have already reported that the prevalence of sleep problems in children and

adolescents ranges from 66% to 90%.[22] In this study, the prevalence of adolescents with sleep disturbances was 43.6%. A report from China in 2000 revealed that 16.9% of the sample was troubled with insomnia symptoms,[23] while a report from China in 1987 revealed that the prevalence was 14.9%.[24] This study agrees with the results from a Western report in which 43.0% of children experienced a sleep problem.[25] Therefore, the considerable variation in the prevalence of sleep disturbances may due to the different time periods, different target populations, and different methodological definitions of sleep disturbances, and now poor sleep quality is a prevalent public health problem among Chinese adolescents.

Our results indicated that the proportion of male and female adolescents with a sleep disturbance was 21.8% respectively; and the girls were all more likely to suffer from sleep disturbance, and these results agreed with the previous study from Anhui province in China.[14] Additionally, the previous study from Hong Kong had reported that the prevalence of sleep disturbances among females was higher, [9] and most of the studies from other countries also found that girls were more likely to report sleep disturbances than boys.[26-28] In this study, the 14-18 year olds and the senior grade group were the groups most commonly associated with sleep disturbance, which was in line with a previous study from China that reported that older age or higher grade level was associated with more sleep problems.[23] Additionally, multivariate logistic regression analyses performed to control for confounding factors and to determine the main correlates of sleep disturbance finally presented that family relationships, relationships with teachers, feeling lonely, suicide-ideation, running away from home, and depression were correlated with sleep disturbance; in particular, students with the adverse events of the above factors had a higher probability of suffering from sleep disturbance. These findings are in accordance with the results of many previous studies; for example, a study from Shandong province of China in 2000 also reflected that poor marital relations of parents, poor family economic status, poor child-parent and peer relations, poor school achievement and social competence were the risk factors for sleep problems.[23] Therefore, we find that adolescents' sleep problems are correlated with multiple family, school and psychosocial factors; thus, we should focus on these factors to reduce the prevalence of adolescents with sleep disturbances.

In this study, we found that the prevalence of students having depression was 6.7%; similarly, an Australia study reported that the prevalence was 8.0%.[19] As previously reported, adolescent depression is a prevalent and disabling condition resulting in emotional suffering and sleep dysfunction;

therefore, it is important for us to focus on this problem.[3] Our study reported that the prevalence of depression among females was not much higher than among males, but a previous study reported prevalence rates of emotional problems to be higher in boys than in girls.[29] These differences may due to emotional problems, including depression and others. The results of our multivariate logistic regression were that average or below average relationships with classmates, feeling lonely more than 1 day per week, having suicide-ideations, considering or attempting to run away from home, and having sleep disturbances were risk factors for having depression. A previous study reported that the point prevalence of major depression was 8.4%, and the effects of age, socioeconomic status, and psychosocial status yielded significant odds ratios for Chinese group depression.[30] Thus, we observed that depression can lead to sleep disturbances, and vice versa.

There are several limitations to the current study. First, although the sample size was large, the sample was drawn from a rural prefecture of mainland China; therefore, further studies are required to generalize the results to all Chinese children. Secondly, the questionnaires did not include items that could address students with sleep-related breathing problems, and some psychological diseases, such as attention-deficit hyperactivity disorder (ADHD). Thirdly, it should be noted that the present results that were based on a structured self-rating questionnaire were cross-sectional and retrospective; although self-reporting is a common and accepted method, we could not completely rule out the possibility of recall bias. To minimize subjectivity, students were provided with a detailed definition of the information about *the PSQI* and *the CES-D*.

Our study presents the prevalence and relevant risk factors for sleep disturbances and depression among youth in China; further research is warranted. Although there were some limitations to this study, the results were similar to the previous study about adolescents' sleep qualities and depression. In summary, an adolescent's family, school, and psychosocial factors influence their sleep quality and depressive mood. The prevalence of sleep disturbance observed in this study suggests the importance of research on preventive interventions targeting sleep quality among Chinese students, and effective preventive measures require full consideration of the social and environmental factors, and we should focus on the high-risk population whose family factors, school factors, and psychosocial adjustments are negative.

Ethical statement

This study received approval from the Sun Yat-Sen University School of Public Health Institutional Review Board. The participants were fully informed of the purpose of the study and were invited to participate voluntarily. Written letters of consent were obtained from the schools of the participating students and either of the student's parents.

Contributors

GL and LCY searched the literature, conceived the study, designed the study analysed the data, interpreted the results, and draft the report. DJX and HY organized the study, collected the data and analysed the data. DXQ, HJW, HGL, GX collected the data, interpreted the results, and obtained funding.

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Table 1. Demographic characteristics of the Total Sample.

Variables	Numbers (%)
Total	3485 (100.0)
Gender	
Male	1877 (53.9)
Female	1608 (46.1)
Age (years)	
9-13	507 (14.5)
14-18	2734 (78.5)
⩾19	244 (7.0)
Grade	
Junior	1734 (49.8)
Senior	1751 (50.2)
Living arrangement	
Two biological parents	3099 (88.9)
Only father or mother	160 (4.6)
Others	226 (6.5)
Family economic status	
Good	1041 (29.9)
Average	2116 (60.7)
Bad	328 (9.4)
Family relationship	
Above average	2740 (78.6)
Average	536 (15.4)
Below average	209 (6.0)
Parental caring	
Satisfied with father or mother	598 (17.2)
Satisfied with both of them	2686 (77.1)
Dissatisfied with both of them	201 (5.7)
Academic achievement	
Above average	1473 (42.3)
Average	1013 (29.1)
Below average	999 (28.7)
Academic pressure	
Above average	1497 (42.9)
Average	1487 (42.7)
Below average	501 (14.4)
Relationship with teachers	
Good	1681 (48.2)
Average	1542 (44.2)
Poor	262 (7.5)

Table 1. Demographic characteristics of the Total Sample (continued).

Variables	Numbers (%)
Relationship with classmates	
Good	2413 (69.2)
Average	931 (26.7)
Poor	141 (4.1)
Feel lonely	
Less than 1 Day/Week	1825 (52.4)
1 to 4 Days/Week	1178 (33.8)
More than 4 Days/Week	482 (13.8)
Suicide-ideation	
Never	2822 (81.0)
Occasionally (1-2 times/year)	439 (12.6)
Sometimes (3-6 times/year)	105 (3.0)
Often (over 6 times/year)	119 (3.5)
Suicide-attempt	
Never	3292 (94.5)
Occasionally (1-2 times/year)	88 (2.5)
Sometimes (3-6 times/year)	39 (1.2)
Often (over 6 times/year)	66 (1.9)
Hurt themselves on purpose	
Never	2996 (86.0)
Occasionally (1-2 times/year)	291 (8.4)
Sometimes (3-6 times/year)	99 (2.8)
Often (over 6 times/year)	99 (2.8)
Running away from home	
Never	2447 (70.2)
Considered	873 (25.1)
Planned	57 (1.6)
Attempted	108 (3.1)

Table 2. Univariate chi-square analysis for sleep disturbance and depression, n (%).

Variables	Total	Sleep disturbance	Depression
Total	3485 (100.0)	1519 (43.6)	232 (6.7)
Gender #			
Male	1877 (53.9)	759 (21.8)	110 (3.2)
Female	1608 (46.1)	760 (21.8)	122 (3.5)
Age (years) *			
9-13	507 (14.5)	146 (4.2)	28 (0.8)
14-18	2734 (78.7)	1247 (35.8)	180 (5.2)
≥19	235 (6.7)	126 (3.6)	24 (0.7)
Grade *			
Junior	1734 (49.8)	664 (19.1)	114 (3.3)
Senior	1751 (50.2)	855 (24.5)	118 (3.4)
Living arrangement **			
Two biological parents	3099 (88.9)	1341 (38.5)	191 (5.5)
Only father or mother	60 (4.6)	82 (2.4)	16 (0.5)
Others	26 (6.5)	96 (2.7)	25 (0.7)
Family economic status #			
Good	1041 (29.9)	406 (11.8)	54 (1.5)
Average	2116 (60.7)	932 (26.8)	133 (3.8)
Bad	328 (9.4)	181 (5.0)	45 (1.3)
Family relationship #			
Above average	2740 (78.6)	1106 (31.8)	136 (3.9)
Average	536 (15.4)	282 (8.1)	49 (1.4)
Below average	209 (6.0)	131 (3.7)	47 (1.3)
Parental caring #			
Satisfied with father or mother	598 (17.2)	295 (8.5)	63 (1.8)
Satisfied with both of them	2686 (77.1)	1103 (31.6)	137 (4.0)
Dissatisfied with both of them	201 (5.7)	121 (3.5)	32 (0.9)
Academic achievement **			
Above average	1473 (42.3)	612 (17.6)	95 (2.7)
Average	1013 (29.1)	430 (12.3)	60 (1.7)
Below average	999 (28.7)	477 (13.7)	77 (2.3)
Academic pressure #			
Above average	1497 (42.9)	811 (23.3)	153 (4.4)
Average	1487 (42.7)	545 (15.7)	56 (1.6)
Below average	501 (14.4)	163 (4.7)	23 (0.7)
Relationship with teachers #			
Good	1681 (48.2)	616 (17.7)	79 (2.3)
Average	1542 (44.2)	756 (21.7)	109 (3.1)
Poor	262 (7.5)	147 (4.2)	44 (1.3)

Table 2. Univariate Chi-square analysis for sleep disturbance and depression mood, n (%) (continued).

Relationship with classmates #			
Good	2413 (69.2)	974 (28.0)	103 (3.0)
Average	931 (26.7)	468 (13.4)	90 (2.6)
Poor	141 (4.1)	77 (2.2)	39 (1.1)
Feel lonely #			
Less than 1 Day/Week	1825 (52.4)	614 (17.6)	35 (1.0)
1 to 4 Days/Week	1178 (33.8)	620 (17.8)	107 (3.1)
More than 4 Days/Week	482 (13.8)	285 (8.2)	90 (2.6)
Suicide-ideation #			
Never	2822 (81.0)	1112 (31.9)	94 (2.7)
Occasionally (1-2 times/year)	439 (12.6)	271 (7.8)	83 (2.4)
Sometimes (3-6 times/year)	105 (3.0)	66 (1.9)	21 (0.6)
Often (over 6 times/year)	119 (3.5)	70 (2.0)	34 (1.0)
Suicide-attempt #			
Never	3292 (94.5)	1407 (40.4)	190 (5.5)
Occasionally (1-2 times/year)	88 (2.5)	58 (1.7)	23 (0.7)
Sometimes (3-6 times/year)	39 (1.2)	30 (0.8)	3 (0.1)
Often (over 6 times/year)	66 (1.9)	24 (0.7)	16 (0.5)
Hurt themselves on purpose #			
Never	2996 (86.0)	1251 (35.9)	159 (4.6)
Occasionally (1-2 times/year)	291 (8.4)	165 (4.7)	44 (1.3)
Sometimes (3-6 times/year)	99 (2.8)	54 (1.5)	14 (0.4)
Often (over 6 times/year)	99 (2.8)	49 (1.4)	15 (0.4)
Running away from home #			
Never	2447 (70.2)	924 (26.5)	87 (2.5)
Considered	873 (25.1)	495 (14.2)	117 (3.4)
Planned	57 (1.6)	42 (1.2)	10 (0.3)
Attempted	108 (3.1)	58 (1.7)	18 (0.5)
Depression mood *			
Yes	232 (6.7)	183 (5.3)	-
No	3253 (93.3)	1336 (38.3)	-
Sleep disturbance **			
Yes	1519 (43.6)	-	183 (5.3)
No	1966 (56.4)	-	49 (1.4)

#: According to the Chi-square test without adjust other variables, $P<0.05$ both in Sleep disturbance and Depression group.

*: $P<0.05$, only in Sleep disturbance group.

**: P<0.05, only in Depression mood group.

Table 3. Adjusted OR (95% CI) for Sleep disturbance by multi-level logistic regression.

Covariates	Adjusted OR (95% CI)	*P-value*
Age (years)		
9-13	1.00 (reference)	-
14-18	2.09 (1.66-2.63)	<.001
⩾19	2.80 (1.92-4.07)	<.001
Gender		
Male	1.00 (reference)	-
Female	1.29 (1.11-1.50)	0.001
Habit of sleep duration after lunch		
Never	1.00 (reference)	-
Occasionally (1-4 times/week)	1.64 (1.22-2.19)	0.001
Often (over 4 times/week)	1.73 (1.29-2.34)	<.001
Family relationship		
Above average	1.00 (reference)	-
Average	1.31 (1.06-1.62)	0.012
Below average	1.27 (0.90-1.81)	0.178
Relationship with teachers		
Good	1.00 (reference)	-
Average	1.84 (1.32-2.56)	<.001
Poor	1.41 (1.21-1.65)	<.001
Feel lonely		
Less than 1 Day/Week	1.00 (reference)	-
1 to 4 Days/Week	1.69 (1.38-2.07)	<.001
More than 4 Days/Week	3.30 (2.42-4.50)	<.001
Suicide-ideation		
Never	1.00 (reference)	-
Occasionally (1-2 times/year)	1.39 (1.09-1.77)	0.008
Sometimes (3-6 times/year)	1.77 (1.01-3.12)	0.048
Often (over 6 times/year)	0.95 (0.55-1.63)	0.852
Running away from home		
Never	1.00 (reference)	-
Considered	1.43 (1.19-1.73)	<.001
Planned	1.63 (0.86-3.09)	0.135
Attempted	2.38 (1.23-4.62)	0.010
Depression mood		
No	1.00 (reference)	-
Yes	3.17 (2.18-4.62)	<.001

NOTE: Adjusted OR means odds ration adjusted by student's age in the total sample because age a confounding for screening risk factors for adolescents sleep disturbances; 95% CI=95% confident interval.

Table 4. Adjusted OR (95% CI) for Depression mood by multi-level logistic regression.

Covariates	Adjusted OR (95% CI)	*P-value*
Age (years)		
9-13	1.00 (reference)	-
14-18	1.16 (0.76-1.79)	0.486
⩾19	1.86 (0.99-3.49)	0.054
Relationship with classmates		
Good	1.00 (reference)	-
Average	3.10 (1.83-5.25)	<.001
Poor	1.55 (1.11-2.16)	0.010
Feel lonely		
Less than 1 Day/Week	1.00 (reference)	-
1 to 4 Days/Week	1.77 (1.01-3.08)	0.045
More than 4 Days/Week	3.83 (2.10-7.00)	<.001
Suicide-ideation		
Never	1.00 (reference)	-
Occasionally (1-2 times/year)	2.91 (1.99-4.25)	<.001
Sometimes (3-6 times/year)	3.71 (1.98-6.93)	<.001
Often (over 6 times/year)	4.62 (2.48-8.63)	<.001
Running away from home		
Never	1.00 (reference)	-
Considered	2.91 (1.99-4.25)	<.001
Planned	3.71 (1.98-6.93)	<.001
Attempted	4.63 (2.48-8.63)	<.001
Sleep disturbance		
No	1.00 (reference)	-
Yes	3.35 (2.31-4.87)	<.001

NOTE: Adjusted OR means a student's age was adjusted for in the total sample because age was a confounding for screening risk factors for depression mood among adolescents; 95% CI=95% confident interval.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Prevalence and Correlates of Sleep Disturbance and Depressive symptoms Among Chinese Adolescents: a cross-sectional survey study

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Prevalence and Correlates of Sleep Disturbance and Depressive symptoms Among Chinese Adolescents: a cross-sectional survey study

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Keywords: Prevalence, Sleep disturbance, depressive symptoms, risk factors, Chinese adolescents

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ABSTRACT

Study objective: To investigate the prevalence and the correlates of sleep disturbance and depressive symptoms among Chinese adolescents and to examine the association between the two problems.

Design: Cross-sectional survey.

Participants: A total of 3,186 school students in grades 7-12 were sampled from the schools in Guangdong. A stratified-cluster random-sampling strategy was used to select the schools.

Main outcome measures: A self-administered questionnaire was used. The *Pittsburgh Sleep Quality index (PSQI)* was used to assess the occurrence of sleep disturbance, and the *Center for Epidemiology Scale for Depression* (*CES-D*) was used to identify whether individuals had depressive symptoms.

Results: The mean PSQI global score was 8.7 (± 2.4) points, and 39.6% of the total sample had sleep disturbance. The mean CES-D score of students was 15.2 (± 9.4) points, and 6.4% of the students had depressive symptoms. Additionally, girls and older adolescents were more likely to suffer from sleep disturbance, and the students who had depressive symptoms were 2.47 (95% CI=1.61-3.79) times more likely to suffer from sleep disturbance. Factors that were correlated with both sleep disturbance and depressive symptoms were having a poor relationship with teachers, feeling lonely, suicide ideation, and having run away from home.

Conclusion: Sleep disturbance was determined to be more prevalent among Chinese adolescents with depressive symptoms. Sleep disturbance and depressive symptoms were associated with each other, while school factors, family factors, and psychosocial adjustment were comprehensively correlated with both.

Strengths and limitations of this study:

There has been a lack of epidemiological research about both sleep disturbance and depressive symptoms among Chinese adolescents.

The results of the study show that sleep disturbance is more prevalent among Chinese adolescents

who have depressive symptoms.

There is a link between sleep disturbance and depressive symptoms

.

The study demonstrates that an adolescent's demographic, family, school, and psychosocial factors influence sleep disturbance and depressive symptoms.

The sample size limits the conclusions that can be drawn from the multivariate analysis; however, quantifying correlates of sleep disturbance and depressive symptoms was a secondary objective of the study.

INTRODUCTION

Adolescence is often described as occurring between 13 and 18 years of age, which is roughly the period of high school for much of the world. [1] Sleep plays a very important role in the development of adolescents; it not only impacts physical growth and behavior, but it also affects mental health status. [2] Studies in Western countries have estimated that a large proportion (25%-40%) of adolescents have sleep disturbance, [3-5] and a report from China in 2000 revealed that 16.9% of the sample was troubled with sleep disturbance. [6] In total, adolescents' sleep disturbance has been a major international public health problem, and China is no exception, although the prevalence of Chinese adolescents with sleep disturbance has been a little lower than Western countries.

Depressive symptoms are a type of mental disorder, and the link between sleep disturbance and depressive symptoms in adulthood is well established. [7] For instance, women suffering from sleep disturbances have lower self-rated health and more physical and mental health complaints, such as depressive symptoms. [8] In contrast, a limited number of studies (especially epidemiological studies) have addressed the link between sleep disturbance and depressive symptoms among adolescents, and the link is not uniform. One study in the US has found that adolescents with sleep disturbance are more likely to develop and maintain depressive symptoms than are adolescents without sleep disturbance, [9] but one study found that there did not appear to be a strong association between sleep disturbance and depressive symptoms in adolescents. [10] Additionally, many researchers in US have reported that sleep disturbance can be a sign of depressive symptoms, and depressive symptoms can likewise be a sign of sleep disturbance. [11] Xu's research in China also demonstrated that sleep disturbance and depressive symptoms are closely related, and insufficient sleep may result in depressive symptoms. [12] The recent increase in interest in the link between sleep disturbance and depressive symptoms in adolescents is warranted.

Sleep disturbance and depressive symptoms among adolescents are not only influenced by each other but also by demographics, family, school and social factors. [13] Several variables have been associated with sleep disturbance and depressive

symptoms. Previous studies have differing results about the characteristics of sleep disturbances between the two genders. Boys in Hong Kong were more likely to be troubled by sleep disturbance than girls, [14] but most of the studies from other countries found that girls were more likely to report sleep disturbances than boys. [15 16] Such inconsistencies may be attributed to differences in the sample and place, which suggested further research with larger samples is warranted. Additionally, Liu's study in China indicated that the prevalence of sleep disturbance varies with age and grade level among adolescents, and adolescents from incomplete families were more likely to have sleep disturbance compared with their peers. [17] Furthermore, parents' sleep patterns and psychological functionally was associated with adolescents' sleep in Iran. [18] In addition, the school environment is important for the sleep quality and mental status of adolescents. [19] Li's research has demonstrated that poor classmate relation predicted a high level of sleep disturbance and depressive symptoms among Chinese adolescents. One striking difference between Chinese and US adolescents is the salience of school and academic achievements relative to other concerns, and Chinese adolescents care more about academic achievements. [20] Overall, although we conclude that sleep disturbance and depressive symptoms are universal phenomenon among adolescents, it is clear that there are cultural variations in their prevalence and the way that sleep disturbance or depressive symptoms relate to other factors. [21] Most previous studies, however, have been carried out in Western or developed countries, and only a handful of studies have been conducted in developing countries. There is also a paucity of studies on family status (i.e., living arrangement, family economic status), school dynamics (i.e., relationships with classmates or teachers), and personal psychosocial adjustment (i.e., feeling lonely, attempting suicide) in the Chinese cultural context. Therefore, we conducted this large-scale cross-sectional study in China to estimate the prevalence of sleep disturbance and depressive symptoms; to comprehensively examine the potentially contributing factors to sleep disturbance and depressive symptoms among demographics, school, family, and psychosocial health; and to discuss the link between sleep disturbance and depressive symptoms.

The following three hypotheses were formulated. First, following the results of

previous studies, [6 19] we hypothesized that sleep disturbance or depressive symptoms are a major public health problem nationwide among Chinese adolescents. Second, consistent with previous findings, [15 18-20] we expected that demographics, family, school, and psychosocial factors would be related to sleep disturbance or depressive symptoms among Chinese adolescents. Third, in line with prior research linking sleep disturbance and depressive symptoms, [9 12] we expected sleep disturbance to be a risk factor for depressive symptoms among Chinese adolescents, and vice versa.

METHODS

Study design and participants

This cross-sectional study was based on a province-wide sample to estimate the prevalence of sleep disturbance and depressive symptoms and to examine the relationship between potentially influential factors and their involvement in sleep disturbance and depressive symptoms among Chinese adolescents. The participants were high school students from Guangdong, China. Guangdong is known as an immigrant province, with more than half of the population migrating from other provinces; therefore, the sample from Guangdong has a certain degree of representativeness. First, the schools were divided into three categories: junior high schools (grades 7-9), senior high schools (grades 10-12), and vocational schools (grades 7-12). A stratified-cluster random-sampling method was used to randomly select participants among the three types of schools. Six junior high schools, four senior high schools, and two vocational schools were selected. Next, two classes were randomly selected from each grade in these schools. All available students within the grade were surveyed; those not surveyed were absent or refused to participate and consisted of less than 1% of the student population. All the participants were fully informed of the purpose of the survey and were invited to participate voluntarily. Written consent letters were obtained from the school, each participating student and one of the student's parents. A rigorously anonymous method for collection of the self-report questionnaires was guaranteed. The questionnaires were administered by

research assistants in the classrooms without the presence of the teachers. It is important to stress that we used a self-designed questionnaire whose questions were based on an instrument proposed by the WHO and adapted to the realities of China, and the findings of a number of investigations indicate that such data can be extremely useful. [1 22]

Measures

Independent variables

Socio-demographic variables: Age, grade, gender.

Family factors: Living arrangement, family economic status, family relationship, and parental caring. Living arrangements were assessed by asking who lived in the student's primary home. Family economic status was measured by asking the student's perception of their family's current economic status (rated from below average to above average). Family relationships were assessed by asking the students, with the responses coded on a 3-point scale ranging from below average to above average. Parental caring was assessed by asking, "Are you satisfied with the love you receive from your father, mother, or both of them, based on a 4-point scale from dissatisfaction to satisfaction?"

School factors: Classmate relations and teacher-classmate relations were also assessed based on the student's self-rating about their relationships with classmates and teachers, ranging from poor to good. Academic achievements and academic pressure were captured by a single item asking about a personal appraisal of students' performances or pressure relative to that of their classmates (responses were coded as "above average", "average", and "below average").

Psychosocial adjustment: Feeling lonely was assessed by asking, "During the past 12 months, how often did you feel lonely per week?" Response options ranged from 1 (never) to 4 (over 4 days). Suicide-ideation status was based on whether a participant had endorsed thoughts of suicide over the past year. Suicide-attempt status was based on attempts made over the past year, with 1 or more attempts indicating endorsement. A student's attempt to hurt themselves was assessed by asking, "During the past 12

months, did you ever hurt yourself on purpose?" Responses were categorized into 4 groups: never, considered, planned, and attempted. Running away from home was assessed by asking, "During the past 12 months, did you run away from home without your parents' permission for more than 24 hours?" Response options were 1) never, 2) considered, 3) attempted, or 4) have run away from home one time or more. Habits of sleeping after lunch were assessed based on the student's self-rating about their habit, ranging from poor to good.

Dependent variables

We used the *Chinese Pittsburgh Sleep Quality Index (CPSQI)* to assess sleep quality and disturbances over a 1-month time interval; the sum of the scores for these seven components yields one global score with a range of 0-21 points in which higher scores indicate worse sleep quality. [22 23] The CPSQI was translated into Mandarin Chinese to better correspond to the meaning of the original items in PSQI, and it is valid, reliable, and commonly used. In China, a PSQI global score of above 7 points indicates poor sleep quality collectively known as *sleep disturbance*; a higher score indicates a greater reduction in sleep quality. [22]

The *Center for Epidemiology Scale for Depression* (*CES-D*) in Chinese was used to identify whether individuals had depressive symptoms. The respondents were asked to rate the frequency, over the past week, of 20 depressive symptoms by choosing one of four response options ranging from "rarely or none of the time" to "most or all of the time". [24] The Chinese version of this scale has been validated, [25-27] and extensively utilized in Chinese studies. [28] The score ranges from 0 to 60, and the original recommended cut-off point for having depressive symptoms was 16 points (corresponding to the 80th percentiles) by the founder of the CES-D in 1977. [29] We adopted the 80th percentile as the cut-off (a score greater than 28 indicating "having depressive symptoms"), and the area under the ROC curve was 0.78. For the CES-D survey, those who failed to answer at least 17 of the 20 items were discarded.

Statistical analysis

All data were entered by two investigators independently using EpiData 3.1, and the statistical analyses were conducted using SPSS 21.0 and SAS 9.2. Descriptive analyses were used to describe demographic characteristics and the prevalence of sleep disturbances and depressive symptoms among adolescents. Categorical and continuous data were reported in the form of proportions and means (SD). Chi-squared tests were used to test the difference between the categorical variables referred to above. Multivariate logistic regression models included the significant variables that had been tested by univariate analyses or that have been widely reported in the literature; these were used to screen for the risk factors for sleep disturbance/depressive symptoms according to the odds ratios (ORs) and 95% confidence intervals (95% CIs). An OR>1 with $P<0.05$ was reported as a risk factor. Considering that our study used a multi-stage sampling, students were grouped into classes; therefore, differences might not segregate independently. Thus, multi-level analyses (the generalized linear mixed effects models adopting the GLMMIX procedure in SAS) in which classes were treated as clusters were adopted in the multivariate logistic regression analyses. All statistical tests were two-sided, with a *P* value less than 0.05 considered significant.

RESULTS

There were 3,508 students invited to participate, and 3,485 students' questionnaires were completed and qualified for our survey; the response rate was 95.2%. After excluding students who were not 13 to 18 years old, we analyzed 3,186 students' data.

Demographic information

A total of 3,186 participants were involved in this analysis. *Table 1* provides the basic demographic information for the sample involved in this study. The proportion of boys was 53.4%, and the male-to-female ratio was approximately 1.2:1. The students ranged in age from 13 to 18 years old, and the mean age of the students was 15.6 (±1.6) years. The students who never slept after lunch accounted for 9.7%. The grade

7-9 group of students represented 52.9% of the sample. Regarding the family factors, a total of 89.0% of students lived with both biological parents, whereas 4.7% lived in single-parent families. A total of 15.8% of students thought of their family relationships as average, and 77.6% of students were satisfied with both of their parents' love. A subset of students (30.6%) reported that their current economic status was above average, whereas 8.4% reported that their economic status was below average. Regarding school factors, 28.0% of students rated their academic achievement as below average, and 42.2% of the students thought their academic pressure was above average. A total of 7.1% of participants reported poor relationships with their teachers, and 3.8% had poor relations with their classmates. Regarding the psychosocial factors, 11.9% of students felt lonely more than 4 days per week. A total of 4.1% of students often had suicide ideation, and 1.2% of students had attempted suicide often. In addition, 1.5% of participants often hurt themselves on purpose, and 1.9% of participants had run away from home more than once.

Univariate Analysis for Sleep disturbance and Depressive symptoms

The mean PSQI global score was 8.7 (± 2.4) points (8.6 (±2.5) points among boys, 8.6 (±2.4) points among girls), and 39.6% of the total sample was classified as having sleep disturbances (global score higher than 8 points). In addition, 6.4% of the students had depressive symptoms, according the CES-D. The mean CES-D score of students was 15.2 (± 9.4) points (14.6 (±9.1) points among boys, 15.6 (±8.8) points among girls). There were no gender differences in the PSQI global scores or the CES-D scores. (P>0.05)

As shown in *Table 2*, without adjustment for other variables, sleep disturbances and depressive groups were correlated with gender, family economic status, family relationships, parental caring, academic pressure, relationships with classmates, feeling lonely, suicide ideation, suicide attempts, hurting themselves on purpose, and having run away from home. Only age, grade, relationship with teachers, and having depressive symptoms were significantly correlated with having a sleep disturbance, while only living arrangements and having sleep disturbances were significantly

correlated with having depressive symptoms.

Multilevel Logistic Regression Analysis: Sleep disturbance

The final logistic regression model for sleep disturbance is presented in *Table 3*. Ten of the original variables remained in the final model: gender, age, habit of sleeping after lunch, family relationships, academic pressure, relationships with teachers, feeling lonely, suicide ideation, running away from home, and depressive symptoms. The results revealed that the girls, the 15-16-year age group, and the 17-18-year age group were all more likely to suffer from sleep disturbance. Taking occasional naps after lunch was a risk factor for sleep disturbance compared with the group that never napped after lunch (adjusted OR=1.68, 95% CI=1.27-2.22). Adolescents with below-average family relationships (AOR=1.54, 95% CI=1.06-2.26) had a slightly higher probability of sleep disturbance. Likewise, students with poor relationships with teachers (AOR=1.26, 95% CI=1.19-1.77) were more troubled with sleep disturbances. In addition, students feeling lonely 1-4 days a week (AOR=1.64, 95% CI=1.39-1.94) or over 4 days a week (AOR=2.22, 95% CI=1.70-2.89) had a higher probability of sleep disturbances compared those never feeling lonely. Having suicide ideations occasionally or sometimes was a risk factor for sleep disturbance, and students who considered running away from home (AOR=1.76, 95% CI=1.46-2.13) or attempted running away from home (OR=2.59, 95% CI=1.38-4.88) were also more likely to have a sleep disturbance compared to students who had never considered running away from home. Finally, students who had depressive symptoms were 2.47 (95% CI=1.61-3.79) times more likely to suffer from sleep disturbance than those who did not. Notably, students with average academic pressure (AOR=0.80, 95% CI=0.65-0.99) or below-average academic pressure (AOR=0.41, 95% CI=0.33-0.51) compared with the above-average academic pressure group were less likely to be troubled by sleep disturbance.

Multilevel Logistic Regression Analysis: Depressive symptoms

The final model for depressive symptoms in *Table 4* showed many correlations.

Adolescents with a below-average family relationship (AOR=1.97, 95% CI=1.24-3.15) were more likely to have depressive symptoms. Having average relationships with classmates (AOR=2.82, 95% CI=1.62-4.90) or poor relationships with classmates (AOR=1.60, 95% CI=1.14-2.25) was a risk factor for having depressive symptoms. Students who felt lonely 1 to 4 days a week (AOR=2.67, 95% CI=1.75-4.07) or over 4 days a week (AOR=4.24, 95% CI=2.65-6.80) also had a higher probability of having depressive symptoms. Likewise, students occasionally, sometimes or often having suicide ideation had a higher probability of having depressive symptoms. Considering running away from home (AOR=1.71, 95% CI=1.20-2.44) was also a risk factor for depressive symptoms compared to students who never considered running away from home. Students with sleep disturbance were also more likely to have depressive symptoms (AOR=2.52, 95% CI=1.64-3.86).

DISCUSSION

In this study, we found that sleep disturbance was not rare among Chinese adolescents, with a prevalence of 39.6%. Similar studies have reported that the prevalence of sleep disturbance in children and adolescents ranges from 66% to 90%. [30] A report from China in 2000 revealed that 16.9% of the sample was troubled with sleep disturbance, [6] while a report from China in 1987 reported a prevalence of 14.9%. [31] This study also agrees with the results from a Western report in which 43.0% of children experienced sleep disturbance. [32] The considerable variation in the prevalence of sleep disturbances may be due to the different time periods, different target populations, and different methodological definitions of sleep disturbances. Adolescent sleep disturbance has been recognized as a major international public health problem, and China is no exception, although the prevalence of Chinese adolescents with sleep disturbance was a little lower than Western countries.

In addition, our results indicate that girls were more likely to suffer from sleep disturbance, which agrees with the previous study from Anhui province and Hong Kong in China. [12 14] In this study, older age was more associated with sleep

disturbance compared with the younger group, which is in line with a previous study from China that reported that older age was associated with more sleep problems. [6]

Additionally, multivariate logistic regression analyses performed to control for confounding factors and to determine the main correlates of sleep disturbance showed that poor family relationships, poor relationships with teachers, feeling lonely, suicide ideation, running away from home, and depressive symptoms were correlated with sleep disturbance. These findings are in accordance with the results of many previous studies. For example, a study from Shandong province of China in 2000 also reported that poor marital relations of parents, poor family economic status, poor child-parent and peer relations, poor school achievement and social competence were risk factors for sleep problems, [6] and a study in Switzerland also documented the relationship between sleep disturbance in adolescents and family functioning and demonstrated that the mother's and adolescent children's sleep and well-being are particularly strongly correlated with each other. [33] Furthermore, prior studies also demonstrated that suicide completers had higher rates of overall sleep disturbance among adolescents, [34] and running away from home was as common as suicide completion among adolescents with depressive symptoms. [35] Notably, our results also indicate that students with average or below-average academic pressure compared with above-average academic pressure were less likely to be troubled by sleep disturbance. This indicates that academic pressure is an important type of stress that affects sleep, and other studies have provided evidence that stress is associated with sleep disturbance. [36]

Consistent with our expectation, adolescents who had depressive symptoms were at a higher risk for sleep disturbance. Xu has detected an association between sleep disturbance and depressive symptoms among Chinese adolescents. [12] We found that sleep disturbance was common among adolescents in China, and an adolescent's family, school, and psychosocial factors have influences on sleep disturbance. Thus, educational campaigns directed at families and schools are needed to improve awareness of the adverse consequence of sleep disturbance.

In this study, the prevalence of students with depressive symptoms was 6.4%,

slightly lower than the 8.0% reported in an Australian study. [37] Depressive symptoms are a prevalent and disabling condition among adolescents that results in emotional suffering and sleep disturbance; therefore, it is important for us to focus on this problem. [38] Our study reports that the prevalence of depressive symptoms among girls was not much higher than among boys, but a previous study reported prevalence rates of emotional problems to be higher in boys than in girls. [39] These differences may due to emotional problems, including depressive symptoms and others. Additionally, our multivariate logistic regression showed that below-average family relationship, average or below-average relationships with classmates, emotional problems (including feeling lonely more than 1 day per week, having suicide ideations, considering running away from home), and having sleep disturbance was a risk factor for having depressive symptoms. Given that depressive symptoms are a type of emotional problem, [40] it is not surprising that our results indicate a link between sleep disturbance and emotional problems. Consistent with the third hypothesis, our results clearly showed a link between sleep disturbance and depressive symptoms. However, the direction of the link was difficult to determine due to the nature of this cross-sectional study; they might mutually reinforce each other, thereby formulating a vicious circle.

Given adolescents' vulnerability to both sleep disturbance and depressive symptoms, we conducted this large-scale study aimed to investigate the prevalence and correlates of both problems in Chinese adolescents. To date, no research has expressly considered comprehensively the correlates of sleep disturbance and depressive symptoms among demographics, school, family, and psychosocial domains in this population. Additionally, it must be stressed that there are several limitations to the current large-scale study. First, the data are cross-sectional, so no causal inference can be made regarding the observed relationships between sleep disturbance and depressive symptoms, and the common-method variance interpretation for the findings might apply. Second, the questionnaires did not include items that could address students with sleep-related breathing problems or psychological diseases such as attention-deficit hyperactivity disorder (ADHD). Third, it should be noted that the

present results that were based on a structured self-rating questionnaire were cross-sectional and retrospective; although self-reporting is a common and accepted method, we could not completely rule out the possibility of recall bias. To minimize incorrect or unavailable data given by students who did not fully understand the contents of the PSQI and the CES-D, we have provided a detailed explanation of the *PSQI* and *CES-D*.

In conclusion, the prevalence and correlates of sleep disturbances and depressive symptoms among adolescents in China are high, and further research into their causes, effects, and remedies is warranted. The prevalence of sleep disturbance observed in this study suggests the importance of research on preventive interventions targeting sleep quality among Chinese students. Effective preventive measures require full consideration of the social and environmental factors. We should focus on the high-risk population whose family factors, school factors, and psychosocial adjustments are negative.

Contributors

GL and LCY searched the literature, conceived the study, designed the study, analyzed the data, interpreted the results, and drafted the report. DJX and HY organized the study, collected the data and analyzed the data. DXQ, HJW, HGL, GX collected the data, interpreted the results, and obtained funding.

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Table 1. Demographic characteristics of the total sample.

Variable	Number (%)
Total	3186 (100.0)
Gender	
Male	1700 (53.4)
Female	1486 (46.6)
Age (years)	
13-14	420 (13.2)
15-16	1687 (53.0)
17-18	1079 (33.9)
Grade	
7^{th}-9^{th}	1686 (52.9)
10^{th}-12^{th}	1500 (47.1)
Living arrangement	
Two biological parents	2836 (89.0)
Only father or mother	149 (4.7)
Others	201 (6.3)
Family economic status	
Above average	975(30.6)
Average	1942 (61.0)
Below average	269(8.4)
Family relationship	
Above average	2501 (78.5)
Average	502 (15.8)
Below average	183 (5.7)
Parental caring	
Satisfied with father or mother	545 (17.1)
Satisfied with both of them	2471 (77.6)
Dissatisfied with both of them	170 (5.3)
Academic achievement	
Above average	1361 (42.7)
Average	932 (29.3)
Below average	893 (28.0)
Academic pressure	
Above average	1344 (42.2)
Average	1376 (43.2)
Below average	466 (14.4)
Relationship with teachers	
Good	1552 (48.7)
Average	1408 (44.2)
Poor	226 (7.1)

Table 1. Demographic characteristics of the total sample (continued).

Variable	Number (%)
Relationship with classmates	
Good	2220 (69.7)
Average	846 (26.6)
Poor	120 (3.8)
Feel lonely	
Less than 1 day/week	1733 (54.4)
1 to 4 days/week	1073 (33.7)
More than 4 days/week	380 (11.9)
Suicide ideation	
Never	2589 (81.3)
Occasionally (1-2 times/year)	391 (12.3)
Sometimes (3-6 times/year)	75 (2.4)
Often (over 6 times/year)	131 (4.1)
Suicide attempt	
Never	3083 (95.8)
Occasionally (1-2 times/year)	81 (2.5)
Sometimes (3-6 times/year)	14(0.4)
Often (over 6 times/year)	38 (1.2)
Hurt themselves on purpose	
Never	2807 (88.1)
Occasionally (1-2 times/year)	269 (8.4)
Sometimes (3-6 times/year)	61 (1.9)
Often (over 6 times/year)	49 (1.5)
Running away from home	
Never	2262 (71.0)
Considered	815 (25.6)
Planned	48 (1.5)
Attempted	61 (1.9)
Habit of sleeping after lunch	
Never	308 (9.7)
Occasionally (1-4 times/week)	1598 (50.2)
Often (over 4 times/week)	1280 (40.2)

Table 2. Univariate chi-square analysis for sleep disturbance and depressive symptoms, n (%).

Variable	Total	With sleep disturbance	With depressive symptoms
Total	3186 (100.0)	1261 (100.0)	205 (100.0)
Gender #			
Male	1700 (53.4)	729 (57.8)	92 (44.9)
Female	1486 (46.6)	532 (42.2)	113 (55.1)
Age (years) *			
13-14	420 (13.2)	240 (19.0)	22 (10.7)
15-16	1687 (53.0)	667 (52.9)	111 (54.1)
17-18	1079 (33.9)	354 (28.1)	72 (35.1)
Grade *			
7^{th}-9^{th}	1686 (52.9)	740 (58.7)	108 (52.7)
10^{th}-12^{th}	1500 (47.1)	521(41.3)	97 (47.3)
Living arrangement **			
Two biological parents	2836 (89.0)	1125(89.2)	169 (82.4)
Only father or mother	149 (4.7)	51 (4.0)	16 (7.8)
Others	201 (6.3)	85 (6.7)	20 (9.8)
Family economic status #			
Above average	975(30.6)	437 (34.7)	45 (22.0)
Average	1942 (61.0)	738 (58.5)	127 (62.0)
Below average	269(8.4)	86 (6.8)	33 (16.1)
Family relationship #			
Above average	2501 (78.5)	1063 (84.3)	115 (56.1)
Average	502 (15.8)	155 (12.3)	46 (22.4)
Below average	183 (5.7)	43 (3.4)	44 (21.5)
Parental caring #			
Satisfied with father or mother	545 (17.1)	184 (14.6)	58 (28.3)
Satisfied with both of them	2471 (77.6)	1029 (81.6)	118 (57.6)
Dissatisfied with both of them	170 (5.3)	48 (3.8)	29 (14.1)
Academic achievement			
Above average	1361 (42.7)	558 (44.3)	84 (41.0)
Average	932 (29.3)	362 (28.7)	59 (28.8)
Below average	893 (28.0)	341 (27.0)	62 (30.2)
Academic pressure #			
Above average	1344 (42.2)	399 (31.6)	137 (66.8)
Average	1376 (43.2)	625 (49.6)	49 (23.9)
Below average	466 (14.4)	237 (18.8)	19 (9.3)
Relationship with teachers *			
Good	1552 (48.7)	694 (55.0)	69 (33.7)
Average	1408 (44.2)	493 (39.1)	95 (46.3)
Poor	226 (7.1)	74 (5.9)	41 (20.0)

Table 2. Univariate chi-square analysis for sleep disturbance and depressive symptoms, n (%) (continued).

Relationship with classmates #			
Good	2220 (69.7)	928 (73.6)	94 (45.9)
Average	846 (26.6)	289 (22.9)	79 (38.5)
Poor	120 (3.8)	44 (3.5)	32 (15.6)
Feel lonely #			
Less than 1 day/week	1733 (54.4)	830 (65.8)	34 (16.6)
1 to 4 days/week	1073 (33.7)	335 (26.6)	98 (47.8)
More than 4 days/week	380 (11.9)	96 (7.6)	73 (35.6)
Suicide ideation #			
Never	2589 (81.3)	1108(87.9)	88 (42.9)
Occasionally (1-2 times/year)	391 (12.3)	88 (7.0)	68 (33.2)
Sometimes (3-6 times/year)	75 (2.4)	12 (1.0)	18 (8.8)
Often (over 6 times/year)	131 (4.1)	53 (4.2)	31 (15.1)
Suicide attempt #			
Never	3083 (95.8)	1223 (97.0)	169 (82.4)
Occasionally (1-2 times/year)	81 (2.5)	17 (1.3)	20 (9.8)
Sometimes (3-6 times/year)	14(0.4)	4 (0.3)	3 (1.5)
Often (over 6 times/year)	38 (1.2)	17 (1.3)	13 (6.3)
Hurt themselves on purpose #			
Never	2807 (88.1)	1147 (91.0)	140 (68.3)
Occasionally (1-2 times/year)	269 (8.4)	78 (6.2)	43 (21.0)
Sometimes (3-6 times/year)	61 (1.9)	20 (1.6)	7 (3.4)
Often (over 6 times/year)	49 (1.5)	16 (1.3)	15 (7.3)
Running away from home #			
Never	2262 (71.0)	1006 (79.8)	79 (38.5)
Considered	815 (25.6)	226 (17.9)	103 (50.2)
Planned	48 (1.5)	14 (1.1)	6 (2.9)
Attempted	61 (1.9)	15 (1.2)	17 (8.3)
Depressive symptoms*			
Yes	205 (6.4)	29 (2.3)	-
No	2981 (93.6)	1232 (97.7)	-
Sleep disturbance **			
Yes	1261 (39.6)	-	29 (14.1)
No	1925(60.4)	-	176 (85.9)

#: According to the chi-square test, without adjusting for other variables, $P<0.05$ in both the sleep disturbance group and the depressive symptoms group.

*: $P<0.05$, only in the sleep disturbance group.

**: P<0.05, only in the depressive symptoms group.

Table 3. Adjusted OR (95% CI) for sleep disturbance by multi-level logistic regression.

Covariate	Adjusted OR (95% CI)	*P-value*
Age (years)		
13-14	1.00 (reference)	
15-16	2.40 (1.87-3.08)	<.001
17-18	1.36 (1.15-1.62)	<.001
Gender		
Male	1.00 (reference)	
Female	1.27 (1.08-1.48)	0.003
Habit of sleeping after lunch		
Never	1.00 (reference)	
Occasionally (1-4 times/week)	1.68 (1.27-2.22)	<.001
Often (over 4 times/week)	1.05 (0.89-1.23)	0.590
Family relationship		
Above average	1.00 (reference)	
Average	1.08(0.71-1.64)	0.723
Below average	1.54 (1.06-2.26)	0.025
Academic pressure [#]		
Above average	1.00 (reference)	
Average	0.80 (0.65-0.99)	<.001
Below average	0.41 (0.33-0.51)	<.001
Relationship with teachers		
Good	1.00 (reference)	
Average	0.79 (0.57-1.11)	0.174
Poor	1.26 (1.19-1.77)	<.001
Feel lonely		
Less than 1 day/week	1.00 (reference)	
1 to 4 days/week	1.64 (1.39-1.94)	<.001
More than 4 days/week	2.22 (1.70-2.89)	<.001
Suicide ideation		
Never	1.00 (reference)	
Occasionally (1-2 times/year)	1.78 (1.36-2.34)	<.001
Sometimes (3-6 times/year)	2.37 (1.25-4.54)	0.009
Often (over 6 times/year)	0.80 (0.54-1.20)	0.280
Running away from home		
Never	1.00 (reference)	
Considered	1.76 (1.46-2.13)	<.001
Planned	1.42 (0.74-2.73)	0.298
Attempted	2.59 (1.38-4.88)	0.003
Depressive symptoms		
No	1.00 (reference)	
Yes	2.47 (1.61-3.79)	<.001

NOTE: Adjusted OR means odds ratio adjusted by multivariate analysis for screening risk factors for adolescents with sleep disturbance; 95% CI=95% confident interval.

Table 4. Adjusted OR (95% CI) for depressive symptoms by multi-level logistic regression.

Covariate	Adjusted OR (95% CI)	*P-value*
Family relationship		
Above average	1.00 (reference)	
Average	1.22 (0.82-1.81)	0.329
Below average	1.97 (1.24-3.15)	0.004
Relationship with classmates		
Good	1.00 (reference)	
Average	2.82 (1.62-4.90)	<.001
Poor	1.60 (1.14-2.25)	0.007
Feel lonely		
Less than 1 day/week	1.00 (reference)	
1 to 4 days/week	2.67 (1.75-4.07)	<.001
More than 4 days/week	4.24 (2.65-6.80)	<.001
Suicide ideation		
Never	1.00 (reference)	
Occasionally (1-2 times/year)	2.72 (1.85-3.98)	<.001
Sometimes (3-6 times/year)	2.77 (1.46-5.26)	0.002
Often (over 6 times/year)	3.38 (1.89-6.04)	<.001
Running away from home		
Never	1.00 (reference)	
Considered	1.71 (1.20-2.44)	0.003
Planned	1.08 (0.40-2.90)	0.885
Attempted	1.42 (0.65-3.10)	0.386
Sleep disturbance		
No	1.00 (reference)	
Yes	2.52 (1.64-3.86)	<.001

NOTE: Adjusted OR means odds ratio adjusted by multivariate analysis for screening risk factors for adolescents showing depressive symptoms; 95% CI=95% confident interval.

Prevalence and Correlates of Sleep Disturbance and Depressive symptoms Among Chinese Adolescents: a cross-sectional survey study

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Strengths and limitations of this study:

There has been a lack of epidemiological research about both sleep disturbance and depressive symptoms among Chinese adolescents.

The results of the study show that sleep disturbance is more prevalent among Chinese adolescents who have depressive symptoms.

There is a link between sleep disturbance and depressive symptoms~~depression~~.

The study demonstrates that an adolescent's demographic, family, school, and psychosocial factors influence sleep disturbance and depressive symptoms.

The sample size limits the conclusions that can be drawn from the multivariate analysis; however, quantifying correlates of sleep disturbance and depressive symptoms was a secondary objective of the study.

ABSTRACT

Study objective: To investigate the prevalence and the correlates of sleep disturbance and depressive symptoms among Chinese adolescents and to examine the association betweenof the two problems.

Design: Cross-sectional survey research.

Participants: A total of 3,186 school students in grades 7-12 were sampled from the schools in Guangdong. A stratified-cluster random-sampling strategy was used to select the schools.

Main outcome measures: A self-administered questionnaire was used. The *Pittsburgh Sleep Quality index (PSQI)* was used to assess the occurrence of sleep disturbance, and the *Center for Epidemiology Scale for Depression* (*CES-D*) was used to identify whether individuals had depressive symptoms.

Results: The mean PSQI global score was 8.7 (± 2.4) points, and 39.6% of the total sample had sleep disturbance. The mean CES-D score of students was 15.2 (± 9.4) points, and 6.4% of the students had depressive symptoms. Additionally, girls and older adolescents were more likely to suffer from sleep disturbance, and the students who had depressive symptoms were 2.47 (95% CI=1.61-3.79) times more likely to suffer from sleep disturbance. Factors that were correlated with both sleep disturbance and depressive symptoms were having a poor relationship with teachers, feeling lonely, suicide ideation, and having run away from home.

Conclusion: Sleep disturbance was determined to be more prevalent among Chinese adolescents with depressive symptoms. Sleep disturbance and depressive symptoms were associated with each other, while school factors, family factors, and psychosocial adjustment were comprehensively correlated with both.

INTRODUCTION

Adolescence is often described as occurring between 13 and 18 years of age, which is roughly the period of high school for much of the world. [1] Sleep plays a very important role in the development of adolescents; it not only impacts physical growth and behavior, but it also affects mental health status.[2] Studies in Western countries have estimated that a large proportion (25%-40%) of adolescents have sleep disturbance, [3-5] and a report from China in 2000 revealed that 16.9% of the sample was troubled with sleep disturbance. [6] In total, adolescents' sleep disturbance has been a major international public health problem, and China is no exception, although the prevalence of Chinese adolescents with sleep disturbance has been a little lower than Western countries.

Depressive symptoms are a type of mental disorder, and the link between sleep disturbance and depressive symptoms in adulthood is well established. [7] For instance, women suffering from sleep disturbances have lower self-rated health and more physical and mental health complaints, such as depressive symptoms. [8] In contrast, a limited number of studies (especially epidemiological studies) have addressed the link between sleep disturbance and depressive symptoms among adolescents, and the link is not uniform. One study in the US has found that adolescents with sleep disturbance are more likely to develop and maintain depressive symptoms than are adolescents without sleep disturbance, [9] but one study found that there did not appear to be a strong association between sleep disturbance and depressive symptoms in adolescents. [10] Additionally, many researchers in US have reported that sleep disturbance can be a sign of depressive symptoms, and depressive symptoms can likewise be a sign of sleep disturbance. [11] Xu's research in China also demonstrated that sleep disturbance and depressive symptoms are closely related, and insufficient sleep may result in depressive symptoms. [12] The recent increase in interest in the link between sleep disturbance and depressive symptoms in adolescents is warranted.

Sleep disturbance and depressive symptoms among adolescents are not only influenced by each other but also by demographics, family, school and social factors. [13] Several variables have been associated with sleep disturbance and depressive

symptoms. Previous studies have differing results about the characteristics of sleep disturbances between the two genders. Boys in Hong Kong were more likely to be troubled by sleep disturbance than girls, [14] but most of the studies from other countries found that girls were more likely to report sleep disturbances than boys. [15 16] Such inconsistencies may be attributed to differences in the sample and place, which suggested further research with larger samples is warranted. Additionally, Liu's study in China indicated that the prevalence of sleep disturbance varies with age and grade level among adolescents, and adolescents from incomplete families were more likely to have sleep disturbance compared with their peers. [17] Furthermore, parents' sleep patterns and psychological functionally was associated with adolescents' sleep in Iran. [18] In addition, the school environment is important for the sleep quality and mental status of adolescents. [19] Li's research has demonstrated that poor classmate relation predicted a high level of sleep disturbance and depressive symptoms among Chinese adolescents. One striking difference between Chinese and US adolescents is the salience of school and academic achievements relative to other concerns, and Chinese adolescents care more about academic achievements. [20] Overall, although we conclude that sleep disturbance and depressive symptoms are universal phenomenon among adolescents, it is clear that there are cultural variations in their prevalence and the way that sleep disturbance or depressive symptoms relate to other factors. [21] Most previous studies, however, have been carried out in Western or developed countries, and only a handful of studies have been conducted in developing countries. There is also a paucity of studies on family status (i.e., living arrangement, family economic status), school dynamics (i.e., relationships with classmates or teachers), and personal psychosocial adjustment (i.e., feeling lonely, attempting suicide) in the Chinese cultural context. Therefore, we conducted this large-scale cross-sectional study in China to estimate the prevalence of sleep disturbance and depressive symptoms; to comprehensively examine the potentially contributing factors to sleep disturbance and depressive symptoms among demographics, school, family, and psychosocial health; and to discuss the link between sleep disturbance and depressive symptoms.

The following three hypotheses were formulated. First, following the results of

previous studies,[6 19] we hypothesized that sleep disturbance or depressive symptoms are a major public health problem nationwide among Chinese adolescents. Second, consistent with previous findings,[15 18-20] we expected that demographics, family, school, and psychosocial factors would be related to sleep disturbance or depressive symptoms among Chinese adolescents. Third, in line with prior research linking sleep disturbance and depressive symptoms,[9 12] we expected sleep disturbance to be a risk factor for depressive symptoms among Chinese adolescents, and vice versa.

METHODS

Study design and participantss

This ~~A~~ cross-sectional study was ~~conducted and~~ based on a province-wide sample to ~~investigate~~ estimate the prevalence of sleep disturbance and depressive symptoms and to examine the relationship between potentially influential factors and their involvement in sleep disturbance and depressive symptoms among Chinese adolescents. The participants were ~~middle school students~~ high school students from Guangdong, China. Guangdong is known as an immigrant province, with more than half of the population migrating from other provinces; therefore, the sample from Guangdong has a certain degree of representativeness. First, the schools were divided into three categories: junior high schools (grades 7-9), senior high schools (grades 10-12), and vocational schools (grades 7-12). A stratified-cluster random-sampling method was used to randomly select participants among the three types of schools. Six junior high schools, four senior high schools, and two vocational schools were selected. Next, two classes were randomly selected from each grade in these schools. All available students within the grade were surveyed; those not surveyed were absent or refused to participate and consisted of less than 1% of the student population. All the participants were fully informed of the purpose of the survey and were invited to participate voluntarily. Written consent letters were obtained from the school, each participating student and one of the student's parents. A rigorously anonymous method for collection of the self-report questionnaires was guaranteed. The questionnaires were administered by research assistants in the classrooms without the

presence of the teachers. It is important to stress that we used a self-designed questionnaire whose questions were based on an instrument proposed by the WHO and adapted to the realities of China, and the findings of a number of investigations indicate that such data can be extremely useful. [1 22]

Measures

Independent variables

Socio-demographic variables: Age, grade, gender ~~and so on~~.

Family factors: Living arrangement, family economic status, family relationship, and parental caring. Living arrangements were assessed by asking who lived in the student's primary home. Family economic status was measured by asking the student's perception of their family's current economic status (rated from below average to above average). Family relationships were assessed by asking the students, with the responses coded on a 3-point scale ranging from below average to above average. Parental caring was assessed by asking, "Are you satisfied with the love you receive from your father, mother, or both of them, based on a 4-point scale from dissatisfaction to satisfaction?"

School factors: Classmate relations and teacher-classmate relations were also assessed based on the student's self-rating about their relationships with classmates and teachers, ranging from poor to good. Academic achievements and academic pressure were captured by a single item asking about a personal appraisal of students' performances or pressure relative to that of their classmates (responses were coded as "above average", "average", and "below average").

Psychosocial adjustment: Feeling lonely was assessed by asking, "During the past 12 months, how often did you feel lonely per week?" Response options ranged from 1 (never) to 4 (over 4 days). Suicide-ideation status was based on whether a participant had endorsed thoughts of suicide over the past year. Suicide-attempt status was based on attempts made over the past year, with 1 or more attempts indicating endorsement. A student's attempt to hurt themselves was assessed by asking, "During the past 12 months, did you ever hurt yourself on purpose?" Responses were categorized into 4

groups: never, considered, planned, and attempted. Running away from home was assessed by asking, "During the past 12 months, did you run away from home without your parents' permission for more than 24 hours?" Response options were 1) never, 2) considered, 3) attempted, or 4) have run away from home one time or more. Habits of sleeping after lunch were assessed based on the student's self-rating about their habit, ranging from poor to good.

Dependent variables

We used the *Chinese Pittsburgh Sleep Quality Index (CPSQI)* to assess sleep quality and disturbances over a 1-month time interval; the sum of the scores for these seven components yields one global score with a range of 0-21 points in which higher scores indicate worse sleep quality.[22 23] The CPSQI was translated into Mandarin Chinese to better correspond to the meaning of the original items in PSQI, and it is valid, reliable, and commonly used. In China, a PSQI global score of above 7 points indicates poor sleep quality collectively known as *sleep disturbance*; a higher score indicates a greater reduction in sleep quality. [22]

The *Center for Epidemiology Scale for Depression* (*CES-D*) in Chinese was used to identify whether individuals had depressive symptoms. The respondents were asked to rate the frequency, over the past week, of 20 depressive symptoms ~~symptoms of depression~~ by choosing one of four response options ranging from "rarely or none of the time" to "most or all of the time". [24] The Chinese version of this scale has been validated, [25-27] and extensively utilized in Chinese studies. [28] The score ranges from 0 to 60, and the original recommended cut-off point for having depressive symptoms was 16 points (corresponding to the 80th percentiles) by the founder of the CES-D in 1977. [29] We adopted the 80th percentile as the cut-off (a score greater than 28 indicating "having depressive symptoms"), and the area under the ROC curve was 0.78. For the CES-D survey, those who failed to answer at least 17 of the 20 items were discarded.

Statistical analysis

All data were entered by two investigators independently using EpiData 3.1, and the statistical analyses were conducted using SPSS 21.0 and SAS 9.2. Descriptive analyses were used to describe demographic characteristics and the prevalence of sleep disturbances and depressive symptoms among adolescents. Categorical and continuous data were reported in the form of proportions and means (SD). Chi-squared tests were used to test the difference between the categorical variables referred to above. Multivariate logistic regression models included the significant variables that had been tested by univariate analyses or that have been widely reported in the literature; these were used to screen for the risk factors for sleep disturbance/depressive symptoms according to the odds ratios (ORs) and 95% confidence intervals (95% CIs). An OR>1 with $P<0.05$ was reported as a risk factor. Considering that our study used a multi-stage sampling, students were grouped into classes; therefore, differences might not segregate independently. Thus, multi-level analyses (the generalized linear mixed effects models adopting the GLMMIX procedure in SAS) in which classes were treated as clusters were adopted in the multivariate logistic regression analyses. All statistical tests were two-sided, with a *P* value less than 0.05 considered significant.

RESULTS

There were 3,508 students invited to participate, and 3,485 students' questionnaires were completed and qualified for our survey; the response rate was 95.2%. After excluding students who were not 13 to 18 years old, we analyzed 3,186 students' data.

Demographic information

A total of 3,186 participants were involved in this analysis. *Table 1* provides the basic demographic information for the sample involved in this study. The proportion of boys was 53.4%, and the male-to-female ratio was approximately 1.2:1. The students ranged in age from 13 to 18 years old, and the mean age of the students was 15.6 (±1.6) years. The students who never slept after lunch accounted for 9.7%. The grade 7-9 group of students represented 52.9% of the sample. Regarding the family factors,

a total of 89.0% of students lived with both biological parents, whereas 4.7% lived in single-parent families. A total of 15.8% of students thought of their family relationships as average, and 77.6% of students were satisfied with both of their parents' love. A subset of students (30.6%) reported that their current economic status was above average, whereas 8.4% reported that their economic status was below average. Regarding school factors, 28.0% of students rated their academic achievement as below average, and 42.2% of the students thought their academic pressure was above average. A total of 7.1% of participants reported poor relationships with their teachers, and 3.8% had poor relations with their classmates. Regarding the psychosocial factors, 11.9% of students felt lonely more than 4 days per week. A total of 4.1% of students often had suicide ideation, and 1.2% of students had attempted suicide often. In addition, 1.5% of participants often hurt themselves on purpose, and 1.9% of participants had run away from home more than once.

Univariate Analysis for Sleep disturbance and Depressive symptoms~~on~~

The mean PSQI global score was 8.7 (± 2.4) points (8.6 (±2.5) points among boys, 8.6 (±2.4) points among girls), and 39.6% of the total sample was classified as having sleep disturbances (global score higher than 8 points). In addition, 6.4% of the students had~~–~~ depressive symptoms~~depression~~, according the CES-D. The mean CES-D score of students was 15.2 (± 9.4) points (14.6 (±9.1) points among boys, 15.6 (±8.8) points among girls). There were no gender differences in the PSQI global scores or the CES-D scores. (P>0.05)

As shown in *Table 2*, without adjustment for other variables, sleep disturbances and depressive groups were correlated with gender, family economic status, family relationships, parental caring, academic pressure, relationships with classmates, feeling lonely, suicide ideation, suicide attempts, hurting themselves on purpose, and having run away from home. Only age, grade, relationship with teachers, and having depressive symptoms were significantly correlated with having a sleep disturbance, while only living arrangements and having sleep disturbances were significantly correlated with having depressive symptoms.

Multilevel Logistic Regression Analysis: Sleep disturbance

The final logistic regression model for sleep disturbance is presented in *Table 3*. Ten of the original variables remained in the final model: gender, age, habit of sleeping after lunch, family relationships, academic pressure, relationships with teachers, feeling lonely, suicide ideation, running away from home, and depressive symptoms. The results revealed that the girls, the 15-16-year age group, and the 17-18-year age group were all more likely to suffer from sleep disturbance. Taking occasional naps after lunch was a risk factor for sleep disturbance compared with the group that never napped after lunch (adjusted OR=1.68, 95% CI=1.27-2.22). Adolescents with below-average family relationships (AOR=1.54, 95% CI=1.06-2.26) had a slightly higher probability of sleep disturbance. Likewise, students with poor relationships with teachers (AOR=1.26, 95% CI=1.19-1.77) were more troubled with sleep disturbances. In addition, students feeling lonely 1-4 days a week (AOR=1.64, 95% CI=1.39-1.94) or over 4 days a week (AOR=2.22, 95% CI=1.70-2.89) had a higher probability of sleep disturbances compared those never feeling lonely. Having suicide ideations occasionally or sometimes was a risk factor for sleep disturbance, and students who considered running away from home (AOR=1.76, 95% CI=1.46-2.13) or attempted running away from home (OR=2.59, 95% CI=1.38-4.88) were also more likely to have a sleep disturbance compared to students who had never considered running away from home. Finally, students who had depressive symptoms were 2.47 (95% CI=1.61-3.79) times more likely to suffer from sleep disturbance than those who did not. Notably, students with average academic pressure (AOR=0.80, 95% CI=0.65-0.99) or below-average academic pressure (AOR=0.41, 95% CI=0.33-0.51) compared with the above-average academic pressure group were less likely to be troubled by sleep disturbance.

Multilevel Logistic Regression Analysis: Depressive symptoms

The final model for depressive symptoms in *Table 4* showed many correlations. Adolescents with a below-average family relationship (AOR=1.97, 95% CI=1.24-3.15)

were more likely to have depressive symptoms. Having average relationships with classmates (AOR=2.82, 95% CI=1.62-4.90) or poor relationships with classmates (AOR=1.60, 95% CI=1.14-2.25) was a risk factor for having depressive symptoms. Students who felt lonely 1 to 4 days a week (AOR=2.67, 95% CI=1.75-4.07) or over 4 days a week (AOR=4.24, 95% CI=2.65-6.80) also had a higher probability of having depressive symptoms. Likewise, students occasionally, sometimes or often having suicide ideation had a higher probability of having depressive symptoms. Considering running away from home (AOR=1.71, 95% CI=1.20-2.44) was also a risk factor for depressive symptoms compared to students who never considered running away from home. Students with sleep disturbance were also more likely to have depressive symptoms (AOR=2.52, 95% CI=1.64-3.86).

DISCUSSION

In this study, we found that sleep disturbance was not rare among Chinese adolescents, with a prevalence of 39.6%. Similar studies have ~~already~~ reported that the prevalence of sleep ~~problems~~ disturbance in children and adolescents ranges from 66% to 90%. [30] A report from China in 2000 revealed that 16.9% of the sample was troubled with sleep disturbance, [6] while a report from China in 1987 reported a prevalence of 14.9%. [31] This study also agrees with the results from a Western report in which 43.0% of children experienced sleep disturbance. [32] The considerable variation in the prevalence of sleep disturbances may be due to the different time periods, different target populations, and different methodological definitions of sleep disturbances. Adolescent sleep disturbance has been recognized as a major international public health problem, and China is no exception, although the prevalence of Chinese adolescents with sleep disturbance was a little lower than Western countries.

In addition, o~~O~~ur results indicate that girls were more likely to suffer from sleep disturbance, which agrees with the previous study from Anhui province and Hong Kong in China. [12 14] In this study, older age was more associated with sleep disturbance compared with the younger group, which is in line with a previous study from China that reported that older age was associated with more sleep problems. [6]

Additionally, multivariate logistic regression analyses performed to control for confounding factors and to determine the main correlates of sleep disturbance showed that poor family relationships, poor relationships with teachers, feeling lonely, suicide ideation, running away from home, and depressive symptoms were correlated with sleep disturbance. These findings are in accordance with the results of many previous studies. For example, a study from Shandong province of China in 2000 also reported that poor marital relations of parents, poor family economic status, poor child-parent and peer relations, poor school achievement and social competence were risk factors for sleep problems, [6] and a study in Switzerland also documented the relationship between sleep disturbance in adolescents and family functioning and demonstrated that the mother's and adolescent children's sleep and well-being are particularly strongly correlated with each other.[33] Furthermore, prior studies also demonstrated that suicide completers had higher rates of overall sleep disturbance among adolescents, [34] and running away from home was as common as suicide completion among adolescents with depressive symptoms. [35] Notably, our results also indicate that students with average or below-average academic pressure compared with above-average academic pressure were less likely to be troubled by sleep disturbance. This indicates that academic pressure is an important type of stress that affects sleep, and other studies have provided evidence that stress is associated with sleep disturbance.[36]

Consistent with our expectation, adolescents who had depressive symptoms were at a higher risk for sleep disturbance. Xu has detected an association between sleep disturbance and depressive symptoms among Chinese adolescents.[12] We found that sleep disturbance was common among adolescents in China, and an adolescent's family, school, and psychosocial factors have influences on sleep disturbance. Thus, educational campaigns directed at families and schools are needed to improve awareness of the adverse consequence of sleep disturbance.

In this study, the prevalence of students with depressive symptoms was 6.4%, slightly lower than the 8.0% reported in an Australian study. [37] Depressive symptoms are a prevalent and disabling condition among adolescents that results in emotional

suffering and sleep disturbance; therefore, it is important for us to focus on this problem. [38] Our study reports that the prevalence of depressive symptoms~~on~~ among girls was not much higher than among boys, but a previous study reported prevalence rates of emotional problems to be higher in boys than in girls. [39] These differences may due to emotional problems, including depressive symptoms and others. Additionally, our multivariate logistic regression showed that below-average family relationship, average or below-average relationships with classmates, emotional problems (including feeling lonely more than 1 day per week, having suicide ideations, considering running away from home), and having sleep disturbance was a risk factor for having depressive symptoms. Given that depressive symptoms are a type of emotional problem, [40] it is not surprising that our results indicate a link between sleep disturbance and emotional problems. Consistent with the third hypothesis, our results clearly showed a link between sleep disturbance and depressive symptoms. However, the direction of the link was difficult to determine due to the nature of this cross-sectional study; they might mutually reinforce each other, thereby formulating a vicious circle.

Given adolescents' vulnerability to both sleep disturbance and depressive symptoms, we conducted this large-scale study aimed to investigate the prevalence and correlates of both problems in Chinese adolescents. To date, no research has expressly considered comprehensively the correlates of sleep disturbance and depressive symptoms among demographics, school, family, and psychosocial domains in this population. Additionally, it must be stressed that there are several limitations to the current large-scale study. First, the data are cross-sectional, so no causal inference can be made regarding the observed relationships between sleep disturbance and depressive symptoms, and the common-method variance interpretation for the findings might apply. Second, the questionnaires did not include items that could address students with sleep-related breathing problems or psychological diseases such as attention-deficit hyperactivity disorder (ADHD). Third, it should be noted that the present results that were based on a structured self-rating questionnaire were cross-sectional and retrospective; although self-reporting is a common and accepted

method, we could not completely rule out the possibility of recall bias. To minimize incorrect or unavailable data given by students who did not fully understand the contents of the PSQI and the CES-D, we have provided a detailed explanation of the *PSQI* and *CES-D*.

In conclusion, the prevalence and correlates of sleep disturbances and depressive symptoms among adolescents in China are high, and further research into their causes, effects, and remedies is warranted. The prevalence of sleep disturbance observed in this study suggests the importance of research on preventive interventions targeting sleep quality among Chinese students. Effective preventive measures require full consideration of the social and environmental factors. We should focus on the high-risk population whose family factors, school factors, and psychosocial adjustments are negative.

Contributors

GL and LCY searched the literature, conceived the study, designed the study, analyzed the data, interpreted the results, and drafted the report. DJX and HY organized the study, collected the data and analyzed the data. DXQ, HJW, HGL, GX collected the data, interpreted the results, and obtained funding.

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Table 1. Demographic characteristics of the total sample.

Variable	Number (%)
Total	3186 (100.0)
Gender	
Male	1700 (53.4)
Female	1486 (46.6)
Age (years)	
13-14	420 (13.2)
15-16	1687 (53.0)
17-18	1079 (33.9)
Grade	
7^{th}-9^{th}	1686 (52.9)
10^{th}-12^{th}	1500 (47.1)
Living arrangement	
Two biological parents	2836 (89.0)
Only father or mother	149 (4.7)
Others	201 (6.3)
Family economic status	
Above average	975(30.6)
Average	1942 (61.0)
Below average	269(8.4)
Family relationship	
Above average	2501 (78.5)
Average	502 (15.8)
Below average	183 (5.7)
Parental caring	
Satisfied with father or mother	545 (17.1)
Satisfied with both of them	2471 (77.6)
Dissatisfied with both of them	170 (5.3)
Academic achievement	
Above average	1361 (42.7)
Average	932 (29.3)
Below average	893 (28.0)
Academic pressure	
Above average	1344 (42.2)
Average	1376 (43.2)
Below average	466 (14.4)
Relationship with teachers	
Good	1552 (48.7)
Average	1408 (44.2)
Poor	226 (7.1)

Table 1. Demographic characteristics of the total sample (continued).

Variable	Number (%)
Relationship with classmates	
Good	2220 (69.7)
Average	846 (26.6)
Poor	120 (3.8)
Feel lonely	
Less than 1 day/week	1733 (54.4)
1 to 4 days/week	1073 (33.7)
More than 4 days/week	380 (11.9)
Suicide ideation	
Never	2589 (81.3)
Occasionally (1-2 times/year)	391 (12.3)
Sometimes (3-6 times/year)	75 (2.4)
Often (over 6 times/year)	131 (4.1)
Suicide attempt	
Never	3083 (95.8)
Occasionally (1-2 times/year)	81 (2.5)
Sometimes (3-6 times/year)	14(0.4)
Often (over 6 times/year)	38 (1.2)
Hurt themselves on purpose	
Never	2807 (88.1)
Occasionally (1-2 times/year)	269 (8.4)
Sometimes (3-6 times/year)	61 (1.9)
Often (over 6 times/year)	49 (1.5)
Running away from home	
Never	2262 (71.0)
Considered	815 (25.6)
Planned	48 (1.5)
Attempted	61 (1.9)
Habit of sleeping after lunch	
Never	308 (9.7)
Occasionally (1-4 times/week)	1598 (50.2)
Often (over 4 times/week)	1280 (40.2)

Table 2. Univariate chi-square analysis for sleep disturbance and depressive symptoms, n (%).

Variable	Total	With sleep disturbance	With depressive symptoms
Total	3186 (100.0)	1261 (100.0)	205 (100.0)
Gender #			
Male	1700 (53.4)	729 (57.8)	92 (44.9)
Female	1486 (46.6)	532 (42.2)	113 (55.1)
Age (years) *			
13-14	420 (13.2)	240 (19.0)	22 (10.7)
15-16	1687 (53.0)	667 (52.9)	111 (54.1)
17-18	1079 (33.9)	354 (28.1)	72 (35.1)
Grade *			
7^{th}-9^{th}	1686 (52.9)	740 (58.7)	108 (52.7)
10^{th}-12^{th}	1500 (47.1)	521(41.3)	97 (47.3)
Living arrangement **			
Two biological parents	2836 (89.0)	1125(89.2)	169 (82.4)
Only father or mother	149 (4.7)	51 (4.0)	16 (7.8)
Others	201 (6.3)	85 (6.7)	20 (9.8)
Family economic status #			
Above average	975(30.6)	437 (34.7)	45 (22.0)
Average	1942 (61.0)	738 (58.5)	127 (62.0)
Below average	269(8.4)	86 (6.8)	33 (16.1)
Family relationship #			
Above average	2501 (78.5)	1063 (84.3)	115 (56.1)
Average	502 (15.8)	155 (12.3)	46 (22.4)
Below average	183 (5.7)	43 (3.4)	44 (21.5)
Parental caring #			
Satisfied with father or mother	545 (17.1)	184 (14.6)	58 (28.3)
Satisfied with both of them	2471 (77.6)	1029 (81.6)	118 (57.6)
Dissatisfied with both of them	170 (5.3)	48 (3.8)	29 (14.1)
Academic achievement			
Above average	1361 (42.7)	558 (44.3)	84 (41.0)
Average	932 (29.3)	362 (28.7)	59 (28.8)
Below average	893 (28.0)	341 (27.0)	62 (30.2)
Academic pressure #			
Above average	1344 (42.2)	399 (31.6)	137 (66.8)
Average	1376 (43.2)	625 (49.6)	49 (23.9)
Below average	466 (14.4)	237 (18.8)	19 (9.3)
Relationship with teachers *			
Good	1552 (48.7)	694 (55.0)	69 (33.7)
Average	1408 (44.2)	493 (39.1)	95 (46.3)
Poor	226 (7.1)	74 (5.9)	41 (20.0)

Table 2. Univariate chi-square analysis for sleep disturbance and depressive symptoms, n (%) (continued).

Relationship with classmates #			
Good	2220 (69.7)	928 (73.6)	94 (45.9)
Average	846 (26.6)	289 (22.9)	79 (38.5)
Poor	120 (3.8)	44 (3.5)	32 (15.6)
Feel lonely #			
Less than 1 day/week	1733 (54.4)	830 (65.8)	34 (16.6)
1 to 4 days/week	1073 (33.7)	335 (26.6)	98 (47.8)
More than 4 days/week	380 (11.9)	96 (7.6)	73 (35.6)
Suicide ideation #			
Never	2589 (81.3)	1108(87.9)	88 (42.9)
Occasionally (1-2 times/year)	391 (12.3)	88 (7.0)	68 (33.2)
Sometimes (3-6 times/year)	75 (2.4)	12 (1.0)	18 (8.8)
Often (over 6 times/year)	131 (4.1)	53 (4.2)	31 (15.1)
Suicide attempt #			
Never	3083 (95.8)	1223 (97.0)	169 (82.4)
Occasionally (1-2 times/year)	81 (2.5)	17 (1.3)	20 (9.8)
Sometimes (3-6 times/year)	14(0.4)	4 (0.3)	3 (1.5)
Often (over 6 times/year)	38 (1.2)	17 (1.3)	13 (6.3)
Hurt themselves on purpose #			
Never	2807 (88.1)	1147 (91.0)	140 (68.3)
Occasionally (1-2 times/year)	269 (8.4)	78 (6.2)	43 (21.0)
Sometimes (3-6 times/year)	61 (1.9)	20 (1.6)	7 (3.4)
Often (over 6 times/year)	49 (1.5)	16 (1.3)	15 (7.3)
Running away from home #			
Never	2262 (71.0)	1006 (79.8)	79 (38.5)
Considered	815 (25.6)	226 (17.9)	103 (50.2)
Planned	48 (1.5)	14 (1.1)	6 (2.9)
Attempted	61 (1.9)	15 (1.2)	17 (8.3)
Depressive symptoms *			
Yes	205 (6.4)	29 (2.3)	-
No	2981 (93.6)	1232 (97.7)	-
Sleep disturbance **			
Yes	1261 (39.6)	-	29 (14.1)
No	1925(60.4)	-	176 (85.9)

#: According to the chi-square test, without adjusting for other variables, $P<0.05$ in both the sleep disturbance group and the depressive symptoms group.

*: $P<0.05$, only in the sleep disturbance group.

**: P<0.05, only in the depressive symptoms group.

Table 3. Adjusted OR (95% CI) for sleep disturbance by multi-level logistic regression.

Covariate	Adjusted OR (95% CI)	*P-value*
Age (years)		
13-14	1.00 (reference)	
15-16	2.40 (1.87-3.08)	<.001
17-18	1.36 (1.15-1.62)	<.001
Gender		
Male	1.00 (reference)	
Female	1.27 (1.08-1.48)	0.003
Habit of sleeping after lunch		
Never	1.00 (reference)	
Occasionally (1-4 times/week)	1.68 (1.27-2.22)	<.001
Often (over 4 times/week)	1.05 (0.89-1.23)	0.590
Family relationship		
Above average	1.00 (reference)	
Average	1.08(0.71-1.64)	0.723
Below average	1.54 (1.06-2.26)	0.025
Academic pressure [#]		
Above average	1.00 (reference)	
Average	0.80 (0.65-0.99)	<.001
Below average	0.41 (0.33-0.51)	<.001
Relationship with teachers		
Good	1.00 (reference)	
Average	0.79 (0.57-1.11)	0.174
Poor	1.26 (1.19-1.77)	<.001
Feel lonely		
Less than 1 day/week	1.00 (reference)	
1 to 4 days/week	1.64 (1.39-1.94)	<.001
More than 4 days/week	2.22 (1.70-2.89)	<.001
Suicide ideation		
Never	1.00 (reference)	
Occasionally (1-2 times/year)	1.78 (1.36-2.34)	<.001
Sometimes (3-6 times/year)	2.37 (1.25-4.54)	0.009
Often (over 6 times/year)	0.80 (0.54-1.20)	0.280
Running away from home		
Never	1.00 (reference)	
Considered	1.76 (1.46-2.13)	<.001
Planned	1.42 (0.74-2.73)	0.298
Attempted	2.59 (1.38-4.88)	0.003
Depressive symptoms		
No	1.00 (reference)	
Yes	2.47 (1.61-3.79)	<.001

NOTE: Adjusted OR means odds ratio adjusted by multivariate analysis for screening risk factors for adolescents with sleep disturbance; 95% CI=95% confident interval.

Table 4. Adjusted OR (95% CI) for depressive symptoms by multi-level logistic regression.

Covariate	Adjusted OR (95% CI)	*P-value*
Family relationship		
Above average	1.00 (reference)	
Average	1.22 (0.82-1.81)	0.329
Below average	1.97 (1.24-3.15)	0.004
Relationship with classmates		
Good	1.00 (reference)	
Average	2.82 (1.62-4.90)	<.001
Poor	1.60 (1.14-2.25)	0.007
Feel lonely		
Less than 1 day/week	1.00 (reference)	
1 to 4 days/week	2.67 (1.75-4.07)	<.001
More than 4 days/week	4.24 (2.65-6.80)	<.001
Suicide ideation		
Never	1.00 (reference)	
Occasionally (1-2 times/year)	2.72 (1.85-3.98)	<.001
Sometimes (3-6 times/year)	2.77 (1.46-5.26)	0.002
Often (over 6 times/year)	3.38 (1.89-6.04)	<.001
Running away from home		
Never	1.00 (reference)	
Considered	1.71 (1.20-2.44)	0.003
Planned	1.08 (0.40-2.90)	0.885
Attempted	1.42 (0.65-3.10)	0.386
Sleep disturbance		
No	1.00 (reference)	
Yes	2.52 (1.64-3.86)	<.001

NOTE: Adjusted OR means odds ratio adjusted by multivariate analysis for screening risk factors for adolescents showing depressive symptoms; 95% CI=95% confident interval.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.