

# BMJ Open Association between poor sleep quality and depression symptoms among the elderly in nursing homes in Hunan province, China: a cross-sectional study

Zhao Hu <sup>1</sup>, Xidi Zhu,<sup>1</sup> Atipatsa Chiwanda Kaminga,<sup>2,3</sup> Tingting Zhu,<sup>4</sup> Yu Nie,<sup>5</sup> Huilan Xu<sup>1</sup>

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ZH and XZ contributed equally.

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For numbered affiliations see end of article.

**Correspondence to**  
Professor Huilan Xu;  
[xhl6363@sina.com](mailto:xhl6363@sina.com)

## ABSTRACT

**Objectives** To examine the association between the prevalence of poor sleep quality and depression symptoms among the elderly in the nursing homes of Hunan province in China.

**Design, Setting and participants** This was a cross-sectional study investigating 817 elderly people from 24 nursing homes in China's Hunan province.

**Main outcome measures** Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) such that poor sleep quality was defined as PSQI Score >5. In addition, depression symptoms were assessed using the Geriatric Depression Scale (GDS). Linear regression models and binary logistic regression models were used to analyse the relationship between the prevalence of poor sleep quality and depression symptoms.

**Results** The mean PSQI Score was  $8.5 \pm 4.9$ , and the prevalence of poor sleep quality was 67.3%. Additionally, the mean GDS Score was  $9.8 \pm 7.5$ , and the prevalence of depression symptoms was 36.0%. Elderly people with poor sleep quality had increased GDS Score (mean difference = 2.54, 95% CI 1.66 to 3.42) and increased risk of depression symptoms (OR = 3.19, 95% CI 2.04 to 4.98) after controlling for demographics, chronic disease history, lifestyle behaviours, social support, activities of daily living and negative life events.

**Conclusions** The prevalence of poor sleep quality was relatively high, and this was associated with increased depression symptoms. Therefore, poor sleep quality could be speculated as a marker of current depression symptoms in the elderly.

## INTRODUCTION

Ageing is a challenging problem in China and all over the world. Research has shown that as age increases in old age, the risk of problems with sleep also increases, which is a public health concern for the elderly. For examples, a cross-sectional investigation conducted among 2398 community-dwelling older persons in Italy indicated that 74% of men and 79% of women had sleep complaints.<sup>1</sup> Another cross-sectional study on 2565 elderly Singaporeans showed that 69.4%

## Strengths and limitations of this study

- This is the first study to examine the impact of sleep quality on depression symptoms among the Chinese elderly in nursing homes.
- The study provides valuable information on sleep pattern and emotional problems among the elderly in a nursing home setting.
- The statistical power was satisfied as the study included adequate samples.
- All data were obtained from self-reports, hence recall bias was unavoidable.
- The cross-sectional study design makes causal relationships undeterminable.

experienced sleep interruption at night and 48.9% reported having difficulty falling asleep.<sup>2</sup>

In agreement with the foregoing observations, the prevalence of poor sleep quality among older adults was also relatively high. For instance, in China, the prevalence of poor sleep quality among the elderly was 41.5% in urban communities<sup>3</sup> and 49.7% in rural areas.<sup>4</sup> However, several studies demonstrated that most sleep problems can be exacerbated by an institutional setting.<sup>5–7</sup> In this regard, Fetveit and Bjorvatn<sup>6</sup> found that the prevalence of sleep disturbance was approximately 70% among nursing home residents, whereas Hoffman<sup>7</sup> reported that approximately two-thirds of older adults living in long-term care facilities had some degree of sleep disturbance. In summary, sleep problems are very common among the elderly in nursing homes and pose a great challenge for public health.

Poor sleep quality has significant negative effects on physical and mental health, and health-related quality of life.<sup>8–10</sup> Specifically, epidemiological studies suggested that poor sleep quality is a strong risk factor

for suicidal ideation among the elderly.<sup>8 9</sup> Further, in a large population-based cohort study, long sleepers with poor sleep quality had a 95% higher risk of cardiovascular disease mortality than those who slept for 7 hours.<sup>11</sup> Another large cohort study found that poor sleep quality was associated with increased odds of hypertension in a Chinese rural population.<sup>12</sup> However, despite the significance of poor sleep quality among the elderly population, its prevalence and the underlying effect on their physical and mental functioning are not entirely understood.

Depression is a common psychiatric disorder among the elderly. It contributes not only to mild cognitive impairment but also to an increased risk of comorbidity and mortality.<sup>13–15</sup> In addition, many studies indicated that the institutionalised elderly have a higher prevalence of depression than the community-dwelling elderly. Notwithstanding, the reported prevalence of depression symptoms in nursing homes varied widely across different localities due to differences in diagnostic criteria, assessment tools and sample characteristics. For example, epidemiological studies indicated that the prevalence of depression symptoms among the elderly in nursing homes was 90.2% in Iran,<sup>16</sup> 81.8% in Taiwan,<sup>17</sup> 29.6% in London<sup>18</sup> and 46.1% in the Mainland China.<sup>19</sup>

The association between sleep quality and depression symptoms among the elderly is complex, bidirectional and not entirely understood. However, many studies have suggested that elderly people with some sleep disturbance are more likely to develop depression symptoms than younger people with some sleep disturbance.<sup>20 21</sup> Conversely, people with depression symptoms reported a higher prevalence of poor sleep quality.<sup>22</sup> Although many previous studies have demonstrated that poor sleep quality is positively associated with depression symptoms among the elderly, the evidence of this relationship among the elderly in nursing homes was scarce. Therefore, the purpose of this study was to examine the association between poor sleep quality and depression symptoms among the elderly of nursing homes in China.

## METHODS

### Sample size

To examine the impact of sleep quality on depression symptoms among the elderly of nursing homes, a sample size was calculated using the formula as follows:

$$n = 4 \left\{ (\mu_{\alpha} + \mu_{\beta}) / \ln \left[ (1 + \rho) / (1 - \rho) \right] \right\}^2 + 3$$

where  $\mu_{\alpha}=1.96$  when  $\alpha=0.05$ ;  $\mu_{\beta}=0.84$  when  $\beta=0.80$  and  $\rho$  is the correlation coefficient between sleep quality and depression symptoms in the elderly in nursing homes. Thus,  $\rho$  was taken as 0.231, according to a previous study,<sup>23</sup> when calculating the sample size. Therefore, using the formula, the theoretical sample size was 145 and, after including an extra 10% of 145, to make up for subjects who may be withdrawn during the study, the total sample size was 160.

### Study population

This cross-sectional study was conducted among the elderly living in nursing homes in Changsha, Hengyang and Yiyang cities of Hunan province in China from October 2018 up until December 2018. A multistage sampling method was used to select a representative sample as follows. First, three cities Yiyang, Changsha and Hengyang were randomly selected from Northern Hunan, Central Hunan and Southern Hunan, respectively. Then, three counties, one from each city; and six districts, two from each city, were randomly selected and this resulted in the following counties and districts chosen: Changsha county, Kaifu and Yuelu districts from Changsha city; Hengyang county, Yanfeng and Shigu districts from Hengyang city and Yuanjiang county, Ziyang and Heshan districts from Yiyang city. Furthermore, six townships, two from each county, were randomly selected and this resulted in the following townships chosen: Xingsha and Tiaoma from Changsha county; Xidu and Jingtou from Hengyang county and Qionghu and Caowei from Yuanjiang county. Finally, 24 nursing homes were randomly selected, two from each district and two from each township.

The elderly population in the selected nursing homes formed the sampling frame and participants were included in our study if they met the following inclusion criteria: (1) had age 60 years and above and (2) had been in the nursing home for more than 1 year. However, participants were excluded if they (1) refused to participate in this study and (2) had a severe hearing impairment or a language barrier. A total of 2055 older adults reside in the 24 nursing homes, of which 511 were excluded because of less than 60 years or staying in a nursing home less than 1 year. Six hundred and three older adults have severe hearing impairment or language barrier and 112 older adults, who did not agree to participate, were also excluded in this study. Of the remaining 829 older adults, 12 were excluded for incomplete data. Finally, a total of 817 subjects were included in the data analysis of this study.

### Data collection

Trained staff collected data through face-to-face interviews using a set of structured questionnaires, and each interview lasted between 1/2 and 1 hour. Demographic information collected included gender, age, education level, marital status, monthly personal income, duration of admission, number of living children, a history of chronic diseases, a history of smoking tobacco and a history of alcohol consumption. Marital status was classified as either stable or unstable. Unstable marital status meant divorced, widowed or never married. Smoking was defined as averaging at least one cigarette per day in the last year. Alcohol consumption was defined as drinking one glass of wine per day in the last week.

### Sleep quality assessment

Sleep quality among the participants was assessed using the Chinese version of the Pittsburgh Sleep Quality

Index (PSQI). The PSQI is a self-rated questionnaire that assesses sleep quality in the past month. It contains nineteen items grouped according to seven components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction.<sup>24</sup> These components were defined as follows in this study: subjective sleep quality (good or poor); sleep efficiency (reduced sleep efficiency was sleep efficiency <85%); sleep latency (increased sleep latency was Sleep Latency Component Score >1); sleep duration (<7, 7–8 and >8 hours); sleep disturbances (any kind of sleep disturbance  $\geq 1$  time/week); use of sleep medication (use of sleep medication  $\geq 1$  time/week) and daytime dysfunction was daytime dysfunction of at least once a week. Each component's score ranges from 0 to 3 points such that 0 is the most positive score and 3 the most negative score. Therefore, the global PSQI Score ranges from 0 to 21 points. The Chinese version of the PSQI has been shown to have good validity and reliability among older adults.<sup>25</sup> Participants with a global PSQI Score greater than 5 were defined as having poor sleep quality.<sup>24</sup>

### Depression symptoms assessment

Depressive symptoms were assessed using the Chinese version of the Geriatric Depression Scale-30 items (GDS-30). The 30 items of this instrument are true/false questions whose total score ranges from 0 to 30 points. The GDS-30 has been widely used to assess depression symptoms in the elderly worldwide.<sup>26</sup> Several studies have demonstrated that this measurement tool is reliable and valid in multiple settings and recommended it for use in nursing home populations.<sup>27,28</sup> The validity and reliability of the Chinese version of the GDS-30 have been extensively assessed in China.<sup>29,30</sup> Participants who scored 11 or greater were considered as having depression symptoms in this study.<sup>26</sup>

### Covariates

Other information, including social support, activities of daily living (ADL) and negative life events, was also collected. Social support among the elderly was assessed using the Social Support Rating Scale (SSRS), which was developed by Xiao.<sup>31</sup> The scale consists of 10 items and is divided into three parts: objective support, subjective support and availability of social support. For items 1–4, and 8–10, each item's score ranges from 1 to 4 points. For item 5, the first, second, third and fourth options represent 1, 2, 3 and 4 points for each support source, respectively. In addition, for items 6 and 7, each option is 1 point when selected and 0 when not selected. The total social support score ranges from 12 to 66 points, and higher scores indicate higher social support. An SSRS Score greater than 30 points was defined as indicating high social support in this study. Furthermore, ADL status was assessed using Lawton and Brody's ADL Scale.<sup>32</sup> It includes 16 items, and each item is scored from 1 (can do it myself) to 4 (cannot do it myself). Participants' possible

total scores on this instrument range between 16 and 64 points. A participant is classified as having disabled ADL status when the participant's ADL total score is greater than 14 points. Negative life events were assessed using the Life Events Scale for the Elderly (LESE). The LESE is a valid and reliable tool widely used in China for assessing the elderly population.<sup>33</sup> It includes 46 items that are grouped into three main domains: health-related problems, family-related problems and social-related problems. Participants were determined to have experienced a negative life event when any such event occurred and caused them to have stress.

### Statistical analysis

Categorical data were summarised as frequency counts and percentages, whereas continuous data were summarised as mean $\pm$ SD. The  $\chi^2$  test was used to compare categorical data between the good sleep quality group and the poor sleep quality group; while the student's t-test was used to compare continuous data between the good sleep quality group and the poor sleep quality group. Linear regression models were used to estimate the difference in the mean GDS-30 Scores with respect to sleep quality (poor=1 and good=0) using both the univariate (crude) and the multivariable (adjusted) models. Furthermore, the crude and adjusted binary logistic regression models were used to examine the association between sleep quality and depression symptoms; and the association between components of sleep quality and depression symptoms. A  $p < 0.05$  was considered statistically significant. All data analyses were performed using the Statistical Package for the Social Sciences (SPSS) V.20.0 software (SPSS).

### Patient and public involvement

Neither patients nor the public was directly involved in the development, design or recruitment of the study. Test results were provided to the participants at the point of testing.

## RESULTS

### Characteristics of the study sample

The average age was 79.1 $\pm$ 8.7 years, and more than half of the participants were female. Furthermore, about 90% of the participants had medical insurance and one child. Besides, about 70% of the participants had at least one kind of chronic disease. Also, more than 10% of the participants were smokers, and alcohol consumers, whereas about a third of the participants had normal ADL status.

In addition, 550 (67.3%) participants had poor sleep quality, 35.9% had a sleep duration between 7 and 8 hours, 30.4% reported sleep disturbances, 49.9% reported daytime dysfunction and 10.3% had taken sleep medication more than once a week. Based on the  $\chi^2$  test, the good sleep quality group and the poor sleep quality group had statistically significant differences with respect to education level, marital status, monthly personal income, a history of chronic disease, negative life events,

**Table 1** Characteristics of the elderly people in the nursing homes

Characteristic	Total (n=817)	Sleep quality		P value
		Poor (n=550)	Good (n=267)	
Age	79.1±8.7	79.4±8.3	78.6±9.5	0.228
Gender male	376 (46.0)	251 (45.6)	125 (46.8)	0.751
Education				
Primary school and below	364 (44.6)	263 (47.8)	101 (37.8)	0.004
Junior high school	203 (24.8)	138 (25.1)	65 (24.3)	
Senior high school and above	250 (30.6)	149 (27.1)	101 (37.8)	
Stable marital status	302 (37.0)	186 (33.8)	116 (43.4)	0.007
Medical insurance	766 (93.8)	517 (94.0)	249 (93.3)	0.681
Monthly personal income ≤3000 RMB	568 (69.5)	404 (73.5)	164 (61.4)	<0.001
Duration of admission >3 years	251 (30.7)	180 (32.7)	71 (26.6)	0.075
History of chronic disease	620 (75.9)	454 (82.5)	166 (62.2)	<0.001
Smoking	132 (16.2)	82 (14.9)	50 (18.7)	0.164
Alcohol drinking	96 (11.8)	60 (10.9)	36 (13.5)	0.284
Have a child or more	746 (91.3)	496 (90.2)	250 (93.6)	0.100
Negative life events	725 (88.7)	515 (93.6)	210 (78.7)	<0.001
High social support	382 (46.8)	213 (38.7)	169 (63.3)	<0.001
Normal ADL status	268 (32.8)	152 (27.6)	116 (43.4)	<0.001
Good subjective sleep quality	483 (59.1)	220 (40.0)	263 (98.5)	<0.001
Increased sleep latency	433 (53.0)	421 (76.5)	12 (4.5)	<0.001
Sleep duration				
<7 hours	388 (47.5)	373 (67.8)	15 (5.6)	<0.001
7–8 hours	293 (35.9)	140 (25.5)	153 (57.3)	
>8 hours	136 (16.6)	37 (6.7)	99 (37.1)	
Reduced sleep efficiency	499 (61.1)	457 (83.1)	42 (15.7)	<0.001
Sleep disturbances	248 (30.4)	231 (42.0)	17 (6.4)	<0.001
Use of sleep medication	84 (10.3)	83 (15.1)	1 (0.4)	<0.001
Daytime dysfunction	408 (49.9)	366 (66.5)	42 (15.7)	<0.001

Values are n (%) or mean±SD.

ADL, activities of daily living; RMB, Ren Min Bi.

social support and ADL status. Additionally, participants with poor sleep quality were those who had an unstable marital status, a monthly personal income below 3000 Ren Min Bi (RMB), a history of chronic disease, an experience of negative life events, low social support and disabled ADL status. The results are shown in [table 1](#).

#### Association between sleep quality and depression symptoms

Based on the results of the linear models, the differences in the mean GDS-30 Scores, between the poor sleep quality and the good sleep quality groups, were examined. In the crude model, a linear independent pairwise comparison showed that participants with poor sleep quality had significantly higher GDS-30 Scores than those with good sleep quality (mean difference ( $M_{diff}$ )=5.19, 95% CI 4.15 to 6.24). After adjusting for age, gender, educational level, marital status, medical insurance status, monthly personal income, duration of admission, number of

living children, smoking status, drinking alcohol status, a history of chronic disease, SSRS status, ADL status, negative life events and GAD, results still indicated that participants with poor sleep quality had higher GDS-30 Scores ( $M_{diff}$ =2.54, 95% CI 1.66 to 3.42). The results are shown in [table 2](#).

Furthermore, participants were divided into two groups according to the GDS-30 cut-off value between depression symptoms and no depression symptoms. Therefore, binary logistic regression analysis showed that participants with poor sleep quality had an increased risk of depression symptoms in the crude model (OR=4.37, 95% CI 3.03 to 6.31). This relationship remained significant after adjusting for other covariates. In this regard, participants with poor sleep quality were 3.19-fold more likely to have depressive symptoms than those with good sleep quality (OR=3.19, 95% CI 2.04 to 4.98). Similar

**Table 2** Association between sleep quality and GDS-30 Scores among the elderly in the nursing homes

	Poor sleep quality		Good sleep quality		Difference	
	Mean	SE	Mean	SE	M <sub>diff</sub> (95% CI)	P value
Crude model	11.53	0.31	6.33	0.45	5.19 (4.15 to 6.24)	<0.001
Adjusted model 1 (R <sup>2</sup> =0.11, F=33.54, p<0.001)						
	11.31	0.29	6.79	0.42	4.52 (3.51 to 5.53)	<0.001
Adjusted model 2 (R <sup>2</sup> =0.24, F=27.42, p<0.001)						
	11.01	0.27	7.40	0.40	3.50 (2.54 to 4.47)	<0.001
Adjusted model 3 (R <sup>2</sup> =0.40, F=30.78, p<0.001)						
	10.67	0.24	8.09	0.36	2.54 (1.66 to 3.42)	<0.001

Model 1: adjusted for age and gender.

Model 2: adjusted for all covariates as in model 1 plus education level, marital status, medical insurance status, monthly personal income, duration of admission and number of living children.

Model 3: adjusted for all covariates as in model 2 plus smoking status, alcohol drinking status, a history of chronic disease, Social Support Rating Scale status, activities of daily living status and negative life events.

GDS-30, Geriatric Depression Scale-30 items; M<sub>diff</sub>, mean difference.

results were observed for all but two components of sleep quality, namely use of sleep medication and sleep duration between 6 and 7 hours. The OR values, which indicated an association between depression symptoms and sleep quality components, ranged from 1.95 to 3.15. The results are shown in [table 3](#).

## DISCUSSION

This study examined the prevalence of poor sleep quality and its relationship with depression symptoms among the elderly in nursing homes in Hunan, China. Accordingly, the prevalence of poor sleep quality was 67.3%, which was associated with higher GDS-30 Scores than good sleep quality. Moreover, participants with poor sleep quality had an increased risk of depression symptoms.

Considerable evidence suggested that sleep problems are very common among the elderly, and institutional settings may exacerbate them. The prevalence of poor sleep quality in this study is higher than that found in some previous studies among the elderly in nursing homes. For instance, Eser *et al*<sup>34</sup> estimated that the prevalence of poor sleep quality was 60.9% among 540 elderly people in Turkey, and a similar study in the same country found that 60.3% of the elderly had poor sleep quality.<sup>23</sup> Lower prevalence was also observed in Zagreb (54.5%) among 894 elderly people,<sup>35</sup> and in Taiwan (46.4%).<sup>36</sup> A reason for this variation in these prevalence estimates may be attributed to differences in study designs with regard to inclusion criteria for participants, and differences in the facilities and medical care used in different nursing homes. In addition, the most commonly reported components of poor sleep quality were decreased sleep efficiency (61.1%), increased sleep latency (53.0%) and sleep disturbances (30.4%). This pattern indicates that these participants had problems with both initiating and maintaining sleep. Similarly, Fetveit and Bjorvatn<sup>6</sup> found that 72% of the elderly participants in nursing

homes had a sleep efficiency below 85%, while 77.8% reported a sleep-onset latency of more than 30 min. Also, Wilfling *et al*<sup>37</sup> found that 23.0% of the elderly in German nursing homes had sleep disturbances and, in the same way, Wang *et al*<sup>38</sup> found that 27.8% of older Chinese adults living in nursing homes had sleep disturbances. One of the important factors that may contribute to the development of a higher prevalence of sleep problems among the elderly in nursing homes is the environment, particularly with respect to the high levels of night-time noise and light, the low levels of daytime light and care routines that do not promote sleep.<sup>39</sup> However, the use of sleep medication is not popular among the elderly in the Chinese nursing homes and this could be the reason why only 10.3% of residents in this study had taken sleep medication. Moreover, among the participants that had taken sleep medication, majority of them had poor sleep quality. Nevertheless, due to the cross-sectional study design, a causal relationship between sleep quality and taking sleep medication could not be established. Therefore, from this result, it can be assumed that participants with poor sleep quality are more likely to take sleep medication, but this proportion is lower in the Chinese nursing homes.

Additionally, the prevalence of depression symptoms in this study was associated with sleep quality. For example, participants with poor sleep quality scored 2.54 points higher than those with good sleep quality on the GDS-30 Score after adjusting for many important covariates. Moreover, participants with poor sleep quality were 3.19-fold more likely to develop depression symptoms than those who had good sleep quality. Furthermore, participants with increased sleep latency, shorter sleep duration, lower sleep efficiency, sleep disturbances and daytime dysfunction had increased risk of depression symptoms. These findings are in accordance with those of several previous similar studies in both nursing homes and

**Table 3** Association between sleep quality and depression symptoms among the elderly in the nursing homes

	Crude model			Adjusted model*		
	OR	95% CI	P value	OR	95% CI	P value
<b>Overall sleep quality</b>						
Good	1.00			1.00		
Poor	4.37	3.03 to 6.31	<0.001	3.19	2.04 to 4.98	<0.001
<b>Subjective sleep quality</b>						
Good	1.00			1.00		
Poor	5.05	3.71 to 6.87	<0.001	3.15	2.18 to 4.56	<0.001
<b>Increased sleep latency</b>						
Yes	1.00			1.00		
No	3.81	2.79 to 5.20	<0.001	2.58	1.78 to 3.74	<0.001
<b>Sleep duration</b>						
>8 hours	1.00			1.00		
7–8 hours	1.09	0.70 to 1.71	0.700	1.24	0.73 to 2.11	0.431
<7 hours	2.64	1.89 to 3.70	<0.001	1.95	1.29 to 2.95	0.001
<b>Reduced sleep efficiency</b>						
No	1.00			1.00		
Yes	2.74	1.99 to 3.78	<0.001	1.89	1.27 to 2.80	0.002
<b>Sleep disturbances</b>						
No	1.00			1.00		
Yes	3.49	2.56 to 4.77	<0.001	2.33	1.59 to 3.41	<0.001
<b>Use of sleep medication</b>						
No	1.00			1.00		
Yes	1.63	1.03 to 2.56	0.037	1.30	0.72 to 2.35	0.379
<b>Daytime dysfunction</b>						
No	1.00			1.00		
Yes	3.22	2.38 to 4.36	<0.001	2.21	1.53 to 3.20	<0.001

\*Adjusted for age, gender, education, marital status, medical insurance, monthly personal income, duration of admission, number of living children, smoking status, alcohol drinking status, a history of chronic disease, social support status, activities of daily living status and negative life events.

communities.<sup>23 40 41</sup> In this regard, a cross-sectional study by Orhan *et al*<sup>23</sup> demonstrated that the GDS-30 Score was positively correlated with the global PSQI Score ( $r=0.231$ ) as well as the sleep latency and sleep disturbances scores ( $r=0.261$  and  $0.380$ , respectively) among 73 elderly people living in a nursing home in Turkey. Additionally, Foley *et al*<sup>22</sup> conducted a study on over 9000 participants aged at least 65 and found that the Sleep Complaint Score was positively associated with the Center for Epidemiologic Studies Depression Scale Score. Also, Sukegawa *et al*<sup>42</sup> found that elderly persons with depression symptoms were more likely to report poor sleep efficiency, sleep disturbances, long sleep latency and poor subjective sleep quality. In agreement with the preceding results, a prospective cohort study by Livingston *et al*<sup>40</sup> reported that the best predictor of future depression in the elderly people, who were not depressed at baseline, was sleep disturbance at baseline. Moreover, Rodin *et al*<sup>41</sup> found that the frequency

of depressed affect was positively associated with sleep disturbances in the elderly after controlling for adjustment factors. Similarly, Cho *et al*<sup>21</sup> suggested that, among the elderly with prior depression, depression recurrence was predicted by sleep disturbance, and this association was independent of other depression symptoms. Furthermore, in a previous cross-sectional study, elderly persons with a GDS-30 Score  $\geq 6$  were 1.29 times more likely to develop sleep disturbances than those with a GDS-30 Score of 0–2.<sup>43</sup> Another cross-sectional study<sup>44</sup> found that depression was independently positively associated with poor sleep quality among the elderly after adjusting for other confounders (OR=1.21, 95% CI 1.12 to 1.52). However, the mechanism underlying the relationship between poor sleep quality and depression symptoms is not thoroughly understood. Certainly, many studies have suggested that sleep problems and depression symptoms can reinforce each other and this relationship might be

bidirectional. Although the direction of the association between sleep quality and depression symptoms in this study was not possible to determine as a result of the use of a cross-sectional study design, poor sleep quality was viewed as a prodromal state or even a core symptom of depression symptoms in the elderly.

To our knowledge, this is the first study to focus on the elderly in a nursing home in China and demonstrate that poor sleep quality was independently associated with depression symptoms. However, there are several limitations in this study. First, the causal relationship between poor sleep quality and depression symptoms could not be assessed due to the use of a cross-sectional study design. Therefore, further longitudinal and prospective studies should be conducted to confirm this relationship in the elderly in nursing homes. Second, all data were obtained from self-reports, which may compromise the accuracy of measurements due to recall bias; and there was lack of objective measurement of sleep quality, which might have led to misclassification of some of the components of sleep quality. Third, the findings of this study cannot be generalised to patients with dementia and hearing or cognition impairment as these were excluded from this study. Finally, although the  $M_{diffs}$  and OR were decreased in the adjusted models, the mediating effect of other variables on the association between poor sleep quality and depression symptoms was not analysed and should be investigated in future studies.

## CONCLUSIONS

In summary, a high prevalence of poor sleep quality among the elderly living in nursing homes in Hunan in China was observed. In addition, poor sleep quality was associated with increased GDS-30 Scores and the development of depression symptoms. Nonetheless, further studies are needed to (1) explore whether the intervention and treatment of poor sleep quality can ameliorate depression symptoms among the elderly in nursing homes and (2) investigate the mediating effects of other variables on the association between sleep quality and depression symptoms.

### Author affiliations

<sup>1</sup>Department of Social Medicine and Health Management, Xiangya School of Public Health, Central South University, Changsha, Hunan, China

<sup>2</sup>Department of Epidemiology and Health Statistics, Xiangya School of Public Health, Central South University, Changsha, Hunan, China

<sup>3</sup>Department of Mathematics and Statistics, Mzuzu University, Mzuzu, Malawi

<sup>4</sup>Department of Scientific Research Management, Shanghai Health Development Research Center, Shanghai, China

<sup>5</sup>Educational Administration Office, The Second Xiangya Hospital, Changsha, Hunan, China

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**Data availability statement** Data are available upon reasonable request. The data analysed during this study are included in the article. The numerical data used to support the findings of this study are available from the corresponding author upon reasonable request.

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### ORCID iD

Zhao Hu <http://orcid.org/0000-0002-6787-4074>

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