



ORIGINAL ARTICLE

Insomnia symptom, mental disorder and suicide: A case-control study in Chinese rural youths

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Insomnia has been reported as a risk factor of suicidal behaviors, but few studies have examined the association among insomnia, mental disorder and suicide, especially among Chinese populations. In this study, we examined the effect of insomnia symptoms on completed suicide in a large sample of suicides and their controls in Chinese rural youths. Subjects were 388 consecutively recruited suicides and 416 community living controls aged 15–34 years in the rural areas of three provinces in China. Established psychological autopsy method was used for data collection. Insomnia symptoms were assessed with sleep questions in the Hamilton Depression Rating Scale (HAMD) about insomnia, including difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS) and early morning awakening (EMA). The results showed that DIS (OR = 12.01, $P < 0.001$), DMS (OR = 12.82, $P < 0.001$) or EMA (OR = 12.08, $P < 0.001$) was significantly associated with increased risk of suicide even after mental disorder was controlled for. Our study showed that insomnia can be an independent risk factor for suicide. Mental disorders mediated the association between insomnia and suicide. Insomnia should be assessed and treated for individuals at risk of suicide.

Key words: case-control study, China, insomnia, mental disorder, suicide.**INTRODUCTION**

China is a country that has one of the highest suicide rates in the world.¹ Patterns and rates of Chinese suicide are different from those in Western societies in several prominent ways. First, the Chinese female suicide rates are very close to those for the males. Second, the rural suicide rate is much higher than that in cities. Third, the suicide rates peak for those aged 65+ years around the

world, but there is a minor peak for those 15–34 years old in China.² So Chinese rural women aged 15–34 years are a high risk group of suicide.

Although the suicide rates in China have been decreased in the past two decades years,^{3,4} suicide is still an important public health problem in China. In investigating the patterns and exploring the risk factors of Chinese suicide, previous researchers found that the risk factors for suicide were complex, including social, psychological, cultural, and biological factors.^{5–7} Recently, a growing body of literature has appeared on the associations between sleep problems and suicide.^{8–11}

For suicide ideation or attempt, Wong and colleagues¹² found that having trouble sleeping was a strong predictor for suicidal thoughts and self-harm behaviors in adolescence. A national study in the USA indicated that short sleep was associated with suicidal ideation and suicide attempts.¹³ Another nation-wide

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study in Hungarians also illustrated that nightmares had an independent role in the formation of suicidal behavior.¹⁴ Similar results were also found in some special samples.^{15–17} There were also some studies that conducted the association between sleep problems and completed suicide.^{18,19} A cohort study in Norway reported that sleeping problem was a marker of suicide risk.²⁰ Similar results were also found in another cohort study in Japan.²¹ A study among veterans also showed that sleep disturbance was associated with time to suicide in this sample of veterans who died by suicide.²²

With the previous studies having identified the relationship between sleep problems and suicide, there are some further questions which need be discussed. First, which kinds of sleep problems are most important among all the sleep problems? Second, how sleep problems affect suicide? Some studies have indicated that insomnia can be a symptom of mental disease, and mental diseases rather than sleep problems predicting suicide.²³ Some other studies showed that insomnia increased the risk of mental disorder, and mental disorder mediated the association between insomnia and suicide.^{10,20}

In this study, we aim to answer the following questions: (i) Which kinds of insomnia are most important in completed suicide? (ii) Can insomnia be a risk factor when mental disorder is controlled for? (iii) Can mental disorder be a mediator between insomnia and suicide? These may be helpful for us to further understand the association between insomnia and completed suicide in China, and find some methods that are useful for suicide prevention.

METHODS

Subjects

Subjects were 388 consecutively recruited suicides and 416 community living controls aged 15–34 years in the rural areas of three provinces (Liaoning, Hunan and Shandong) in China. Liaoning is an industrial province located in Northeast China, Hunan is an agricultural province in Central South China, and Shandong is a province with economic prosperity in both industry and agriculture that is located on the east coast of China mid-way between Liaoning and Hunan. Sixteen rural counties were randomly selected from the three provinces (six from Liaoning, five from Hunan, and five from Shandong). Suicides aged 15–34 years were consecutively recruited from October 2005 through June 2008. Similar numbers of comparison subjects aged 15–34

years were recruited in the same communities during approximately the same period.

Procedure

In each of the 16 counties, all village doctors in the research areas were required to report suicidal deaths to the county level Center for Disease Control and Prevention (CDC) by steps. A project coordinator from the county level CDC monitored suicide occurrences. In each of the three provinces, a project director from the provincial CDC or the university the study was affiliated with received reports on suicide cases each month.

For each suicide, we tried to interview two informants. For each control, we tried to interview two informants and themselves. However, we recognized that the type of informants rather than the number of informants used in psychological autopsy studies was an extremely important and complex consideration.²⁴ We selected the informants based on the context or environment (how people observe the target, e.g. home vs. non-home setting). This way, each informant was carefully selected to optimize the information available on each case so that home, work, family and non-family aspects were included in the data.

Based on the above considerations, we used the following three guidelines for the inclusion of informants: (i) Informants were selected with recommendations from the village head and the village doctor, as those individuals were most familiar with the subject's life and circumstances, who were available for, and consented to, in-person interviews. (ii) Although target persons could be as young as 15 years of age, informants had to be 18 years of age or older. Characteristics of the informants were noted in several questions (i.e., most recent contact, number of contacts in the last month, frequency of contacts in the last year, number of years informant has known the target, relationships, and the informant's impression of their familiarity with target).³ Informant #1 was always a parent, spouse, or another important family member, and informant #2 was always a friend, co-worker, or a neighbor.

Informants were first approached by the local health agency or the village administration, who could identify the suicide case on the job, by a personal visit. Upon their agreement on written informed consent, the interview time was scheduled between 2 and 6 months after a suicide incident. Each informant was interviewed separately by one trained interviewer, in a private place of a hospital/clinic or the informant's home. The average time for each interview was 2.5 h.

Due to the fact that the cases were deceased, blinding of raters to case status was not possible. Inter-rater reliability was established and maintained by limiting the principal data gathering role to the 24 trained clinical interviewers and by comparison of duplicate ratings of the interviewers on a regular basis. The same interviewers participated in data collection for the case samples, promoting inter-rater reliability across that study.

There were two proxy interviews for each suicide case or control. The majority of the responses for the target person were the same or similar. For different responses pertaining to the target person, data were integrated with the following three principles. For demographic information, we basically relied on the answers by the informant who had the best access to the information. For example, a family member should be able to tell the target person's age and birth date more accurately than does a friend. Second, in estimating the cultural values of the target person, we used the higher score of the two informants' responses if they are different. Finally, to determine a diagnosis with the Structured Clinical Interview for the Diagnostic (SCID), we selected the response representing a positive symptom, because the other informant may not have had an opportunity to observe the specific characteristic or behavior. These three guidelines were applied in integrating responses of suicide cases and controls.

This study was approved by the institutional review boards of State University of New York College at Buffalo; Central South University, Hunan; Provincial Center for Disease Prevention and Control, Liaoning; and Shandong University, Shandong. The research nature of the interview and the background of the research project were explained to all interviewees, and informed consent forms detailing the rights of interviewees were read and signed by both parties prior to each interview.

Measures

As there were few being separated, widowed or divorced, marital status was categorized as "never married", "being married," and "others" including those who were divorced, separated, or widowed. Occupation was measured by farmer, businessman, government employee, student, factory worker, rural doctor, teacher, housewife, unemployed and others. It was re-coded to farming peasants, factory workers and others. Religious belief was assessed by asking what religion the target person believed in, and the choices were Atheism, Taoism, Muslim, Christianity, Buddhism, and other reli-

gion. The atheist group was seen as having no belief, and the others were seen as having a religious belief.

Mental disorder

We used the Chinese version of the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders (SCID)²⁵ to generate diagnoses for suicides. Diagnoses were made by the psychiatrists on each team in a consensus meeting at which all responses from each informant were presented by the interviewers.

Impulsivity

Dysfunctional impulsivity was measured by the Dickman Impulsivity Inventory (DII),²⁶ and the scale was translated and validated in Chinese samples prior to this current project.²⁷

Insomnia symptom

We used three questions from the Hamilton Depression Rating Scale (HAMD) about insomnia to estimate it.²⁸ The first question was about difficulty initiating sleep (DIS) (is it difficult to fall asleep at night?), the answer can be chosen from three options: 0 = no difficulty; 1 = occasional difficulty falling asleep (i.e. more than 1/2 an hour); 2 = nightly difficulty falling asleep. The second question was about difficulty maintaining sleep (DMS) (Did you wake up during the night, and found it hard to fall asleep again?), the answer also could be chosen from three options: 0 = no difficulty; 1 = being restless and disturbed during the night; 2 = waking during the night – any getting out of bed (except to void). The third question was about early morning awakening (EMA) (Did you wake up earlier in the morning than before, and found it hard to fall asleep again?), the answer also can be chosen from three options: 0 = no; 1 = waking in early hours of morning but going back to sleep; 2 = unable to fall asleep again if getting out of bed. If a question was scored 1 or 2, the subject was considered to have the corresponding insomnia. If all of the three questions were scored 0, the subject was considered as having no insomnia. For the suicide cases, we asked about sleeping disorder observed during the week prior to the suicide date. For the community controls, we asked about sleep disorder during the week prior to the interview.

Statistical analysis

SPSS for Windows (version 16.0) was used for data analysis. *T*-test or χ^2 test was used to compare the

Table 1 Description of the case and control ($n = 804$)

Variables		Case ($n = 388$)		Control ($n = 416$)		χ^2/t	P-value
		Mean/n	SD/%	Mean/n	SD/%		
Gender	Male	177	45.6	214	51.4	2.726	0.099
	Female	211	54.4	202	48.6		
Age	–	26.53	6.36	26.68	6.19	–0.338	0.735
Education years	–	7.37	2.76	9.14	2.39	9.709	0.000
Ethnicity	Han	354	91.2	382	91.8	0.090	0.764
	Others	34	8.8	34	8.2		
Marital status	Never married	161	41.5	144	34.6	15.486	0.000
	Being married	208	53.6	267	64.2		
	Others	19	4.9	5	1.2		
Occupation	Farming peasants	196	50.5	173	41.6	75.866	0.000
	Factory workers	110	28.4	45	10.8		
	Others	82	21.1	198	47.6		
Religious belief	Yes	30	7.7	24	5.8	1.234	0.267
	No	358	92.3	392	94.2		
Living alone	Yes	34	8.8	17	4.1	7.390	0.007
	No	354	91.2	399	95.9		
Impulsivity	–	13.81	5.64	11.33	4.03	–7.207	0.000
Physical disease	Yes	138	35.6	57	13.7	52.243	0.000
	No	250	64.4	359	86.3		

difference in continuous or categorical variables across groups. Logistic regression analysis was performed to examine the factors related to suicide. Gender, age, education years, marital status, occupation, religious belief, living alone, physical disease, impulsivity, mental disorder, insomnia symptom (DIS, DMS or EMA) were chosen as the independent variables in the regression. The thesis brought the unordered categorical variable (such as occupation) as dummy variables into the regression analysis model. All tests were two-tailed and a P -value of <0.05 was considered statistically significant.

Multiple mediator macros SPSS (INDIRECT) was used to analyze the mediator effect.²⁹ There are four steps to conduct the mediating effect.³⁰ First, the independent variable should be associated with the dependent variable without the mediator (path c). Second, the independent variable should be associated with the mediator (path a). Third, the mediator should be associated with the dependent variable (path b). Finally, it should conduct the regression between independent variable and dependent variable with the mediator (path c'). If the association becomes non-significant, it is a complete mediation. If the association decreases but remains statistically significant, it is a partial mediating effect.³¹

RESULTS

Socio-demographic characteristics of the sample

Socio-demographic characteristics of the sample are presented in Table 1. A total of 804 subjects answered the questions regarding insomnia.

Mental disorder and insomnia symptoms in the cases and the controls

The distribution of mental disorder and insomnia are illustrated in Table 2. The results show that the percentage of mental disorder in the suicide cases (47.4%) is higher than the community controls (3.8%). There is also a statistical difference with suicide on DIS ($P = 0.000$), DMS ($P = 0.000$), EMA ($P = 0.000$) and any insomnia ($P = 0.000$). The percentages of insomnia in the cases are much higher than in the controls.

Logistic regression analysis

The logistic regression analyses of suicide are shown in Table 3. When we adjust mental disorder, the OR of insomnia changes from 25.25 to 10.63 (Model 1 and 2).

Table 2 Distribution of mental disorder and insomnia symptom in suicides and controls

Variables	Yes (n and %)		χ^2	P
	Case (n = 388)	Control (n = 416)		
Mental disorder	184 (47.4)	16 (3.8)	204.00	0.000
DIS	109 (28.1)	5 (1.2)	119.30	0.000
DMS	85 (21.9)	3 (0.7)	92.45	0.000
EMA	80 (20.6)	4 (1.0)	82.91	0.000
Any insomnia symptom	129 (33.2)	8 (1.9)	139.30	0.000

DIS, Difficulty Initiating Sleep; DMS, Difficulty Maintaining Sleep; EMA, Early Morning Awakening.

Education years (OR = 0.78), occupation, physical disease (OR = 3.38), impulsivity (OR = 1.12), mental disorders (OR = 13.21) and insomnia (OR = 10.63) are significantly associated with suicide in Chinese rural youths. DIS, DMA or EMA is also associated with suicide (Model 3–5).

The mediating effect of mental disorder between insomnia symptom and suicide

Table 4 shows the results of mediating effect, and mental disorder can be a mediator between insomnia and suicide. It is a partial mediating effect. The indirect effects of mental disorder (Path $a \times b$) can explain about 47% ($1.5226/3.2348 \times 100\% = 47.07\%$) of the total effect.

DISCUSSION

In this study, we found that the prevalence rates of insomnia symptoms in the cases and the controls were 33.2% and 1.9% in the last week, respectively. However, the criteria and time frame for insomnia are different in various studies, and the prevalence rates are also in a large range. A study in the Chinese general population showed that the prevalence rate of insomnia symptom defined by the Fourth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) was 9.2%.³² Another study showed that there were 23.7% of subjects who experienced insomnia symptoms estimated by Insomnia Severity Index in the last month.³³ However, a study that used the same criterion with us found that the rates of insomnia symptoms were respectively 30% and 3% in the cases and the controls.¹⁸ They are close to our results. In our study, the insomnia was estimated for the past one week. It is helpful for us to examine the insomnia symptoms immediately prior to suicide.

We also found that the prevalence rate of mental disorder was 47.4% in the suicide cases. Some other studies also showed that mental disorders can be found about 40–70% of all suicides in China.^{5,34} However, the prevalence rate of mental disorder among suicides in the West countries was over 90%.³⁵ One possible explanation for the differences is that suicides in China are more strongly related to social stresses or cultural differences.^{36,37} It may also be caused by the effect of stigma on reporting of mental disorder.^{38,39} Although the prevalence rate of mental disorder among Chinese suicides is at a lower level, it is also a strong predictor for suicide which has been identified in many studies.⁴⁰

Our results supported that insomnia could be a factor associated with completed suicide in Chinese rural youths. The cohort studies in Norway and Taiwan also identified that the sleeping problems were associated with committing suicide.^{19,20} The similar results were also found in some other studies.^{18,41} The results showed that DIS, DMS or EMA was associated with suicide even after mental disorder was controlled for. Similar results were also identified in previous studies.⁴²

Previous studies illustrated that insomnia can be a symptom of mental disease, and mental disease rather than insomnia predicted suicide.²³ In our study, the results support that insomnia can be a risk factor for suicide even after mental disorder is controlled for. The results are also found in previous studies. A study among undergraduate students showed that insomnia symptoms were significantly associated with suicide risk independent of controlling for mental symptoms.⁴³ The result was also found among veterans,²² and college students.⁴⁴ So we can conclude that insomnia is an independent risk factor for suicide.

Some others claimed that insomnia increases the risk of mental disorder and mediate by mental disorder and life style factors.^{10,20} The results of mediation analysis showed that mental disorder can be a partial mediator

Table 3 Logistic regression analysis for suicide (OR and its 95% CI)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Gender (male)	1.06 (0.73, 1.54)	0.93 (0.62, 1.40)	0.94 (0.63, 1.40)	0.96 (0.65, 1.44)	0.90 (0.60, 1.35)
Age	0.97 (0.93, 1.01)	0.96 (0.92, 1.01)	0.96 (0.92, 1.01)	0.97 (0.93, 1.02)	0.98 (0.93, 1.02)
Education years	0.78 (0.72, 0.84)***	0.78 (0.72, 0.85)***	0.78 (0.72, 0.85)***	0.79 (0.73, 0.86)***	0.79 (0.72, 0.85)***
Ethnicity (Others)	0.98 (0.52, 1.86)	1.05 (0.54, 2.04)	1.05 (0.55, 2.03)	1.03 (0.53, 1.98)	1.06 (0.55, 2.04)
Marital status (reference = others)					
Never married	0.54 (0.16, 1.82)	0.55 (0.15, 2.04)	0.58 (0.16, 2.11)	0.44 (0.12, 1.56)	0.48 (0.13, 1.73)
Being married	0.45 (0.14, 1.41)	0.48 (0.14, 1.63)	0.50 (0.15, 1.67)	0.36 (0.11, 1.17)	0.37 (0.11, 1.23)
Occupation (reference = others)					
Farming peasants	1.72 (1.11, 2.67)*	1.71 (1.06, 2.76)*	1.68 (1.04, 2.70)*	1.77 (1.10, 2.85)*	1.73 (1.07, 2.78)*
Factory workers	5.01 (2.99, 8.40)***	4.94 (2.86, 8.53)***	4.95 (2.88, 8.53)***	4.81 (2.80, 8.28)***	5.12 (2.98, 8.78)***
Religious belief	1.42 (0.69, 2.93)	1.54 (0.71, 3.31)	1.51 (0.70, 3.23)	1.42 (0.65, 3.07)	1.54 (0.72, 3.30)
Living alone	1.76 (0.83, 3.73)	1.57 (0.71, 3.49)	1.52 (0.69, 3.36)	1.43 (0.64, 3.18)	1.43 (0.64, 3.18)
Physical disease	3.38 (2.17, 5.28)***	2.01 (1.23, 3.31)*	2.03 (1.24, 3.32)**	2.01 (1.24, 3.27)**	2.05 (1.26, 3.33)**
Impulsivity	1.11 (1.06, 1.15)***	1.12 (1.08, 1.17)***	1.13 (1.08, 1.18)***	1.13 (1.09, 1.18)***	1.13 (1.09, 1.18)***
Mental disorder	—	13.21 (7.03, 24.82)***	13.23 (7.06, 24.76)***	14.76 (7.96, 27.39)***	16.27 (8.76, 30.22)***
Insomnia symptom	25.25 (11.40, 55.92)***	10.63 (4.57, 24.69)***	—	—	—
DIS	—	—	12.01 (4.32, 33.39)***	—	—
DMS	—	—	—	12.82 (3.67, 44.77)***	—
EMA	—	—	—	—	12.08 (3.87, 37.76)***
Constant	2.66	1.90	1.76	1.87	1.48
Nagelkerke R ²	0.48	0.57	0.56	0.55	0.56

***P < 0.001, **P < 0.01, *P < 0.05. CI, Confidence Interval; DIS, Difficulty Initiating Sleep; DMS, Difficulty Maintaining Sleep; EMA, Early Morning Awakening; OR, Odds Ratio.

Table 4 Mediating effect of mental disorder between insomnia symptom and suicide

Path	Independent variable	Dependent variable	β	SE	P
a	Insomnia symptom	Mental disorder	0.589	0.035	0.000
b	Mental disorder	Suicide	2.586	0.284	0.000
c	Insomnia symptom (without mental disorder)	Suicide	3.235	0.373	0.000
c'	Insomnia symptom (with mental disorder)	Suicide	2.348	0.394	0.000

B is partial regression coefficient, and SE is its standard error.

between insomnia and suicide. So we can conclude that insomnia can influence suicide by mental disorder, and it also has a direct effect on suicide. A study in Japanese white-collar employees showed there is a significant indirect effect of insomnia symptoms on suicide ideation through depressive symptoms.⁴⁵ For suicide victims, the pattern has also been identified.⁴²

There is a well-known limitation for the psychological autopsy method we have used for the data collection in this study. As data were obtained from the proxy informants, errors and biases can be a problem for the truth of the data. For example, mental disorders diagnosed with SCID without the presence of the target person may not be as accurate as a face-to-face interview between the patient and the psychiatrist. Also we estimated insomnia based on the information from informants, so it cannot be an exact diagnosis. The informants reported it based on their observations of symptoms.

Despite these limitations, this study has provided much information on the relationship between insomnia and rural youth suicide in China. In this study, we found that insomnia could increase the risk of suicide even after mental disorder was controlled for. DIS, DMS or EMA were also associated with suicide. Mental disorder can be a mediator between insomnia and suicide, and it was a partial mediation effect. The major finding that insomnia can influence completed suicide may be translated into practical measures in suicide prevention in China as well as elsewhere in the world. Assessment of insomnia may be an effective method for detecting suicide.

CONFLICT OF INTEREST

All the authors declare that they have no conflicts of interest.

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