



RESEARCH ARTICLE

# The Relationship Between Sleep Duration and Life Satisfaction in Middle-Aged and Older Adults: Evidence from China

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## Abstract

Aging is becoming increasingly common worldwide, which has a profound impact on the social structure, making it imperative to enhance the life satisfaction of the middle-aged and older adults. While life satisfaction serves as a crucial metric for assessing quality of life in aging societies, empirical evidence suggests improvement lags behind advancements in medical technology and living standards. Thus, identifying the key factors influencing their life satisfaction is crucial. We employed data from 12,525 validated samples from the 2020 China Health and Retirement Longitudinal Study to examine sleep's impact on life satisfaction through multiple mediation modeling. The findings revealed that insufficient sleep emerged as a widespread phenomenon significantly compromising the life satisfaction of the middle-aged and older adults. Physical health and depressive symptoms mediated 85% of sleep's total effect, with depressive symptoms alone accounting for 65% of the mediation. The disproportionate mediation effect of depressive symptoms highlights mental health's critical role in the well-being assessment of the middle-aged and older adults.

**Keywords:** aging; sleep duration; life satisfaction; physical health; mental health; mediation effect

## INTRODUCTION

By the end of 2024, China's elderly population aged 60 and above has reached 310 million, accounting for 22% of the total population, officially marking the country's entry into a deeply aging society, as reported by the National Bureau of Statistics in 2025. It is expected that by 2035, the number of elderly people will further climb to 400 million, comprising over 30% of the total population. The acceleration of this aging process will profoundly impact the social structure, significantly increasing the demand for social services and highlighting the need to effectively enhance the life satisfaction of the middle-aged and older adults (Clark, Yi, & Huang, 2019). Life satisfaction, defined as an individual's overall cognitive assessment of their quality of life according to their self-selected standards (Diener, Wolsic, & Fujita, 1995; Nan, Feng, Hu, & Qi, 2020), is a crucial indicator of successful aging and well-being in this population (Li, Xia, & Zhang, 2023; Zhu, Lian, Huang, Zhong, & Wang, 2023). Despite the rapid development of medical technology in recent years, living conditions have also been significantly improved, and people's average life expectancy has been effectively extended. However, these positive changes have not been fully and directly translated into synchronous improvement of life satisfaction of the

middle-aged and older adults. This situation suggests that in the process of dealing with the challenges of aging, in addition to paying attention to the basic living security and medical needs of the middle-aged and older adults, it is necessary to further explore the key factors affecting the well-being of the middle-aged and older adults, to achieve substantial improvement in their life satisfaction.

To understand how various factors influence life satisfaction, it is useful to adopt a theoretical framework that connects objective circumstances to subjective appraisal. Life satisfaction, as a cognitive evaluation, is not a direct reflection of one's objective state but is formed by assessing one's health, capabilities, and emotional experiences against internal and external standards. The Bottom-Up Theory of Life Satisfaction posits that global life satisfaction is constructed from satisfaction within specific life domains, such as health, work, and social relationships. An individual's overall assessment of their life is, therefore, an aggregate of their experiences and evaluations in these key areas (Diener, Wolsic, & Fujita, 1995). Furthermore, the Cognitive Evaluation Theory, a sub-theory of Self-Determination Theory, emphasizes that events and conditions influence well-being by affecting an individual's fundamental psychological needs and their cognitive appraisal of these events (Diener & Lucas, 2000). In this view, life satisfaction is not merely a sum of parts but a cognitive judgment that is informed by an individual's functional capacities and emotional state.

The life satisfaction of the middle-aged and older adults is intricately linked to various factors, with sleep being a pivotal one that cannot be overlooked. Sleep constitutes approximately one-third of an individual's life

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and is a critical component of overall well-being. However, sleep disturbances have emerged as a significant health concern among middle-aged and older populations (Brouwer et al., 2022; Crowley, 2011). As individuals age, they often grapple with the dual challenges of difficulty initiating and maintaining sleep (Du, Liu, Wang, Qin, & Liu, 2024). In the middle-aged and older adults, there is an increase in the proportion of light sleep stages, accompanied by a corresponding decrease in deep sleep stages. These physiological changes tend to result in frequent nighttime awakenings, thereby shortening total sleep duration and diminishing sleep quality (Gulia & Kumar, 2018; Moraes et al., 2014; Ohayon, Carskadon, Guilleminault, & Vitiello, 2004). Studies have demonstrated a notable correlation between sleep duration and subjective life satisfaction among older adults. Specifically, those who sleep for less than six hours per night are more prone to expressing dissatisfaction with their lives compared to their counterparts who sleep for seven to eight hours per night. Elderly individuals who experience inadequate sleep are nearly twice as likely to report dissatisfaction with their lives as those who obtain sufficient sleep (Zhi et al., 2016). Sleep loss not only affects life satisfaction, but also negatively affects physical health, cognitive function, and mental health in a variety of ways. This study proposes that sleep, a fundamental biological process, serves as a distal factor that influences life satisfaction by impacting the more proximal domains of physical health, mental health, and cognitive function—key pillars that form the basis for an individual's cognitive evaluation of their life.

First, inadequate sleep negatively affects physical health, a fundamental domain in the bottom-up model of life satisfaction. When sleep is insufficient, various physiological functions of the human body will be disturbed and damaged to varying degrees. Metabolic disorders, hypertension, cerebrovascular diseases, diabetes, and cardiometabolic abnormalities are all related to sleep deficiency (Hirshkowitz et al., 2015; Madan Jha, 2023). These physical health issues not only cause physical discomfort but may also elevate the risk of mortality (Nguyen, Costa, & Raizen, 2024).

In addition, sleep loss is strongly linked to poor mental health, particularly depressive symptoms, which represent a critical negative affective domain influencing life satisfaction. Quality sleep plays a crucial role in regulating emotions and helping individuals maintain a positive mood and optimistic mindset. However, inadequate sleep predisposes individuals to mood swings, anxiety, depression, and other mental health concerns (de Almondes, Costa, Malloy-Diniz, & Diniz, 2016; Palmer et al., 2024). Studies indicate that the correlation between sleep quality and depression and anxiety among the middle-aged and older adults is intensifying with time and age (Brouwer et al., 2022). These depressive symptoms can color an individual's worldview and self-perception, leading to a more negative cognitive appraisal of their life overall.

Furthermore, sleep loss adversely affects cognitive function. Researches show that sleep is essential for the optimal functioning of cognitive processes including memory, learning, and attention. When sleep is insufficient, people tend to have problems such as memory loss, vigilance lapses, and slowed reaction times (Killgore, 2010; Krause et al., 2017; Mao et al., 2023), which could hinder daily functioning and potentially impact long-term cognitive development. Crucially, this cognitive decline directly impedes the very process of evaluating one's life. Forming a life satisfaction judgment requires the capacity

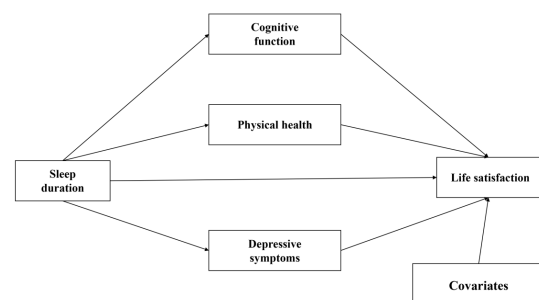
to recall past experiences, compare one's situation to others or to past selves, and make a reasoned overall assessment. Compromised cognitive function—the "machinery" of evaluation—can therefore lead to a less coherent, potentially more negative, or simply less accurate appraisal of one's life, independent of one's objective physical or emotional state. Thus, cognitive function is theoretically justified as a distinct pathway through which sleep influences the cognitive construction of life satisfaction. The adverse consequences of sleep loss on physical health, cognitive function, and mental well-being can further diminish an individual's overall life satisfaction.

The present study aimed to explore the mediating effects of physical health, cognitive function, and depressive symptoms in the relationship between sleep duration and life satisfaction among middle-aged and older individuals, and to provide empirical support for understanding the multidimensional influencing factors of life satisfaction in middle-aged and older adults people. The present study was based on the findings of the China Health and Aging Longitudinal Study (CHARLS) in 2020. Focusing on the middle-aged and older population, multiple mediating effects analysis was conducted to explore the role of physical health, cognitive function, and depressive symptoms in the complex pathway of sleep duration on life satisfaction. Additionally, we compared the magnitude of their respective mediating effects to ascertain which factors play a more pivotal role in this dynamic process. This endeavor not only contributed to a deeper understanding of life satisfaction among the middle-aged and older adults but also offered a scientific rationale for developing targeted health intervention strategies aimed at enhancing their life satisfaction. Based on the mentioned analysis above, the present study proposed the following hypothesis model, shown in Figure 1. We hypothesized that:

H1: Sleep duration positively predicted life satisfaction.

H2: Physical health mediated the relationship between sleep duration and life satisfaction.

H3: Depressive symptoms and cognitive function also mediated the relationship between sleep duration and life satisfaction, with a stronger effect than physical health.



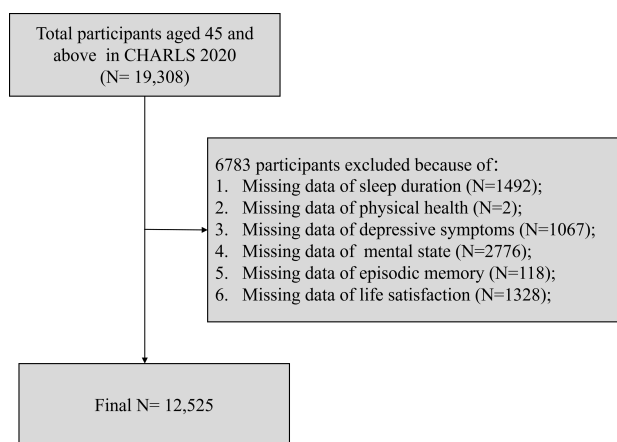
**Figure 1.** A hypothetical model of the mediating effects of physical health, cognitive function, and depressive symptoms on sleep duration and life satisfaction.

## MATERIALS AND METHODS

### Participants

The current study utilized survey data from CHARLS in 2020, encompassing 19,308 middle-aged and older

individuals aged 45 and above from 27 provinces, municipalities, and autonomous regions in China (excluding Hong Kong, Macao, Taiwan, Tibet, Xinjiang, Hainan, and Ningxia). The sample was recruited through the proportional probability sampling (PPS) method to ensure broad coverage and representativeness (Zhao, 2013). After rigorous data cleaning to exclude invalid and missing entries, a total of 12,525 valid samples were retained for analysis. The flowchart of the analytic sample was referred to in Figure 2. The sample's age ranged from 45 to 93 years, with a mean age of 61.7 years. The gender distribution was 52.3% male, and 88.4% of the participants were married. Approximately 56.1% resided in rural areas. In terms of education, 29.1% had less than primary school education, 24.7% completed primary school, 28.3% completed junior high school, and 16.8% completed senior high school. All sample data are publicly available on the Peking University Open Research Data Platform.



**Figure 2.** Flowchart of analytic sample.

## Research tools

### *Sleep duration*

The question, "How many hours did you actually sleep each night on average over the past month?" was used to inquire about participants' nightly sleep duration during the preceding month. Based on their responses, participants were categorized into three groups: those who slept for 6 hours or less, those who slept between 6 and 8 hours, and those who slept for more than 8 hours each night.

### *Physical health*

The question, "How do you perceive your physical health?" was used to assess participants' subjective evaluations of their physical health. In the original questionnaire, scores ranged from 1 (very good) to 5 (very bad). However, for ease of interpretation, this item has been reversed scored such that a higher score indicates a higher level of physical health, with 5 now representing very good health and 1 representing very bad health.

### *Depressive symptom*

The Chinese version of the 10-item Center for Epidemiological Studies Depression Scale (CESD-10) was utilized to assess depression among participants. This self-

reported scale is specifically designed to measure depressive symptoms in the general population. CES-D-10 has demonstrated good validity and reliability in Charls, with a Cronbach's  $\alpha$  coefficient of 0.78-0.79. Participants were asked to reflect on their feelings and behaviors over the past week and were provided with four response options for each item: 0 indicating "Rarely or not at all (<1 day)", 1 for "not much (1-2 days)", 2 for "sometimes or half the time (3-4 days)", and 3 for "most of the time (5-7 days)". The total score of the CESD-10 ranges from 0 to 30, with higher scores indicative of more severe depressive symptoms. A score of 10 or above is considered indicative of depressive symptoms (Andresen, Malmgren, Carter, & Patrick, 1994).

### *Cognitive function*

In the present study, cognitive function included episodic memory and mental state. Episodic memory was assessed using two tasks: immediate word recall and delayed word recall. In the immediate word recall task, participants were asked to recall 10 words immediately after reading them, with scores ranging from 0 to 10. The delayed word recall task required participants to recall the same 10 words a few minutes later and also scored on a 0-10 scale. The overall score for episodic memory, therefore, ranged from 0 to 20. Mental status was assessed using tasks such as time orientation (answering questions about the day, month, year, week, and season, scored 0-5), serial 7s subtraction (subtracting 7 from 100 consecutively, scored 0-5), and drawing (copying overlapping pentagons, scored 0-1). The overall score for mental status ranged from 0 to 11. Cognitive function was calculated as the sum of episodic memory and mental status scores, with a total score ranging from 0 to 31. Higher scores indicated better cognitive function.

### *Life satisfaction*

The question "Overall, how satisfied are you with your life?" is used to assess participants' subjective life satisfaction. In the original questionnaire, the scoring was as follows: 1 represented "extremely satisfied," 2 represented "very satisfied," 3 represented "somewhat satisfied," 4 represented "not very satisfied," and 5 represented "not satisfied at all." However, for ease of interpretation, this item had been reverse-scored, meaning that a higher score indicated a higher level of life satisfaction.

## Statistics

Univariate analysis of variance (ANOVA) was utilized to examine differences in continuous variables across various sleep duration categories, while the Chi-square test was employed to assess differences in categorical variables. The Bonferroni method was applied to adjust for multiple comparisons post-hoc. Pearson correlation analysis was conducted to investigate the relationships between sleep duration, physical health, depressive symptoms, cognitive function, and life satisfaction. The variance inflation factor (VIF) of all predictor variables is less than 2, indicating that there was no potential multicollinearity of all continuous variables. Model 4 of the PROCESS macro was used to explore the concurrent mediating effects of physical health, depressive symptoms, and cognitive function on the relationship between sleep duration and life satisfaction (Hayes, 2013). A 5,000 time bootstrap bias-corrected and accelerated procedure was implemented for

more robust results. Level of statistical significance is determined when the 95% bias-corrected bootstrap confidence interval (CI) of the index of moderated mediation does not contain 0. The unstandardized coefficient was reported. Covariates such as age, sex, place of residence (urban/rural), marital status (single/married), and educational level (below primary school, primary school, middle school, high school, and above) were taken into account in the analyses. All statistical analyses were performed using SPSS 21, with statistical significance set at  $P < 0.05$ . Results were indicated as follows: \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , and \* $P < 0.05$ .

## RESULTS OF STUDY

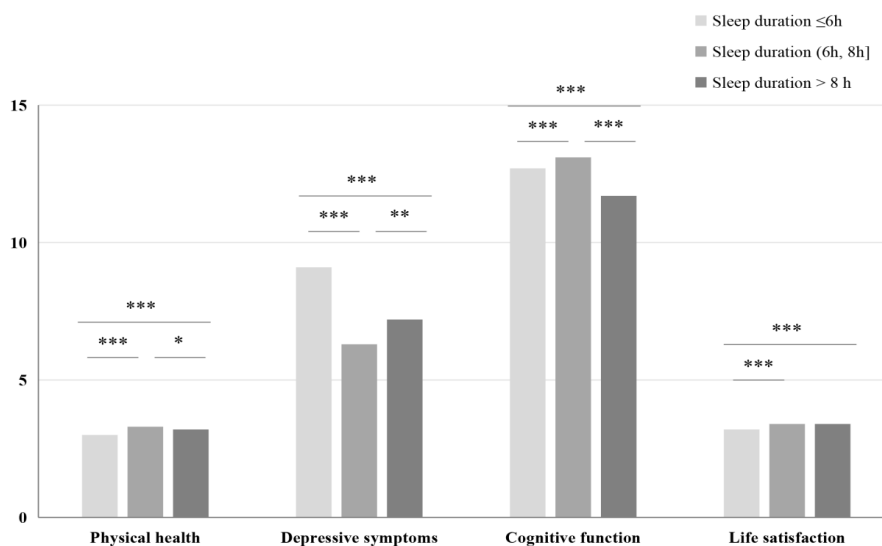
### Sample characteristics

In the older age group, 59.4% of individuals reported sleeping less than 6 hours, 35.0% slept between 6 and 8

hours, and 5.6% slept more than 8 hours, indicating that over half of middle-aged and older people experience insufficient sleep. Significant differences were observed in physical health, depressive symptoms, cognitive function, and life satisfaction among these different sleep duration categories. Specifically, middle-aged and older individuals who slept for 6-8 hours exhibited the best physical health, cognitive function, and life satisfaction, while also reporting the mildest depressive symptoms. Both insufficient and excessive sleep were associated with poorer health, decreased cognitive function, and increased depressive symptoms. Compared with the 6-8 hours group, insufficient sleep significantly reduced life satisfaction, whereas excessive sleep did not significantly increase on life satisfaction, as illustrated in Figure 3. Additionally, demographic information such as age, gender, place of residence, marital status, and education level showed significant variations across different sleep duration categories, as presented in Table 1.

**Table 1** Descriptive statistics and difference tests of major variables and covariates

Characteristics	Sample	Sleep duration			P
		≤6h	(6h, 8h]	> 8 h	
Number, N (%)	12525	7445(59.4)	4384(35.0)	696(5.6)	
Age (mean±SD, years)	61.7 ± 8.9	62.0 ± 8.7	60.8 ± 8.9	63.8 ± 9.1	<0.001
Gender, N (%)	6545(52.3)	3701(49.7)	2428(55.4)	416(59.8)	<0.001
Married, N (%)	11070(88.4)	6479(87.0)	3978(90.7)	486(88.1)	<0.001
Rural, N (%)	7028(56.1)	4069(54.7)	2473(56.4)	486(69.8)	<0.001
Education Level, N (%)					
Illiterate	3645(29.1)	2233(30.0)	1149(26.2)	265(38.1)	
Primary school	3219(24.7)	1882(25.3)	1137(25.9)	200(28.7)	<0.001
Lower secondary school	3549(28.3)	2079(27.9)	1305(29.8)	165(23.7)	
Upper secondary school and higher	2110(16.8)	1251(16.8)	793(18.1)	66(9.5)	
Physical health(mean±SD)	3.1 ± 1.0	3.0 ± 1.0	3.3 ± 1.0	3.2 ± 1.1	<0.001
Depressive symptoms(mean±SD)	8.0 ± 6.2	9.1 ± 6.5	6.3 ± 5.4	7.2 ± 5.7	<0.001
Cognitive function(mean±SD)	12.8 ± 3.2	12.7 ± 3.2	13.1 ± 3.1	11.7 ± 3.3	<0.001
Life satisfaction(mean±SD)	3.3 ± 0.7	3.2 ± 0.8	3.4 ± 0.7	3.4 ± 0.7	<0.001



**Figure 3.** Physical health, depressive symptoms, cognitive function, and life satisfaction with different sleep duration.

**Correlation analysis**

The correlations between variables are summarized in Table 2. Sleep duration was significantly correlated with physical health, depressive symptoms, cognitive function, and life satisfaction. Specifically, as sleep duration increased, physical health improved, depressive symptoms decreased, cognitive function enhanced, and life satisfaction rose. Notably, life satisfaction was significantly correlated with both physical health and depressive symptoms: better physical health was associated with higher life satisfaction, and lower depressive symptoms were linked to higher life satisfaction. However, the correlation between cognitive function and life satisfaction was not statistically significant, prompting the exclusion of cognitive function from subsequent analyses of mediating effects. As a result, the original hypothesis (H3) regarding cognitive function as a mediator was not supported in this study.

**Mediation effect analysis**

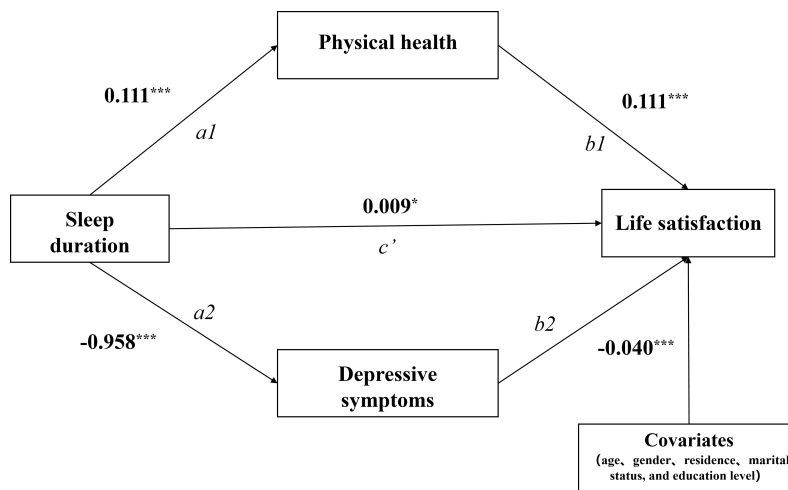
Figure 4 showed the results of the mediation effect analysis. Sleep duration was significant in predicting life satisfaction ( $\beta = 0.159, P < 0.001$ ). When physical health and depressive symptoms were added as mediating

variables to the prediction model, the direct predictive effect of sleep duration on life satisfaction had diminished yet remained statistically significant ( $c', \beta = 0.009, P < 0.05, 95\% \text{ CI: } [0.002, 0.017]$ ). Sleep duration was also proven to be a significant predictor of both physical health ( $a1, \beta = 0.111, P < 0.001, 95\% \text{ CI: } [0.101, 0.121]$ ) and depressive symptoms ( $a2, \beta = -0.958, P < 0.001, 95\% \text{ CI: } [-1.018, -0.897]$ ). Furthermore, physical health ( $b1, \beta = 0.111, P < 0.001, 95\% \text{ CI: } [0.098, 0.124]$ ) and depressive symptoms ( $b2, \beta = -0.040, P < 0.001, 95\% \text{ CI: } [-0.043, -0.038]$ ) had been significant predictors of life satisfaction.

As shown in Table 3, this established a multiple mediation model, wherein sleep duration not only directly predicted life satisfaction (direct effect,  $\beta = 0.009, P < 0.05, 95\% \text{ CI: } [0.002, 0.017]$ ) but also influenced it through the mediating effects of physical health and depressive symptoms (indirect effect,  $\beta = 0.051, P < 0.05, 95\% \text{ CI: } [0.047, 0.055]$ ; mediating effects of depressive symptoms,  $\beta = 0.039, P < 0.05, 95\% \text{ CI: } [0.035, 0.042]$ ; mediating effects of physical health  $\beta = 0.012, P < 0.05, 95\% \text{ CI: } [0.010, 0.014]$ ). In this model, the direct effect of sleep duration on life satisfaction, the mediating effect via physical health, and the mediating effect via depressive symptoms accounted for 15%, 20%, and 65% of the total effect, respectively.

**Table 2.** Correlation analysis of main variables

	Sleep duration	Physical health	Depressive symptoms	Cognitive function	Life satisfaction
Sleep duration	1				
Physical health	0.198***	1			
Depressive symptoms	-0.283***	-0.391***	1		
Cognitive function	0.060***	0.109***	-0.277***	1	
Life satisfaction	0.134***	0.267***	-0.372***	0.013	1



**Figure 4.** The multiple mediation effect of physical health and depressive symptoms between sleep duration and life satisfaction.

**Table 3.** Total effect, direct effect and the mediation effect

	Effect value	BootSE	Boot LLCI	Boot ULCI	Relative effect value
Total effect	0.060	0.004	0.052	0.068	100%
Direct effect	0.009	0.004	0.002	0.017	15%
Indirect effect	0.051	0.002	0.047	0.055	85%
Mediating effects of depressive symptoms	0.039	0.002	0.035	0.042	65%
Mediating effects of physical health	0.012	0.001	0.010	0.014	20%

## DISCUSSION

Based on a large sample of questionnaire data, the current study deeply analyzed the impact of sleep on the life satisfaction of middle-aged and older individuals. Utilizing a multiple mediation model, the study explored the underlying mechanisms linking sleep duration to life satisfaction among this demographic. The findings revealed that insufficient sleep was a prevalent issue among middle-aged and older people in China, and this lack of sleep significantly diminished their life satisfaction. Furthermore, the relationship between sleep duration and life satisfaction was largely mediated by two factors: physical health and depressive symptoms. Specifically, the mediating effect of physical health accounted for 20% of the total effect, while the mediating effect of depressive symptoms was as high as 65%. This indicated that sleep duration influenced life satisfaction among middle-aged and older individuals by affecting both their physical and mental health, with depressive symptoms having a particularly prominent impact. Notably, mental health appeared to have a more significant influence on the life satisfaction of middle-aged and older people compared to physical health, suggesting that greater attention should be paid to their mental well-being in order to comprehensively enhance their quality of life. The dual mediating model of physical and mental health was verified in the nationwide large sample of CHARLS. For the first time, the relative mediating effects of physical health and mental health (depression symptoms) on the relationship between sleep and life satisfaction were quantitatively compared, and it was found that the role of mental health was more prominent. This provides new and more detailed empirical evidence for understanding this field.

Consistent with previous studies, there was a clear positive correlation between sleep duration and life satisfaction (Liu, Pan, & Pei, 2022; Zhi et al., 2016). However, only 35.0% of middle-aged and older people in China could ensure the recommended sleep duration of 6 to 8 hours per night, with more than half struggling with insufficient sleep. Those who slept for less than six hours reported notably lower levels of life satisfaction. Furthermore, the impact of sleep duration on physical health, depressive symptoms, and cognitive function exhibited an inverted U-shaped or U-shaped pattern (Bliwise & Young 2007; Lin et al., 2022). Specifically, middle-aged and older adults who slept between six and eight hours experience optimal physical health, cognitive function, and life satisfaction, along with the fewest depressive symptoms. Sleeping for less than six hours not only impaired physical health and cognitive function but also exacerbated depressive symptoms. While extending sleep duration did enhance life satisfaction to a certain extent, sleeping for more than eight hours did not significantly improve life satisfaction compared to the optimal range of six to eight hours. Instead, excessive sleep could lead to poor physical health, cognitive function decline, and increased depressive symptoms. Therefore, maintaining a sleep duration of 6 to 8 hours per night is particularly crucial for middle-aged and older individuals.

The present study revealed the pivotal mediating role of mental health in the association between sleep duration and life satisfaction. Prior research had similarly emphasized the intimate connection between subjective life satisfaction and mental health (Li, Xia, & Zhang, 2023; Zhu, Lian, Huang, Zhong, & Wang, 2023). Depression, as a psychological state opposite to happiness, had often been accompanied by a substantial decline in life satisfaction

(Freire & Ferreira, 2019; Ventura-Leon, Caycho-Rodriguez, Talledo-Sanchez, & Casiano-Valdivieso, 2022). As individuals aged, the adverse effects of depression on life satisfaction tended to intensify (Li et al., 2023). However, effective treatment for depression had been shown to markedly improve patients' life satisfaction (Koivumaa-Honkanen et al., 2008). Further research had indicated that insufficient sleep at night could exacerbate daytime fatigue, thereby increasing the risk of encountering negative events and emotions, making individuals more susceptible to depression (Nes et al., 2013). In patients with obstructive sleep apnea, sleep quality had emerged as the strongest predictor of depressive symptoms (Lee, Lee, Chung, & Kim, 2015). Consequently, inadequate sleep had been found to exacerbate depressive symptoms, which in turn adversely affected life satisfaction. Together, these studies suggested that the relationship between sleep duration and life satisfaction was largely mediated by depression symptoms.

Consistent with previous studies, our study also found a close relationship between the physical health of middle-aged and older people and their life satisfaction (Gana et al., 2013; Phulkerd, Thapsuwan, Chamrathirong, & Gray, 2021). Compared to those in good physical health, middle-aged and older individuals experiencing a decline in physical health often reported reduced life satisfaction. Poor physical health might elevate the risk of disability or restrict their participation in social activities, further diminishing their life satisfaction (Zhi et al., 2016). Moreover, poor physical health significantly raised the risk of depression among middle-aged and older adults, with individuals in poor health nearly twice as likely to suffer from depression compared to their healthy peers (Read, Sharpe, Modini, & Dear, 2017). This depression exacerbated their psychological burden, further lowered their life satisfaction, and trapped them in a vicious cycle of physical and mental exhaustion. Therefore, while physical health had a notable impact on life satisfaction, mental health played an even more crucial role in the relationship between sleep duration and life satisfaction. These findings emphasized the importance of addressing mental health alongside the impact of sleep duration on life satisfaction. By considering multiple factors such as physical health, mental health, and sleep duration, we could gain a more comprehensive understanding of the intricate mechanisms underlying life satisfaction in middle-aged and older individuals. This enabled us to provide them with more precise and effective health interventions. For instance, during the primary medical care for the elderly with major sleep problems, include screening for depressive symptoms, and carry out sleep health education and mental health promotion programs in the community.

Several limitations need to be taken into account. Firstly, our study relied solely on 2020 CHARLS cross-sectional data, preventing direct causality inferences. Future research should adopt longitudinal designs to track variable changes over time, enabling a deeper understanding of potential relationships among sleep duration, life satisfaction, physical health, mental health, and cognitive function. Secondly, sleep duration data was self-reported, potentially introducing bias due to respondents' current state. Incorporating objective sleep data from monitoring devices could enhance the study's credibility. Thirdly, our cognitive function test was limited to episodic memory and mental state, missing the complexity of cognitive function. Future studies should include more cognitive measures. Fourthly, our control variables were limited to demographic characteristics like age, gender, residence, marital status, and education.

Incorporating family economic status, family structure, and subjective social hierarchy could further refine research accuracy and persuasiveness. Lastly, our analyses did not account for the complex survey design of CHARLS (weights, cluster, strata). Therefore, while our findings elucidate theoretical relationships, they may not be directly generalizable to the entire Chinese middle-aged and older adult population. Future research should employ survey-weighted techniques to validate these results at the population level.

## CONCLUSIONS

For middle-aged and older adults, achieving 6 to 8 hours of sleep per night is optimal for enhancing physical health, cognitive function, and life satisfaction, while also alleviating symptoms of depression. However, a pressing issue in China is that over half of the middle-aged and older adults' population suffers from sleep deficiency. Both physical and mental health serve as mediators in the relationship between sleep duration and life satisfaction, with mental health exerting a more prominent influence. Notably, depression, a key mental health indicator, is significantly associated with a decline in life satisfaction. Consequently, it is crucial to optimize sleep duration for middle-aged and older adults' individuals and prioritize their mental health to enhance their overall well-being.

## DECLARATION

### Ethics approval and consent to participate

The studies involving humans were approved by Institutional Review Board of Peking University. The studies were conducted in accordance with the local legislation and institutional requirements. All participants gave their written informed consent before the experiment.

### Consent for publication

Note Applicable

### Availability of data and materials

Note Applicable

### Conflicts of interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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### Artificial Intelligence-Assisted Technology

Note Applicable

## Authors' contributions

Chao Hao: Conceptualization, data curation, formal analysis, visualization, writing – revising original draft; Feiyang Xie: Data curation, formal analysis; Naifeng Bu: Formal analysis, methodology; Xue Wang: review and editing original draft

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## REFERENCES

- Andresen, E. M., Malmgren, J. A., Carter, W. B., & Patrick, D. L. (1994). Screening for Depression in Well Older Adults: Evaluation of a Short Form of the CES-D. *American Journal of Preventive Medicine, 10*(2), 77-84. [https://doi.org/10.1016/s0749-3797\(18\)30622-6](https://doi.org/10.1016/s0749-3797(18)30622-6)
- Bliwise, D. L., & Young, T. B. (2007). The Parable of Parabola: What the U-Shaped Curve Can and Cannot Tell Us about Sleep. *Sleep, 30*(12), 1614-1615. <https://doi.org/10.1093/sleep/30.12.1614>
- Brouwer, A., van de Ven, P. M., Kok, A., Snoek, F. J., Beekman, A. T. F., & Bremmer, M. A. (2022). Symptoms of depression and insomnia in older age: A within-individual analysis over 20 years. *Journal of the American Geriatrics Society, 70*(7), 2051-2059. <https://doi.org/10.1111/jgs.17765>
- Clark, W. A., Yi, D., & Huang, Y. (2019). Subjective well-being in China's changing society. *Proceedings of the National Academy of Sciences, 116*(34), 16799-16804. <https://doi.org/10.1073/pnas.1902926116>
- Crowley K. (2011). Sleep and sleep disorders in older adults. *Neuropsychology review, 21*(1), 41-53. <https://doi.org/10.1007/s11065-010-9154-6>

- de Almondes, K. M., Costa, M. V., Malloy-Diniz, L. F., & Diniz, B. S. (2016). The Relationship between Sleep Complaints, Depression, and Executive Functions on Older Adults. *Frontiers in psychology, 7*, 1547. <https://doi.org/10.3389/fpsyg.2016.01547>
- Diener, E., & Lucas, R. E. (2000). Explaining Differences in Societal Levels of Happiness: Relative Standards, Need Fulfillment, Culture, and Evaluation Theory. *Journal of Happiness Studies, 1*(1), 41-78. <https://doi.org/10.1023/A:1010076127199>
- Diener, E., Wolsic, B., & Fujita, F. (1995). Physical attractiveness and subjective well-being. *Journal of personality and social psychology, 69*(1), 120-129. <https://doi.org/10.1037/0022-3514.69.1.120>
- Du, M., Liu, M., Wang, Y., Qin, C., & Liu, J. (2023). Global burden of sleep disturbances among older adults and the disparities by geographical regions and pandemic periods. *SSM - population health, 25*, 101588. <https://doi.org/10.1016/j.ssmph.2023.101588>
- Freire, T., & Ferreira, G. (2019). Do I Need to Be Positive to Be Happy? Considering the Role of Self-Esteem, Life Satisfaction, and Psychological Distress in Portuguese Adolescents' Subjective Happiness. *Psychological Reports, 123*(4), 1064-1082. <https://doi.org/10.1177/0033294119846064>
- Gana, K., Bailly, N., Saada, Y., Joulain, M., Trouillet, R., Hervé, C., & Alaphilippe, D. (2013). Relationship between life satisfaction and physical health in older adults: A longitudinal test of cross-lagged and simultaneous effects. *Health Psychology, 32*(8), 896-904. <https://doi.org/10.1037/a0031656>
- Gulia, K. K., & Kumar, V. M. (2018). Sleep disorders in the elderly: a growing challenge. *Psychogeriatrics, 18*(3), 155-165. <https://doi.org/10.1111/psyg.12319>
- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis*. New York: The Guilford Press.
- Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Adams Hillard, P. J., Katz, E. S., Kheirandish-Gozal, L., Neubauer, D. N., O'Donnell, A. E., Ohayon, M., Peever, J., Rawding, R., Sachdeva, R. C., Setters, B., Vitiello, M. V., & Ware, J. C. (2015). National Sleep Foundation's updated sleep duration recommendations: final report. *Sleep health, 1*(4), 233-243. <https://doi.org/10.1016/j.sleh.2015.10.004>
- Killgore W. D. (2010). Effects of sleep deprivation on cognition. *Progress in brain research, 185*, 105-129. <https://doi.org/10.1016/B978-0-444-53702-7.00007-5>
- Koivumaa-Honkanen, H., Tuovinen, T. K., Honkalampi, K., Antikainen, R., Hintikka, J., Haatainen, K., & Viinamäki, H. (2008). Mental health and well-being in a 6-year follow-up of patients with depression. *Social Psychiatry and Psychiatric Epidemiology, 43*(9), 688-696. <https://doi.org/10.1007/s00127-008-0353-x>
- Krause, A. J., Simon, E. B., Mander, B. A., Greer, S. M., Saletin, J. M., Goldstein-Piekarski, A. N., & Walker, M. P. (2017). The sleep-deprived human brain. *Nature reviews. Neuroscience, 18*(7), 404-418. <https://doi.org/10.1038/nrn.2017.55>
- Lee, W., Lee, S.-A., Chung, Y.-S., & Kim, W. S. (2015). The Relation Between Apnea and Depressive Symptoms in Men with Severe Obstructive Sleep Apnea: Mediation Effects of Sleep Quality. *Lung, 193*(2), 261-267. <https://doi.org/10.1007/s00408-015-9687-9>
- Li, C., Xia, Y., & Zhang, Y. (2023). Relationship between subjective well-being and depressive disorders: Novel findings of cohort variations and demographic heterogeneities. *Frontiers in Psychology, 13*. <https://doi.org/10.3389/fpsyg.2022.1022643>
- Lin, L.-H., Xu, W.-Q., Wang, S.-B., Hu, Q., Zhang, P., Huang, J.-H., Ke, Y.-F., Ding, K.-R., Hou, C.-L., & Jia, F.-J.. (2022). U-shaped association between sleep duration and subjective cognitive complaints in Chinese elderly: a cross-sectional study. *BMC Psychiatry, 22*(1). <https://doi.org/10.1186/s12888-022-03738-0>
- Liu, Q., Pan, H., & Pei, Y. (2022). Sleep duration and life satisfaction among older people in China: a longitudinal investigation. *Current Psychology, 42*(35), 30737-30746. <https://doi.org/10.1007/s12144-022-04104-9>
- Madan Jha V. (2022). The prevalence of sleep loss and sleep disorders in young and old adults. *Aging brain, 3*, 100057. <https://doi.org/10.1016/j.nbas.2022.100057>
- Mao, T., Fang, Z., Chai, Y., Deng, Y., Rao, J., Quan, P., Goel, N., Basner, M., Guo, B., Dinges, D. F., Liu, J., Detre, J. A., & Rao, H. (2024). Sleep deprivation attenuates neural responses to outcomes from risky decision-making. *Psychophysiology, 61*(4), e14465. <https://doi.org/10.1111/psyp.14465>
- Moraes, W., Piovezan, R., Poyares, D., Bittencourt, L. R., Santos-Silva, R., & Tufik, S. (2014). Effects of aging on sleep structure throughout adulthood: a population-based study. *Sleep medicine, 15*(4), 401-409. <https://doi.org/10.1016/j.sleep.2013.11.791>
- Nan, Y., Feng, T., Hu, Y., & Qi, X. (2020). Understanding Aging Policies in China: A Bibliometric Analysis of Policy Documents, 1978-2019. *International journal of environmental research and public health, 17*(16), 5956. <https://doi.org/10.3390/ijerph17165956>
- Nes, R. B., Czajkowski, N. O., Røysamb, E., Orstavik, R. E., Tambs, K., & Reichborn-Kjennerud, T. (2013). Major depression and life satisfaction: a population-based twin study. *Journal of affective disorders, 144*(1-2), 51-58. <https://doi.org/10.1016/j.jad.2012.05.060>
- Nguyen, A. D., Costa, P. C., & Raizen, D. M. (2024). A perfect storm: sleep loss causes systemic inflammation and death. *Cell Research, 34*(5), 341-342. <https://doi.org/10.1038/s41422-023-00924-x>
- Ohayon, M. M., Carskadon, M. A., Guilleminault, C., & Vitiello, M. V. (2004). Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: developing normative sleep values across

the human lifespan. *Sleep*, 27(7), 1255-1273. <https://doi.org/10.1093/sleep/27.7.1255>

- Palmer, C. A., Bower, J. L., Cho, K. W., Clementi, M. A., Lau, S., Oosterhoff, B., & Alfano, C. A. (2024). Sleep loss and emotion: A systematic review and meta-analysis of over 50 years of experimental research. *Psychological Bulletin*, 150(4), 440–463. <https://doi.org/10.1037/bul0000410>
- Phulkerd, S., Thapsuwan, S., Chamratrithirong, A., & Gray, R. S. (2021). Influence of healthy lifestyle behaviors on life satisfaction in the aging population of Thailand: a national population-based survey. *BMC Public Health*, 21(1), 43. <https://doi.org/10.1186/s12889-020-10032-9>
- Read, J. R., Sharpe, L., Modini, M., & Dear, B. F. (2017). Multimorbidity and depression: A systematic review and meta-analysis. *Journal of affective disorders*, 221, 36–46. <https://doi.org/10.1016/j.jad.2017.06.009>
- Ventura-Leon, J., Caycho-Rodriguez, T., Talledo-Sanchez, K., & Casiano-Valdivieso, K. (2022). Depression, COVID-19 Anxiety, Subjective Well-being, and Academic Performance in University Students With COVID-19-Infected Relatives: A Network Analysis. *Frontiers in Psychology*, 13, 837606. <https://doi.org/10.3389/fpsyg.2022.837606>
- Zhao, Y., John Strauss, Gonghuan Yang, John Giles, Peifeng (Perry) Hu, Yisong Hu, Xiaoyan Lei, Man Liu, Albert Park, James P. Smith, Yafeng Wang. (2013). China Health and Retirement Longitudinal Study: 2011-2012 National Baseline User's Guide. *National School of Development, Peking University*.
- Zhi, T. F., Sun, X. M., Li, S. J., Wang, Q. S., Cai, J., Li, L. Z., Li, Y. X., Xu, M. J., Wang, Y., Chu, X. F., Wang, Z. D., & Jiang, X. Y. (2016). Associations of sleep duration and sleep quality with life satisfaction in elderly Chinese: The mediating role of depression. *Archives of gerontology and geriatrics*, 65, 211–217. <https://doi.org/10.1016/j.archger.2016.03.023>
- Zhu, C., Lian, Z., Huang, Y., Zhong, Q., & Wang, J.. (2023). Association between subjective well-being and all-cause mortality among older adults in China. *BMC Psychiatry*, 23(1). <https://doi.org/10.1186/s12888-023-05079-y>

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