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ORIGINAL RESEARCH

Relationship Between Sleep Time and Depressive Symptoms in Middle-Aged and Elderly Chinese: Mediating Role of Body Pain

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Objective: Existing research has yet to adequately examine the correlation between sleep time, body pain, and depressive symptoms. This study seeks to elucidate the interconnections between these three elements.

Methods: The study used 2020 CHARLS data for analysis. To assess the intricate association among sleep time, body pain, and depressive symptoms, the study employed Spearman correlation analysis, multiple logistic regression, restricted cubic splines, and mediation effect analysis based on bootstrap testing.

Results: Risk factors for depressive symptoms in middle-aged and elderly Chinese include physical pain and reduced sleep duration. Results from the RCS suggest that the lowest risk of depressive symptoms occurs when the sleep time for the middle-aged and elderly population is approximately 7.5 hours. Body pain accounts for a 19.05% mediating effect between sleep time and depressive symptoms, and even after controlling confounding factors, there remains a 7.5% mediating effect.

Conclusion: The research findings indicate that there is a significant correlation among sleep time, body pain, and depressive symptoms. Insufficient sleep time and body pain can lead to depressive symptoms. Body pain plays a partial mediating role between sleep time and depressive symptoms.

Keywords: middle-aged and elderly people, sleep time, body pain, depressive symptoms

Introduction

The World Health Organization reports that depression is a major contributor to global disability and a significant part of the worldwide disease burden, affecting over 350 million people.[1,2] In China, the prevalence of depression among the elderly surpasses 20%, with many exhibiting symptoms without meeting full clinical diagnostic criteria.[3,4] As a psychological disorder, depression can precipitate a range of health complications; research indicates that those with depression are substantially more likely to develop heart disease and chronic conditions than those without.[5] In extreme cases, it can lead to suicidal behavior, highlighting depression's status as a critical public health concern globally and within China. Findings from the China Health and Retirement Longitudinal Study point to a rising prevalence of

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depressive symptoms nationwide.[6] With advancing urbanization and an increasing aging population, the determinants of depression among middle-aged and elderly Chinese are becoming more complex and varied.[7]

Some studies have shown a correlation between sleep and depression, but the dose-response relationship has not been clearly explained.[8] Previous research has established a correlation between the duration of sleep and the manifestation of depressive symptoms in middle-aged and elderly individuals.[9] Sleep duration, as a significant factor influencing the risk of depression, has now garnered considerable attention. Studies have indicated that insomnia or short sleep duration can increase the risk of developing depression.[10] Additionally, sleep disturbances serve as a factor in the recurrence of depression and as a predictor of its onset.[11] However, there are also studies suggesting that restricting sleep can alleviate negative moods, thereby reducing the likelihood of developing depression.[12] Current research has predominantly focused on the effects of short sleep duration on depression, with fewer studies examining the impact of prolonged sleep duration. Therefore, the relationship between sleep duration and depression warrants further investigation.

Globally, physical pain is a prevalent issue among older adults, resulting in substantial health consequences.[13–15] Prior research has established a link between sleep duration and physical pain, revealing that poor sleep quality can worsen chronic pain symptoms.[16] A review study found a two-way effect between sleep and pain, with poor sleep quality exacerbating pain and pain disrupting sleep.[17] The study of American showed, sleep-active basal cortical pathways were critical for the production and maintenance of chronic pain. Studies in China have also found that poor sleep duration and quality at night can lead to lower back pain.[18] Furthermore, evidence suggests that physical pain can increase the likelihood of depressive symptoms in this demographic. The review of studies found that both physical and psychological pain significantly increased the risk of depression symptoms.[19] Studies in China have found that lower back pain can worsen depressive symptoms.[20] Significantly, chronic pain has been found to triple the risk of developing depression symptoms in comparison to individuals without chronic pain.[21] It is evident that both sleep time and body pain significantly influence the prevalence of depressive symptoms in middle-aged and older adults. Additionally, a correlation exists between sleep duration and physical pain. Current research indicates that as individuals age and experience a decline in bodily functions, middle-aged and older adults encounter an increasing number of health challenges, with sleep disturbances and physical pain being common issues.[22,23] A recent review study found that sleep disorders play a partial mediating role between depressive symptoms and chronic pain. Therefore, it is crucial for research to investigate the connections between sleep duration, physical pain, and depression. While studies have examined these relationships among middle-aged and older Chinese populations, there is a scarcity of research using large, recent national samples.[24] Furthermore, the causal pathways linking sleep duration and physical pain to depression have yet to be fully elucidated.

This study utilized data from the 2020 China Health and Retirement Longitudinal Study (CHARLS) to investigate the association between sleep time and depressive symptoms among middle-aged and elderly Chinese, and to examine the mediating role of body pain in this relationship. The following hypotheses are proposed and tested in this study. First, sleep duration is hypothesized to influence depressive symptoms. Second, physical pain is posited to have an impact on depressive symptoms. Third, it is suggested that sleep duration affects physical pain, which subsequently influences depressive symptoms. The findings offer valuable insights for the development and implementation of mental health policies aimed at improving the well-being of China's middle-aged and elderly population, thereby holding significant social importance.

Methods

Data Resource

The dataset utilized in this study is derived from the 2020 China Health and Retirement Longitudinal Study (CHARLS), which is dedicated to amassing high-quality micro-data that accurately represents individuals and households aged 45 and older in China. This dataset encompasses five waves of data collection, starting with the baseline survey in 2011 and extending through to the latest survey conducted in 2020. It spans 30 provinces or municipalities, encompassing 150 counties (districts) and 450 communities (villages) across China. After eliminating individuals younger than 45 years of age, and cases with missing values for key variables (such as depressive symptoms, sleep time, and body pain) as well as other control variables, the final sample comprised 5724 participants. The methodology for selecting the sample is illustrated in Figure 1.

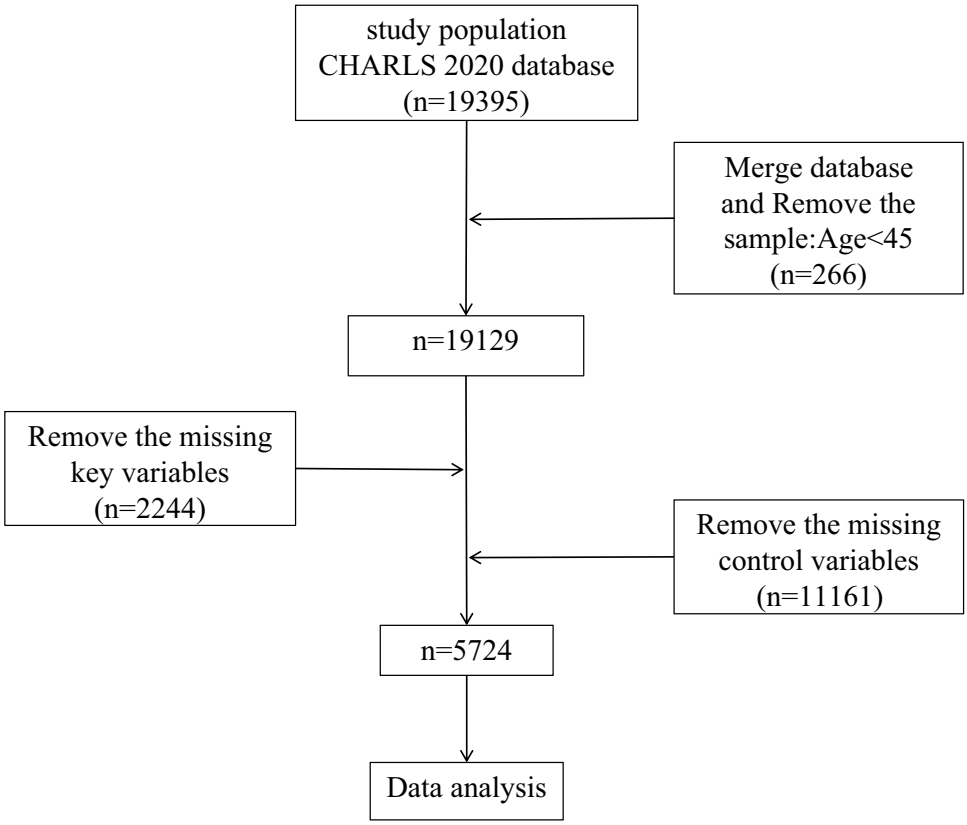

Figure 1 Sample selection process.

Measurement

Depressive Symptoms

Depressive symptoms were measured using the CES-D scale in the questionnaire. The scale consists of four levels, "rarely or not at all =0", "not much =1", "sometimes or half the time =2", "most of the time =3", with a total score of 0 to 30. When an individual's total score is greater than or equal to 10 points, they are considered to have depressive symptoms and are classified as depressed. When an individual's total score is less than 10 points, they are considered to have no depressive symptoms and are classified as non-depressed. The scale has been widely used to measure depression symptoms in Chinese middle-aged and elderly people and has a good measurement effect.[25]

Sleep Time

Sleep time was measured using the questionnaire question "About how many hours did you actually sleep each night during the past month?(Probably less than the time spent in bed)".The time to fill this question is between 0 and 24 hours. The reliability of self-reported nighttime sleep duration has been validated within the field of sleep epidemiology.[26] According to previous research, continuous variables are often used to evaluate sleep duration in CHARLS databases.[27,28]

Body Pain

Body pain was measured using the questionnaire question "Do you often suffer from pain?" Is it nothing, a little, some, quiet a lot, or a lot?". Self-reported measures of body pain have been used in most epidemiological studies of pain.[29] Based on previous research, we divided these responses into two categories, with and without body pain.[30] This study classified "not at all" as having no body pain, and "a little", "some", "quite a lot", and "a lot" as having body pain.[31,32]

Control Variable

We referred to several previous research, considering that it was critical to control potential covariates that may affect results when using CHARLS databases.[33] The study incorporated covariates grouped into three categories:

sociodemographic factors, lifestyle factors, and health status.[34,35] Sociodemographic factors encompassed gender, age, place of residence, marital status, and educational level. Places of residence were classified into rural, township, and urban areas. Both age and gender significantly influenced sleep time and pain prevalence.[31,36] Education and residence indicated socioeconomic status. Different Marital status affects depressive symptoms differently[36] Marital status was divided into married and not in a marital relationship. Educational levels were divided into three groups: primary or below, secondary, and tertiary. Lifestyle factors assessed included alcohol consumption and smoking habits. Smoking and drinking were risk factors for many diseases.[37,38] Health status variables consisted of self-rated health, which was further categorized into good, fair, and poor, as well as the presence of chronic diseases. Self-rated health reflected an individual's overall health assessment and influenced depression, pain, and sleep duration.[31,36] Chronic diseases were linked to depression, making them a significant confounding variable.[36]

Statistical methods

Frequency and percentage statistics were used for categorical data, and chi-square test was used for component comparison. Mean and standard deviation statistics were used for measurement data, and *T*-test was used for inter group comparison. Spearman correlation analysis and variance inflation factors were used to check the collinearity of explanatory variables, and all variables passed the collinearity test.[39] (Table S1 and Table S2 in supplementary) Spearman correlation analysis was employed to examine the relationships among depressive symptoms, sleep time, and body pain. Multiple logistic regression model was used to explore the influencing factors of depressive symptoms. We build a crude model and a fully tuned model. Restricted cubic spline was used to explore the nonlinear relationship between sleep time and depressive symptoms. Mediation analysis was further used to explore the role of body pain between sleep time and depressive symptoms, and bootstrap method was used to test the mediation effect. Finally, we performed binary logistic regression to verify the robustness of the main results by excluding samples with chronic diseases. (Table S3 in supplementary) This study used stata 17.0 for data processing and analysis. The threshold for statistical significance in this study was established at P values less than 0.05.

Results

Sample Characteristics

The overall prevalence of depressive symptoms in the sample was 44.86%.Chi-square test and *T* test showed that the differences in gender, age, residence, education, marriage, drinking, smoking, self-rated health, chronic disease, body pain, and sleep time were statistically significant. (Table 1) In the depressive symptoms group, the prevalence of depressive symptoms in females was 87.58%, and that in males was 12.42%, with a significantly higher prevalence in females than in males. The average age of the non-depressive symptoms group was (58.87±9.08) years old, and that of the depressive symptoms group was (61.49±9.29) years old. There were 3476 individuals living in rural areas, 734 in towns and villages, and 1514 in cities. Most individuals had an education level of primary school or below and were married. Most individuals did not have smoking or drinking behaviors. In the depressive symptoms group, 86.57% of the individuals rated their self-rated health as general or poor. Most individuals had chronic diseases, especially in the depressive symptoms group, where 77.49% of the individuals had chronic diseases. The average sleep time of the non-depressive symptoms group was (6.40 ±1.63) hours, while the average sleep time of the depressive symptoms group was (5.50±2.03) hours. Most people had body pain, and 75.51% of the individuals in the depressive symptoms group had body pain.

Correlation Analysis

Spearman correlation analysis revealed significant associations among depressive symptoms, sleep duration, and body pain. (Table 2) Sleep duration exhibited a negative correlation with depressive symptoms (r=−0.25) and body pain (r=−0.21). Conversely, body pain showed a positive correlation with depressive symptoms (r=0.26). These results also satisfy the prerequisites for subsequent mediation analysis.

Table 1 Sample Characteristics Classified by Depressive Symptoms or Not

Variable	No depressive symptoms 3156(55.14)	Depressive symptoms 2568(44.86)	*P* value
Gender			*p*<0.001
Male	770(24.40)	319(12.42)	
Female	2386(75.60)	2249(87.58)	
Age	58.87±9.08	61.49±9.29	*p*<0.001
Residence			*p*<0.001
Rural	1716(54.37)	1760(68.54)	
Town	449(14.23)	285(11.10)	
City	991(31.40)	523(20.37)	
Education			*p*<0.001
Primary and below	1856(58.81)	1982(77.18)	
Secondary school	1200(38.02)	561(21.85)	
Junior college or above	100(3.17)	25(0.97)	
Marital status			*p*<0.001
Nonexistent marriage	409(12.96)	526(20.48)	
marriage	2747(87.04)	2042(79.52)	
Drinking			*p*<0.001
No	2256(71.48)	2080(81.00)	
Yes	900(28.52)	488(19.00)	
Smoking			*p*<0.001
No	2986(94.61)	2490(96.96)	
Yes	170(5.39)	78(3.04)	
Body pain			*p*<0.001
No	1572(49.81)	629(24.49)	
Yes	1584(50.19)	1939(75.51)	
Self-rated health			*p*<0.001
good	1161(36.79)	345(13.43)	
common	1544(48.92)	1162(45.25)	
poor	451(14.29)	1061(41.32)	
Chronic disease status			*p*<0.001
No	1350(42.78)	578(22.51)	
Yes	1806(57.22)	1990(77.49)	
Sleep time	6.40±1.63	5.50±2.03	*p*<0.001

Table 2 Correlation Analysis of Depressive Symptoms, Sleep Time and Body Pain

	Depressive symptoms	Sleep time	Body pain
Depressive symptoms	1		
Sleep time	−0.25*	1	
Body pain	0.26*	−0.21*	1

Note:* indicates *P*<0.01.

Binary Logistic Regression Analysis

Table 3 presents the odds ratios (OR) and 95% confidence intervals (CI) for variables significantly associated with the onset of depressive symptoms in middle-aged and elderly individuals, as determined by univariate analysis. Model 1 and Model 2 show the binary logistic regression results of whether depressive symptoms occur in middle-aged and elderly people. Model 1 only includes two variables: sleep time and body pain. The results show that both sleep time and body

Table 3 Multiple Model Binary Logistic Regression Analysis

Variable	Model 1		Model 2	
	OR(95% CI)	*P* value	OR(95% CI)	*P* value
Sleep time	0.79(0.77–0.82)	*p*<0.001	0.83(0.80–0.86)	*p*<0.001
Body pain				
No	1		1	
Yes	2.67(2.38–3.00)	*p*<0.001	1.68(1.47–1.91)	*p*<0.001
Gender				
Male			1	
Female			1.52(1.28–1.81)	*p*<0.001
Age			1.01(1.01–1.02)	*p*<0.001
Residence				
Rural			1	
Town			0.70(0.59–0.84)	*p*<0.001
City			0.59(0.51–0.68)	*p*<0.001
Education				
Primary and below			1	
Secondary school			0.65(0.56–0.74)	*p*<0.001
Junior college or above			0.48(0.30–0.77)	0.003
Marital status				
Nonexistent marriage			1	
marriage			0.78(0.66–0.92)	0.003
Drinking				
No			1	
Yes			0.87(0.75–1.01)	0.070
Smoking				
No			1	
Yes			0.87(0.63–1.20)	0.381
Self-rated health				
good			1	
common			1.87(1.60–2.19)	*p*<0.001
poor			4.01(3.32–4.85)	*p*<0.001
Chronic disease status				
No			1	
Yes			1.24(1.07–1.42)	0.003

pain are important influencing factors for the occurrence of depressive symptoms. Depression risk decreased with increasing sleep time. People with body pain were 2.67 times more likely to have depressive symptoms than people without body pain. Model 2 includes confounding variables for control, and the two variables of sleep time and body pain are still significant in the model. Specifically, the incidence of depressive symptoms in women is 1.52 times higher than that in men. Aging is a risk factor for developing depressive symptoms. Increasing sleep time may reduce the risk of depression symptoms. The incidence of depressive symptoms in people with body pain is 1.68 times higher than that in people without body pain. The incidence of depressive symptoms in people with chronic diseases is 1.24 times higher than that in people without chronic diseases. The incidence of depressive symptoms in people with general self-rated health and poor self-rated health is 1.87 times and 4.01 times higher than that in people with good self-rated health. The likelihood of exhibiting symptoms of depression among populations residing in towns and cities is 70.3% and 58.9% of that in rural populations, respectively. The risk of depressive symptoms was 64.6% for those with a secondary education and 47.8% for those with an associate's degree or above, compared with those with a primary school education or less. The risk of depressive symptoms in married people was 0.78 times higher than People who are not in a marital

relationship. Smoking and drinking did not have a significant effect on the occurrence of depressive symptoms in Model 2.

Nonlinear Analysis of Sleep Time and Depressive Symptoms

To further elucidate the association between sleep duration and depressive symptoms, the study employed the restricted cubic spline method to adjust for confounding factors and examine this relationship across three distinct groups: the entire middle-aged and elderly population, as well as the male and female cohorts within this demographic. For the general population, an optimal sleep time was identified at approximately 7.5 hours (OR=0.51, 95% CI: 0.44–0.59), beyond which the risk of depressive symptoms incrementally increased. (Figure 2) Subgroup analysis revealed that, for women, the risk of depressive symptoms significantly dropped at around 7.5 hours of sleep (OR=0.48, 95% CI: 0.41–0.57) and subsequently began a gradual ascent. (Figure 3) Conversely, for men, the trend between sleep time and depression risk paralleled the linear analytical results, indicating a higher risk of depressive symptoms with shorter sleep duration (Figure 4).

Mediating Effects of Body Pain on Sleep Time and Depressive Symptoms

Based on the aforementioned analysis, to further verify the relationship between physical pain, sleep duration, and the onset of depressive symptoms, the present study established Model 3 and Model 4, with the occurrence of depressive

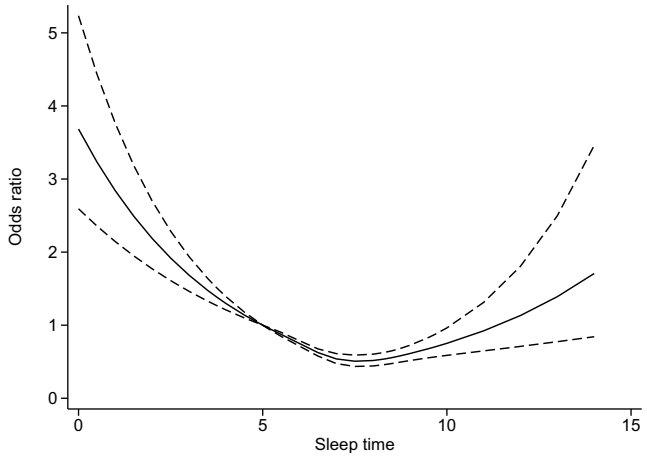

Figure 2 Restriction cubic splines of sleep time and depression in the whole population.

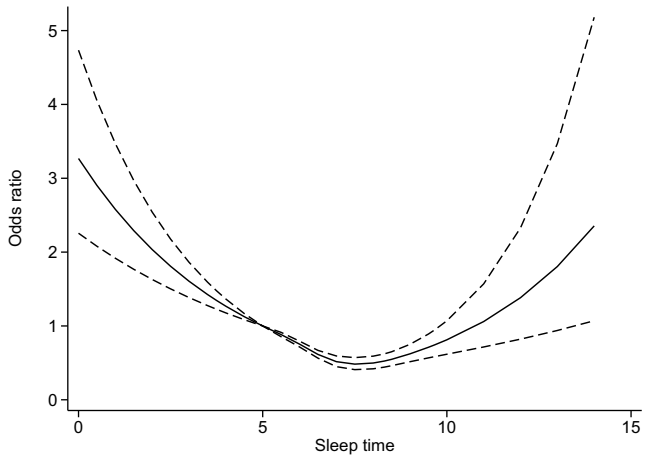

Figure 3 Restriction cubic splines of sleep time and depression in the female.

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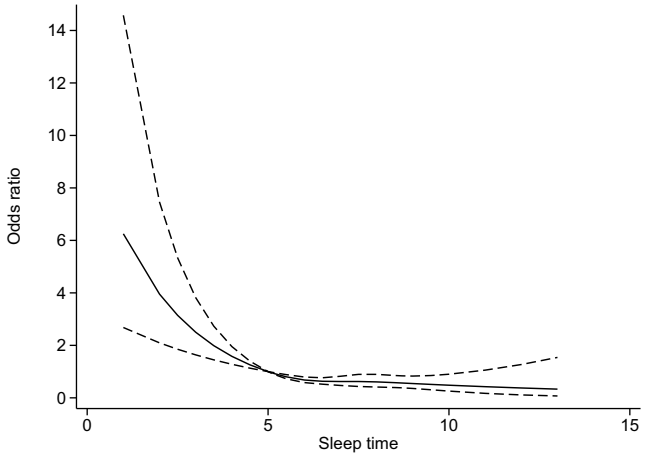

Figure 4 Restriction cubic splines of sleep time and depression in the male.

symptoms as the dependent variable, sleep duration as the independent variable, and physical pain as the mediating variable. Model 3 included only sleep duration and physical pain. (Table 4) The total effect of sleep duration on depressive symptoms was −0.063 (p<0.001), the direct effect was −0.051 (p<0.001), and the indirect effect was −0.012 (p<0.001), with the mediating effect accounting for 19.05%. Model 4, built upon Model 3, incorporated all control variables. At this point, the total effect of sleep duration on depressive symptoms was −0.040 (p<0.001), the direct effect was −0.038 (p<0.001), and the indirect effect was −0.003 (p<0.001), with the mediating effect accounting for 7.50%. Figure 5 presents a schematic diagram of the mediating effect without adjusting for all control variables. Path c in Figure 5 showed the total effect of sleep time on depressive symptoms as −0.063, path a showed the effect of sleep time on body pain as −0.052, path b showed the effect of body pain on depression symptoms as 0.225, and path C "showed the effect of sleep time on depressive symptoms as −0.051 when body pain acts as a mediator. With significant paths a and b, path C" remains significant, indicating that the mediation is partial.

Sensitivity Analysis

Finally, we performed a sensitivity check. We removed samples with chronic conditions, which can affect depression symptoms. Then, we built two models. Model 1 is the crude model, showing that both pain (OR=2.24, 95% CI: 1.83–2.75) and sleep duration (OR=0.82, 95% CI: 0.78–0.88) influence depressive symptoms. Model 2, a fully adjusted model, showed that sleep duration (OR=0.85, 95% CI: 0.80–0.91) had a protective effect on depressive symptoms, while pain (OR=1.84, 95% CI: 1.49–2.30) exacerbated depressive symptoms. Both models agree with the main results (Table S3 in supplementary).

Table 4 Mediation Effect Model

effect	Model path	Effect value	Standard error	*P* value	95% CI	Mediating effect ratio
Model 3						
Total effect	Sleep time→ depressive symptoms	−0.063	0.0035	*p*<0.001	(−0.070,-0.056)	
Direct effect	Sleep time→ depressive symptoms	−0.051	0.0035	p<0.001	(−0.058,-0.045)	
Indirect effect	Sleep time→ body pain→ depressive symptoms	−0.012	0.0010	p<0.001	(−0.014,-0.010)	19.05%
Model 4						
Total effect	Sleep time→ depressive symptoms	−0.040	0.0034	p<0.001	(−0.047,-0.034)	
Direct effect	Sleep time→ depressive symptoms	−0.038	0.0034	p<0.001	(−0.044,-0.031)	
Indirect effect	Sleep time→ body pain→ depressive symptoms	−0.003	0.0005	p<0.001	(−0.003,-0.002)	7.50%

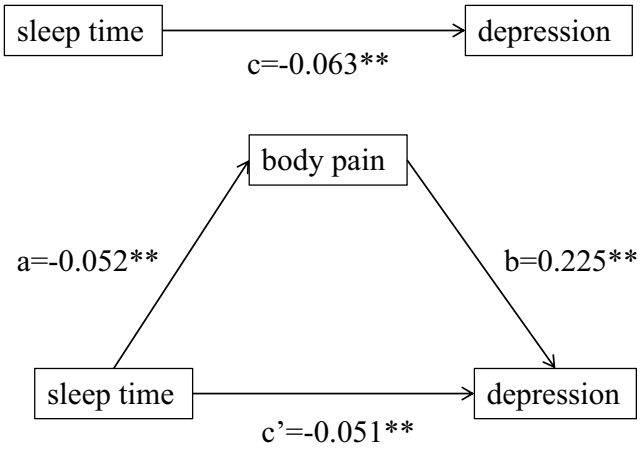

Figure 5 Schematic diagram of the mediating effect.
Note:** indicates P<0.001.

Discussion

To our knowledge, this is the first study to explore the relationship between sleep duration, physical pain, and depressive symptoms in middle-aged and older adults using the 2020 CHARLS database. Our study found that Chinese middle-aged and elderly people are at greater risk of depressive symptoms, and 7.5 hours of sleep may help reduce the risk of depressive symptoms. At the same time, physical pain plays a partial mediating role between sleep duration and depressive symptoms.

The results of this study indicate that the relationship between sleep duration and depression symptoms is complex. Firstly, short sleep duration is associated with an increased risk of depression symptoms, consistent with previous research findings. This may be due to insufficient sleep leading to a decrease in the levels of neurotransmitters that regulate mood, disruption of the circadian rhythm, thereby impacting mental health and causing depression symptoms.[40] Additionally, lack of sleep can increase the body's stress response, leading to an overproduction of stress hormones, which in turn can lead to depression symptoms.[41,42]

Further analysis revealed a nonlinear relationship between sleep duration and the risk of depression symptoms among the general population of middle-aged and older adults, as well as among female middle-aged and older adults, exhibiting an "L" shape. Approximately 7.5 hours of sleep can significantly reduce the risk of depression symptoms, which aligns with the findings of previous studies.[43] Moreover, some research has explored the relationship between long sleep duration and depression symptoms, suggesting that long sleep duration may also increase the risk of depression symptoms.[44] However, in this study, the association between long sleep duration and depressive symptoms was not significant. This could be due to certain limitations of the study itself, such as potential bias in self-reported sleep duration.

The research also found that in the male middle-aged and older adult population, the results of the nonlinear analysis of sleep duration and depression symptoms were close to those of the linear analysis. The shorter the sleep duration, the greater the risk of depression symptoms. Studies have shown that there are indeed differences in the relationship between sleep duration and depression symptoms between male and female populations[45] Men and women may exhibit different psychological reactions and coping strategies when faced with insufficient sleep. The research suggests that inadequate sleep may exacerbate stress responses in men, while women may demonstrate more difficulty with emotional regulation[46.] This may be one reason for their differing responses. Overall, the study concludes that interventions targeting sleep duration can reduce the risk of depression symptoms in middle-aged and older adults. We need to actively intervene using appropriate methods to help this population achieve approximately 7.5 hours of sleep.

Sleep duration can directly affect the risk of depressive symptoms and can also indirectly affect the risk of depressive symptoms through body pain. Sleep time can affect body pain. Studies have shown that insufficient sleep can lead to an increase in inflammatory responses in the body, which may lead to body pain.[47] Sleep time also affects hormone levels,

especially hormones that promote the feeling of pain.[37] Therefore, insufficient sleep duration may increase body pain, which in turn affects the occurrence of depressive symptoms. Studies have shown that the greater the degree of body pain, the greater the risk of depression symptoms.[48] This may be because body pain can cause a decline in quality of life, which may lead to depressive emotions.[49,50] Previous studies have found that depressive symptoms can play an intermediary role between sleep duration and body pain.[51] However, this study found that body pain also played a mediating role between sleep duration and depression symptoms. It can be seen that there may be a bidirectional effect between body pain and depression symptoms.

The study indicates that the prevalence of depressive symptoms among middle-aged and elderly individuals in China is 44.86%, corroborating prior research findings and underscoring the need to address depression symptoms in this demographic.[52] Identified risk factors for depression symptoms in this group include gender, age, place of residence, education level, marital status, self-rated health, chronic disease, sleep time, and body pain. The data reveals that women have a 1.52-fold higher risk of developing depressive symptoms compared to men, a disparity that may be attributed to greater emotional sensitivity in women.[53] Advancing age is associated with an increased risk of depression symptoms, as is a lower level of education, particularly in rural areas, likely due to reduced health literacy and poorer coping mechanisms for negative events.[54,55] Married individuals have a lower risk (0.775 times) of depression than people who not in the marriage, possibly due to the greater social and emotional support marriage provides.[56] Poor self-rated health significantly elevates the risk of depression symptoms, with individuals perceiving their health as poor being 4.009 times more likely to experience depressive symptoms. Therefore, self-rated health is an important factor in the occurrence of depression symptoms. Although self-rated health is a person's subjective assessment of their own health status, it is based on objective physical and mental health status. In this study, the risk of developing depression symptoms was 1.237 times higher with chronic conditions than without chronic conditions, which is consistent with previous research suggesting that many chronic conditions, such as diabetes and high blood pressure, increase the risk of depression symptoms in middle-aged and older adults.[57–59]

Finally, although this study found a significant association between sleep time, body pain, and depressive symptoms, it is necessary to consider the potential impact of lifestyle factors on these relationships. Studies have shown that physical activity was linked to sleep quality and depression symptoms, with regular physical activity helping to relieve pain symptoms and reduced the risk of depression and sleep disorders.[60,61] Dietary habits also played a crucial role in sleep and mood regulation, as a healthy diet could improve sleep quality and have a positive impact on mental health.[62,63] Furthermore, the interplay between sleep and immune function significantly impacted the recovery process and overall mental health of individuals experiencing pain. Adequate sleep has been found to bolster immune function, which subsequently may expedite pain recovery and contribute to improved mental health outcomes.[64] Therefore, while the analysis in this study was limited to survey data and did not include lifestyle and physiological factors such as diet, immune factors, etc, it is important to carefully consider these potential confounding variables when interpreting the results. Future studies are needed to further control for these factors to explore the interrelationship between sleep time, body pain, and depression symptoms.

The study utilized cross-sectional data obtained from the 2020 China Health and Retirement Longitudinal Study (CHARLS). Although it is the latest data, it is still limited in causal inference. Secondly, the sleep duration used in the study was self-reported, which may have certain memory biases, causing bias problems. Third, there may be a two-way relationship between sleep duration, body pain, and depression symptoms that needs further study. However, the study used data from the CHARLS database, and the sample has a certain degree of representativeness, and the results can be extrapolated to the middle-aged and elderly population in China. In the future, the study will consider using longitudinal data to further explore the relationship between sleep time, body pain, and depressive symptoms in the middle-aged and elderly population in China.

Conclusion

The study, based on a nationally representative survey, revealed a significant correlation between sleep duration, physical pain, and depression among middle-aged and elderly individuals in China. It established that shorter sleep time significantly increases the risk of depression symptoms, although the link between longer sleep time and increased

depression symptoms risk was not statistically significant in this research. Optimal sleep, around 7.5 hours, appears to effectively mitigate depression symptoms risk in this demographic. Nonetheless, gender differences introduce additional layers to the sleep-depression dynamic, suggesting the need for further research into these nuances. The study also highlighted the considerable influence of physical pain on depression symptoms, noting its partial mediating effect on the relationship between sleep duration and depression symptoms. Consequently, strategies to prevent depression symptoms in middle-aged and elderly populations should prioritize ensuring adequate sleep and addressing physical pain.

Ethical

We conducted research using the CHARLS database. During the research process, our study did not cause harm to human subjects, did not involve sensitive personal information or commercial interests, and utilized publicly available and anonymized data. The CHARLS database has been approved by the Biomedical Ethics Committee of Peking University (IRB00001052-11015), and all participants provided written informed consent.According to Article 32, Items 1 and 2 of the "Ethical Review Measures for Life Science and Medical Research Involving Human Subjects" issued on February 18, 2023, in China:

1. Item 1: Research involving human subjects that only uses de-identified data from public databases and does not involve direct information related to individuals may generally be exempt from ethical review.

2. Item 2: If the research data comes from a project that has obtained informed consent and the use of the data conforms to the scope of the original informed consent, it may also be considered exempt from ethical review.

Therefore, our research meets the criteria outlined above and can be exempt from further ethical review.

Disclosure

We declare that we have no conflict of interest.

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