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A Study on the Current Status of Frailty and Sleep Disorders Among Chinese Older Adults and Their Relationship—Based on the CLHLS Database

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Abstract: This study selected older adults aged 60 years and above from the 2018 CLHLS survey as research subjects. It aimed to analyze the prevalence and correlation of frailty and sleep disorders among older adults, so as to provide evidence-based references for developing targeted health intervention strategies for this population.The mean frailty index of the 5,522 older adults was (0.141 ± 0.094), and 760 participants were frail, accounting for 13.77%. Sleep duration and sleep quality were influencing factors for frailty in older adults. Older adults with long sleep duration and poor sleep quality had a higher prevalence of frailty, and the difference was statistically significant ($P<0.05$). Spearman correlation analysis showed that frailty was positively correlated with sleep duration ($r=0.125$, $P<0.01$) and negatively correlated with sleep quality ($r=-0.152$, $P<0.01$).The study found that the prevalence of frailty is relatively high among Chinese older adults aged 60 years and above. Sleep duration and sleep quality are factors affecting frailty. It is recommended to pay attention to the sleep health of older adults, ensure adequate sleep while avoiding excessive sleep duration, and attach importance to improving sleep quality to prevent the onset of frailty.

1. Introduction

With population aging accelerating, the health of older adults has become a focus of global public health attention. As of 2020, the proportion of people aged 60 and above in China had reached 18.7%[1]. Frailty, a geriatric syndrome closely related to aging, is characterized by declines in multisystem functional reserve and increased vulnerability to stressors, and serves as an important predictor of adverse health outcomes in older adults such as disability, hospitalization, and even death[2]. Existing studies indicate that the prevalence of frailty in community-dwelling older adults is approximately 10%[3], and as China's population continues to age, this figure may keep rising[2]. Sleep health is an important component of healthy aging; sleep duration and sleep quality are the two basic dimensions for assessing sleep status—the former refers to total sleep time within 24 hours, and the latter reflects an individual's subjective evaluation of their sleep experience[4,5]. Previous surveys show that the prevalence of sleep disorders among older adults in

China is as high as 46.0% [6], and tends to decrease in sleep duration and decline in sleep quality with age [7]. Sleep problems not only directly affect the physical and mental health and functional maintenance of older adults, but also pose challenges to public health services; therefore, exploring the relationship between sleep and healthy aging is of practical significance. The CLHLS is organized by the Center for Healthy Aging and Development Studies/National School of Development at Peking University, using multistage stratified random sampling across 23 provinces with good sample representativeness [8]; its content covers demographic characteristics, socioeconomic status, health status, and lifestyle, and the data are made freely available to the public and academia through Peking University's Open Research Data Platform. This study uses the 2018 CLHLS cross-sectional data, with older adults aged 60 and above as the study population, and constructs a frailty index using the cumulative deficits approach to analyze the status and correlation of frailty and sleep disorders.

2. Subjects and Methods

2.1. Study Subjects

2.1.1. Source of Subjects

The data for this study were drawn from the 2018 survey of the Chinese Longitudinal Healthy Longevity Survey (CLHLS). This study used the 2018 cross-sectional data, with an initial sample size of 15874.

2.1.2. Inclusion Criteria

This study selected older adults aged 60 and above from the 2018 CLHLS survey as the study population. Inclusion criteria were: age ≥ 60 years, and complete information on frailty-index-related variables and key covariates. A final sample of 5522 cases met the inclusion criteria.

2.1.3. Exclusion Criteria

① Missing values in frailty-index-related variables;
② Incomplete information on activities of daily living (ADL) or instrumental activities of daily living (IADL);
③ Missing information on key indicators such as self-rated health;
④ Fewer than 33 frailty-index items.

2.2. Study Measures

2.2.1. Frailty Index (FI)

This study constructed the frailty index using the cumulative deficits approach, following Rockwood's cumulative deficits model, and selected 42 items covering six dimensions: physical activities of daily living, instrumental activities of daily living, physical functional limitations, self-rated health, chronic disease prevalence, and sensory function. Most items were binary, and some ordinal items were scored equidistantly; the frailty index FI = sum of item scores / total number of valid assessed items, with FI ranging from 0 to 1. Following previous research standards, FI > 0.25 was classified as frail and FI ≤ 0.25 as non-frail [9]. To ensure assessment reliability, samples with fewer than 33 valid items were excluded.

2.2.2. Sleep Disorders

①Sleep duration: following existing literature, categorized as short sleep (<6 h), normal sleep (6–8 h), and long sleep (>8 h); ②Sleep quality: categorized into three groups—good, fair, and poor.

2.3. Quality Control

The raw CLHLS database had already undergone questionnaire logic checks. Before data analysis, this study performed a secondary check of the variables: ①Samples were strictly screened according to the inclusion and exclusion criteria, excluding those with missing information on sleep, frailty index, or key covariates; ②The scoring rules for each frailty-index item were verified, excluding samples with fewer than 33 valid FI items to ensure the reliability of the frailty index assessment; ③After data export, variable coding and grouping were checked to avoid entry errors.

2.4. Statistical Analysis

Statistical analysis was performed using the SPSS 26.0 software package, with the following methods:

①General demographic characteristics of the study subjects were analyzed by descriptive analysis; categorical variables were described by frequency (percentage), and continuous variables were expressed as mean ± standard deviation according to their distribution.

②The chi-square test was used to compare differences in frailty among older adults with different sleep characteristics, with $P < 0.05$ considered statistically significant;

③Spearman rank correlation was used to analyze the relationship between frailty and sleep disorders in older adults.

2.5. Ethical Principles

This study used the publicly available CLHLS database, which has been approved by the Ethics Review Committee of Peking University.

The researchers registered and applied on Peking University's Open Research Data Platform to download and use the data; all data were anonymized and contained no personal privacy information.

This study followed the data use agreement and used the data solely for academic research purposes.

3. Results

3.1. Basic Characteristics of the Study Subjects

A total of 5522 older adults aged 60 and above were included, of whom 3051 (55.25%) were male and 2471 (44.75%) were female. By age group: 848 (15.36%) were 60-69 years, 1844 (33.39%) were 70-79, 1502 (27.20%) were 80-89, 954 (17.28%) were 90-99, and 374 (6.77%) were ≥100 years. Regarding residence, 1247 (22.58%) lived in urban areas and 4275 (77.42%) in rural areas.

3.2. Current Status of Frailty in Older Adults

The mean frailty index among the 5522 older adults was 0.141 ± 0.094. Based on previous

research, the following cutoffs were used for classification: non-frail (FI ≤ 0.25) and frail (FI > 0.25) [10]. Among the 5522 older adults, 4762 (86.24%) were non-frail and 760 (13.76%) were frail.

3.3. Current Status of Sleep Disorders in Older Adults

Among the 5522 older adults, 954 (17.28%) had short sleep (<6 h), 3274 (59.29%) had normal sleep (6-8 h), and 1294 (23.43%) had long sleep (>8 h); 3070 (55.60%) reported good sleep quality, 1697 (30.73%) fair sleep quality, and 755 (13.67%) poor sleep quality.

3.4. Comparison of Frailty Among Older Adults with Different Sleep Characteristics

The results showed that sleep duration and sleep quality were factors associated with frailty in older adults; the frailty prevalence was higher among those with long sleep duration and poor sleep quality, and the difference was statistically significant (P < 0.05). The results are shown in Table 1.

Table 1: Comparison of Frailty Among Older Adults with Different Sleep Characteristics.

Clauses	Divide into groups	Total	Non-frail	Frail	χ^2	*p*
Sleep duration	Short sleep(<6 h)	954 (17.28)	808 (84.70)	146 (15.30)	69.604	<0.001
	Normal sleep(6-8 h)	3274 (59.29)	2920 (89.19)	354 (10.81)		
	Long sleep(>8 h)	1294 (23.43)	1034 (79.91)	260 (20.09)		
Sleep quality	Poor sleep quality	755 (13.67)	626 (82.91)	129 (17.09)	11.029	0.004
	Fair sleep quality	1697 (30.73)	1453 (85.62)	244 (14.38)		
	Good sleep quality	3070 (55.60)	2683 (87.39)	387 (12.61)		

3.5. Spearman Correlation Analysis of Frailty and Sleep Disorders in Older Adults

The variables were assigned values as follows: non-frail = 0, frail = 1; short sleep (<6 h) = 1, normal sleep (6-8 h) = 2, long sleep (>8 h) = 3; poor sleep quality = 1, fair sleep quality = 2, good sleep quality = 3. Spearman correlation analysis showed that frailty was positively correlated with sleep duration (r = 0.125, P < 0.01) and negatively correlated with sleep quality (r = −0.152, P < 0.01).The results are shown in the table 2.

Table 2: Spearman Correlation Analysis of Frailty and Sleep Disorders in Older Adults.

Variable	Frailty	Sleep duration	Sleep quality
Frailty	1	0.125**	−0.152**
Sleep duration	0.125**	1	−0.859**
Sleep quality	−0.152**	−0.859**	1

Note: ** indicates significance at P < 0.01 (Two-tailed).

4. Conclusions

4.1. Prevalence of Frailty in Older Adults

This study, based on the 2018 cross-sectional data from CLHLS, included a total of 5,522 elderly individuals aged 60 and above, with a frailty prevalence rate of 13.76%, which is relatively high. This result is close to the 11.18% reported by Zhang Jiajun[11] using the same database, although there are differences, likely due to variations in inclusion/exclusion criteria and selection of items used to construct the frailty index. Compared with international studies, our findings are lower than the 24.5% reported by Ge[12] among older adults over 60 in Singapore, and also lower than the

16.0% prevalence found by Melo[13] in Brazil among those aged 65 and above. However, this is higher than the 7.4% observed by Kojima[14] in Japan among individuals aged 65 and older. These discrepancies may stem from differences in age distribution, living environments, cultural backgrounds, and frailty assessment tools across the studied populations.

4.2. Prevalence of Sleep Disorders in Older Adults

The National Sleep Foundation recommends 7-8 hours of sleep per night for older adults [15]. In this study, 59.29% of older adults had normal sleep (6-8 h), yet a considerable proportion still experienced excessively short or long sleep. Previous research suggests that short sleep can raise C-reactive protein levels and increase inflammation risk, potentially elevating the risk of depression and cardiometabolic diseases; long sleep, in turn, may be a consequence of various adverse health conditions such as brain diseases and cardiovascular diseasesand is associated with cognitive decline [16,17].

In this study, 55.60% of older adults had good sleep quality, which is largely consistent with the survey findings of Shui Yuhang[18]. Previous studies have shown that poor sleep quality is associated with reduced grip strength, increased risk of low back pain, and elevated risk of chronic diseases and their comorbidities in middle-aged and older adults[19], and plays a moderating role in the association between chronic diseases and pain [20], directly affecting the quality of life of older adults.

4.3. Sleep Duration Affects Frailty in Older Adults

This study found that the long-sleep group (>8 h) had the highest frailty prevalence (20.09%), followed by the short-sleep group (<6 h) (15.30%), and the normal-sleep group (6-8 h) had the lowest (10.81%), similar to the findings of Zhong Wenfang[2]. Correlation analysis also showed a positive association between sleep duration and frailty in older adults ($r = 0.125$, $P < 0.01$): the longer the sleep duration, the higher the frailty prevalence. Possible reasons include:①Long sleep may be a manifestation rather than a cause of poor underlying health—older adults may need more time in bed due to physical weakness, chronic disease, or cognitive decline, and this ‘passive long sleep’ reflects a decline in the body’s functional reserve [21]; ② Long sleep may be accompanied by reduced sleep efficiency and increased sleep fragmentation, leading to a lower proportion of deep sleep and impairing the body’s repair and metabolic clearance functions[21]; ③Long sleep is associated with circadian rhythm disruption, which may promote frailty by affecting hormone secretion (e.g., melatonin, cortisol) and inflammatory cytokine levels [2].

4.4. Sleep Quality Affects Frailty in Older Adults

Univariate analysis showed that the frailty prevalence among those with poor sleep quality (17.09%) was higher than that of the fair sleep quality group (14.38%) and the good sleep quality group (12.61%), and the difference was statistically significant ($\chi^2 = 11.029$, $P = 0.004$). Correlation analysis showed a negative association between frailty and sleep quality in older adults ($r = -0.152$, $P < 0.01$): the better the sleep quality, the lower the frailty prevalence. This is consistent with the findings of Bai Yun et al.that sleep problems are a risk factor for frailty [21] .A large cross-sectional survey in Greece showed that older adults with sleep disorders had a 2–4 times higher risk of frailty compared with those with good sleep[22]. The physiological reserve and physical function of the elderly continuously decline with advancing age, and adverse health outcomes such as poor sleep and frailty may occur concurrently. Sleep disorders can hinder or disrupt the rest and recovery of physical function in older adults. Insufficient and sustained blood circulation to various body

systems and mechanisms leads to reduced immune and metabolic capacity , thereby significantly exacerbating the severity of frailty among older adults[23].

4.5. Limitations and Prospects

This study used nationally representative CLHLS data with a large sample size, giving the results good generalizability. However, objective sleep parameters such as sleep efficiency, sleep architecture (proportions of deep and light sleep), and daytime napping were not available, limiting deeper exploration of the mechanisms by which sleep affects frailty. Future research could conduct cohort studies incorporating objective sleep monitoring devices to collect multidimensional objective sleep indicators—sleep efficiency, deep/light sleep architecture, daytime napping—and carry out clinical empirical research to further reveal the mechanisms linking sleep to frailty in older adults.

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