RESEARCH ARTICLE

The prevalence of poor sleep quality and associated risk factors among Chinese elderly adults in nursing homes: A cross-sectional study

Xidi Zhu[1◉], Zhao Hu[1◉], Yu Nie[1], Tingting Zhu[2], Atipatsa Chiwanda Kaminga[3,4], Yunhan Yu[1], Huilan Xu[1]*

1 Department of Social Medicine and Health Management, Xiangya School of Public Health, Central South University, Changsha, China, **2** Department of Scientific Research Management, Shanghai Health Development Research Center, Shanghai, China, **3** Department of Mathematics and Statistics, Mzuzu University, Mzuzu, Malawi, **4** Department of Epidemiology and Health Statistics, Xiangya School of Public Health, Central South University, Changsha, Hunan, China

◉ These authors contributed equally to this work.

* xhl6363@sina.com

Abstract

Background

Sleep problems have become the most common complaints among the elderly. There are a few studies that explored the prevalence of poor sleep quality and its associated factors among the elderly in nursing homes. Therefore, this study aimed to examine the prevalence of poor sleep quality and its associated factors among the Chinese elderly in nursing homes.

Methods

A total of 817 elderly residents, from 24 nursing homes, were included in this cross-sectional study. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), and poor sleep quality was defined as PSQI >5. Multiple binary logistic regression was used to estimate the strength of the association between risk factors and poor sleep quality in terms of adjusted odds ratios (AORs) and their 95% confidence intervals (CIs), and interactions of risk factors for poor sleep quality were also examined.

Results

The prevalence of poor sleep quality was 67.3% (95% CI: 64.0, 70.5%) among the Chinese elderly in nursing homes. Multiple binary logistic regression results showed that participants with the following characteristics had an increased risk of poor sleep quality after adjustments for other confounders: being 70–79 years old (AOR: 1.78, 95% CI: 1.08, 2.92) or 80 years old and above (AOR: 2.67, 95% CI: 1.68, 4.24); having one to two kinds of chronic diseases (AOR: 2.05, 95% CI: 1.39, 3.01) or three or more kinds of chronic diseases (AOR: 2.35, 95% CI: 1.39, 4.00); depression symptoms (AOR: 1.08, 95% CI: 1.04, 1.11), anxiety

Xiangya School of Public Health of Central South
University (csugwxy@126.com).

symptoms (AOR: 1.11, 95% CI: 1.05, 1.18), and social support(AOR: 0.97, 95% CI: 0.95, 0.99). Additive interactions were detected between age and anxiety symptoms (AOR: 8.34, 95% CI: 4.43, 15.69); between chronic disease and anxiety symptoms (AOR: 8.61, 95% CI: 4.28, 17.31); and between social support and anxiety symptoms (AOR: 6.43, 95% CI: 3.22, 12.86).

Conclusions

The prevalence of poor sleep quality among the elderly in nursing homes is relatively high. Besides, anxiety symptoms has additive interactions with age, chronic disease and social support for poor sleep quality. These findings have significant implications for interventions that aim to improve sleep quality among elderly residents in nursing homes.

Introduction

Ageing is a severe problem in China as well as throughout the world. According to the data of the Sixth National Population Census in 2010, the number of people in China aged 60 years and above was approximately 177 million, accounting for 13.26% of the total population [1]. The United Nations (UN) Commission on Population Development predicted that by 2020 the elderly population aged 60 and above in China would reach 243.8 million, accounting for 17.1% of the total population [2]. Sleep problems have become the most common complaints among the elderly. Approximately 74% of the elderly men and 79% of the elderly women reported sleep complaints in Italy [3]. In addition, previous studies reported that the prevalence of sleep disorders was approximately 30–40% among older residents [4,5]. However, as a complicated phenomenon, the sleep quality of individuals is difficult to define and assess objectively. Using a standardized assessment tool for sleep quality, the Pittsburgh Sleep Quality Index (PSQI), epidemiological studies indicated that the self-rated prevalence of poor sleep quality was 62.4% among older adults in Thailand [6], 16.6% among Mexican Americans aged 75 and older [7], 41.5% and 33.8% among the elderly adults living in urban and rural areas of China, respectively [8,9]. However, several studies demonstrated that most sleep problems may be exacerbated by institutional settings [10,11]. For instance, a study conducted on 100 selected individuals of over 65 years of age found that institutionalized elderly people presented more worse overall sleep quality and higher levels of daytime somnolence than non-institutionalized elderly people [10]. Fetveit and colleagues [11] found that the prevalence of sleep disturbance was approximately 70% among nursing home residents. In summary, sleep problems are very common among the elderly and pose a major challenge to public health.

Evidence is emerging that poor sleep quality is positively associated with physical health, mental disorders and quality of life [12,13]. For example, a large cohort study found that poor sleep quality was associated with higher odds of hypertension among a Chinese rural population [13]. Another large cohort study indicated that short sleepers with poor sleep quality had an increased risk of cardiovascular disease [14]. In addition, many studies [15–17] have indicated that poor sleep quality is a powerful predictor of suicidal ideation and depressive symptoms among the elderly. However, the underlying mechanisms between poor sleep quality and these harmful consequences are still unclear.

To alleviate the personal suffering and adverse effects introduced by poor sleep quality, it is essential to understand its prevalence pattern and associated factors. Previous studies have

demonstrated many factors related to poor sleep quality among older adults, including but not limited to the following four domains: (1) socio-demographic factors, such as age [9], marital status [18] and education [19]; (2) lifestyle factors, such as physical activity [20] and caffeine intake [21]; (3) emotional factors, such as stress [22] and depression [20]; and (4) chronic conditions, such as arthritis [9] and pulmonary disease [23]. However, few studies have examined the prevalence and risk factors of poor sleep quality in a nursing home population. Moreover, no study has explored the interactions of risk factors for poor sleep quality among elderly residents in nursing homes. Thus, the aims of this study were as follows: (1) to find the prevalence of poor sleep quality among the elderly in nursing homes in China; (2) to explore the risk factors for poor sleep quality; and (3) to explore the interactions of risk factors for poor sleep quality.

Materials and methods

Study population

This was a cross-sectional study conducted in the nursing homes of Hunan Province in China from October to December 2018. This study was approved by the Ethical Committee of Xiangya School of Public Health in Central South University (No.XYGW-2018-49). Written informed consent was obtained from all participants of this study. In order to select a representative elderly sample living in the nursing homes of Hunan Province, a multistage sampling method was used. First, each city from northern Hunan, southern Hunan and central Hunan was selected (i.e., based on geographical region): Changsha city, Hengyang city and Yiyang city, respectively. Subsequently, one county and two districts were randomly chosen from each selected city. For instance, Changsha County and the districts, Kaifu and Yuelu, were selected from Changsha City; Hengyang County and the districts, Yanfeng and Shigu, were selected from Hengyang City; and Yuanjiang County and the districts, Ziyang and Heshan, were selected from Yiyang City. Second, two townships were randomly chosen from each county. For example, Xingsha and Tiaoma were sampled from Changsha County; Xidu and Jingtou were sampled from Hengyang County; and Qionghu and Caowei were sampled from Yuanjiang County. Finally, two nursing homes were randomly selected from each selected district and township, and a total of 24 nursing homes were ultimately selected.

Residents in the selected nursing homes were included in our study if they met the following inclusion criteria: (1) had age 60 years and above; (2) had duration of entrance into nursing homes of more than one year; and (3) had physical and mental ability to participate in interviews. However, residents in the same homes were excluded if they (1) refused to participate in this study; (2) had a severe hearing impairment or language barrier, and (3) had a history of severe cognitive deficit. In summary, among a total of 2,055 older adults residents in the 24 nursing homes, 511 adults were excluded because they were younger than 60 years old or had stayed in a nursing home less than one year. A total of 603 older adults had a severe hearing impairment, language barrier or severe cognitive deficit, and 112 older adult residents who did not agree to participate were also excluded from this study. Of the remaining 829 older adults, 12 were excluded due to incomplete data. Ultimately, a total of 817 elderly adults were included in the data analysis in this study.

Data measurement

All data were obtained through face-to-face interviews by trained staff who spent 30 to 60 minutes with each respondent when conducting the interviews. Data on the following variables were collected: socio-demographics (age, gender, education, marital status, monthly individual income, number of descendants, length of stay in a nursing home and medical insurance

status), lifestyle behavioural factors (smoking, alcohol drinking and physical exercise), physical status (activities of daily living (ADLs) and number of chronic disease) and social psychological factors (social support, depression symptoms and anxiety symptoms). Furthermore, marital status was dichotomized into stable and unstable, where unstable marital status included divorce, widow/widower and never having been married. Besides, smoking was assessed by a single item and defined as an average of at least one cigarette per day in the last year, and alcohol drinking was also assessed by a single item and defined as drinking a glass of wine per day in the last week. In addition, regular physical exercise was defined as to engage in at least 30 minutes of physical exercise at least three times a week. Moreover, ADL status was assessed using the Chinese version of Lawton and Brody's ADL scale, which subsequently dichotomized participants into disabled and normal [24]. Disabled ADL status was determined when participants had a total score of greater than 14 points. Cronbach's α of this instrument was 0.926 in this study. Additionally, self-reported chronic diseases were measured by a multiple choices question, which referred to chronic non-communicable diseases, including hypertension, diabetes, coronary heart disease (CHD), chronic obstructive pulmonary disease (COPD), hyperlipidaemia, stroke and others. Further, social support was measured using the Social Support Rating Scale (SSRS), which was developed by Xiao and is widely used in China. Using this instrument, participants were divided into two groups based on the median of the global scores (low social support: score≤30 points; and high social support: score>30 points). As regards depression symptoms, they were measured using the Chinese version of the Geriatric Depression Scale-30 items (GDS-30) [25]. This instrument has been commonly used in China and has indicated high validity and reliability among the Chinese elderly population[26]. Thus, when used on the sample of this study, a Cronbach's α of 0.925 was obtained. The GDS-30 consists of 30 true/false questions, and the total score ranges from 0 to 30 points. In this study, participants had depression symptoms if they scored 11 or more points on this instrument. On the other hand, anxiety symptoms were measured using the Chinese version of the Generalized Anxiety Disorder-7 scale (GAD-7). This instrument is a seven-item self-report instrument, in which each item assesses one of the typical symptoms of GAD over the last two weeks, thus, a total score ranges between 0 and 21. Cronbach's α of this tool was 0.933 in this study. Participants who scored 10 or more were considered to have anxiety symptoms in this study [27].

Assessment of sleep quality

Sleep quality among the subjects was assessed using the Chinese version of the Pittsburgh Sleep Quality Index (PSQI) [28], which has been proven to have good validity and reliability among older adults [29]. The PSQI is a self-rated questionnaire that assesses sleep quality in the past month. It contains nineteen items grouped into seven components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component score ranges from 0 to 3, and the total score ranges from 0 to 21 points. Participants with a global PSQI score greater than 5 were defined as having poor sleep quality in this study. Cronbach's α for this tool was 0.781 in this study.

Statistical analysis

Categorical variables were presented as frequencies and percentages. Continuous variables were presented as the mean±standard deviation (SD). The distribution of continuous variables across subgroups of categorical variables was compared using Student's t-test or one-way analysis of variance (ANOVA). The relationship between categorical variables was analysed using the Pearson chi-square test or the Mantel-Haenszel chi-square test. Multiple binary logistic

regression analysis was used to examine risk factors associated with poor sleep quality. The adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were also estimated after controlling for other confounders. Microsoft Excel, developed by Andersson and colleagues [30], was used to detect and calculate the additive interaction of risk factors for poor sleep quality. The relative excess risk due to interaction (RERI) and the attributable proportion due to interaction (AP) of equal to 0, or the synergy index (S) of equal to 1, suggested no additive interaction between two factors. A $P<0.05$ and $P<0.025$ indicated statistically significant results for groups and multiple comparisons, respectively. All statistical analyses were performed in SAS 9.3 (SAS Institute Inc., Cary, NC, USA).

Results

Characteristics of the study sample

In total, 817 elderly residents living in nursing homes were included in this study. Among them, more than half of participants aged 80 years and above. In addition, 54.0% of the subjects were female, and 46.0% were male. Also, approximately 40% of the participants had completed less than 6 years of education, and a similar proportion had stable marriages. Moreover, approximately one-third of the total sample reported monthly individual incomes of more than 3,000 RMB. Also, a small proportion of cigarette smoking (16.2%), alcohol drinking (11.8%), and subjects that had no chronic diseases (24.1%) were observed among the participants. Furthermore, approximately 36.0% of the subjects had depressive symptoms, while 16.0% had anxiety symptoms.

There were statistically significant differences between poor sleepers and good sleepers in age, education, marital status, monthly individual income, length of stay, number of chronic diseases, depression symptoms, anxiety symptoms, social support and ADL status (all $P<0.05$). Poor sleepers were seemingly those who had older age, lower education, unstable marriages, lower monthly individual incomes, longer lengths of stay, at least one type of chronic disease, depression symptoms, anxiety symptoms, lower social support and disabled ADLs. The results in detail are presented in Table 1.

Prevalence of poor sleep quality

The mean global PSQI score was 8.5 points overall (95% CI: 8.2, 8.8), 8.3 points in males (95% CI: 7.8, 8.8) and 8.7 points in females (95% CI: 8.2, 9.1). There was no statistically significant difference in the PSQI score between males and females ($P = 0.293$). The total PSQI score increased with increased age, for example, from 7.4 points (95% CI: 6.6, 8.2) in subjects aged 60–69 to 8.9 points (95% CI: 8.4, 9.3) in subjects aged ≥80 ($P = 0.010$). Additionally, 550 individuals had a total PSQI score of greater than 5, and the overall prevalence of poor sleep quality was 67.3% (95% CI: 64.0%, 70.5%). Nevertheless, the prevalence of poor sleep quality was 66.8% (95% CI: 61.7%, 71.0%) among males and 67.8% (95% CI: 63.5%, 72.1%) among females. The prevalence also increased with increased age, that is, the prevalence increased from 54.1% (95% CI: 45.9%, 63.0%) in participants aged 60–69 years to 72.7% (95% CI: 68.7%, 77.1%) in participants aged ≥80 years (P for trend <0.001). The results are shown in Table 2.

Components of sleep quality

Most of the participants went to bed at 9 PM and woke up at approximately 6 AM. The average bedtime of the participants was 9.1±3.5 hours, and the average sleep duration was 6.8±3.9 hours. Most subjects could not fall asleep within 30 minutes. The average sleep efficiency of the participants was 80.0%. Approximately 85% of the subjects never used sleep medication.

Table 1. Characteristics of the elderly residents in the nursing homes.

Characteristic	Total (n = 817)	Poor sleeper (n = 550)	Good sleeper (n = 267)	*P*-value[†]
Age (years)				
60~	135(16.5)	73(13.3)	62(23.2)	<0.001
70~	232(28.4)	150(27.3)	82(30.7)	
80~	450(55.1)	327(59.4)	123(46.1)	
Gender				
Male	376(46.0)	251(45.6)	125(46.8)	0.751
Female	441(54.0)	299(54.4)	142(53.2)	
Education (years)				
0–6	364(44.6)	263(47.8)	101(37.8)	0.004
7~	203(24.8)	138(25.1)	65(24.4)	
10~	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 individual 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)	
Length of stay (years)				
1~	444(54.3)	284(51.6)	160(59.9)	0.026
3~	373(45.7)	266(48.4)	107(40.1)	
Have descendants				
Yes	746(91.3)	496(90.2)	250(93.6)	0.100
No	71(8.7)	54(9.8)	17(6.4)	
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)	
Physical exercise				
Regular	353(43.2)	233(42.4)	120(44.9)	0.485
Irregular	464(56.8)	317(57.6)	147(55.1)	
Number of chronic diseases				
0	197(24.1)	96(17.5)	101(37.8)	<0.001
1~	450(55.1)	318(57.8)	132(49.5)	
3~	170(20.8)	136(24.7)	34(12.7)	
ADL status				
Normal	268(32.8)	152(27.6)	116(43.4)	<0.001
Disabled	549(67.2)	398(72.4)	151(56.6)	
Depression symptoms				
Yes	294(36.0)	251(45.6)	43(16.1)	<0.001
No	523(64.0)	299(54.4)	224(83.9)	
Anxiety symptoms				
Yes	136(16.6)	124(22.5)	12(4.5)	<0.001

(*Continued*)

Table 1. (Continued)

Characteristic	Total (n = 817)	Poor sleeper (n = 550)	Good sleeper (n = 267)	P-value[†]
No	681(83.4)	426(77.5)	255(95.5)	
Social support				
Low	435(53.2)	337(61.3)	98(36.7)	<0.001
High	382(46.8)	213(38.7)	169(63.3)	

Data are presented as n (%). ADLs, activities of daily living.

† P-value was determined by the Pearson chi-square test.

The mean scores for subjective sleep quality, sleep disturbance and daytime dysfunction were 1.3±0.9, 1.2±0.6 and 1.4 ±1.1, respectively.

No statistically significant differences were observed between males and females on all components of sleep quality. More older residents than younger people have used sleep medication. Moreover, older adults have more daytime dysfunction than younger individuals do. No significant differences were obtained in sleep latency, sleep efficiency or sleep disturbance between age groups. The results are shown in Table 3.

Risk factors for poor sleep quality

Multiple binary logistic regression analysis results suggested that having age between 70 and 79 years (AOR: 1.78, 95% CI: 1.08, 2.92) or 80 years and above (AOR: 2.67, 95% CI: 1.68, 4.24) increased the risk of poor sleep quality when compared with age between 60 and 69 years after adjustments were made for other confounding factors. Moreover, participants with one to two kinds of chronic diseases (AOR: 2.05, 95% CI: 1.39, 3.01), three or more kinds of chronic diseases (AOR: 2.35, 95%: 1.39, 4.00), depression symptoms (AOR: 1.08, 95% CI: 1.04, 1.11), anxiety symptoms (AOR: 1.11, 95% CI: 1.05, 1.18) and social support (AOR: 0.97, 95% CI: 0.95, 0.99) were more likely to report poor sleep quality after adjustments were made for other variables. The results are shown in Table 4.

Interactions of risk factors for poor sleep quality

The Andersson's Excel was used to detect interactions between risk factors for sleep quality and calculate their effect size on poor sleep quality. Thus, interactions were detected between the following variables: older age and anxiety symptoms, with a RERI of 2.83 (95% CI: 0.13,

Table 2. The PSQI global score and the prevalence of poor sleep quality among the elderly in the nursing homes stratified by age and gender.

	N	PSQI score Mean (95% CI)	P-value	Poor sleep quality[†]Prevalence (95% CI)	P-value
Total	817	8.5(8.2, 8.8)		67.3(64.0, 70.5)	
Gender					
Male	376	8.3(7.8, 8.8)	0.293	66.8(61.7, 71.0)	0.751
Female	441	8.7(8.2, 9.1)		67.8(63.5, 72.1)	
Age					
60~	135	7.4(6.6, 8.2)	0.010*	54.1(45.9, 63.0)	<0.001*
70~	232	8.4(7.8, 9.1)		64.7(58.6, 70.5)	
80~	450	8.9(8.4, 9.3)		72.7(68.7, 77.1)	

†Poor sleep quality was determined by PSQI score >5.

*P-value for trend.

Table 3. Gender- and age-specific scores of sleep quality components measured by the Chinese version of the Pittsburgh Sleep Quality Index.

Sleep quality components		Total (n = 817)	Gender			Age group (years)			
			Male (n = 376)	Female (n = 441)	P-value	60–69 (n = 135)	70–79 (n = 232)	≥80 (n = 450)	P-value
Subjective sleep quality†, mean ±SD		1.3±0.9	1.3±0.9	1.3±0.9	0.674	1.2±0.9	1.3±0.9	1.3±0.9	0.482
Sleep latency, n(%)	≤15 min	236(28.9)	116(30.9)	120(27.2)	0.200	51(37.8)	63(27.2)	122(27.1)	0.161
	16~min	252(30.8)	121(32.2)	131(29.7)		34(25.2)	75(32.3)	143(31.8)	
	31~min	329(40.3)	139(36.9)	190(43.1)		50(37.0)	94(40.5)	185(41.1)	
Sleep duration, mean±SD		6.8±3.9	6.8±3.1	6.8±4.4	0.908	6.9±2.1	6.7±2.7	6.9±4.7	0.759
Sleep duration, n(%)	<6 h	262(32.1)	121(32.2)	141(32.0)	0.253	38(28.1)	80(34.5)	144(32.0)	0.008
	6–7 h	278(34.0)	118(31.4)	160(36.3)		38(28.1)	67(28.9)	173(38.4)	
	>7 h	277(33.9)	137(36.4)	140(31.7)		59(43.8)	85(36.6)	133(29.6)	
Habitual sleep efficiency*, mean ±SD		0.8±0.4	0.8±0.3	0.8±0.4	0.593	0.8±0.2	0.7±0.2	0.8±0.5	0.558
Habitual sleep efficiency, n(%)	<65%	270(33.1)	125(33.2)	145(32.8)	0.803	41(30.4)	80(34.4)	149(33.1)	0.075
	65–74%	103(12.6)	48(12.8)	55(12.5)		14(10.4)	28(12.1)	61(13.6)	
	75–84%	135(16.5)	57(15.2)	78(17.7)		15(11.1)	34(14.7)	86(19.1)	
	>85%	309(37.8)	146(38.8)	163(37.0)		65(48.1)	90(38.8)	154 (34.2)	
Sleep disturbances‡, mean±SD		1.2±0.6	1.2±0.6	1.2±0.6	0.914	1.2±0.6	1.3±0.6	1.3±0.5	0.148
Any sleep disturbance, n(%)	Yes	248(30.4)	112(29.8)	136(30.8)	0.745	38(28.1)	72(31.0)	138(30.7)	0.826
	No	569(69.6)	264(60.2)	305(69.2)		97(71.9)	160(69.0)	312(69.3)	
Use of sleep medication, n(%)	Yes	115(14.1)	44(11.7)	71(16.1)	0.072	9(6.7)	23(9.9)	83(18.4)	<0.001
	No	702(85.9)	332(88.3)	370(83.9)		126(93.3)	209(90.1)	367(81.6)	
Daytime dysfunction**, mean ±SD		1.4±1.1	1.4±1.1	1.5±1.0	0.620	1.2 ±1.0	1.5±1.1	1.5±1.0	0.037

SD, standard deviation.

†Score range 0 to 3; higher scores indicate poor subjective sleep quality

*Derived from the formula: hours of sleep/(get-up time−usual bedtime)×100%; score range from 0 to 1; higher scores indicate higher sleep efficiency

‡Derived from PSQI items 5b-5j; score range from 0 to 3; higher scores indicate more sleep disturbances

**Derived from PSQI item 8 and 9; score range from 0 to 3; higher scores indicate more daytime dysfunction.

https://doi.org/10.1371/journal.pone.0232834.t003

5.52), an AP of 0.34 (95% CI: 0.13, 0.55) and an S of 1.63 (95% CI: 1.11, 2.39); chronic disease and anxiety symptoms, with a RERI of 3.32 (95% CI: 0.31, 6.33), an AP of 0.39 (95% CI: 0.29, 0.48) and an S of 1.77 (95% CI: 1.54, 2.04); and social support and anxiety symptoms, with a RERI of 2.96 (95% CI: 1.02, 4.90), an AP of 0.46 (95% CI: 0.38, 0.54) and an S of 2.20 (95% CI: 1.65, 2.93). No statistically significant interactions were found between other factors after adjusting for confounders. The results are shown in Table 5.

Discussion

This study examined the prevalence of poor sleep quality and its risk factors among the elderly in nursing homes in China. Additionally, interactions of risk factors for poor sleep quality were explored. It was found that poor sleep quality affected nearly two-thirds (67.3%) of the elderly residents in nursing homes of this sample, and those with older age, chronic diseases, depression symptoms, anxiety symptoms and lower social support were the most likely to be affected by poor sleep quality. Moreover, additive interactions were detected between age and anxiety symptoms; and between education and anxiety symptoms.

Table 4. Risk factors for poor sleep quality among the elderly in nursing homes.

Variable	B	SE	Wald	AOR(95% CI)[†]	P-value
Age (years)					
60~				1.00	
70~	0.58	0.25	5.15	1.78(1.08, 2.92)	0.023
80~	0.98	0.24	17.37	2.67(1.68, 4.24)	<0.001
Number of chronic diseases					
0~				1.00	
1~	0.72	0.20	13.31	2.05(1.39, 3.01)	<0.001
3~	0.86	0.27	10.01	2.35(1.39, 4.00)	<0.001
Depression symptoms	0.07	0.02	17.29	1.08(1.04,1.11)	<0.001
Anxiety symptoms	0.11	0.03	14.02	1.11(1.05,1.18)	<0.001
Social support	-0.03	0.01	5.32	0.97(0.95,0.99)	0.021

SE, standard error; AOR, adjusted odds ratio.

†Adjusted for gender, education, marital status, smoking, alcohol drinking, physical exercise, descendants, medical insurance, monthly individual income, length of stay and ADL status, as well as the variables in the table.

This large population-based study used a standardized and valid PSQI tool to measure the characteristics of sleep quality among elderly adults in nursing homes in China. Based on this approach, we found that the prevalence of poor sleep quality was 67.3% among elderly residents in nursing homes in China. This finding is comparable to those of other previous studies conducted in elderly adults living in nursing homes in Turkey [31,32]. However, with a similar population, the same institutional setting and measurement tool, Stefan et al [33] found that 54.5% of individuals were poor sleepers among 894 elderly adults in Zagreb nursing homes. Tsai et al [34] found that 46.4% of participants reported poor sleep quality among 196 elderly

Table 5. Interactions between risk factors for poor sleep quality among the elderly in nursing homes.

Factor 1	Factor 2	AOR[†]	RERI	AP	S
Age (years)	Anxiety symptoms		2.83(0.13, 5.52)	0.34(0.13, 0.55)	1.63(1.11, 2.39)
60–69	No	1.00			
≥70	No	2.09(1.01, 4.32)			
60–69	Yes	4.43(2.13, 9.20)			
≥70	Yes	8.34(4.43, 15.69)			
Chronic disease	Anxiety symptoms		3.32(0.31, 6.33)	0.39(0.29, 0.48)	1.77(1.54, 2.04)
No	No	1.00			
Yes	No	2.51(1.92, 3.29)			
No	Yes	3.79(1.82, 7.86)			
Yes	Yes	8.61(4.28, 17.31)			
Social support	Anxiety symptoms		2.96(1.02, 4.90)	0.46(0.38, 0.54)	2.20(1.65, 2.93)
High	No	1.00			
Low	No	1.61(1.10, 2.35)			
High	Yes	2.87(1.38, 5.95)			
Low	Yes	6.43(3.22, 12.86)			

AOR, adjusted odds ratio; RERI, the relative excess risk due to interaction; AP, the attributable proportion due to interaction; S, the synergy index.

†Adjusted for gender, education, marital status, smoking, alcohol drinking, physical exercise, descendants, medical insurance, monthly individual income, length of stay, depression symptoms and ADL status, as well as the variables in the table.

nursing home residents in Taiwan. A reason for the variance in these estimates may be explained by the different inclusion criteria for the study sample, as well as the differences in facilities and medical care among different institutions. As mentioned in the introduction, some sleep problems may be exacerbated by institutional setting. Our study also indicates that the prevalence of poor sleep quality in nursing homes was higher than in community homes. For instance, only 33.8% of community-dwelling elderly adults in Yanggu County [8] and 27.7% in Deqing County [35] in China reported poor sleep quality. On the one hand, the high self-rated prevalence may result from residents in nursing homes being older (55.1% of participants were aged 80 years and above in this study) and having more chronic conditions (78.5% of participants have at least one kind of chronic disease) than elderly adults in the community [36]. On the other hand, an uncomfortable environment and care routines in the institution may not promote sleep [37]. Among the seven PSQI components, lower sleep efficiency (62.2%) was the most common, followed by longer sleep latency (40.3%) and sleep disturbances (30.4%). These results were consistent with those of previous studies [31,32]. As shown in our study, elderly adults suffered from several negative emotions (e.g., depression and anxiety) that may lead to longer sleep latency and lower sleep efficiency [38]. The main cause of sleep disturbances in nursing home settings may be nocturia in elderly adults, as well as noise and an uncomfortable environment [39]. However, the use of sleep medication was not prevalent in this population, and only 14.1% of individuals reported that they had taken sleep medication in the previous month. These results indicated that sleep problems in residents may not attract enough attention by administrative and healthcare staff in nursing homes. Otherwise, people had no awareness and believed that they were obtaining healthcare services for sleep problems in such a setting.

Consistent with previous epidemiological studies in the community, our study found that the prevalence of poor sleep quality was higher in older participants [9,40]. However, the findings of studies on the association between sleep quality and gender were conflicting. Many studies indicate that females are more prone than males to experience poor sleep quality because a higher proportion of females have lower socioeconomic status and are more susceptible to anxiety and depression [40,41]. In contrast, some studies indicate that males were more likely to report sleep problems than females [42,43]. In our study, no significant difference in prevalence was observed between males and females, which is consistent with the findings of a study conducted among elderly attendees of a primary care centre in Malaysia [43] and the findings of another study conducted in nursing homes in Taiwan [34]. The differences in these findings may be related to the differences in the study sample and research location. Specific chronic conditions, such as hypertension [44], heart disease [45], arthritis [9] and COPD [8], were found to be associated with poor sleep quality. In our current study, one interesting finding is that the risk of poor sleep quality was increased with an increasing number of chronic diseases. This result is in accordance with those of other previous studies. For example, a cross-sectional study performed among 16,680 residents aged 65 years in eight low- and middle-income countries demonstrated that poor health and a high number of comorbidities were associated with more sleep complaints [46]. Also, another population-based cross-sectional study among 5,107 adults in Japan suggested that sleep quality was directly proportional to the number of comorbid conditions in a subject [47]. Thus, the mechanism underlying the association between multiple chronic conditions and poor sleep quality requires investigation to find ways for improving sleep quality among the elderly with at least one chronic disease.

Additionally, like in the previous studies [48–50], this study found that depression and anxiety symptoms independently increased the risk of poor sleep quality. Similarly, Cho HJ et al [51] found that a greater level of depressive symptoms had increased odds of sleep latency ($\geq$1 hour) among 3,051 participants aged 67 and older in the United States of America (USA).

Moreover, another study conducted among 2,040 elderly Koreans suggested that poor subjective sleep quality, longer sleep latency and frequent use of sleeping medication were independently associated with depression [52]. Also, Potvin et al [53] suggested that daytime sleepiness and sleep disturbances were significantly associated with anxiety. In addition, Press et al [54] reported that depressive symptoms were associated with decreased sleep satisfaction, while anxiety symptoms were associated with difficulty in falling asleep, waking up during the night and morning weakness. Therefore, these findings suggest that reducing depressive and anxiety symptoms in the elderly may help improve sleep quality.

Further, in this study, investigations on additive interactions of risk factors for sleep quality found that anxiety symptoms had additive interactions with older age, and chronic disease. That is, participants who had anxiety symptoms and older age, or anxiety symptoms and chronic disease were more likely to have poor sleep quality than those with anxiety symptoms and aged between 60 and 69, or anxiety symptoms and without chronic disease, respectively. This is in line with the findings of some previous studies that anxiety symptoms were more common among older people [55,56], and chronic diseases and anxiety symptoms occurred contemporaneously among the elderly [57,58]. These results, therefore, may partly be the reason for the occurrence of the foregoing interactions, which provide new insights into the prevention and treatment of sleep problems among the elderly.

We assessed social support using the SSRS, which is a self-rated questionnaire developed by Xiao and widely used in epidemiological studies in China. This perceived social support scale evaluates social relationships with friends, neighbours, colleagues and family members as well as the availability of functional support. Many studies consider social support to be an important factor in the maintenance of health status. Considering social support and sleep quality, this study found that lower level of social support increased the risk of poor sleep quality among the elderly in the nursing homes. This result was consistent with the findings of previous studies [59–61]. Specifically, Kishimoto et al [60] found that individuals with weak social support from spouses or family members were at a higher risk of sleep disturbances than their counterparts with strong social support. In addition, lower level of emotional social support was associated with more difficulties in initiating and maintaining sleep among the 998 elderly African-Americans [61]. In this regard, evidence has shown that social support may influence sleep quality by enabling a feeling of belonging, and protection from social isolation and negative emotions (e.g., loneliness, depression and anxiety), thus decreasing the incident risk of sleep disorders [62–64]. Therefore, improving social support among the elderly is a necessary cause in the prevention of sleeping problems among the elderly. Similar to our study results, people with anxiety had an increased risk of poor sleep quality, especially those with lower social support. Additionally, a stronger social network may contribute to individuals having multiple sources of health information, thus increasing the probability of obtaining information that may help maintain and promote healthy sleep behaviour [65,66].

Quality of life is a comprehensive and multidimensional condition that refers to an individual's perceived physical and mental health under the influence of illness, injury and treatment over time. Obviously, sleep is an important influence factor for quality of life among Chinese elderly adults. It may provide a new perspective for us to improve quality of life among elderly in nursing homes due to sleep quality improvement.

To the best of our knowledge, this is the first study in China to explore the risk factors and their interactions for poor sleep quality among the elderly in nursing homes. Given the large population-based randomly selected sample, and the higher response rate, the findings of this study may provide valuable information for improving sleep quality among the aging populations in nursing homes. From a clinical point of view, concern about mental health in residents and intervention and treatment for anxiety symptoms may be helpful in the improvement of

sleep quality in nursing homes. Additionally, the amelioration of the living environment and the provision of more social support were also important.

However, there are several limitations pertaining to this study that need to be highlighted. First, this study cannot establish a causal relationship between poor sleep quality and its associated risk factors due to the cross-sectional study design. For example, some studies also declared that poor sleep quality was positively associated with depression, anxiety and chronic diseases [67,68]. Second, all data were measurements of self-rating, which may introduce recall bias in the findings. Third, the limited sensitivity and specificity of the Chinese version of PSQI may lead to misclassifications of poor sleepers. Finally, the findings may not be generalized to the elderly populations that are not living in nursing homes.

Conclusions

The prevalence of poor sleep quality in nursing homes in China is relatively high. Its risk factors included older age, chronic diseases, depression symptoms, anxiety symptoms and lower social support. Besides, anxiety symptoms have additive interactions with age, chronic disease and social support for poor sleep quality. These findings have significant implications for interventions that aim to improve sleep quality among the elderly residents in nursing homes.

Acknowledgments

We thank all the elderly residents in the nursing homes who participated in this study for their cooperation.

Author Contributions

Conceptualization: Huilan Xu.

Formal analysis: Xidi Zhu, Zhao Hu, Yunhan Yu.

Investigation: Xidi Zhu, Yu Nie, Tingting Zhu, Yunhan Yu.

Writing – original draft: Xidi Zhu, Zhao Hu.

Writing – review & editing: Atipatsa Chiwanda Kaminga, Huilan Xu.

References

1. (Beijing, China: 2011) National Bureau of Statistics of China. The Sixth National Population Census Data Gazette (No. 1). National Census Bureau.

2. (2007-12-27) National committee on aging.Report on prediction of population aging trend in China. http://www.cncaprc.gov.cn/contents/16/11224.html.

3. Maggi S, Langlois JA, Minicuci N, Grigoletto F, Pavan M, et al. (1998) Sleep complaints in community-dwelling older persons: prevalence, associated factors, and reported causes. J Am Geriatr Soc 46: 161–168. https://doi.org/10.1111/j.1532-5415.1998.tb02533.x PMID: 9475443

4. Roepke SK, Ancoli-Israel S (2010) Sleep disorders in the elderly. Indian J Med Res 131: 302–310. PMID: 20308755

5. Roberts RE, Shema SJ, Kaplan GA, Strawbridge WJ (2000) Sleep complaints and depression in an aging cohort: A prospective perspective. Am J Psychiatry 157: 81–88. https://doi.org/10.1176/ajp.157.1.81 PMID: 10618017

6. Aunjitsakul W, Pitanupong J, Werachattawan N (2018) Sleep Quality among Elderly People in Songkhla Province, Thailand: A Two-Stage Cluster Sampling Study. Journal of the Medical Association of Thailand 101: 137–144.

7. Pedraza S, Al Snih S, Ottenbacher KJ, Markides KS, Raji MA (2012) Sleep quality and sleep problems in Mexican Americans aged 75 and older. Aging Clin Exp Res 24: 391–397. https://doi.org/10.3275/8106 PMID: 22102513

8. Wang P, Song L, Wang K, Han X, Cong L, et al. (2019) Prevalence and associated factors of poor sleep quality among Chinese older adults living in a rural area: a population-based study. Aging clinical and experimental research.

9. Luo J, Zhu G, Zhao Q, Guo Q, Meng H, et al. (2013) Prevalence and Risk Factors of Poor Sleep Quality among Chinese Elderly in an Urban Community: Results from the Shanghai Aging Study. Plos One 8.

10. Martins da Silva R, Afonso P, Fonseca M, Teodoro T (2019) Comparing sleep quality in institutionalized and non-institutionalized elderly individuals. Aging Ment Health: 1–7.

11. Fetveit A, Bjorvatn B (2002) Sleep disturbances among nursing home residents. International Journal of Geriatric Psychiatry 17: 604–609. https://doi.org/10.1002/gps.639 PMID: 12112156

12. Uchmanowicz I, Markiewicz K, Uchmanowicz B, Koltuniuk A, Rosinczuk J (2019) The relationship between sleep disturbances and quality of life in elderly patients with hypertension. Clin Interv Aging 14: 155–165. https://doi.org/10.2147/CIA.S188499 PMID: 30697040

13. Zhang H, Li Y, Zhao X, Mao Z, Abdulai T, et al. (2019) The association between PSQI score and hypertension in a Chinese rural population: the Henan Rural Cohort Study. Sleep Med 58: 27–34. https://doi.org/10.1016/j.sleep.2019.03.001 PMID: 31059971

14. Hoevenaar-Blom MP, Spijkerman AM, Kromhout D, van den Berg JF, Verschuren WM (2011) Sleep duration and sleep quality in relation to 12-year cardiovascular disease incidence: the MORGEN study. Sleep 34: 1487–1492. https://doi.org/10.5665/sleep.1382 PMID: 22043119

15. Gelaye B, Okeiga J, Ayantoye I, Berhane HY, Berhane Y, et al. (2016) Association of suicidal ideation with poor sleep quality among Ethiopian adults. Sleep Breath 20: 1319–1326. https://doi.org/10.1007/s11325-016-1418-9 PMID: 27771845

16. Livingston G, Blizard B, Mann A (1993) Does sleep disturbance predict depression in elderly people? A study in inner London. Br J Gen Pract 43: 445–448. PMID: 8292414

17. Sukegawa T, Itoga M, Seno H, Miura S, Inagaki T, et al. (2003) Sleep disturbances and depression in the elderly in Japan. Psychiatry and Clinical Neurosciences 57: 265–270. https://doi.org/10.1046/j.1440-1819.2003.01115.x PMID: 12753565

18. Stranges S, Tigbe W, Gomez-Olive FX, Thorogood M, Kandala NB (2012) Sleep problems: an emerging global epidemic? Findings from the INDEPTH WHO-SAGE study among more than 40,000 older adults from 8 countries across Africa and Asia. Sleep 35: 1173–1181. https://doi.org/10.5665/sleep.2012 PMID: 22851813

19. Thichumpa W, Howteerakul N, Suwannapong N, Tantrakul V (2018) Sleep quality and associated factors among the elderly living in rural Chiang Rai, northern Thailand. Epidemiol Health 40: e2018018. https://doi.org/10.4178/epih.e2018018 PMID: 29807410

20. Sagayadevan V, Abdin E, Binte Shafie S, Jeyagurunathan A, Sambasivam R, et al. (2017) Prevalence and correlates of sleep problems among elderly Singaporeans. Psychogeriatrics 17: 43–51. https://doi.org/10.1111/psyg.12190 PMID: 26817951

21. de Pooter-Stijnman LMM, Vrijkotte S, Smalbrugge M (2018) Effect of caffeine on sleep and behaviour in nursing home residents with dementia. Eur Geriatr Med 9: 829–835. https://doi.org/10.1007/s41999-018-0115-6 PMID: 30574215

22. Quan SA, Li YC, Li WJ, Li Y, Jeong JY, et al. (2016) Gender Differences in Sleep Disturbance among Elderly Koreans: Hallym Aging Study. J Korean Med Sci 31: 1689–1695. https://doi.org/10.3346/jkms.2016.31.11.1689 PMID: 27709844

23. Su TP, Huang SR, Chou P (2004) Prevalence and risk factors of insomnia in community-dwelling Chinese elderly: a Taiwanese urban area survey. Aust N Z J Psychiatry 38: 706–713. https://doi.org/10.1080/j.1440-1614.2004.01444.x PMID: 15324335

24. Lawton MP, Brody EM (1969) Assessment of older people: self-maintaining and instrumental activities of daily living. The Gerontologist 9: 179–186. PMID: 5349366

25. Smalbrugge M, Jongenelis L, Pot AM, Beckman ATF, Eefsting JA (2008) 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 12: 244–248.

26. Lu J, Wang Y, Wang X, Song R, Yi X (2013) Reliability and Validity of the Chinese Version of Geriatric Depression Scale Among Chinese Urban Community-dwelling Elderly Population. Chinese Journal of Clinical Psychology 21: 39–41.

27. Spitzer RL, Kroenke K, Williams JBW, Loewe B (2006) A brief measure for assessing generalized anxiety disorder—The GAD-7. Archives of Internal Medicine 166: 1092–1097. https://doi.org/10.1001/archinte.166.10.1092 PMID: 16717171

28. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ(1989) The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry research 28: 193–213. https://doi.org/10.1016/0165-1781(89)90047-4 PMID: 2748771

29. Jian-qing Q, Mi Z, Pei-yuan Q, Na Z, Yang W (2016) Reliability and Validity of the Pittsburgh Sleep Quality Index in older adults in rural area. Modern Preventive Medicine 43: 1835–1838.In Chinese.

30. Andersson T, Alfredsson L, Kallberg H, Zdravkovic S, Ahlbom A (2005) Calculating measures of biological interaction. Eur J Epidemiol 20: 575–579. https://doi.org/10.1007/s10654-005-7835-x PMID: 16119429

31. Orhan FO, Tuncel D, Tas F, Demirci N, Ozer A, et al. (2012) Relationship between sleep quality and depression among elderly nursing home residents in Turkey. Sleep and Breathing 16: 1059–1067. https://doi.org/10.1007/s11325-011-0601-2 PMID: 22120045

32. Eser I, Khorshid L, Cinar S (2007) Sleep quality of older adults in nursing homes in Turkey: enhancing the quality of sleep improves quality of life. J Gerontol Nurs 33: 42–49.

33. Stefan L, Vrgoc G, Rupcic T, Sporis G, Sekulic D (2018) Sleep Duration and Sleep Quality Are Associated with Physical Activity in Elderly People Living in Nursing Homes. Int J Environ Res Public Health 15.

34. Tsai YF, Wong TKS, Ku YC (2008) Self-care management of sleep disturbances and risk factors for poor sleep among older residents of Taiwanese nursing homes. Journal of Clinical Nursing 17: 1219–1226. https://doi.org/10.1111/j.1365-2702.2007.02020.x PMID: 18266847

35. Dong X, Wang Y, Chen Y, Wang X, Zhu J, et al. (2018) Poor sleep quality and influencing factors among rural adults in Deqing, China. Sleep Breath 22: 1213–1220. https://doi.org/10.1007/s11325-018-1685-8 PMID: 29936592

36. Gnadinger M, Herzig L, Ceschi A, Conen D, Staehelin A, et al. (2018) Chronic conditions and multimorbidity in a primary care population: a study in the Swiss Sentinel Surveillance Network (Sentinella). Int J Public Health 63: 1017–1026. https://doi.org/10.1007/s00038-018-1114-6 PMID: 29786762

37. Gentili A, Weiner DK, Kuchibhatil M, Edinger JD (1997) Factors that disturb sleep in nursing home residents. Aging (Milan, Italy) 9: 207–213.

38. Gentili A, Weiner DK, Kuchibhatil M, Edinger JD (1997) Factors that disturb sleep in nursing home residents. Aging (Milano) 9: 207–213.

39. Ersser S, Wiles A, Taylor H, Wade S, Walsh R, et al. (1999) The sleep of older people in hospital and nursing homes. J Clin Nurs 8: 360–368. https://doi.org/10.1046/j.1365-2702.1999.00267.x PMID: 10624252

40. Razali R, Ariffin J, Aziz AFA, Puteh SEW, Wahab S, et al. (2016) Sleep quality and psychosocial correlates among elderly attendees of an urban primary care centre in Malaysia. Neurology Asia 21: 265–273.

41. Kara B, Tenekeci E (2017) Sleep Quality and Associated Factors in Older Turkish Adults With Hypertension: A Pilot Study. Journal of Transcultural Nursing 28: 296–305. https://doi.org/10.1177/1043659615623330 PMID: 26711885

42. Wilfling D, Dichter MN, Trutschel D, Kopke S (2019) Prevalence of Sleep Disturbances in German Nursing Home Residents with Dementia: A Multicenter Cross-Sectional Study. J Alzheimers Dis 69: 227–236. https://doi.org/10.3233/JAD-180784 PMID: 30958349

43. Gu DN, Sautter J, Pipkin R, Zeng Y (2010) Sociodemographic and Health Correlates of Sleep Quality and Duration among Very Old Chinese. Sleep 33: 601–610. https://doi.org/10.1093/sleep/33.5.601 PMID: 20469802

44. Yang CY, Chiou AF (2012) Predictors of Sleep Quality in Community-Dwelling Older Adults in Northern Taiwan. Journal of Nursing Research 20: 249–260. https://doi.org/10.1097/jnr.0b013e3182736461 PMID: 23154436

45. Wang Y, Li Y, Liu X, Liu R, Mao Z, et al. (2019) Gender-specific prevalence of poor sleep quality and related factors in a Chinese rural population: the Henan Rural Cohort Study. Sleep Med 54: 134–141. https://doi.org/10.1016/j.sleep.2018.10.031 PMID: 30554057

46. Mazzotti DR, Guindalini C, Sosa AL, Ferri CP, Tufik S (2012) Prevalence and correlates for sleep complaints in older adults in low and middle income countries: A 10/66 Dementia Research Group study. Sleep Medicine 13: 697–702. https://doi.org/10.1016/j.sleep.2012.02.009 PMID: 22503944

47. Hayashino Y, Yamazaki S, Takegami M, Nakayama T, Sokejima S, et al. (2010) Association between number of comorbid conditions, depression, and sleep quality using the Pittsburgh Sleep Quality Index: results from a population-based survey. Sleep Med 11: 366–371. https://doi.org/10.1016/j.sleep.2009.05.021 PMID: 20219425

48. Park JH, Yoo MS, Bae SH (2013) Prevalence and predictors of poor sleep quality in Korean older adults. International Journal of Nursing Practice 19: 116–123. https://doi.org/10.1111/ijn.12047 PMID: 23577968

49. Yu J, Rawtaer I, Fam J, Jiang MJ, Feng L, et al. (2016) Sleep correlates of depression and anxiety in an elderly Asian population. Psychogeriatrics 16: 191–195. https://doi.org/10.1111/psyg.12138 PMID: 26179204

50. Paudel ML, Taylor BC, Diem SJ, Stone KL, Ancoli-Israel S, et al. (2008) Association between depressive symptoms and sleep disturbances in community-dwelling older men. Journal of the American Geriatrics Society 56: 1228–1235. https://doi.org/10.1111/j.1532-5415.2008.01753.x PMID: 18482297

51. Cho HJ, Lavretsky H, Olmstead R, Levin MJ, Oxman MN, et al. (2008) Sleep Disturbance and Depression Recurrence in Community-Dwelling Older Adults: A Prospective Study. American Journal of Psychiatry 165: 1543–1550. https://doi.org/10.1176/appi.ajp.2008.07121882 PMID: 18765482

52. Chang KJ, Son SJ, Lee Y, Back JH, Lee KS, et al. (2014) Perceived sleep quality is associated with depression in a Korean elderly population. Archives of Gerontology and Geriatrics 59: 468–473. https://doi.org/10.1016/j.archger.2014.04.007 PMID: 24852666

53. Potvin O, Lorrain D, Belleville G, Grenier S, Preville M (2014) Subjective sleep characteristics associated with anxiety and depression in older adults: a population-based study. International Journal of Geriatric Psychiatry 29: 1262–1270. https://doi.org/10.1002/gps.4106 PMID: 24733621

54. Press Y, Punchik B, Freud T (2018) The association between subjectively impaired sleep and symptoms of depression and anxiety in a frail elderly population. Aging Clinical and Experimental Research 30: 755–765. https://doi.org/10.1007/s40520-017-0837-1 PMID: 29022191

55. Ahmed D, El Shair IH, Taher E, Zyada F (2014) Prevalence and predictors of depression and anxiety among the elderly population living in geriatric homes in Cairo, Egypt. The Journal of the Egyptian Public Health Association 89: 127–135. https://doi.org/10.1097/01.EPX.0000455729.66131.49 PMID: 25534177

56. Kirmizioglu Y, Dogan O, Kugu N, Akyuz G (2009) Prevalence of anxiety disorders among elderly people. International Journal of Geriatric Psychiatry 24: 1026–1033. https://doi.org/10.1002/gps.2215 PMID: 19259977

57. Teesson M, Mitchell PB, Deady M, Memedovic S, Slade T, et al. (2011) Affective and anxiety disorders and their relationship with chronic physical conditions in Australia: findings of the 2007 National Survey of Mental Health and Wellbeing. Australian and New Zealand Journal of Psychiatry 45: 939–946. https://doi.org/10.3109/00048674.2011.614590 PMID: 21967412

58. Beekman ATF, de Beurs E, van Balkom A, Deeg DJH, van Dyck R, et al. (2000) Anxiety and depression in later life: Co-occurrence and communality of risk factors. American Journal of Psychiatry 157: 89–95. https://doi.org/10.1176/ajp.157.1.89 PMID: 10618018

59. Eshkoor SA, Hamid TA, Nudin SSH, Mun CY (2013) The Effects of Social Support and Having a Partner on Sleep Quality in Dementia. American Journal of Alzheimers Disease and Other Dementias 28: 253–257.

60. Kishimoto Y, Okamoto N, Saeki K, Tomioka K, Obayashi K, et al. (2016) Bodily pain, social support, depression symptoms and stroke history are independently associated with sleep disturbance among the elderly: a cross-sectional analysis of the Fujiwara-kyo study. Environmental Health and Preventive Medicine 21: 295–303. https://doi.org/10.1007/s12199-016-0529-z PMID: 27072924

61. Bazargan M (1996) Self-reported sleep disturbance among African-American elderly: the effects of depression, health status, exercise, and social support. International journal of aging & human development 42: 143–160.

62. Troxel WM, Buysse DJ, Monk TH, Begley A, Hall M (2010) Does social support differentially affect sleep in older adults with versus without insomnia? J Psychosom Res 69: 459–466. https://doi.org/10.1016/j.jpsychores.2010.04.003 PMID: 20955865

63. Olivera J, Benabarre S, Lorente T, Rodriguez M, Peleogrin C, et al. (2008) Prevalence of psychiatric symptoms and mental disorders detected in primary care in an elderly Spanish population. The PSICOTARD Study: preliminary findings. International Journal of Geriatric Psychiatry 23: 915–921. https://doi.org/10.1002/gps.2004 PMID: 18311851

64. Paukert AL, Pettit JW, Kunik ME, Wilson N, Novy DM, et al. (2010) The Roles of Social Support and Self-Efficacy in Physical Health's Impact on Depressive and Anxiety Symptoms in Older Adults. Journal of Clinical Psychology in Medical Settings 17: 387–400. https://doi.org/10.1007/s10880-010-9211-6 PMID: 21110074

65. Cacioppo JT, Hawkley LC (2003) Social isolation and health, with an emphasis on underlying mechanisms. Perspect Biol Med 46: S39–52. PMID: 14563073

66. Costa SV, Ceolim MF, Neri AL (2011) Sleep problems and social support: Frailty in a Brazilian Elderly Multicenter study. Rev Lat Am Enfermagem 19: 920–927. https://doi.org/10.1590/s0104-11692011000400010 PMID: 21876944

67. Matsuda R, Kohno T, Kohsaka S, Fukuoka R, Maekawa Y, et al. (2017) The prevalence of poor sleep quality and its association with depression and anxiety scores in patients admitted for cardiovascular

disease: A cross-sectional designed study. Int J Cardiol 228: 977–982. https://doi.org/10.1016/j.ijcard.2016.11.091 PMID: 27915216

68. Bo Y, Yeoh EK, Guo C, Zhang Z, Tam T, et al. (2019) Sleep and the Risk of Chronic Kidney Disease: A Cohort Study. J Clin Sleep Med 15: 393–400. https://doi.org/10.5664/jcsm.7660 PMID: 30853043