

# BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email [info.bmjopen@bmj.com](mailto:info.bmjopen@bmj.com)

# BMJ Open

## The prevalence of poor sleep quality and its association with depression symptoms among the elderly in nursing homes in Hunan province, China

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-036401
Article Type:	Original research
Date Submitted by the Author:	13-Dec-2019
Complete List of Authors:	Hu, Zhao; Central South University Xiangya School of Public Health, Zhu, Xidi Kaminga, Atipatsa; XiangYa School of Public Health, Central South University, Department of Epidemiology and Health Statistics Huilan, Xu; Central South University Xiangya School of Public Health, Department of Social Medicine and Health Management
Keywords:	Depression & mood disorders < PSYCHIATRY, SLEEP MEDICINE, Epidemiology < THORACIC MEDICINE

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3  
4 **The prevalence of poor sleep quality and its association with depression symptoms**  
5  
6  
7 **among the elderly in nursing homes in Hunan province,China**

8 Zhao Hu<sup>a,†</sup>, Xidi Zhu<sup>a,†</sup>, Atipatsa Chiwanda Kaminga<sup>b,c</sup>, Huilan Xu<sup>a,\*</sup>  
9

10  
11 <sup>a</sup> Department of Social Medicine and Health Management, Xiangya School of Public Health,  
12 Central South University, Changsha, China

13 <sup>b</sup> Department of Epidemiology and Health Statistics, Xiangya School of Public Health, Central  
14 South University, Changsha, China

15 <sup>c</sup> Department of Mathematics and Statistics, Mzuzu University, P/Bag 201, Mzuzu, Malawi

16 †Contributed equally

17 \*Corresponding author at: Department of social medicine and health management, Xiangya  
18 school of public health, Central South University, Changsha, 410078, China. Tel: +86-0731  
19 -8484-5454. E-mail address:xhl6363@sina.com  
20

21 Word count:4606;Tables:4  
22

23  
24  
25 **ABSTRACT**

26  
27 **Objectives:** To examine the association between the prevalence of poor sleep quality and  
28 depression symptoms among the elderly in the nursing homes of Hunan Province in China.  
29

30  
31  
32 **Design, Setting and participants:** A Cross-sectional study was conducted among 817  
33 elderly people from 24 nursing homes in China's Hunan Province.  
34

35  
36  
37 **Main outcome measures:** Sleep quality was assessed using the Pittsburgh Sleep Quality  
38 Index (PSQI), and poor sleep quality was defined by a PSQI score>5. Depression symptoms  
39 were assessed using the Geriatric Depression Scale (GDS). General linear models (GLM) and  
40 binary logistic regression models were used to analyse the relationship between the  
41 prevalence of poor sleep quality and depression symptoms.  
42  
43  
44  
45  
46  
47  
48  
49

50  
51 **Results:** The mean PSQI score was 8.5±4.9, and the prevalence of poor sleep quality was  
52 67.3%. Additionally, the mean GDS score was 9.8±7.5, and the prevalence of depression  
53 symptoms was 36.0%. Elderly people with poor sleep quality had increased GDS score  
54 (mean difference=2.54, 95%CI: 1.66, 3.42) and increased risk of depression symptoms (odds  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 ratio [OR]=3.19, 95% CI: 2.04, 4.98) after controlling for other factors.  
5

6 **Conclusions:** The prevalence of poor sleep quality was relatively high, and this was  
7  
8 associated with increased depression symptoms. Therefore, poor sleep quality could be  
9  
10 speculated as a marker of current depression symptoms in the elderly.  
11  
12

13  
14 **Keywords:** depression; sleep quality; elderly; nursing home; risk factors.  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For peer review only

## Article Summary

### Strengths and limitations of this study

- This is the first study to examine the impact of sleep quality on depression symptoms among elderly individuals in nursing homes.
- The study provides valuable information on sleep pattern and emotion problems with a nursing home setting.
- The cross-sectional study design makes causal relationships undeterminable.

## 1. Introduction

Aging is a challenge problem in China and all over the world. As age increases in old age, the risk of problems with sleep also increases, which has emerged as a critical issue. For examples, a cross-sectional investigation conducted among 2,398 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 2,565 elderly Singaporeans showed that 69.4% experienced sleep interruption at night and 48.9% reported having difficulty falling asleep <sup>2</sup>. Moreover, the prevalence of poor sleep quality among older adults was also relatively high. In China, the prevalence of poor sleep quality was 41.5% in urban communities <sup>3</sup> and 49.7% in rural areas among the elderly <sup>4</sup>. However, several studies demonstrated that most sleep problems can be exacerbated by an institutional setting <sup>5-7</sup>. Fetveit and colleagues <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 have 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.

There is many of evidence to suggesting that poor sleep quality has significant negative effects on physical and mental health, and health-related quality of life <sup>8-10</sup>. The findings of epidemiological studies suggest that poor sleep quality is a strong risk factor for suicidal ideation among the elderly <sup>8 9</sup>. 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

1  
2  
3  
4 with increased odds of hypertension in a Chinese rural population <sup>12</sup>. However, despite the  
5  
6 significance of poor sleep quality among the elderly population, its prevalence and the  
7  
8 underlying effect on physical and mental function are not entirely understood.  
9

10  
11 Depression is a common psychiatric disorder among the elderly. It contributes not only  
12  
13 to mild cognitive impairment but also to an increased risk of comorbidity and mortality <sup>13-15</sup>.  
14  
15 In addition, many studies indicated that the institutionalized elderly have a higher  
16  
17 prevalence of depression than the community-dwelling elderly. Due to differences in  
18  
19 diagnostic criteria, assessment tools and sample characteristics, the reported prevalence of  
20  
21 depression symptoms in nursing homes varied widely across different localities.  
22  
23 Epidemiological studies indicated that the prevalence of depressive symptoms among the  
24  
25 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  
26  
27 46.1% in mainland China <sup>19</sup>.  
28  
29  
30  
31  
32  
33  
34

35 The association between sleep quality and depressive symptoms among the elderly is  
36  
37 complex, bidirectional and not entirely understood. On one hand, many studies have  
38  
39 suggested that elderly people with some sleep disturbance are more likely to develop  
40  
41 depressive symptoms than younger people <sup>20 21</sup>. On the other hand, people with depression  
42  
43 symptoms reported a higher prevalence of poor sleep quality <sup>22</sup>. Although many previous  
44  
45 studies have demonstrated that poor sleep quality is positively associated with depression  
46  
47 symptoms among the elderly, the evidence of this relationship among the elderly in nursing  
48  
49 homes was scarce. Therefore, the purpose of this study was to examine the association  
50  
51 between poor sleep quality and depression symptoms among the elderly of nursing homes  
52  
53 in China.  
54  
55  
56  
57  
58  
59  
60



## 2. Methods

### 2.1 Study population

This cross-sectional study was conducted in Changsha, Hengyang and Yiyang Cities of Hunan Province in China from October 2018 up until December 2018. In order to select a representative sample of elderly people living in nursing homes of Hunan Province, a multistage sampling method was used. Firstly, three cities, Yiyang, Changsha and Hengyang were randomly selected from Northern Hunan, Central Hunan, and Southern Hunan, respectively. Subsequently, 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 selected nursing homes formed the sampling frame and participants were included in our study if they met the following inclusion criteria: (1) age 60 years and above; (2) has been in the nursing home for more than one year. Participants were excluded if they (1) refused to participate in this study; (2) have a severe hearing impairment or a language barrier. A total of 2,055 older adults residents in the 24 nursing homes, of which 511 were excluded because of less than 60 years or staying in a nursing

1  
2  
3  
4 home less than one year. 603 older adults have severe hearing impairment or language  
5  
6 barrier and 112 older adults residents who did not agree to participate were also excluded  
7  
8 in this study. Of the remaining 829 older adults, 12 were excluded for incomplete data.  
9  
10  
11 Finally, in total of 817 elderly were included in data analysis in this study.  
12  
13

## 14 **2.2 Data collection**

15  
16  
17 Trained staff collected data through face-to-face interviews using a set of structured  
18  
19 questionnaires, and each interview lasted between 1/2 and 1 hour. General demographic  
20  
21 information were collected including gender, age, education level, marital status, monthly  
22  
23 personal income, duration of admission, number of living children, history of chronic  
24  
25 diseases, history of smoking tobacco and history of alcohol consumption. Marital status was  
26  
27 classified as either stable or unstable. Unstable marital status meant either divorce, loss of a  
28  
29 partner or has never married. Smoking was defined as averaging at least one cigarette per  
30  
31 day in the last year. Alcohol consumption was defined as drinking one glass of wine per day  
32  
33 in the last week. Chronic diseases included type 2 diabetes, hypertension, coronary heart  
34  
35 disease, chronic obstructive pulmonary disease and other chronic diseases as specified in  
36  
37 the medical records of the respondent.  
38  
39  
40  
41  
42  
43  
44

## 45 **2.3 Sleep quality assessment**

46  
47  
48 Sleep quality among the participants was assessed using the Chinese version of the  
49  
50 Pittsburgh Sleep Quality Index (PSQI). The PSQI is a self-rated questionnaire that assesses  
51  
52 sleep quality in the past month. It contains nineteen items grouped according to seven  
53  
54 components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep  
55  
56 disturbances, use of sleeping medication, and daytime dysfunction<sup>23</sup>. These components  
57  
58  
59  
60

1  
2  
3  
4 were defined as follows in this study: subjective sleep quality (good or poor); reduced sleep  
5  
6 efficiency (sleep efficiency < 85%); increased sleep latency (sleep latency component  
7  
8 score > 1); sleep duration (< 6 h, 6-7 h and > 7 h); sleep disturbances (any kind of sleep  
9  
10 disturbance  $\geq 1$  time/week); use of sleep medication (use of sleep medication  $\geq 1$  time/week);  
11  
12 and daytime dysfunction (daytime dysfunction component score > 1). Each component's  
13  
14 score ranges from 0 to 3 points so that the global PSQI score ranges from 0 to 21 points. The  
15  
16 Chinese version of the PSQI has been shown to have good validity and reliability among  
17  
18 older adults <sup>24</sup>. Participants with a global PSQI score greater than 5 were defined as having  
19  
20 poor sleep quality <sup>23</sup>.  
21  
22  
23  
24  
25  
26

#### 27 **2.4 Depression symptoms assessment**

28  
29  
30 Depressive symptoms were assessed using the Chinese version of the Geriatric  
31  
32 Depression Scale-30 items (GDS-30). The 30 items of this instrument are true/false  
33  
34 questions whose total score ranges from 0 to 30 points. Participants who scored 11 or  
35  
36 greater were considered as having depression symptoms in this study. The GDS-30 was  
37  
38 developed by Brink and colleagues in 1982 and has been widely used to assess depression  
39  
40 symptoms in the elderly worldwide <sup>25</sup>. Several studies have demonstrated that this  
41  
42 measurement tool is reliable and valid in multiple settings and have recommended it for use  
43  
44 in nursing home populations <sup>26 27</sup>. The validity and reliability of the Chinese version of the  
45  
46 GDS-30 have also been extensively assessed in China <sup>28 29</sup>. The GDS-30 consists of 30  
47  
48 true/false questions, and the total score ranges from 0 to 30 points. Participants who scored  
49  
50 11 or greater are considered to be depressive in this study <sup>30</sup>.  
51  
52  
53  
54  
55  
56  
57

#### 58 **2.5 Covariates**

1  
2  
3  
4 Other information including, social support, activities of daily living (ADL) and negative  
5  
6 life events were collected. Social support among the elderly was assessed using the Social  
7  
8 Support Rating Scale (SSRS), which was developed by Xiao <sup>31</sup>. The scale consists of 10 items  
9  
10 and is divided into three parts: objective support, subjective support and availability of  
11  
12 social support. The total support score ranges from 12 to 66 points, and higher scores  
13  
14 indicate higher social support. An SSRS score greater than 30 points was defined as  
15  
16 indicating high social support in this study. Furthermore, ADL status was assessed using  
17  
18 Lawton and Brody's ADL scale <sup>32</sup>. It includes 16 items, and each item is scored from 1 (can do  
19  
20 it myself) to 4 (cannot do it myself). Participants' possible total scores on this instrument  
21  
22 range between 16 and 64 points. A participant is classified as having Disabled ADL status  
23  
24 when the participant's total score is higher than 14 points. Negative life events were  
25  
26 assessed using the Life Events Scale for the Elderly (LESE). The LESE is a valid and reliable  
27  
28 tool used in the elderly population and is widely used in China <sup>33</sup>. It includes 46 items that  
29  
30 are grouped into three main domains: health-related problems, family-related problems and  
31  
32 social-related problems. Participants were determined to have experienced from negative  
33  
34 life events when any such events occurred and caused stress.  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44

## 45 **2.6 Statistical analysis**

46  
47  
48 Categorical data were summarised as absolute values and percentages, whereas  
49  
50 continuous data were summarised as mean± standard deviation. The  $\chi^2$  test for categorical  
51  
52 data or Student's *t*-test for continuous data was used to compare the differences between the  
53  
54 good sleep quality group and the poor sleep quality group. Additionally, student's *t*-test or  
55  
56 one-way analysis of variance (ANOVA) was used to identify the dependence of the  
57  
58  
59  
60

1  
2  
3  
4 differences in the GDS-30 and PSQI scores on different variables. General linear models  
5  
6 (GLM) were used to estimate the difference in the mean GDS-30 scores with respect to sleep  
7  
8 quality (poor=1, good=0) using both the univariate (crude) and the multivariate (adjusted)  
9  
10 models. Furthermore, the crude and adjusted binary logistic regression models were used to  
11  
12 examine the association between sleep quality and depression symptoms; and the  
13  
14 association between components of sleep quality and depression symptoms. A  $P<0.05$  was  
15  
16 considered statistically significant. All data analyses were performed using the Statistical  
17  
18 Package for the Social Sciences (SPSS) 20.0 software (SPSS Inc., Chicago, IL, USA).  
19  
20  
21  
22  
23

## 24 25 **2.7 Patient and public involvement**

26  
27 Neither patients nor the public was directly involved in the development, design or  
28  
29 recruitment of the study. Test results were provided to the participants at the point of  
30  
31 testing.  
32  
33

## 34 35 **3. Results**

### 36 37 **3.1 Characteristics of the study sample**

38  
39 The average age was  $79.1\pm 8.7$  years, and more than half of the participants were female.  
40  
41 Furthermore, majority of the participants had medical insurance, at least one kind of chronic  
42  
43 disease, and one child. Also, minority of the participants were smokers, were drinkers, and  
44  
45 normal ADL scores.  
46  
47  
48

49  
50 According to the cut-off value of the PSQI in terms of sleep quality, 550 (67.3%)  
51  
52 participants had poor sleep quality. Moreover, 18.6% of the participants had a sleep  
53  
54 duration between 6 and 7 hours, 30.4% reported sleep disturbances, 49.9% reported  
55  
56 daytime dysfunction, and 10.3% had taken sleep medication more than once a week. Based  
57  
58  
59  
60

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, history of chronic disease, negative life events, social support and ADL status. Additionally, participants with poor sleep quality were those who had an unstable marital status, a monthly personal income below 3,000 RMB, a history of chronic disease, the experience of negative life events, low social support and disabled ADL status. The results are shown in Table 1.

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
Female	441(54.0)	299(54.4)	142(53.2)	
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)	
Marital status				
Stable	302(37.0)	186(33.8)	116(43.4)	0.007
Unstable	515(63.0)	364(66.2)	151(56.6)	
Medical insurance				

Yes	766(93.8)	517(94.0)	249(93.3)	0.681
No	51(6.2)	33(6.0)	18(6.7)	
Monthly personal income				
≤3,000 RMB	568(69.5)	404(73.5)	164(61.4)	<0.001
>3,000 RMB	249(30.5)	146(26.5)	103(38.6)	
Duration of admission				
1-3 years	566(69.3)	370(67.3)	196(73.4)	0.075
>3 years	251(30.7)	180(32.7)	71(26.6)	
History of chronic disease				
Yes	620(75.9)	454(82.5)	166(62.2)	<0.001
No	197(24.1)	96(17.5)	101(37.8)	
Smoking				
Yes	132(16.2)	82(14.9)	50(18.7)	0.164
No	685(83.8)	468(85.1)	217(81.3)	
Alcohol drinking				
Yes	96(11.8)	60(10.9)	36(13.5)	0.284
No	721(88.2)	490(89.1)	231(76.5)	
Have a child or more				
Yes	746(91.3)	496(90.2)	250(93.6)	0.100
No	71(8.7)	54(9.8)	17(6.4)	
Negative life events				
Yes	725(88.7)	515(93.6)	210(78.7)	<0.001

No	92(11.3)	35(6.4)	57(21.3)	
Social support				
High	382(46.8)	213(38.7)	169(63.3)	<0.001
Low	435(53.2)	337(61.3)	98(36.7)	
ADL status				
Normal	268(32.8)	152(27.6)	116(43.4)	<0.001
Disabled	549(67.2)	398(72.4)	151(56.6)	
Subjective sleep quality				
Good	483(59.1)	220(40.0)	263(98.5)	<0.001
Poor	334(40.9)	330(60.0)	4(1.5)	
Increased sleep latency				
Yes	433(53.0)	421(76.5)	12(4.5)	<0.001
No	384(47.0)	129(23.5)	255(95.5)	
Sleep duration				
<6 h	388(47.5)	373(67.8)	15(5.6)	<0.001
6-7 h	152(18.6)	98(17.8)	54(20.2)	
>7 h	277(33.9)	79(14.4)	198(74.2)	
Reduced sleep efficiency				
Yes	499(61.1)	457(83.1)	84(31.5)	<0.001
No	309(38.9)	42(16.9)	225(68.5)	
Sleep disturbances				
Yes	248(30.4)	231(42.0)	17(6.4)	<0.001



No	569(69.6)	319(58.0)	250(93.6)	
Use of sleep medication				
Yes	84(10.3)	83(15.1)	1(0.4)	<0.001
No	733(89.7)	467(84.9)	266(99.6)	
Daytime dysfunction				
Yes	408(49.9)	366(66.5)	42(15.7)	<0.001
No	409(50.1)	184(33.5)	225(84.3)	

Values are n (%) or mean±SD; ADL, activities of daily living

### 3.2 PSQI and GDS scores

The average GDS score was  $9.8 \pm 7.5$  points, and 294 (36.0%) participants were determined to have depressive symptoms. Participants with a primary school education or less, an unstable marital status, a monthly personal income  $\leq 3,000$  RMB, a duration of admission  $>3$  years, a chronic disease, smoking status, drinking status, no children, low social support, experience of negative life events, and disabled ADL status appeared to have higher GDS scores (all  $P < 0.001$ ).

The average PSQI score was  $8.5 \pm 4.9$  points. The distribution of PSQI scores was statistically different across the categories of age, education level, marital status, monthly personal income, duration of admission, negative life events, social support and ADL status. Participants who had older age, primary school education or less, an unstable marital status, a monthly income  $\leq 3,000$  RMB, admission  $>3$  years, low social support, experience of negative life events and disabled ADL status were more likely to have higher PSQI scores (all  $P < 0.05$ ). The results are presented in Table 2.

Table 2 Distribution of the GDS-30 and PSQI scores across categories of the categorical variables among the elderly in the nursing homes

Variables	GDS-30 score		PSQI score	
	Mean±SD	<i>P</i> -value <sup>†</sup>	Mean±SD	<i>P</i> -value <sup>†</sup>
Age				
≤70 years	10.8±7.9	0.079	7.8±4.9	0.048
>70 years	9.6±7.4		8.7±4.9	
Gender				
Male	10.0±7.6	0.558	8.3±4.8	0.293
Female	9.7±7.5		8.7±5.0	
Education				
Primary school and below	11.2±7.9	<0.001	9.1±5.0	<0.001
Junior high school	10.1±7.4		8.7±5.0	
Senior high school and above	7.7±6.6		7.4±4.6	
Marital status				
Stable	8.6±7.1	<0.001	7.7±4.9	<0.001
Unstable	10.6±7.7		10.0±4.9	
Medical insurance				
Yes	9.8±7.5	0.351	8.5±4.9	0.892
No	10.8±7.7		8.6±5.0	
Monthly personal income				
≤3,000 RMB	11.1±7.8	<0.001	9.1±4.9	<0.001

>3,000 RMB	6.8±5.8		7.1±4.7	
Duration of admission				
1-3 years	8.7±6.6	<0.001	8.1±4.8	0.001
>3 years	12.5±8.7		9.4±5.1	
Have chronic disease				
Yes	10.4±7.7	<0.001	9.1±4.8	<0.001
No	8.0±6.9		6.6±4.7	
Smoking				
Yes	12.3±8.8	<0.001	8.3±4.9	0.619
No	9.4±7.2		8.5±4.9	
Alcohol drinking				
Yes	14.1±9.1	<0.001	8.9±5.6	0.410
No	9.3±7.1		8.5±4.8	
Have a child or more				
Yes	9.5±7.4	<0.001	8.4±4.9	0.269
No	13.3±7.9		9.1±4.6	
Negative life events				
Yes	10.1±7.6	<0.001	8.9±4.9	<0.001
No	7.4±6.6		5.3±4.0	
Social support				
High	6.4±5.2	<0.001	6.9±4.5	<0.001
Low	12.8±8.0		9.9±4.8	

ADL status				
Normal	6.9±6.2	<0.001	7.2±4.7	<0.001
Disabled	11.3±7.7		9.2±4.9	

† P-value was determined by student t-test or one-way analysis of variance (ANOVA);

SD, standard deviation; GDS, geriatric depression scale; PSQI, pittsburgh sleep quality index;

ADL, activities of daily living.

### 3.3 Association between sleep quality and depression symptoms

Based on the results of the general 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 ( $M_{diff}=5.19$ , 95% CI: 4.15, 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, history of chronic disease, SSRS status, ADL status, negative life events and GAD, results also shown that participants with poor sleep quality had higher GDS-30 scores ( $M_{diff}=2.54$ , 95% CI: 1.66, 3.42). The results are shown in Table 3.

Table 3 Association between sleep quality and GDS score among the elderly in the nursing homes

	Poor sleep quality		Good sleep quality		Difference	
	Mean	SE	Mean	SE	$M_{diff}$ (95%CI)	P-value
Crude model	11.53	0.31	6.33	0.45	5.19(4.15,6.24)	<0.001

## Adjusted model

Model 1	11.31	0.29	6.79	0.42	4.52(3.51,5.53)	<0.001
Model 2	11.01	0.27	7.40	0.40	3.50(2.54,4.47)	<0.001
Model 3	10.67	0.24	8.09	0.36	2.54(1.66,3.42)	<0.001

SE, standard error;  $M_{diff}$ , mean difference

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, history of chronic disease, SSRS status, ADL status, and negative life events.

The participants were divided into two groups according to the GDS-30 cut-off value between depression symptoms and no depression symptoms. Binary logistic regression analysis showed that participants with poor sleep quality had an increased risk of depression symptoms in the crude model (odds ratio [OR] = 4.37, 95% confidence interval [CI]: 3.03, 6.31). The relationship between depression symptoms and poor sleep quality remained significant in the binary logistic regression models that were adjusted for other covariates. 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, 2.04-4.98). Similar results were also observed for all the component of sleep quality except for the two components, use of sleep medication and sleep duration between 6 and 7 hours. The OR values, which indicated the association between depression symptoms and sleep quality

components, ranged from 1.95 to 3.15. The results are shown in Table 4.

Table 4 Association between sleep quality and depression symptoms among the elderly in the nursing homes

	Crude model			Adjusted model <sup>†</sup>		
	OR	95%CI	P-value	OR	95%CI	P-value
Overall sleep quality						
Good	1.00			1.00		
Poor	4.37	3.03-6.31	<0.001	3.19	2.04-4.98	<0.001
Subjective sleep quality						
Good	1.00			1.00		
Poor	5.05	3.71-6.87	<0.001	3.15	2.18-4.56	<0.001
Increased sleep latency						
Yes	1.00			1.00		
No	3.81	2.79-5.20	<0.001	2.58	1.78-3.74	<0.001
Sleep duration						
>7 h	1.00			1.00		
6-7 h	1.09	0.70-1.71	0.700	1.24	0.73-2.11	0.431
≤ 6 h	2.64	1.89-3.70	<0.001	1.95	1.29-2.95	0.001
Reduced sleep efficiency						
No	1.00			1.00		
Yes	2.74	1.99-3.78	<0.001	1.89	1.27-2.80	0.002
Sleep disturbances						

No	1.00			1.00		
Yes	3.49	2.56-4.77	<0.001	2.33	1.59-3.41	<0.001
Use of sleep medication						
No	1.00			1.00		
Yes	1.63	1.03-2.56	0.037	1.30	0.72-2.35	0.379
Daytime dysfunction						
No	1.00			1.00		
Yes	3.22	2.38-4.36	<0.001	2.21	1.53-3.20	<0.001

OR, odds ratio; CI, confidence interval

† adjusted for age, gender, education, marital status, medical insurance, monthly personal income, duration of admission, number of living children, smoking status, alcohol drinking status, history of chronic disease, social support status, ADL status and negative life events.

#### 4. Discussion

In this study, we examined the prevalence of poor sleep quality and its relationship with depression symptoms in the elderly in nursing homes in Hunan, China. We found that participants with poor sleep quality had higher GDS-30 scores than those with good sleep quality. Moreover, participants with poor sleep quality had an increased risk of depression symptoms.

Considerable evidence suggests that sleep problems are very common among the elderly, and institutional settings may exacerbate them. Based on a large random sample of the elderly in nursing homes, our study determined that the prevalence of poor sleep quality was 67.3%. This finding is higher than that found in some previous studies on sleep quality

1  
2  
3  
4 among the elderly in nursing homes. For instance, Eser and colleagues <sup>34</sup> estimated that the  
5  
6 prevalence of poor sleep quality was 60.9% among 540 elderly people in nursing homes in  
7  
8 Turkey. A similar study in Turkey also found that 60.3% of the elderly in nursing homes  
9  
10 had poor sleep quality <sup>35</sup>. In similar institutions and populations, Stefan and colleagues <sup>36</sup>  
11  
12 found that 54.5% of 894 elderly people of Zagreb had poor sleep quality. Furthermore, Tsai  
13  
14 *et al* <sup>37</sup> reported that the prevalence of poor sleep quality was 46.4% in the elderly in nursing  
15  
16 homes. A reason for this variation in these prevalence estimates may be attributed to  
17  
18 differences between studies with regard to inclusion criteria for participants and differences  
19  
20 in the facilities and medical care used in different nursing homes. In addition, the most  
21  
22 commonly reported components of poor sleep quality were decreased sleep efficiency  
23  
24 (61.1%), increased sleep latency (53.0%) and sleep disturbances (30.4%). This pattern  
25  
26 indicates that these participants had problems with both initiating and maintaining sleep.  
27  
28 These results are consistent with those of previous studies conducted on the elderly in  
29  
30 nursing homes. For example, Fetveit *et al.* <sup>6</sup> found that 72% of the elderly participants in  
31  
32 nursing homes had a sleep efficiency below 85%, and 77.8% reported a sleep onset latency  
33  
34 of more than 30 minutes. Also, Wilfling *et al.* <sup>38</sup> found that 23.0% of the elderly in German  
35  
36 nursing homes had sleep disturbances, and Wang *et al.* <sup>39</sup> found that 27.8% of older Chinese  
37  
38 adults living in nursing homes had sleep disturbances. One of the important factors that may  
39  
40 contribute to the development of a higher prevalence of sleep problems in the elderly in  
41  
42 nursing homes is the environment, particularly with respect to the high levels of night-time  
43  
44 noise and light, the low levels of daytime light, and care routines that do not promote sleep  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
<sup>40</sup>. However, the use of sleep medication is not widespread in Chinese nursing homes, and



1  
2  
3  
4 only 10.3% of residents had taken sleep medication once or more a week.  
5  
6

7         The prevalence of depression symptoms in this study was associated with sleep  
8  
9 quality. For example, participants with poor sleep quality scored 2.54 points higher than  
10  
11 those with good sleep quality on the GDS-30 score after adjusting for many important  
12  
13 covariates. It have meaningful difference since one point represent one symptom in GDS-30  
14  
15 scale. Moreover, participants with poor sleep quality were 3.19-fold more likely to develop  
16  
17 depression symptoms compared to those who had good sleep quality. Furthermore,  
18  
19 participants with increased sleep latency, shorter sleep duration, lower sleep efficiency,  
20  
21 sleep disturbances and daytime dysfunction had increased risk of depression symptoms.  
22  
23 These findings are in accordance with those of several previous similar studies in both  
24  
25 nursing homes and communities. In this regard, a cross-sectional study by Orhan et al. <sup>35</sup>  
26  
27 demonstrated that the GDS-30 score was positively correlated with the global PSQI score  
28  
29 ( $r=0.231$ ) as well as the sleep latency and sleep disturbances scores ( $r=0.261$  and  $0.380$ )  
30  
31 among seventy-three elderly people living in a nursing home in Turkey. Additionally, Foley  
32  
33 and colleagues <sup>22</sup> conducted a study on over 9,000 participants aged at least 65 and found  
34  
35 that the sleep complaint score was positively associated with the Center for Epidemiologic  
36  
37 Studies Depression Scale score (CESD). Also, Sukegawa et al. <sup>41</sup> found that elderly persons  
38  
39 with depression symptoms were more likely to report poor sleep efficiency, sleep  
40  
41 disturbances, long sleep latency and poor subjective sleep quality. In agreement with the  
42  
43 preceding results, a prospective cohort study by Livingston et al. <sup>42</sup> reported that the best  
44  
45 predictor of future depression in elderly people, who were not depressed at baseline, was  
46  
47 sleep disturbance at baseline. Moreover, Rodin et al. <sup>43</sup> found that the frequency of  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 depressed affect was positively associated with sleep disturbances in the elderly after  
5  
6 controlling for adjustment factors. Similarly, Cho et al.<sup>21</sup> suggested that, among the elderly  
7  
8 with prior depression, depression recurrence was predicted by sleep disturbance, and this  
9  
10 association was independent of other depression symptoms. Furthermore, in a previous  
11  
12 cross-sectional study, elderly persons with a GDS score  $\geq 6$  were 1.29 times more likely to  
13  
14 develop sleep disturbances than those with a GDS score of 0 to 2<sup>44</sup>. Another cross-sectional  
15  
16 study<sup>45</sup> found that depression was independently positively associated with poor sleep  
17  
18 quality among the elderly after adjusting for other confounders (OR= 1.21, 95% CI:  
19  
20 1.12-1.52). However, the mechanism underlying the relationship between poor sleep quality  
21  
22 and depression symptoms is not thoroughly understood. Certainly, many studies have  
23  
24 suggested that sleep problems and depression symptoms can reinforce each other and that  
25  
26 the relationship might be bidirectionally reinforced. Although the direction of the  
27  
28 association between sleep quality and depression symptoms in this study was not possible  
29  
30 to determine as a result of the use of a cross-sectional study design, poor sleep quality was  
31  
32 viewed as a prodromal state or even a core symptom of depression symptoms in the elderly.  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42

43 To our knowledge, this is the first study to focus on the elderly in a nursing home in  
44  
45 China and to demonstrate that poor sleep quality was independently associated with  
46  
47 depression symptoms. However, there are several limitations in this study. First, the causal  
48  
49 relationship between poor sleep quality and depression symptoms could not be assessed  
50  
51 due to the use of a cross-sectional study design. Therefore, further longitudinal and  
52  
53 prospective studies should be conducted to confirm this relationship in the elderly in  
54  
55 nursing homes. Second, all data were obtained from self-reports, which may compromise the  
56  
57  
58  
59  
60

1  
2  
3  
4 accuracy of measurements due to recall bias, and there was lack of objective measurement  
5  
6 of sleep quality, which might have led to misclassification of some of the measurements.  
7  
8  
9 Finally, although the odds ratio was decreased in the adjusted models, the mediating effect  
10  
11 of other variables on the association between poor sleep quality and depression symptoms  
12  
13 was not analysed and should be investigated in future studies.  
14  
15

## 16 **5. Conclusions**

17  
18  
19 In summary, we observed a high prevalence of poor sleep quality among the elderly  
20  
21 living in nursing homes in Hunan in China. In addition, poor sleep quality was associated  
22  
23 with increased GDS-30 scores and the development of depression symptoms. Nonetheless,  
24  
25 further studies are needed to (1) explore whether the intervention and treatment of poor  
26  
27 sleep quality can ameliorate depression symptoms among the elderly in nursing homes, and  
28  
29 (2) investigate the mediating effects of other variables on the association between sleep  
30  
31 quality and depression symptoms.  
32  
33  
34  
35  
36

## 37 **Acknowledgements**

38  
39 We thank all the participants very much for their collaboration  
40  
41  
42

## 43 **Author contributions**

44  
45 ZH and XZ completed the statistical analyses and drafted the manuscript. Atipatsa CK and YY  
46  
47 contribute to manuscript edit. HX checked and revised the manuscript. All the authors read  
48  
49 and approved the final manuscript.  
50  
51  
52

## 53 **Funding**

54  
55 This research received no specific grant from any funding agency in the public, commercial  
56  
57 or not-for-profit sectors  
58  
59  
60

## Competing interests

None declared

## Patient consent

Obtained.

## Ethical approval

This study was approved by the Ethical Committee of Xiangya School of Public Health in Central South University (No.XYGW-2018-49).

## Data availability statement

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.

## References

1. Maggi S, Langlois JA, Minicuci N, et al. Sleep complaints in community-dwelling older persons: prevalence, associated factors, and reported causes. *J Am Geriatr Soc* 1998;46:161-8.
2. Sagayadevan V, Abidin E, Binte Shafie S, et al. Prevalence and correlates of sleep problems among elderly Singaporeans. *Psychogeriatrics* 2017;17:43-51.
3. Luo J, Zhu G, Zhao Q, et al. Prevalence and Risk Factors of Poor Sleep Quality among Chinese Elderly in an Urban Community: Results from the Shanghai Aging Study. *Plos One* 2013;8
4. Li J, Yao Y-s, Dong Q, et al. Characterization and factors associated with sleep quality among rural elderly in China. *Archives of Gerontology and Geriatrics* 2013;56:237-43.
5. Martins da Silva R, Afonso P, Fonseca M, et al. Comparing sleep quality in institutionalized and non-institutionalized elderly individuals. *Aging & mental health* 2019:1-7.
6. Fetveit A, Bjorvatn B. Sleep disturbances among nursing home residents. *International journal of geriatric psychiatry* 2002;17:604-09.
7. Hoffman S. Sleep in the older adult: implications for nurses (CE). *Geriatric nursing (New York, NY)* 2003;24:210-4; quiz 15-6.
8. Gelaye B, Okeiga J, Ayantoye I, et al. Association of suicidal ideation with poor sleep quality among Ethiopian adults. *Sleep & breathing = Schlaf & Atmung* 2016;20:1319-26.
9. Qian YY, Sun L, Zhou CC, et al. The association between suicidal ideation and sleep quality in elderly individuals: A cross-sectional study in Shandong, China. *Psychiatry Research* 2017;256:453-57.
10. Uchmanowicz I, Markiewicz K, Uchmanowicz B, et al. The relationship between sleep

- 1  
2  
3 disturbances and quality of life in elderly patients with hypertension. *Clinical*  
4 *interventions in aging* 2019;14:155-65.
- 5  
6 11. Suzuki E, Yorifuji T, Ueshima K, et al. Sleep duration, sleep quality and cardiovascular disease  
7 mortality among the elderly: a population-based cohort study. *Preventive medicine*  
8 2009;49:135-41.
- 9  
10 12. Zhang H, Li Y, Zhao X, et al. The association between PSQI score and hypertension in a Chinese  
11 rural population: the Henan Rural Cohort Study. *Sleep medicine* 2019;58:27-34.
- 12  
13 13. Steenland K, Karnes C, Seals R, et al. Late-life depression as a risk factor for mild cognitive  
14 impairment or Alzheimer's disease in 30 US Alzheimer's disease centers. *Journal of*  
15 *Alzheimer's disease : JAD* 2012;31:265-75.
- 16  
17 14. Hare DL, Toukhsati SR, Johansson P, et al. Depression and cardiovascular disease: a clinical  
18 review. *European heart journal* 2014;35:1365-72.
- 19  
20 15. Gilman SE, Sucha E, Kingsbury M, et al. Depression and mortality in a longitudinal study:  
21 1952-2011. *CMAJ : Canadian Medical Association journal = journal de l'Association*  
22 *medicale canadienne* 2017;189:E1304-e10.
- 23  
24 16. Nazemi L, Skoog I, Karlsson I, et al. Depression, prevalence and some risk factors in elderly  
25 nursing homes in tehran, iran. *Iranian journal of public health* 2013;42:559-69.
- 26  
27 17. Lin PC, Wang HH, Huang HT. Depressive symptoms among older residents at nursing homes  
28 in Taiwan. *Journal of clinical nursing* 2007;16:1719-25.
- 29  
30 18. Stewart R, Hotopf M, Dewey M, et al. Current prevalence of dementia, depression and  
31 behavioural problems in the older adult care home sector: the South East London Care  
32 Home Survey. *Age and ageing* 2014;43:562-7.
- 33  
34 19. Liu S, Ouyang Z, Chong AM, et al. Neighborhood Environment, Residential Satisfaction, and  
35 Depressive Symptoms Among Older Adults in Residential Care Homes. *International*  
36 *journal of aging & human development* 2018;87:268-88.
- 37  
38 20. Paudel ML, Taylor BC, Diem SJ, et al. Association between depressive symptoms and sleep  
39 disturbances in community-dwelling older men. *Journal of the American Geriatrics*  
40 *Society* 2008;56:1228-35.
- 41  
42 21. Cho HJ, Lavretsky H, Olmstead R, et al. Sleep Disturbance and Depression Recurrence in  
43 Community-Dwelling Older Adults: A Prospective Study. *American Journal of Psychiatry*  
44 2008;165:1543-50.
- 45  
46 22. Foley DJ, Monjan AA, Brown SL, et al. Sleep complaints among elderly persons: an  
47 epidemiologic study of three communities. *Sleep* 1995;18:425-32.
- 48  
49 23. Buysse DJ, Reynolds CF, 3rd, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new  
50 instrument for psychiatric practice and research. *Psychiatry research* 1989;28:193-213.
- 51  
52 24. Jian-qing Q, Mi Z, Pei-yuan Q, et al. Reliability and Validity of the Pittsburgh Sleep Quality  
53 Index in older adults in rural area. *Modern Preventive Medicine* 2016;43:1835-38. In  
54 Chinese.
- 55  
56 25. Watson LC, Pignone MP. Screening accuracy for late-life depression in primary care: A  
57 systematic review. *J Fam Pract* 2003;52:956-64.
- 58  
59 26. Smalbrugge M, Jongenelis L, Pot AM, et al. Screening for depression and assessing change in  
60 severity of depression. Is the Geriatric Depression Scale (30-, 15- and 8-item versions)  
useful for both purposes in nursing home patients? *Aging & mental health*  
2008;12:244-48.

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
27. Li Z, Jeon YH, Low LF, et al. Validity of the geriatric depression scale and the collateral source version of the geriatric depression scale in nursing homes. *Int Psychogeriatr* 2015;27:1495-504.
  28. Xiaoyan H, Shuiyuan X, Dexing Z. Reliability and Validity of the Chinese Version of Geriatric Depression Scale: A Study in A Population of Chinese Rural Community-dwelling Elderly. *Chinese Journal of Clinical Psychology* 2008;16:473-75.
  29. Lu J, Wang Y, Wang X, et al. Reliability and Validity of the Chinese Version of Geriatric Depression Scale Among Chinese Urban Community-dwelling Elderly Population. *Chinese Journal of Clinical Psychology* 2013;21:39-41.
  30. Watson LC, Pignone MP. Screening accuracy for late-life depression in primary care: a systematic review. *The Journal of family practice* 2003;52:956-64.
  31. Xiao S. The theory basis and application of the social support rating scale. *Chin Ment Health* 1994;2:98-100.
  32. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *The Gerontologist* 1969;9:179-86.
  33. Xiao L, Xu H. Development of life events scale for the elderly. *Chin J Behavioral Med Sci* 2008;17:182-84. In Chinese.
  34. Eser I, Khorshid L, Cinar S. Sleep quality of older adults in nursing homes in Turkey: enhancing the quality of sleep improves quality of life. *Journal of gerontological nursing* 2007;33:42-9.
  35. Orhan FO, Tuncel D, Tas F, et al. Relationship between sleep quality and depression among elderly nursing home residents in Turkey. *Sleep and Breathing* 2012;16:1059-67.
  36. Stefan L, Vrgoc G, Rupcic T, et al. Sleep Duration and Sleep Quality Are Associated with Physical Activity in Elderly People Living in Nursing Homes. *International journal of environmental research and public health* 2018;15
  37. Tsai YF, Wong TKS, Ku YC. Self-care management of sleep disturbances and risk factors for poor sleep among older residents of Taiwanese nursing homes. *Journal of clinical nursing* 2008;17:1219-26.
  38. Wilfling D, Dichter MN, Trutschel D, et al. Prevalence of Sleep Disturbances in German Nursing Home Residents with Dementia: A Multicenter Cross-Sectional Study. *J Alzheimers Dis* 2019;69:227-36.
  39. Wang F, Meng LR, Zhang QE, et al. Sleep disturbance and its relationship with quality of life in older Chinese adults living in nursing homes. *Perspectives in psychiatric care* 2019
  40. Gentili A, Weiner DK, Kuchibhatil M, et al. Factors that disturb sleep in nursing home residents. *Aging (Milan, Italy)* 1997;9:207-13.
  41. Sukegawa T, Itoga M, Seno H, et al. Sleep disturbances and depression in the elderly in Japan. *Psychiatry Clin Neurosci* 2003;57:265-70.
  42. Livingston G, Blizard B, Mann A. Does sleep disturbance predict depression in elderly people? A study in inner London. *The British journal of general practice : the journal of the Royal College of General Practitioners* 1993;43:445-8.
  43. Rodin J, McAvay G, Timko C. A longitudinal study of depressed mood and sleep disturbances in elderly adults. *Journal of gerontology* 1988;43:P45-53.
  44. Kishimoto Y, Okamoto N, Saeki K, et al. Bodily pain, social support, depression symptoms and stroke history are independently associated with sleep disturbance among the elderly: a

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

cross-sectional analysis of the Fujiwara-kyo study. *Environ Health Prev* 2016;21:295-303.

45. Wu CY, Su TP, Fang CL, et al. Sleep quality among community-dwelling elderly people and its demographic, mental, and physical correlates. *J Chin Med Assoc* 2012;75:75-80.

For peer review only

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

Section/Topic	Item #	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	NA
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	NA
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			



Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11,12
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	15,16,17
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15,16,17
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	20,21,22
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	21,22,23
Generalisability	21	Discuss the generalisability (external validity) of the study results	23
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

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

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

# BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-036401.R1
Article Type:	Original research
Date Submitted by the Author:	01-Apr-2020
Complete List of Authors:	Hu, Zhao; Central South University Xiangya School of Public Health, Zhu, Xidi; Central South University Xiangya School of Public Health, Department of Social Medicine and Health Management Kaminga, Atipatsa; XiangYa School of Public Health, Central South University, Department of Epidemiology and Health Statistics Huilan, Xu; Central South University Xiangya School of Public Health, Department of Social Medicine and Health Management
<b>Primary Subject Heading</b>:	Mental health
Secondary Subject Heading:	Epidemiology, Mental health, Geriatric medicine
Keywords:	Depression & mood disorders < PSYCHIATRY, SLEEP MEDICINE, Epidemiology < THORACIC MEDICINE

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3  
4 **Association between poor sleep quality and depression symptoms among the elderly**  
5  
6 **in nursing homes in Hunan province,China:a cross-sectional study**  
7

8 Zhao Hu<sup>a</sup>, Xidi Zhu<sup>a</sup>, Atipatsa Chiwanda Kaminga<sup>b,c</sup>, Huilan Xu<sup>a,\*</sup>  
9

10  
11 <sup>a</sup> Department of Social Medicine and Health Management, Xiangya School of Public Health,  
12 Central South University, Changsha, China

13 <sup>b</sup> Department of Epidemiology and Health Statistics, Xiangya School of Public Health, Central  
14 South University, Changsha, China

15 <sup>c</sup> Department of Mathematics and Statistics, Mzuzu University, P/Bag 201, Mzuzu, Malawi  
16

17  
18  
19 \*Corresponding author at: Department of social medicine and health management, Xiangya  
20 school of public health, Central South University, Changsha, 410078, China. Tel: +86-0731  
21 -8484-5454. E-mail address:xhl6363@sina.com  
22

23 Word count: 4052; Tables:3  
24

25 **ABSTRACT**

26  
27 **Objectives:** To examine the association between the prevalence of poor sleep quality and  
28 depression symptoms among the elderly in the nursing homes of Hunan Province in China.  
29

30  
31  
32 **Design, Setting and participants:** This was a cross-sectional study investigating 817  
33 elderly people from 24 nursing homes in China's Hunan Province.  
34

35  
36  
37 **Main outcome measures:** Sleep quality was assessed using the Pittsburgh Sleep Quality  
38 Index (PSQI) such that poor sleep quality was defined as PSQI score>5. In addition,  
39 depression symptoms were assessed using the Geriatric Depression Scale (GDS).Linear  
40 regression models and binary logistic regression models were used to analyse the  
41 relationship between the prevalence of poor sleep quality and depression symptoms.  
42  
43  
44  
45  
46  
47  
48  
49

50  
51 **Results:** The mean PSQI score was 8.5±4.9, and the prevalence of poor sleep quality was  
52 67.3%. Additionally, the mean GDS score was 9.8±7.5, and the prevalence of depression  
53 symptoms was 36.0%. Elderly people with poor sleep quality had increased GDS score  
54 (mean difference=2.54, 95% CI: 1.66, 3.42) and increased risk of depression symptoms  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 (odds ratio [OR]=3.19, 95% CI: 2.04, 4.98) after controlling for demographics, disease  
5  
6 history, lifestyle behaviours and social support..  
7  
8

9 **Conclusions:** The prevalence of poor sleep quality was relatively high, and this was  
10  
11 associated with increased depression symptoms. Therefore, poor sleep quality could be  
12  
13 speculated as a marker of current depression symptoms in the elderly.  
14  
15

16 **Keywords:** depression; sleep quality; elderly; nursing home; risk factors.  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For peer review only

## Article Summary

### 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.

## 1. Introduction

Aging 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 2,398 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 2,565 elderly Singaporeans showed that 69.4% 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 colleagues <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

1  
2  
3  
4 cohort study found that poor sleep quality was associated with increased odds of  
5  
6 hypertension in a Chinese rural population <sup>12</sup>. However, despite the significance of poor  
7  
8 sleep quality among the elderly population, its prevalence and the underlying effect on their  
9  
10 physical and mental functioning are not entirely understood.  
11  
12

13  
14 Depression is a common psychiatric disorder among the elderly. It contributes not only  
15  
16 to mild cognitive impairment but also to an increased risk of comorbidity and mortality <sup>13-15</sup>.  
17  
18 In addition, many studies indicated that the institutionalized elderly have a higher  
19  
20 prevalence of depression than the community-dwelling elderly. Notwithstanding, the  
21  
22 reported prevalence of depression symptoms in nursing homes varied widely across  
23  
24 different localities due to differences in diagnostic criteria, assessment tools and sample  
25  
26 characteristics. For example, epidemiological studies indicated that the prevalence of  
27  
28 depression symptoms among the elderly in nursing homes was 90.2% in Iran <sup>16</sup>, 81.8% in  
29  
30 Taiwan <sup>17</sup>, 29.6% in London <sup>18</sup> and 46.1% in the Mainland China <sup>19</sup>.  
31  
32  
33  
34  
35  
36  
37

38 The association between sleep quality and depression symptoms among the elderly is  
39  
40 complex, bidirectional and not entirely understood. However, many studies have suggested  
41  
42 that elderly people with some sleep disturbance are more likely to develop depression  
43  
44 symptoms than younger people with some sleep disturbance <sup>20 21</sup>. Conversely, people with  
45  
46 depression symptoms reported a higher prevalence of poor sleep quality <sup>22</sup>. Although many  
47  
48 previous studies have demonstrated that poor sleep quality is positively associated with  
49  
50 depression symptoms among the elderly, the evidence of this relationship among the elderly  
51  
52 in nursing homes was scarce. Therefore, the purpose of this study was to examine the  
53  
54 association between poor sleep quality and depression symptoms among the elderly of  
55  
56  
57  
58  
59  
60



nursing homes in China.

## 2. Methods

### 2.1 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. Firstly, 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 one year. However, participants were excluded if they (1) refused to participate in this study; (2) had a severe hearing impairment or a language barrier. A total of 2,055 older adults residents in the 24 nursing homes, of which 511 were excluded because of less than 60 years or staying

1  
2  
3  
4 in a nursing home less than one year. 603 older adults have severe hearing impairment or  
5  
6 language barrier and 112 older adults residents who did not agree to participate were also  
7  
8 excluded in this study. Of the remaining 829 older adults, 12 were excluded for incomplete  
9  
10 data. Finally, in total of 817 elderly were included in data analysis in this study.  
11  
12

## 13 14 **2.2 Data collection**

15  
16 Trained staff collected data through face-to-face interviews using a set of structured  
17  
18 questionnaires, and each interview lasted between 1/2 and 1 hour. Demographic  
19  
20 information collected included gender, age, education level, marital status, monthly personal  
21  
22 income, duration of admission, number of living children, a history of chronic diseases, a  
23  
24 history of smoking tobacco and a history of alcohol consumption. Marital status was  
25  
26 classified as either stable or unstable. Unstable marital status meant divorced, widowed or  
27  
28 never married. Smoking was defined as averaging at least one cigarette per day in the last  
29  
30 year. Alcohol consumption was defined as drinking one glass of wine per day in the last  
31  
32 week. Chronic diseases were self-reported by respondents included type 2 diabetes,  
33  
34 hypertension, coronary heart disease, chronic obstructive pulmonary disease and other  
35  
36 chronic diseases as specified in the medical records of the respondent.  
37  
38  
39  
40  
41  
42  
43  
44

## 45 46 **2.3 Sleep quality assessment**

47  
48 Sleep quality among the participants was assessed using the Chinese version of the  
49  
50 Pittsburgh Sleep Quality Index (PSQI). The PSQI is a self-rated questionnaire that assesses  
51  
52 sleep quality in the past month. It contains nineteen items grouped according to seven  
53  
54 components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep  
55  
56 disturbances, use of sleeping medication, and daytime dysfunction<sup>23</sup>. These components  
57  
58  
59  
60

1  
2  
3  
4 were defined as follows in this study: subjective sleep quality (good or poor); sleep efficiency  
5  
6 (reduced sleep efficiency was sleep efficiency <85%); sleep latency (increased sleep latency  
7  
8 was sleep latency component score >1); sleep duration (<7 h, 7-8 h and >8 h); sleep  
9  
10 disturbances (any kind of sleep disturbance  $\geq 1$  time/week); use of sleep medication (use of  
11  
12 sleep medication  $\geq 1$  time/week); and daytime dysfunction was daytime dysfunction of at  
13  
14 least once a week. Each component's score ranges from 0 to 3 points such that 0 is the most  
15  
16 positive score and 3 the most negative score. Therefore, the global PSQI score ranges from 0  
17  
18 to 21 points. The Chinese version of the PSQI has been shown to have good validity and  
19  
20 reliability among older adults<sup>24</sup>. Participants with a global PSQI score greater than 5 were  
21  
22 defined as having poor sleep quality<sup>23</sup>.  
23  
24  
25  
26  
27  
28  
29

#### 30 **2.4 Depression symptoms assessment**

31  
32 Depressive symptoms were assessed using the Chinese version of the Geriatric  
33  
34 Depression Scale-30 items (GDS-30). The 30 items of this instrument are true/false  
35  
36 questions whose total score ranges from 0 to 30 points. The GDS-30 was developed by Brink  
37  
38 and colleagues in 1982 and has been widely used to assess depression symptoms in the  
39  
40 elderly worldwide<sup>25</sup>. Several studies have demonstrated that this measurement tool is  
41  
42 reliable and valid in multiple settings and recommended it for use in nursing home  
43  
44 populations<sup>26 27</sup>. The validity and reliability of the Chinese version of the GDS-30 have been  
45  
46 extensively assessed in China<sup>28 29</sup>. Participants who scored 11 or greater were considered as  
47  
48 having depression symptoms in this study<sup>30</sup>.  
49  
50  
51  
52  
53  
54  
55

#### 56 **2.5 Covariates**

57  
58 Other information including, social support, activities of daily living (ADL) and negative  
59  
60

1  
2  
3  
4 life events were also collected. Social support among the elderly was assessed using the  
5  
6 Social Support Rating Scale (SSRS), which was developed by Xiao <sup>31</sup>. The scale consists of 10  
7  
8 items and is divided into three parts: objective support, subjective support and availability  
9  
10 of social support. For items 1 to 4, and 8 to 10, each item's score ranges from 1 to 4 points.  
11  
12 For item 5, the first, second, third, and fourth options represent 1, 2, 3, and 4 points for each  
13  
14 support source, respectively. In addition, for items 6 and 7, each option is 1 point when  
15  
16 selected and zero when not selected. The total social support score ranges from 12 to 66  
17  
18 points, and higher scores indicate higher social support. An SSRS score greater than 30  
19  
20 points was defined as indicating high social support in this study. Furthermore, ADL status  
21  
22 was assessed using Lawton and Brody's ADL scale <sup>32</sup>. It includes 16 items, and each item is  
23  
24 scored from 1 (can do it myself) to 4 (cannot do it myself). Participants' possible total scores  
25  
26 on this instrument range between 16 and 64 points. A participant is classified as having  
27  
28 disabled ADL status when the participant's ADL total score is greater than 14 points.  
29  
30 Negative life events were assessed using the Life Events Scale for the Elderly (LESE). The  
31  
32 LESE is a valid and reliable tool widely used in China for assessing the elderly population<sup>33</sup>.  
33  
34 It includes 46 items that are grouped into three main domains: health-related problems,  
35  
36 family-related problems and social-related problems. Participants were determined to have  
37  
38 experienced a negative life event when any such event occurred and caused them to have  
39  
40 stress.  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51

## 52 53 **2.6 Statistical analysis**

54  
55  
56 Categorical data were summarised as frequency counts and percentages, whereas  
57  
58 continuous data were summarised as mean ± standard deviation. The  $\chi^2$  test was used to  
59  
60

1  
2  
3  
4 compare categorical data between the good sleep quality group and the poor sleep quality  
5  
6 group; while the student's *t*-test was used to compare continuous data between the good  
7  
8 sleep quality group and the poor sleep quality group. Additionally, the student's *t*-test or  
9  
10 one-way analysis of variance (ANOVA) was used to identify the dependence of the  
11  
12 differences in the GDS-30 and PSQI scores on different variables. Additionally, linear models  
13  
14 were used to estimate the difference in the mean GDS-30 scores with respect to sleep quality  
15  
16 (poor=1, good=0) using both the univariate (crude) and the multivariable (adjusted) models.  
17  
18 Furthermore, the crude and adjusted binary logistic regression models were used to  
19  
20 examine the association between sleep quality and depression symptoms; and the  
21  
22 association between components of sleep quality and depression symptoms. A  $P<0.05$  was  
23  
24 considered statistically significant. All data analyses were performed using the Statistical  
25  
26 Package for the Social Sciences (SPSS) 20.0 software (SPSS Inc., Chicago, IL, USA).  
27  
28  
29  
30  
31  
32  
33

## 34 35 **2.7 Patient and public involvement**

36  
37 Neither patients nor the public was directly involved in the development, design or  
38  
39 recruitment of the study. Test results were provided to the participants at the point of  
40  
41 testing.  
42  
43  
44

## 45 46 **3. Results**

### 47 48 **3.1 Characteristics of the study sample**

49  
50 The average age was  $79.1\pm 8.7$  years, and more than half of the participants were female.  
51  
52 Furthermore, about 90% of the participants had medical insurance and one child. Besides,  
53  
54 about 70% of the participants had at least one kind of chronic disease. Also, more than 10%  
55  
56 of the participants were smokers, and alcohol consumers, whereas about a third of the  
57  
58  
59  
60

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, social support and ADL status. Additionally, participants with poor sleep quality were those who had an unstable marital status, a monthly personal income below 3,000 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.

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	568(69.5)	404(73.5)	164(61.4)	<0.001
≤3,000 RMB				
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 h	388(47.5)	373(67.8)	15(5.6)	<0.001
7-8 h	293(35.9)	140(25.5)	153(57.3)	
>8 h	136(16.6)	37(6.7)	99(37.1)	
Reduced sleep efficiency	499(61.1)	457(83.1)	84(31.5)	<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

### 3.2 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 ( $M_{\text{diff}}=5.19$ , 95% CI: 4.15, 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 ( $M_{\text{diff}}=2.54$ , 95% CI: 1.66, 3.42). The results are shown in Table 2.

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	$M_{\text{diff}}$ (95%CI)	P-value
Crude model	11.53	0.31	6.33	0.45	5.19(4.15,6.24)	<0.001
Adjusted Model 1( $R^2=0.11,F=33.54,P<0.001$ )						
	11.31	0.29	6.79	0.42	4.52(3.51,5.53)	<0.001
Adjusted Model 2( $R^2=0.24,F=27.42,P<0.001$ )						
	11.01	0.27	7.40	0.40	3.50(2.54,4.47)	<0.001
Adjusted Model 3( $R^2=0.40,F=30.78,P<0.001$ )						
	10.67	0.24	8.09	0.36	2.54(1.66,3.42)	<0.001

SE, standard error;  $M_{\text{diff}}$ , mean difference



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, SSRS status, ADL status, and negative life events.

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 (odds ratio [OR] = 4.37, 95% confidence interval [CI]: 3.03, 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, 2.04-4.98). Similar 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.

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

	Crude model			Adjusted model <sup>†</sup>		
	OR	95%CI	P-value	OR	95%CI	P-value

Overall sleep quality

Good	1.00			1.00			
Poor	4.37	3.03-6.31	<0.001	3.19	2.04-4.98	<0.001	
Subjective sleep quality							
Good	1.00			1.00			
Poor	5.05	3.71-6.87	<0.001	3.15	2.18-4.56	<0.001	
Increased sleep latency							
Yes	1.00			1.00			
No	3.81	2.79-5.20	<0.001	2.58	1.78-3.74	<0.001	
Sleep duration							
>8h	1.00			1.00			
7-8h	1.09	0.70-1.71	0.700	1.24	0.73-2.11	0.431	
<7 h	2.64	1.89-3.70	<0.001	1.95	1.29-2.95	0.001	
Reduced sleep efficiency							
No	1.00			1.00			
Yes	2.74	1.99-3.78	<0.001	1.89	1.27-2.80	0.002	
Sleep disturbances							
No	1.00			1.00			
Yes	3.49	2.56-4.77	<0.001	2.33	1.59-3.41	<0.001	
Use of sleep medication							
No	1.00			1.00			
Yes	1.63	1.03-2.56	0.037	1.30	0.72-2.35	0.379	
Daytime dysfunction							

No	1.00			1.00		
Yes	3.22	2.38-4.36	<0.001	2.21	1.53-3.20	<0.001

OR, odds ratio; CI, confidence interval

† 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, ADL status and negative life events.

#### 4. 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 and colleagues<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>35</sup>. Lower prevalence was also observed in Zagreb (54.5%) among 894 elderly people<sup>36</sup>, and in Taiwan (46.4%)<sup>37</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

1  
2  
3  
4 components of poor sleep quality were decreased sleep efficiency (61.1%), increased sleep  
5  
6 latency (53.0%) and sleep disturbances (30.4%). This pattern indicates that these  
7  
8 participants had problems with both initiating and maintaining sleep. Similarly, Fetveit et al.  
9  
10  
11  
12<sup>6</sup> found that 72% of the elderly participants in nursing homes had a sleep efficiency below  
13  
14 85%, while 77.8% reported a sleep onset latency of more than 30 minutes. Also, Wilfling et  
15  
16 al.<sup>38</sup> found that 23.0% of the elderly in German nursing homes had sleep disturbances and,  
17  
18 in the same way, Wang et al.<sup>39</sup> found that 27.8% of older Chinese adults living in nursing  
19  
20 homes had sleep disturbances. One of the important factors that may contribute to the  
21  
22 development of a higher prevalence of sleep problems among the elderly in nursing homes  
23  
24 is the environment, particularly with respect to the high levels of night-time noise and light,  
25  
26 the low levels of daytime light, and care routines that do not promote sleep<sup>40</sup>. However, the  
27  
28 use of sleep medication is not popular among the elderly in the Chinese nursing homes and  
29  
30 this could be the reason why only 10.3% of residents in this study had taken sleep  
31  
32 medication.  
33  
34  
35  
36  
37  
38  
39

40  
41 Moreover, among the participants that had taken sleep medication, majority of them  
42  
43 had poor sleep quality. Nevertheless, due to the cross-sectional study design, a causal  
44  
45 relationship between sleep quality and taking sleep medication could not be established.  
46  
47 Therefore, from this result, it can be assumed that participants with poor sleep quality are  
48  
49 more likely to take sleep medication, but this proportion is lower in the Chinese nursing  
50  
51 homes.  
52  
53

54  
55  
56 Additionally, the prevalence of depression symptoms in this study was associated with  
57  
58 sleep quality. For example, participants with poor sleep quality scored 2.54 points higher  
59  
60

1  
2  
3  
4 than those with good sleep quality on the GDS-30 score after adjusting for many important  
5  
6 covariates. Moreover, participants with poor sleep quality were 3.19-fold more likely to  
7  
8 develop depression symptoms than those who had good sleep quality. Furthermore,  
9  
10 participants with increased sleep latency, shorter sleep duration, lower sleep efficiency,  
11  
12 sleep disturbances and daytime dysfunction had increased risk of depression symptoms.  
13  
14 These findings are in accordance with those of several previous similar studies in both  
15  
16 nursing homes and communities<sup>35 41 42</sup>. In this regard, a cross-sectional study by Orhan et al.  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

<sup>35</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 seventy-three elderly people living in a nursing home in Turkey. Additionally, Foley and colleagues<sup>22</sup> conducted a study on over 9,000 participants aged at least 65 and found that the sleep complaint score was positively associated with the Center for Epidemiologic Studies Depression Scale score (CESD). Also, Sukegawa et al.<sup>43</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>41</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>42</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

1  
2  
3  
4 cross-sectional study, elderly persons with a GDS-30 score  $\geq 6$  were 1.29 times more likely to  
5  
6 develop sleep disturbances than those with a GDS-30 score of 0 to 2<sup>44</sup>. Another  
7  
8 cross-sectional study<sup>45</sup> found that depression was independently positively associated with  
9  
10 poor sleep quality among the elderly after adjusting for other confounders (OR= 1.21, 95%  
11  
12 CI: 1.12-1.52). However, the mechanism underlying the relationship between poor sleep  
13  
14 quality and depression symptoms is not thoroughly understood. Certainly, many studies  
15  
16 have suggested that sleep problems and depression symptoms can reinforce each other and  
17  
18 this relationship might be bidirectional. Although the direction of the association between  
19  
20 sleep quality and depression symptoms in this study was not possible to determine as a  
21  
22 result of the use of a cross-sectional study design, poor sleep quality was viewed as a  
23  
24 prodromal state or even a core symptom of depression symptoms in the elderly.  
25  
26  
27  
28  
29  
30  
31

32  
33 To our knowledge, this is the first study to focus on the elderly in a nursing home in  
34  
35 China and demonstrate that poor sleep quality was independently associated with  
36  
37 depression symptoms. However, there are several limitations in this study. First, the causal  
38  
39 relationship between poor sleep quality and depression symptoms could not be assessed  
40  
41 due to the use of a cross-sectional study design. Therefore, further longitudinal and  
42  
43 prospective studies should be conducted to confirm this relationship in the elderly in  
44  
45 nursing homes. Second, all data were obtained from self-reports, which may compromise the  
46  
47 accuracy of measurements due to recall bias; and there was lack of objective measurement  
48  
49 of sleep quality, which might have led to misclassification of some of the components of  
50  
51 sleep quality. Third, stratification by city or county, as well as cluster effect within a nursing  
52  
53 homes, were not considered in this study which may lead to biased findings. Fourth, the  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 findings of this study cannot be generalized to patients with dementia and hearing or  
5  
6 cognition impairment as these were excluded from this study. Finally, although the odds  
7  
8 ratio was decreased in the adjusted models, the mediating effect of other variables on the  
9  
10 association between poor sleep quality and depression symptoms was not analysed and  
11  
12 should be investigated in future studies.  
13  
14  
15

## 16 **5.Conclusions**

17  
18  
19 In summary, a high prevalence of poor sleep quality among the elderly living in  
20  
21 nursing homes in Hunan in China was observed. In addition, poor sleep quality was  
22  
23 associated with increased GDS-30 scores and the development of depression symptoms.  
24  
25 Nonetheless, further studies are needed to (1) explore whether the intervention and  
26  
27 treatment of poor sleep quality can ameliorate depression symptoms among the elderly in  
28  
29 nursing homes; and (2) investigate the mediating effects of other variables on the  
30  
31 association between sleep quality and depression symptoms.  
32  
33  
34  
35  
36

## 37 **Acknowledgements**

38  
39 We thank all the participants very much for their collaboration  
40  
41  
42

## 43 **Author contributions**

44  
45 ZH and XZ completed the statistical analyses and drafted the manuscript. Atipatsa CK  
46  
47 contributed to the manuscript editing. HX checked and revised the manuscript. All the  
48  
49 authors read and approved the final manuscript.  
50  
51  
52

## 53 **Funding**

54  
55 This research received no specific grant from any funding agency in the public, commercial  
56  
57 or not-for-profit sectors  
58  
59  
60

## Competing interests

None declared

## Patient consent

Written informed consent was obtained from all participants.

## Ethical approval

This study was approved by the Ethical Committee of Xiangya School of Public Health in Central South University (No.XYGW-2018-49).

## Data availability statement

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.

## References

1. Maggi S, Langlois JA, Minicuci N, et al. Sleep complaints in community-dwelling older persons: prevalence, associated factors, and reported causes. *Journal of the American Geriatrics Society* 1998;46(2):161-8. [published Online First: 1998/02/25]
2. Sagayadevan V, Abdin E, Binte Shafie S, et al. Prevalence and correlates of sleep problems among elderly Singaporeans. *Psychogeriatrics* 2017;17(1):43-51. doi: 10.1111/psyg.12190
3. Luo J, Zhu G, Zhao Q, et al. Prevalence and Risk Factors of Poor Sleep Quality among Chinese Elderly in an Urban Community: Results from the Shanghai Aging Study. *Plos One* 2013;8(11) doi: 10.1371/journal.pone.0081261
4. Li J, Yao Y-s, Dong Q, et al. Characterization and factors associated with sleep quality among rural elderly in China. *Archives of Gerontology and Geriatrics* 2013;56(1):237-43. doi: 10.1016/j.archger.2012.08.002
5. Martins da Silva R, Afonso P, Fonseca M, et al. Comparing sleep quality in institutionalized and non-institutionalized elderly individuals. *Aging & mental health* 2019:1-7. doi: 10.1080/13607863.2019.1619168 [published Online First: 2019/05/18]
6. Fetveit A, Bjorvatn B. Sleep disturbances among nursing home residents. *Int J Geriatr Psychiatr* 2002;17(7):604-09. doi: 10.1002/gps.639
7. Hoffman S. Sleep in the older adult: implications for nurses (CE). *Geriatric nursing (New York, NY)* 2003;24(4):210-4; quiz 15-6. [published Online First: 2003/10/16]
8. Gelaye B, Okeiga J, Ayantoye I, et al. Association of suicidal ideation with poor sleep quality among Ethiopian adults. *Sleep & breathing = Schlaf & Atmung* 2016;20(4):1319-26. doi:



- 1  
2  
3 10.1007/s11325-016-1418-9 [published Online First: 2016/10/25]  
4  
5 9. Qian YY, Sun L, Zhou CC, et al. The association between suicidal ideation and sleep quality in elderly  
6 individuals: A cross-sectional study in Shandong, China. *Psychiatry Res* 2017;256:453-57. doi:  
7 10.1016/j.psychres.2017.07.017  
8  
9 10. Uchmanowicz I, Markiewicz K, Uchmanowicz B, et al. The relationship between sleep disturbances  
10 and quality of life in elderly patients with hypertension. *Clinical interventions in aging*  
11 2019;14:155-65. doi: 10.2147/cia.s188499 [published Online First: 2019/01/31]  
12  
13 11. Suzuki E, Yorifuji T, Ueshima K, et al. Sleep duration, sleep quality and cardiovascular disease  
14 mortality among the elderly: a population-based cohort study. *Preventive medicine*  
15 2009;49(2-3):135-41. doi: 10.1016/j.ypmed.2009.06.016 [published Online First: 2009/07/04]  
16  
17 12. Zhang H, Li Y, Zhao X, et al. The association between PSQI score and hypertension in a Chinese  
18 rural population: the Henan Rural Cohort Study. *Sleep medicine* 2019;58:27-34. doi:  
19 10.1016/j.sleep.2019.03.001 [published Online First: 2019/05/07]  
20  
21 13. Steenland K, Karnes C, Seals R, et al. Late-life depression as a risk factor for mild cognitive  
22 impairment or Alzheimer's disease in 30 US Alzheimer's disease centers. *Journal of*  
23 *Alzheimer's disease : JAD* 2012;31(2):265-75. doi: 10.3233/jad-2012-111922 [published  
24 Online First: 2012/05/01]  
25  
26 14. Hare DL, Toukhsati SR, Johansson P, et al. Depression and cardiovascular disease: a clinical review.  
27 *European heart journal* 2014;35(21):1365-72. doi: 10.1093/eurheartj/ehu462 [published  
28 Online First: 2013/11/28]  
29  
30 15. Gilman SE, Sucha E, Kingsbury M, et al. Depression and mortality in a longitudinal study:  
31 1952-2011. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale*  
32 *canadienne* 2017;189(42):E1304-e10. doi: 10.1503/cmaj.170125 [published Online First:  
33 2017/10/25]  
34  
35 16. Nazemi L, Skoog I, Karlsson I, et al. Depression, prevalence and some risk factors in elderly nursing  
36 homes in tehran, iran. *Iranian journal of public health* 2013;42(6):559-69. [published Online  
37 First: 2013/08/24]  
38  
39 17. Lin PC, Wang HH, Huang HT. Depressive symptoms among older residents at nursing homes in  
40 Taiwan. *Journal of clinical nursing* 2007;16(9):1719-25. doi:  
41 10.1111/j.1365-2702.2007.01743.x [published Online First: 2007/08/31]  
42  
43 18. Stewart R, Hotopf M, Dewey M, et al. Current prevalence of dementia, depression and  
44 behavioural problems in the older adult care home sector: the South East London Care Home  
45 Survey. *Age and ageing* 2014;43(4):562-7. doi: 10.1093/ageing/afu062 [published Online  
46 First: 2014/05/24]  
47  
48 19. Liu S, Ouyang Z, Chong AM, et al. Neighborhood Environment, Residential Satisfaction, and  
49 Depressive Symptoms Among Older Adults in Residential Care Homes. *International journal*  
50 *of aging & human development* 2018;87(3):268-88. doi: 10.1177/0091415017730812  
51 [published Online First: 2017/09/26]  
52  
53 20. Paudel ML, Taylor BC, Diem SJ, et al. Association between depressive symptoms and sleep  
54 disturbances in community-dwelling older men. *Journal of the American Geriatrics Society*  
55 2008;56(7):1228-35. doi: 10.1111/j.1532-5415.2008.01753.x  
56  
57 21. Cho HJ, Lavretsky H, Olmstead R, et al. Sleep Disturbance and Depression Recurrence in  
58 Community-Dwelling Older Adults: A Prospective Study. *American Journal of Psychiatry*  
59 2008;165(12):1543-50. doi: 10.1176/appi.ajp.2008.07121882  
60

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
22. Foley DJ, Monjan AA, Brown SL, et al. Sleep complaints among elderly persons: an epidemiologic study of three communities. *Sleep* 1995;18(6):425-32. doi: 10.1093/sleep/18.6.425 [published Online First: 1995/07/01]
  23. Buysse DJ, Reynolds CF, 3rd, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1989;28(2):193-213. doi: 10.1016/0165-1781(89)90047-4
  24. Jian-qing Q, Mi Z, Pei-yuan Q, et al. Reliability and Validity of the Pittsburgh Sleep Quality Index in older adults in rural area. *Modern Preventive Medicine* 2016;43(10):1835-38. In Chinese.
  25. Watson LC, Pignone MP. Screening accuracy for late-life depression in primary care: A systematic review. *J Fam Pract* 2003;52(12):956-64.
  26. Smalbrugge M, Jongenelis L, Pot AM, et al. Screening for depression and assessing change in severity of depression. Is the Geriatric Depression Scale (30-, 15- and 8-item versions) useful for both purposes in nursing home patients? *Aging & mental health* 2008;12(2):244-48. doi: 10.1080/13607860801987238
  27. Li Z, Jeon YH, Low LF, et al. Validity of the geriatric depression scale and the collateral source version of the geriatric depression scale in nursing homes. *International psychogeriatrics* 2015;27(9):1495-504. doi: 10.1017/s1041610215000721 [published Online First: 2015/05/21]
  28. Xiaoyan H, Shuiyuan X, Dexing Z. Reliability and Validity of the Chinese Version of Geriatric Depression Scale: A Study in A Population of Chinese Rural Community-dwelling Elderly. *Chinese Journal of Clinical Psychology* 2008;16(5):473-75.
  29. Lu J, Wang Y, Wang X, et al. Reliability and Validity of the Chinese Version of Geriatric Depression Scale Among Chinese Urban Community-dwelling Elderly Population. *Chinese Journal of Clinical Psychology* 2013;21(1):39-41.
  30. Watson LC, Pignone MP. Screening accuracy for late-life depression in primary care: a systematic review. *The Journal of family practice* 2003;52(12):956-64. [published Online First: 2003/12/05]
  31. Xiao S. The theory basis and application of the social support rating scale. *Chin Ment Health* 1994;2:98-100.
  32. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *The Gerontologist* 1969;9(3):179-86. doi: 10.1093/geront/9.3\_Part\_1.179
  33. Xiao L, Xu H. Development of life events scale for the elderly. *Chin J Behavioral Med Sci* 2008;17(2):182-84. In Chinese.
  34. Eser I, Khorshid L, Cinar S. Sleep quality of older adults in nursing homes in Turkey: enhancing the quality of sleep improves quality of life. *Journal of gerontological nursing* 2007;33(10):42-9. [published Online First: 2007/10/25]
  35. Orhan FO, Tuncel D, Tas F, et al. Relationship between sleep quality and depression among elderly nursing home residents in Turkey. *Sleep and Breathing* 2012;16(4):1059-67. doi: 10.1007/s11325-011-0601-2
  36. Stefan L, Vrgoc G, Rupcic T, et al. Sleep Duration and Sleep Quality Are Associated with Physical Activity in Elderly People Living in Nursing Homes. *International journal of environmental research and public health* 2018;15(11) doi: 10.3390/ijerph15112512 [published Online First: 2018/11/15]
  37. Tsai YF, Wong TKS, Ku YC. Self-care management of sleep disturbances and risk factors for poor

- 1  
2  
3 sleep among older residents of Taiwanese nursing homes. *Journal of clinical nursing*  
4 2008;17(9):1219-26. doi: 10.1111/j.1365-2702.2007.02020.x  
5  
6 38. Wilfling D, Dichter MN, Trutschel D, et al. Prevalence of Sleep Disturbances in German Nursing  
7 Home Residents with Dementia: A Multicenter Cross-Sectional Study. *J Alzheimers Dis*  
8 2019;69(1):227-36. doi: 10.3233/jad-180784  
9  
10 39. Wang F, Meng LR, Zhang QE, et al. Sleep disturbance and its relationship with quality of life in  
11 older Chinese adults living in nursing homes. *Perspectives in psychiatric care* 2019 doi:  
12 10.1111/ppc.12363 [published Online First: 2019/02/20]  
13  
14 40. Gentili A, Weiner DK, Kuchibhatil M, et al. Factors that disturb sleep in nursing home residents.  
15 *Aging (Milan, Italy)* 1997;9(3):207-13. doi: 10.1007/bf03340151  
16  
17 41. Livingston G, Blizard B, Mann A. Does sleep disturbance predict depression in elderly people? A  
18 study in inner London. *The British journal of general practice : the journal of the Royal College*  
19 *of General Practitioners* 1993;43(376):445-8. [published Online First: 1993/11/01]  
20  
21 42. Rodin J, McAvay G, Timko C. A longitudinal study of depressed mood and sleep disturbances in  
22 elderly adults. *Journal of gerontology* 1988;43(2):P45-53. [published Online First:  
23 1988/03/01]  
24  
25 43. Sukegawa T, Itoga M, Seno H, et al. Sleep disturbances and depression in the elderly in Japan.  
26 *Psychiatry Clin Neurosci* 2003;57(3):265-70. doi: 10.1046/j.1440-1819.2003.01115.x  
27  
28 44. Kishimoto Y, Okamoto N, Saeki K, et al. Bodily pain, social support, depression symptoms and  
29 stroke history are independently associated with sleep disturbance among the elderly: a  
30 cross-sectional analysis of the Fujiwara-kyo study. *Environ Health Prev* 2016;21(5):295-303.  
31 doi: 10.1007/s12199-016-0529-z  
32  
33 45. Wu CY, Su TP, Fang CL, et al. Sleep quality among community-dwelling elderly people and its  
34 demographic, mental, and physical correlates. *J Chin Med Assoc* 2012;75(2):75-80. doi:  
35 10.1016/j.jcma.2011.12.011  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

Section/Topic	Item #	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	NA
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	NA
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11,12
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	15,16,17
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15,16,17
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	20,21,22
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	21,22,23
Generalisability	21	Discuss the generalisability (external validity) of the study results	23
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

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

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

# BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-036401.R2
Article Type:	Original research
Date Submitted by the Author:	12-May-2020
Complete List of Authors:	Hu, Zhao; Central South University Xiangya School of Public Health, Zhu, Xidi; Central South University Xiangya School of Public Health, Department of Social Medicine and Health Management Kaminga, Atipatsa; Central South University Xiangya School of Public Health, Department of Epidemiology and Health Statistics Zhu, Tingting; Shanghai Health Development Research Center, Department of Scientific Research Management Nie, Yu; Second Xiangya Hospital, Educational Administration Office Huilan, Xu; Central South University Xiangya School of Public Health, Department of Social Medicine and Health Management
<b>Primary Subject Heading</b>:	Mental health
Secondary Subject Heading:	Epidemiology, Mental health, Geriatric medicine
Keywords:	Depression & mood disorders < PSYCHIATRY, SLEEP MEDICINE, EPIDEMIOLOGY

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1  
2  
3  
4 **Association between poor sleep quality and depression symptoms among the elderly**  
5  
6 **in nursing homes in Hunan province,China:a cross-sectional study**  
7

8 Zhao Hu<sup>a,†</sup>, Xidi Zhu<sup>a,†</sup>, Atipatsa Chiwanda Kaminga<sup>b,c</sup>, Tingting Zhu<sup>d</sup>, Yu Nie<sup>e</sup>, Huilan Xu<sup>a,\*</sup>

9  
10 <sup>a</sup> Department of Social Medicine and Health Management, Xiangya School of Public Health,  
11 Central South University, Changsha, China

12 <sup>b</sup> Department of Epidemiology and Health Statistics, Xiangya School of Public Health, Central  
13 South University, Changsha, China

14 <sup>c</sup> Department of Mathematics and Statistics, Mzuzu University, P/Bag 201, Mzuzu, Malawi

15 <sup>d</sup> Department of Scientific Research Management, Shanghai Health Development Research  
16 Center, Shanghai, China

17 <sup>e</sup> Educational Administration Office,The Second Hospital of Xiangya,Changsha,China

18 <sup>†</sup> Contributed equally

19  
20  
21 \*Corresponding author at: Department of social medicine and health management, Xiangya  
22 school of public health, Central South University, Changsha, 410078, China. Tel: +86-0731  
23 -8484-5454. E-mail address:xhl6363@sina.com

24  
25 Word count: 4052; Tables:3

26  
27 **ABSTRACT**  
28

29  
30 **Objectives:** To examine the association between the prevalence of poor sleep quality and  
31 depression symptoms among the elderly in the nursing homes of Hunan Province in China.  
32

33  
34 **Design, Setting and participants:** This was a cross-sectional study investigating 817  
35 elderly people from 24 nursing homes in China's Hunan Province.  
36

37  
38 **Main outcome measures:** Sleep quality was assessed using the Pittsburgh Sleep Quality  
39 Index (PSQI) such that poor sleep quality was defined as PSQI score>5. In addition,  
40 depression symptoms were assessed using the Geriatric Depression Scale (GDS). Linear  
41 regression models and binary logistic regression models were used to analyse the  
42 relationship between the prevalence of poor sleep quality and depression symptoms.  
43  
44  
45  
46  
47  
48  
49  
50  
51

52  
53 **Results:** The mean PSQI score was 8.5±4.9, and the prevalence of poor sleep quality was  
54 67.3%. Additionally, the mean GDS score was 9.8±7.5, and the prevalence of depression  
55 symptoms was 36.0%. Elderly people with poor sleep quality had increased GDS score  
56  
57  
58  
59  
60



1  
2  
3  
4 (mean difference=2.54, 95% CI: 1.66, 3.42) and increased risk of depression symptoms  
5  
6 (odds ratio [OR]=3.19, 95% CI: 2.04, 4.98) after controlling for demographics, chronic  
7  
8 disease history, lifestyle behaviors, social support, activities of daily living (ADL) and  
9  
10 negative life events.  
11  
12

13  
14 **Conclusions:** The prevalence of poor sleep quality was relatively high, and this was  
15  
16 associated with increased depression symptoms. Therefore, poor sleep quality could be  
17  
18 speculated as a marker of current depression symptoms in the elderly.  
19  
20

21  
22 **Keywords:** depression; sleep quality; elderly; nursing home; risk factors.  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Article Summary

### 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.

## 1. Introduction

Aging 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 2,398 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 2,565 elderly Singaporeans showed that 69.4% 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 colleagues<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

1  
2  
3  
4 cohort study found that poor sleep quality was associated with increased odds of  
5  
6 hypertension in a Chinese rural population <sup>12</sup>. However, despite the significance of poor  
7  
8 sleep quality among the elderly population, its prevalence and the underlying effect on their  
9  
10 physical and mental functioning are not entirely understood.  
11  
12

13  
14 Depression is a common psychiatric disorder among the elderly. It contributes not only  
15  
16 to mild cognitive impairment but also to an increased risk of comorbidity and mortality <sup>13-15</sup>.  
17  
18 In addition, many studies indicated that the institutionalized elderly have a higher  
19  
20 prevalence of depression than the community-dwelling elderly. Notwithstanding, the  
21  
22 reported prevalence of depression symptoms in nursing homes varied widely across  
23  
24 different localities due to differences in diagnostic criteria, assessment tools and sample  
25  
26 characteristics. For example, epidemiological studies indicated that the prevalence of  
27  
28 depression symptoms among the elderly in nursing homes was 90.2% in Iran <sup>16</sup>, 81.8% in  
29  
30 Taiwan <sup>17</sup>, 29.6% in London <sup>18</sup> and 46.1% in the Mainland China <sup>19</sup>.  
31  
32  
33  
34  
35  
36  
37

38 The association between sleep quality and depression symptoms among the elderly is  
39  
40 complex, bidirectional and not entirely understood. However, many studies have suggested  
41  
42 that elderly people with some sleep disturbance are more likely to develop depression  
43  
44 symptoms than younger people with some sleep disturbance <sup>20 21</sup>. Conversely, people with  
45  
46 depression symptoms reported a higher prevalence of poor sleep quality <sup>22</sup>. Although many  
47  
48 previous studies have demonstrated that poor sleep quality is positively associated with  
49  
50 depression symptoms among the elderly, the evidence of this relationship among the elderly  
51  
52 in nursing homes was scarce. Therefore, the purpose of this study was to examine the  
53  
54 association between poor sleep quality and depression symptoms among the elderly of  
55  
56  
57  
58  
59  
60

nursing homes in China.

## 2. Methods

### 2.1 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:

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

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.

### 2.2 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. Firstly, 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.

1  
2  
3  
4 Furthermore, six townships, two from each county were randomly selected and this resulted  
5  
6 in the following townships chosen: Xingsha and Tiaoma from Changsha County; Xidu and  
7  
8 Jingtou from Hengyang County; and Qionghu and Caowei from Yuanjiang County. Finally, 24  
9  
10 nursing homes were randomly selected, two from each district and two from each township.  
11  
12

13  
14 The elderly population in the selected nursing homes formed the sampling frame and  
15  
16 participants were included in our study if they met the following inclusion criteria: (1) had  
17  
18 age 60 years and above; and (2) had been in the nursing home for more than one year.  
19  
20 However, participants were excluded if they (1) refused to participate in this study; (2) had  
21  
22 a severe hearing impairment or a language barrier. A total of 2,055 older adults residents in  
23  
24 the 24 nursing homes, of which 511 were excluded because of less than 60 years or staying  
25  
26 in a nursing home less than one year. 603 older adults have severe hearing impairment or  
27  
28 language barrier and 112 older adults, who did not agree to participate, were also excluded  
29  
30 in this study. Of the remaining 829 older adults, 12 were excluded for incomplete data.  
31  
32 Finally, a total of 817 subjects were included in the data analysis of this study.  
33  
34  
35  
36  
37  
38  
39

### 40 **2.3 Data collection**

41  
42 Trained staff collected data through face-to-face interviews using a set of structured  
43  
44 questionnaires, and each interview lasted between 1/2 and 1 hour. Demographic  
45  
46 information collected included gender, age, education level, marital status, monthly personal  
47  
48 income, duration of admission, number of living children, a history of chronic diseases, a  
49  
50 history of smoking tobacco and a history of alcohol consumption. Marital status was  
51  
52 classified as either stable or unstable. Unstable marital status meant divorced, widowed or  
53  
54 never married. Smoking was defined as averaging at least one cigarette per day in the last  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 year. Alcohol consumption was defined as drinking one glass of wine per day in the last  
5  
6 week.  
7

#### 8 9 **2.4 Sleep quality assessment**

10  
11 Sleep quality among the participants was assessed using the Chinese version of the  
12  
13 Pittsburgh Sleep Quality Index (PSQI). The PSQI is a self-rated questionnaire that assesses  
14  
15 sleep quality in the past month. It contains nineteen items grouped according to seven  
16  
17 components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep  
18  
19 disturbances, use of sleeping medication, and daytime dysfunction<sup>24</sup>. These components  
20  
21 were defined as follows in this study: subjective sleep quality (good or poor); sleep efficiency  
22  
23 (reduced sleep efficiency was sleep efficiency <85%); sleep latency (increased sleep latency  
24  
25 was sleep latency component score >1); sleep duration (<7 h, 7-8 h and >8 h); sleep  
26  
27 disturbances (any kind of sleep disturbance  $\geq 1$  time/week); use of sleep medication (use of  
28  
29 sleep medication  $\geq 1$  time/week); and daytime dysfunction was daytime dysfunction of at  
30  
31 least once a week. Each component's score ranges from 0 to 3 points such that 0 is the most  
32  
33 positive score and 3 the most negative score. Therefore, the global PSQI score ranges from 0  
34  
35 to 21 points. The Chinese version of the PSQI has been shown to have good validity and  
36  
37 reliability among older adults<sup>25</sup>. Participants with a global PSQI score greater than 5 were  
38  
39 defined as having poor sleep quality<sup>24</sup>.  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49

#### 50 51 **2.5 Depression symptoms assessment**

52  
53 Depressive symptoms were assessed using the Chinese version of the Geriatric  
54  
55 Depression Scale-30 items (GDS-30). The 30 items of this instrument are true/false  
56  
57 questions whose total score ranges from 0 to 30 points. The GDS-30 was developed by Brink  
58  
59  
60

1  
2  
3  
4 and colleagues in 1982 and has been widely used to assess depression symptoms in the  
5  
6 elderly worldwide <sup>26</sup>. Several studies have demonstrated that this measurement tool is  
7  
8 reliable and valid in multiple settings and recommended it for use in nursing home  
9  
10 populations <sup>27 28</sup>. The validity and reliability of the Chinese version of the GDS-30 have been  
11  
12 extensively assessed in China<sup>29 30</sup>. Participants who scored 11 or greater were considered as  
13  
14 having depression symptoms in this study<sup>31</sup>.  
15  
16  
17  
18

## 19 **2.6 Covariates**

20  
21  
22 Other information including, social support, activities of daily living (ADL) and negative  
23  
24 life events were also collected. Social support among the elderly was assessed using the  
25  
26 Social Support Rating Scale (SSRS), which was developed by Xiao <sup>32</sup>. The scale consists of 10  
27  
28 items and is divided into three parts: objective support, subjective support and availability  
29  
30 of social support. For items 1 to 4, and 8 to 10, each item's score ranges from 1 to 4 points.  
31  
32 For item 5, the first, second, third, and fourth options represent 1, 2, 3, and 4 points for each  
33  
34 support source, respectively. In addition, for items 6 and 7, each option is 1 point when  
35  
36 selected and zero when not selected. The total social support score ranges from 12 to 66  
37  
38 points, and higher scores indicate higher social support. An SSRS score greater than 30  
39  
40 points was defined as indicating high social support in this study. Furthermore, ADL status  
41  
42 was assessed using Lawton and Brody's ADL scale <sup>33</sup>. It includes 16 items, and each item is  
43  
44 scored from 1 (can do it myself) to 4 (cannot do it myself). Participants' possible total scores  
45  
46 on this instrument range between 16 and 64 points. A participant is classified as having  
47  
48 disabled ADL status when the participant's ADL total score is greater than 14 points.  
49  
50 Negative life events were assessed using the Life Events Scale for the Elderly (LESE). The  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3  
4 LESE is a valid and reliable tool widely used in China for assessing the elderly population<sup>34</sup>.

5  
6 It includes 46 items that are grouped into three main domains: health-related problems,  
7  
8 family-related problems and social-related problems. Participants were determined to have  
9  
10 experienced a negative life event when any such event occurred and caused them to have  
11  
12 stress.  
13  
14  
15

## 16 17 **2.7 Statistical analysis**

18  
19 Categorical data were summarised as frequency counts and percentages, whereas  
20  
21 continuous data were summarised as mean± standard deviation. The  $\chi^2$  test was used to  
22  
23 compare categorical data between the good sleep quality group and the poor sleep quality  
24  
25 group; while the student's *t*-test was used to compare continuous data between the good  
26  
27 sleep quality group and the poor sleep quality group. Linear regression models were used to  
28  
29 estimate the difference in the mean GDS-30 scores with respect to sleep quality (poor=1,  
30  
31 good=0) using both the univariate (crude) and the multivariable (adjusted) models.  
32  
33 Furthermore, the crude and adjusted binary logistic regression models were used to  
34  
35 examine the association between sleep quality and depression symptoms; and the  
36  
37 association between components of sleep quality and depression symptoms. A  $P<0.05$  was  
38  
39 considered statistically significant. All data analyses were performed using the Statistical  
40  
41 Package for the Social Sciences (SPSS) 20.0 software (SPSS Inc., Chicago, IL, USA).  
42  
43  
44  
45  
46  
47  
48  
49

## 50 51 **2.8 Patient and public involvement**

52  
53 Neither patients nor the public was directly involved in the development, design or  
54  
55 recruitment of the study. Test results were provided to the participants at the point of  
56  
57 testing.  
58  
59  
60

### 3. Results

#### 3.1 Characteristics of the study sample

The average age was 79.1±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, social support and ADL status. Additionally, participants with poor sleep quality were those who had an unstable marital status, a monthly personal income below 3,000 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.

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

1					
2					
3					
4	Education				
5					
6	Primary school and below	364(44.6)	263(47.8)	101(37.8)	0.004
7					
8	Junior high school	203(24.8)	138(25.1)	65(24.3)	
9					
10	Senior high school and above	250(30.6)	149(27.1)	101(37.8)	
11					
12	Stable marital status	302(37.0)	186(33.8)	116(43.4)	0.007
13					
14	Medical insurance	766(93.8)	517(94.0)	249(93.3)	0.681
15					
16	Monthly personal income	568(69.5)	404(73.5)	164(61.4)	<0.001
17					
18	≤3,000 RMB				
19					
20	Duration of admission >3 years	251(30.7)	180(32.7)	71(26.6)	0.075
21					
22	History of chronic disease	620(75.9)	454(82.5)	166(62.2)	<0.001
23					
24	Smoking	132(16.2)	82(14.9)	50(18.7)	0.164
25					
26	Alcohol drinking	96(11.8)	60(10.9)	36(13.5)	0.284
27					
28	Have a child or more	746(91.3)	496(90.2)	250(93.6)	0.100
29					
30	Negative life events	725(88.7)	515(93.6)	210(78.7)	<0.001
31					
32	High social support	382(46.8)	213(38.7)	169(63.3)	<0.001
33					
34	Normal ADL status	268(32.8)	152(27.6)	116(43.4)	<0.001
35					
36	Good subjective sleep quality	483(59.1)	220(40.0)	263(98.5)	<0.001
37					
38	Increased sleep latency	433(53.0)	421(76.5)	12(4.5)	<0.001
39					
40	Sleep duration				
41					
42	<7 h	388(47.5)	373(67.8)	15(5.6)	<0.001
43					
44	7-8 h	293(35.9)	140(25.5)	153(57.3)	
45					
46	>8 h	136(16.6)	37(6.7)	99(37.1)	
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					

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

### 3.2 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 ( $M_{diff}=5.19$ , 95% CI: 4.15, 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, 3.42). The results are shown in Table 2.

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	$M_{diff}$ (95%CI)	P-value
Crude model	11.53	0.31	6.33	0.45	5.19(4.15,6.24)	<0.001
Adjusted Model 1( $R^2=0.11, F=33.54, P<0.001$ )						

	11.31	0.29	6.79	0.42	4.52(3.51,5.53)	<0.001
Adjusted Model 2( $R^2=0.24, F=27.42, P<0.001$ )						
	11.01	0.27	7.40	0.40	3.50(2.54,4.47)	<0.001
Adjusted Model 3( $R^2=0.40, F=30.78, P<0.001$ )						
	10.67	0.24	8.09	0.36	2.54(1.66,3.42)	<0.001

SE, standard error;  $M_{diff}$  mean difference

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, SSRS status, ADL status, and negative life events.

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 (odds ratio [OR] = 4.37, 95% confidence interval [CI]: 3.03, 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, 2.04-4.98). Similar 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.

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

	Crude model			Adjusted model <sup>†</sup>		
	OR	95%CI	P-value	OR	95%CI	P-value
Overall sleep quality						
Good	1.00			1.00		
Poor	4.37	3.03-6.31	<0.001	3.19	2.04-4.98	<0.001
Subjective sleep quality						
Good	1.00			1.00		
Poor	5.05	3.71-6.87	<0.001	3.15	2.18-4.56	<0.001
Increased sleep latency						
Yes	1.00			1.00		
No	3.81	2.79-5.20	<0.001	2.58	1.78-3.74	<0.001
Sleep duration						
>8h	1.00			1.00		
7-8h	1.09	0.70-1.71	0.700	1.24	0.73-2.11	0.431
<7 h	2.64	1.89-3.70	<0.001	1.95	1.29-2.95	0.001
Reduced sleep efficiency						
No	1.00			1.00		
Yes	2.74	1.99-3.78	<0.001	1.89	1.27-2.80	0.002
Sleep disturbances						

No	1.00			1.00		
Yes	3.49	2.56-4.77	<0.001	2.33	1.59-3.41	<0.001
Use of sleep medication						
No	1.00			1.00		
Yes	1.63	1.03-2.56	0.037	1.30	0.72-2.35	0.379
Daytime dysfunction						
No	1.00			1.00		
Yes	3.22	2.38-4.36	<0.001	2.21	1.53-3.20	<0.001

OR, odds ratio; CI, confidence interval

† 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, ADL status and negative life events.

#### 4. 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 and colleagues<sup>35</sup> estimated that the prevalence of poor sleep

1  
2  
3  
4 quality was 60.9% among 540 elderly people in Turkey, and a similar study in the same  
5  
6 country found that 60.3% of the elderly had poor sleep quality<sup>23</sup>. Lower prevalence was also  
7  
8 observed in Zagreb (54.5%) among 894 elderly people<sup>36</sup>, and in Taiwan (46.4%)<sup>37</sup>. A reason  
9  
10 for this variation in these prevalence estimates may be attributed to differences in study  
11  
12 designs with regard to inclusion criteria for participants, and differences in the facilities and  
13  
14 medical care used in different nursing homes. In addition, the most commonly reported  
15  
16 components of poor sleep quality were decreased sleep efficiency (61.1%), increased sleep  
17  
18 latency (53.0%) and sleep disturbances (30.4%). This pattern indicates that these  
19  
20 participants had problems with both initiating and maintaining sleep. Similarly, Fetveit et al.  
21  
22<sup>6</sup> found that 72% of the elderly participants in nursing homes had a sleep efficiency below  
23  
24 85%, while 77.8% reported a sleep onset latency of more than 30 minutes. Also, Wilfling et  
25  
26 al.<sup>38</sup> found that 23.0% of the elderly in German nursing homes had sleep disturbances and,  
27  
28 in the same way, Wang et al.<sup>39</sup> found that 27.8% of older Chinese adults living in nursing  
29  
30 homes had sleep disturbances. One of the important factors that may contribute to the  
31  
32 development of a higher prevalence of sleep problems among the elderly in nursing homes  
33  
34 is the environment, particularly with respect to the high levels of night-time noise and light,  
35  
36 the low levels of daytime light, and care routines that do not promote sleep<sup>40</sup>. However, the  
37  
38 use of sleep medication is not popular among the elderly in the Chinese nursing homes and  
39  
40 this could be the reason why only 10.3% of residents in this study had taken sleep  
41  
42 medication. Moreover, among the participants that had taken sleep medication, majority of  
43  
44 them had poor sleep quality. Nevertheless, due to the cross-sectional study design, a causal  
45  
46 relationship between sleep quality and taking sleep medication could not be established.  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3  
4 Therefore, from this result, it can be assumed that participants with poor sleep quality are  
5  
6 more likely to take sleep medication, but this proportion is lower in the Chinese nursing  
7  
8 homes.  
9

10  
11 Additionally, the prevalence of depression symptoms in this study was associated with  
12  
13 sleep quality. For example, participants with poor sleep quality scored 2.54 points higher  
14  
15 than those with good sleep quality on the GDS-30 score after adjusting for many important  
16  
17 covariates. Moreover, participants with poor sleep quality were 3.19-fold more likely to  
18  
19 develop depression symptoms than those who had good sleep quality. Furthermore,  
20  
21 participants with increased sleep latency, shorter sleep duration, lower sleep efficiency,  
22  
23 sleep disturbances and daytime dysfunction had increased risk of depression symptoms.  
24  
25 These findings are in accordance with those of several previous similar studies in both  
26  
27 nursing homes and communities<sup>23 41 42</sup>. In this regard, a cross-sectional study by Orhan et al.  
28  
29 <sup>23</sup> demonstrated that the GDS-30 score was positively correlated with the global PSQI score  
30  
31 ( $r=0.231$ ) as well as the sleep latency and sleep disturbances scores ( $r=0.261$  and  $0.380$ ,  
32  
33 respectively) among seventy-three elderly people living in a nursing home in Turkey.  
34  
35 Additionally, Foley and colleagues <sup>22</sup> conducted a study on over 9,000 participants aged at  
36  
37 least 65 and found that the sleep complaint score was positively associated with the Center  
38  
39 for Epidemiologic Studies Depression Scale score (CESD). Also, Sukegawa et al. <sup>43</sup> found that  
40  
41 elderly persons with depression symptoms were more likely to report poor sleep efficiency,  
42  
43 sleep disturbances, long sleep latency and poor subjective sleep quality. In agreement with  
44  
45 the preceding results, a prospective cohort study by Livingston et al. <sup>41</sup> reported that the best  
46  
47 predictor of future depression in the elderly people, who were not depressed at baseline,  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4 was sleep disturbance at baseline. Moreover, Rodin et al. <sup>42</sup> found that the frequency of  
5  
6 depressed affect was positively associated with sleep disturbances in the elderly after  
7  
8 controlling for adjustment factors. Similarly, Cho et al. <sup>21</sup> suggested that, among the elderly  
9  
10 with prior depression, depression recurrence was predicted by sleep disturbance, and this  
11  
12 association was independent of other depression symptoms. Furthermore, in a previous  
13  
14 cross-sectional study, elderly persons with a GDS-30 score  $\geq 6$  were 1.29 times more likely to  
15  
16 develop sleep disturbances than those with a GDS-30 score of 0 to 2 <sup>44</sup>. Another  
17  
18 cross-sectional study <sup>45</sup> found that depression was independently positively associated with  
19  
20 poor sleep quality among the elderly after adjusting for other confounders (OR= 1.21, 95%  
21  
22 CI: 1.12-1.52). However, the mechanism underlying the relationship between poor sleep  
23  
24 quality and depression symptoms is not thoroughly understood. Certainly, many studies  
25  
26 have suggested that sleep problems and depression symptoms can reinforce each other and  
27  
28 this relationship might be bidirectional. Although the direction of the association between  
29  
30 sleep quality and depression symptoms in this study was not possible to determine as a  
31  
32 result of the use of a cross-sectional study design, poor sleep quality was viewed as a  
33  
34 prodromal state or even a core symptom of depression symptoms in the elderly.

35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45 To our knowledge, this is the first study to focus on the elderly in a nursing home in  
46  
47 China and demonstrate that poor sleep quality was independently associated with  
48  
49 depression symptoms. However, there are several limitations in this study. First, the causal  
50  
51 relationship between poor sleep quality and depression symptoms could not be assessed  
52  
53 due to the use of a cross-sectional study design. Therefore, further longitudinal and  
54  
55 prospective studies should be conducted to confirm this relationship in the elderly in  
56  
57  
58  
59  
60

1  
2  
3  
4 nursing homes. Second, all data were obtained from self-reports, which may compromise the  
5  
6 accuracy of measurements due to recall bias; and there was lack of objective measurement  
7  
8 of sleep quality, which might have led to misclassification of some of the components of  
9  
10 sleep quality. Third, the findings of this study cannot be generalized to patients with  
11  
12 dementia and hearing or cognition impairment as these were excluded from this study.  
13  
14 Finally, although the mean differences and odds ratio were decreased in the adjusted  
15  
16 models, the mediating effect of other variables on the association between poor sleep quality  
17  
18 and depression symptoms was not analysed and should be investigated in future studies.  
19  
20  
21  
22  
23  
24

## 25 **5. Conclusions**

26  
27 In summary, a high prevalence of poor sleep quality among the elderly living in  
28  
29 nursing homes in Hunan in China was observed. In addition, poor sleep quality was  
30  
31 associated with increased GDS-30 scores and the development of depression symptoms.  
32  
33 Nonetheless, further studies are needed to (1) explore whether the intervention and  
34  
35 treatment of poor sleep quality can ameliorate depression symptoms among the elderly in  
36  
37 nursing homes; and (2) investigate the mediating effects of other variables on the  
38  
39 association between sleep quality and depression symptoms.  
40  
41  
42  
43  
44

## 45 **Acknowledgements**

46  
47 We thank all the participants very much for their collaboration.  
48  
49

## 50 **Author contributions**

51  
52 ZH and XDZ completed the statistical analyses and drafted the manuscript. Atipatsa CK  
53  
54 contributed to the manuscript editing. TTZ and YN contributed to the investigation and data  
55  
56 collection. HLX checked and revised the manuscript. All the authors read and approved the  
57  
58  
59  
60

1  
2  
3  
4 final manuscript.  
5

## 6 **Funding**

7  
8  
9 This research received no specific grant from any funding agency in the public, commercial  
10  
11 or not-for-profit sectors.  
12

## 13 **Competing interests**

14  
15  
16 None declared  
17

## 18 **Patient consent**

19  
20  
21  
22 Written informed consent was obtained from all participants.  
23

## 24 **Ethical approval**

25  
26  
27 This study was approved by the Ethical Committee of Xiangya School of Public Health in  
28  
29 Central South University (No.XYGW-2018-49).  
30

## 31 **Data availability statement**

32  
33  
34  
35 The data analysed during this study are included in the article. The numerical data used to  
36  
37 support the findings of this study are available from the corresponding author upon  
38  
39 reasonable request.  
40  
41

## 42 **References**

- 43  
44  
45 1. Maggi S, Langlois JA, Minicuci N, et al. Sleep complaints in community-dwelling older persons:  
46 prevalence, associated factors, and reported causes. *Journal of the American Geriatrics*  
47 *Society* 1998;46(2):161-8. [published Online First: 1998/02/25]  
48  
49 2. Sagayadevan V, Abdin E, Binte Shafie S, et al. Prevalence and correlates of sleep problems among  
50 elderly Singaporeans. *Psychogeriatrics* 2017;17(1):43-51. doi: 10.1111/psyg.12190  
51  
52 3. Luo J, Zhu G, Zhao Q, et al. Prevalence and Risk Factors of Poor Sleep Quality among Chinese Elderly  
53 in an Urban Community: Results from the Shanghai Aging Study. *Plos One* 2013;8(11) doi:  
54 10.1371/journal.pone.0081261  
55  
56 4. Li J, Yao Y-s, Dong Q, et al. Characterization and factors associated with sleep quality among rural  
57 elderly in China. *Archives of Gerontology and Geriatrics* 2013;56(1):237-43. doi:  
58 10.1016/j.archger.2012.08.002  
59  
60 5. Martins da Silva R, Afonso P, Fonseca M, et al. Comparing sleep quality in institutionalized and

- 1  
2  
3 non-institutionalized elderly individuals. *Aging & mental health* 2019;1-7. doi:  
4 10.1080/13607863.2019.1619168 [published Online First: 2019/05/18]  
5  
6 6. Fetveit A, Bjorvatn B. Sleep disturbances among nursing home residents. *Int J Geriatr Psychiatr*  
7 2002;17(7):604-09. doi: 10.1002/gps.639  
8  
9 7. Hoffman S. Sleep in the older adult: implications for nurses (CE). *Geriatric nursing (New York, NY)*  
10 2003;24(4):210-4; quiz 15-6. [published Online First: 2003/10/16]  
11  
12 8. Gelaye B, Okeiga J, Ayantoye I, et al. Association of suicidal ideation with poor sleep quality among  
13 Ethiopian adults. *Sleep & breathing = Schlaf & Atmung* 2016;20(4):1319-26. doi:  
14 10.1007/s11325-016-1418-9 [published Online First: 2016/10/25]  
15  
16 9. Qian YY, Sun L, Zhou CC, et al. The association between suicidal ideation and sleep quality in elderly  
17 individuals: A cross-sectional study in Shandong, China. *Psychiatry Res* 2017;256:453-57. doi:  
18 10.1016/j.psychres.2017.07.017  
19  
20 10. Uchmanowicz I, Markiewicz K, Uchmanowicz B, et al. The relationship between sleep disturbances  
21 and quality of life in elderly patients with hypertension. *Clinical interventions in aging*  
22 2019;14:155-65. doi: 10.2147/cia.s188499 [published Online First: 2019/01/31]  
23  
24 11. Suzuki E, Yorifuji T, Ueshima K, et al. Sleep duration, sleep quality and cardiovascular disease  
25 mortality among the elderly: a population-based cohort study. *Preventive medicine*  
26 2009;49(2-3):135-41. doi: 10.1016/j.ypmed.2009.06.016 [published Online First: 2009/07/04]  
27  
28 12. Zhang H, Li Y, Zhao X, et al. The association between PSQI score and hypertension in a Chinese  
29 rural population: the Henan Rural Cohort Study. *Sleep medicine* 2019;58:27-34. doi:  
30 10.1016/j.sleep.2019.03.001 [published Online First: 2019/05/07]  
31  
32 13. Steenland K, Karnes C, Seals R, et al. Late-life depression as a risk factor for mild cognitive  
33 impairment or Alzheimer's disease in 30 US Alzheimer's disease centers. *Journal of*  
34 *Alzheimer's disease : JAD* 2012;31(2):265-75. doi: 10.3233/jad-2012-111922 [published  
35 Online First: 2012/05/01]  
36  
37 14. Hare DL, Toukhsati SR, Johansson P, et al. Depression and cardiovascular disease: a clinical review.  
38 *European heart journal* 2014;35(21):1365-72. doi: 10.1093/eurheartj/eh462 [published  
39 Online First: 2013/11/28]  
40  
41 15. Gilman SE, Sucha E, Kingsbury M, et al. Depression and mortality in a longitudinal study:  
42 1952-2011. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale*  
43 *canadienne* 2017;189(42):E1304-e10. doi: 10.1503/cmaj.170125 [published Online First:  
44 2017/10/25]  
45  
46 16. Nazemi L, Skoog I, Karlsson I, et al. Depression, prevalence and some risk factors in elderly nursing  
47 homes in tehran, iran. *Iranian journal of public health* 2013;42(6):559-69. [published Online  
48 First: 2013/08/24]  
49  
50 17. Lin PC, Wang HH, Huang HT. Depressive symptoms among older residents at nursing homes in  
51 Taiwan. *Journal of clinical nursing* 2007;16(9):1719-25. doi:  
52 10.1111/j.1365-2702.2007.01743.x [published Online First: 2007/08/31]  
53  
54 18. Stewart R, Hotopf M, Dewey M, et al. Current prevalence of dementia, depression and  
55 behavioural problems in the older adult care home sector: the South East London Care Home  
56 Survey. *Age and ageing* 2014;43(4):562-7. doi: 10.1093/ageing/afu062 [published Online  
57 First: 2014/05/24]  
58  
59 19. Liu S, Ouyang Z, Chong AM, et al. Neighborhood Environment, Residential Satisfaction, and  
60 Depressive Symptoms Among Older Adults in Residential Care Homes. *International journal*

- 1  
2  
3 of aging & human development 2018;87(3):268-88. doi: 10.1177/0091415017730812  
4 [published Online First: 2017/09/26]  
5  
6 20. Paudel ML, Taylor BC, Diem SJ, et al. Association between depressive symptoms and sleep  
7 disturbances in community-dwelling older men. *Journal of the American Geriatrics Society*  
8 2008;56(7):1228-35. doi: 10.1111/j.1532-5415.2008.01753.x  
9  
10 21. Cho HJ, Lavretsky H, Olmstead R, et al. Sleep Disturbance and Depression Recurrence in  
11 Community-Dwelling Older Adults: A Prospective Study. *American Journal of Psychiatry*  
12 2008;165(12):1543-50. doi: 10.1176/appi.ajp.2008.07121882  
13  
14 22. Foley DJ, Monjan AA, Brown SL, et al. Sleep complaints among elderly persons: an epidemiologic  
15 study of three communities. *Sleep* 1995;18(6):425-32. doi: 10.1093/sleep/18.6.425  
16 [published Online First: 1995/07/01]  
17  
18 23. Orhan FO, Tuncel D, Tas F, et al. Relationship between sleep quality and depression among elderly  
19 nursing home residents in Turkey. *Sleep and Breathing* 2012;16(4):1059-67. doi:  
20 10.1007/s11325-011-0601-2  
21  
22 24. Buysse DJ, Reynolds CF, 3rd, Monk TH, et al. The Pittsburgh Sleep Quality Index: a new instrument  
23 for psychiatric practice and research. *Psychiatry Res* 1989;28(2):193-213. doi:  
24 10.1016/0165-1781(89)90047-4  
25  
26 25. Jian-qing Q, Mi Z, Pei-yuan Q, et al. Reliability and Validity of the Pittsburgh Sleep Quality Index in  
27 older adults in rural area. *Modern Preventive Medicine* 2016;43(10):1835-38. In Chinese.  
28  
29 26. Watson LC, Pignone MP. Screening accuracy for late-life depression in primary care: A systematic  
30 review. *J Fam Pract* 2003;52(12):956-64.  
31  
32 27. Smalbrugge M, Jongenelis L, Pot AM, et al. Screening for depression and assessing change in  
33 severity of depression. Is the Geriatric Depression Scale (30-, 15- and 8-item versions) useful  
34 for both purposes in nursing home patients? *Aging & mental health* 2008;12(2):244-48. doi:  
35 10.1080/13607860801987238  
36  
37 28. Li Z, Jeon YH, Low LF, et al. Validity of the geriatric depression scale and the collateral source  
38 version of the geriatric depression scale in nursing homes. *International psychogeriatrics*  
39 2015;27(9):1495-504. doi: 10.1017/s1041610215000721 [published Online First:  
40 2015/05/21]  
41  
42 29. Xiaoyan H, Shuiyuan X, Dexing Z. Reliability and Validity of the Chinese Version of Geriatric  
43 Depression Scale: A Study in A Population of Chinese Rural Community-dwelling Elderly.  
44 *Chinese Journal of Clinical Psychology* 2008;16(5):473-75.  
45  
46 30. Lu J, Wang Y, Wang X, et al. Reliability and Validity of the Chinese Version of Geriatric Depression  
47 Scale Among Chinese Urban Community-dwelling Elderly Population. *Chinese Journal of*  
48 *Clinical Psychology* 2013;21(1):39-41.  
49  
50 31. Watson LC, Pignone MP. Screening accuracy for late-life depression in primary care: a systematic  
51 review. *The Journal of family practice* 2003;52(12):956-64. [published Online First:  
52 2003/12/05]  
53  
54 32. Xiao S. The theory basis and application of the social support rating scale. *Chin Ment Health*  
55 1994;2:98-100.  
56  
57 33. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of  
58 daily living. *The Gerontologist* 1969;9(3):179-86. doi: 10.1093/geront/9.3\_Part\_1.179  
59  
60 34. Xiao L, Xu H. Development of life events scale for the elderly. *Chin J Behavioral Med Sci*  
2008;17(2):182-84. In Chinese.

- 1  
2  
3 35. Eser I, Khorshid L, Cinar S. Sleep quality of older adults in nursing homes in Turkey: enhancing the  
4 quality of sleep improves quality of life. *Journal of gerontological nursing* 2007;33(10):42-9.  
5 [published Online First: 2007/10/25]  
6  
7 36. Stefan L, Vrgoc G, Rupcic T, et al. Sleep Duration and Sleep Quality Are Associated with Physical  
8 Activity in Elderly People Living in Nursing Homes. *International journal of environmental*  
9 *research and public health* 2018;15(11) doi: 10.3390/ijerph15112512 [published Online First:  
10 2018/11/15]  
11  
12 37. Tsai YF, Wong TKS, Ku YC. Self-care management of sleep disturbances and risk factors for poor  
13 sleep among older residents of Taiwanese nursing homes. *Journal of clinical nursing*  
14 2008;17(9):1219-26. doi: 10.1111/j.1365-2702.2007.02020.x  
15  
16 38. Wilfling D, Dichter MN, Trutschel D, et al. Prevalence of Sleep Disturbances in German Nursing  
17 Home Residents with Dementia: A Multicenter Cross-Sectional Study. *J Alzheimers Dis*  
18 2019;69(1):227-36. doi: 10.3233/jad-180784  
19  
20 39. Wang F, Meng LR, Zhang QE, et al. Sleep disturbance and its relationship with quality of life in  
21 older Chinese adults living in nursing homes. *Perspectives in psychiatric care* 2019 doi:  
22 10.1111/ppc.12363 [published Online First: 2019/02/20]  
23  
24 40. Gentili A, Weiner DK, Kuchibhatil M, et al. Factors that disturb sleep in nursing home residents.  
25 *Aging (Milan, Italy)* 1997;9(3):207-13. doi: 10.1007/bf03340151  
26  
27 41. Livingston G, Blizard B, Mann A. Does sleep disturbance predict depression in elderly people? A  
28 study in inner London. *The British journal of general practice : the journal of the Royal College*  
29 *of General Practitioners* 1993;43(376):445-8. [published Online First: 1993/11/01]  
30  
31 42. Rodin J, McAvay G, Timko C. A longitudinal study of depressed mood and sleep disturbances in  
32 elderly adults. *Journal of gerontology* 1988;43(2):P45-53. [published Online First:  
33 1988/03/01]  
34  
35 43. Sukegawa T, Itoga M, Seno H, et al. Sleep disturbances and depression in the elderly in Japan.  
36 *Psychiatry Clin Neurosci* 2003;57(3):265-70. doi: 10.1046/j.1440-1819.2003.01115.x  
37  
38 44. Kishimoto Y, Okamoto N, Saeki K, et al. Bodily pain, social support, depression symptoms and  
39 stroke history are independently associated with sleep disturbance among the elderly: a  
40 cross-sectional analysis of the Fujiwara-kyo study. *Environ Health Prev* 2016;21(5):295-303.  
41 doi: 10.1007/s12199-016-0529-z  
42  
43 45. Wu CY, Su TP, Fang CL, et al. Sleep quality among community-dwelling elderly people and its  
44 demographic, mental, and physical correlates. *J Chin Med Assoc* 2012;75(2):75-80. doi:  
45 10.1016/j.jcma.2011.12.011  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

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



Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11,12
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	no
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12,13
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	13,14,15
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13,14,15
		(b) Report category boundaries when continuous variables were categorized	13,14
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	no
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	16,17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19,20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17,18,19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21

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

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