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Title: The Predictive Role of Disability and Comorbidity in the Sleep Quality of Hospitalized
Older Adults

Authors: Farnoosh Rashvand^{1,2}, Fateme Safari Alamuti³, Neda Shahsavari³, Maryam Momeni^{1,2,*}

1. *Social Determinants of Health Research Center, Research Institute for prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran.*
2. *Department of Nursing, Qazvin School of Nursing and Midwifery, Qazvin University of Medical Science, Qazvin, Iran.*
3. *Student Research Committee Qazvin University of Medical Sciences Qazvin, Iran.*

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Abstract

Background: One of the aspects affecting the quality of life of the older adults is sleep quality. Hospitalized older adults may experience a poor quality of sleep due to one or more diseases and their related disabilities. This study aims to determine the predictive role of disability and comorbidities in the sleep quality of hospitalized elderly patients.

Methods: This cross-sectional, correlational study was conducted on 300 hospitalized older adults admitted to the teaching hospitals affiliated with Qazvin University of Medical Sciences- Iran, in 2023. The subjects were recruited by convenience sampling. The data were collected using the demographic characteristics form, Pittsburgh Sleep Quality Index (PSQI), the WHO Disability Assessment Schedule 2.0 (WHODAS 2.0), and the Charlson Comorbidity Index (CCI) and were analyzed using Chi-square or Fisher's exact test, independent t-test, and binary logistic regression in SPSS.v.26. Statistical significance was set at $P < 0.05$.

Results: The mean sleep quality, disability, and comorbidity scores were 6.12 (SD=2.99), 23.36 (SD=9.20), and 1.15 (SD=0.37), respectively. Half of the older adults (50%) had poor sleep quality. There was a significant relationship between the sleep quality scores and all domains of disability ($P < 0.05$) except for participation and life activities ($P \geq 0.05$). The results of the logistic regression model showed that disability (OR=1.044, $P < 0.004$) and comorbidities (OR=2.078, $P < 0.044$) were predictors of sleep quality in the hospitalized older adults. No significant relationship was observed between sleep quality and gender, education, smoking, and non-opioid analgesics in multivariate regression analysis.

Conclusion: The present study showed that disability and comorbidities are important predictors of sleep quality in the hospitalized older adults; therefore, it is necessary to consider effective interventions to minimize hospitalization-associated disability and to help improve the sleep quality of the older adults.

Keyword: Sleep quality, Disability, Older adults, Comorbidity, Hospitalization

Highlights

- Poor sleep quality is one of the key factors threatening the health of older adults.
- An increased number of comorbidities was significantly associated with poor sleep quality among hospitalized older adults.
- Various aspects of disability in the older adults were significantly associated with poor sleep quality.
- Sleep hygiene education, early detection of comorbidities, and minimizing hospitalization-associated disabilities are necessary to improve the sleep quality in the hospitalized older adults.

Plain Language Summary

Poor sleep quality impairs the quality of life of the elderly and is one of the most common problems faced by older adults. The present study showed that co-morbidities and disability can predict the sleep quality of the older adults. Paying attention to the screening of different aspects of disability, early identification of comorbidities, sleep hygiene education and attention to sleep complaints can lead to improvement of sleep quality in the elderly.

Introduction

Since the beginning of the 21st century, aging has become a growing global problem. Nowadays the physical and mental health of the older adults is one of the public health priorities (Yue et al., 2022). Along with the increase of the elderly population, disorders such as dementia, depression and sleep disorders create many challenges for health care systems, among which sleep disorders are more important (Suzuki et al., 2017).

Sleep quality is one of the important aspects affecting the quality of life in older adults (Hu et al., 2022). Poor sleep quality is a common complaint in older adults. Almost 50% of the older persons report poor sleep quality. It is often overlooked compared to other common health issues, because most of the older adults consider it as part of the natural aging process (Chiang et al., 2018). The hospitalized older adults may experience a poor quality of sleep due to one or more diseases, diseases-associated disability, and environmental changes. The factors that affect the sleep quality of the hospitalized older adults are more complex and multifaceted, including the type of ward, the use of sleep-inducing drugs, the length of stay in the hospital, the severity of pain, and suffering from several chronic diseases (Chung et al., 2023).

Among the health-related factors, comorbidities are common in the older adults. Comorbidities may destroy the sleep quality of the older adults due to the physical and mental burden caused by their worries about their health status (Song et al., 2020). Some recent studies indicated the relationship between suffering from chronic diseases and comorbidity with sleep quality among older adults (Idalino et al., 2023; Muhammad et al., 2023). However, there are discrepancies regarding the relationship between comorbidities and sleep quality in the older adults. In some previous studies, comorbidity has not been identified as a predictor of sleep quality among community-dwelling older adults (Aliabadi et al., 2017; Lee et al., 2022).

In recent decades, the issue of disability in the older adults has received considerable attention (Luo et al., 2024). In the aging process, the decrease in muscle strength and functional capacity causes weakness, which ultimately leads to disability. Physical disability is defined as the inability to independently perform essential activities of daily living (Chien and Chen, 2015). A prior study reported that the sleep quality can have more destructive effects on the daily activities of the older adults with disabilities (Mayfield et al., 2023). Also, the results of a previous study indicated that older adults with more disability have reported more insomnia. However, this study was limited to community-dwelling older men (Arakaki et al., 2022). In another study, comorbidities such as musculoskeletal disorders and depression were reported as the main cause of disability among

community-dwelling older adults in Iran (Vafaei et al., 2014). In contrast, another study involving Iranian community-dwelling older adults showed that the poor sleep quality was not associated with dependence in performing daily activities (Aliabadi et al., 2017).

Considering the increasing importance and complexity of the concept of sleep quality, it is important to understand its predictors, especially in the older adults. Most of previous studies have been conducted among community-dwelling healthy older adults living in Western countries, whereas, individual, lifestyle, and medical factors associated with sleep disorders may vary by ethnicity and culture (Wang et al., 2020). Also, hospitalization can significantly reduce the sleep quality of the older adults. It is important to conduct more studies in order to identify the main factors affecting the sleep quality of the hospitalized older adults. To date, limited studies have been conducted to reveal whether the increase in comorbidities and their related disabilities are associated with poor sleep quality among inpatient older adults. Hence, the aim of the present study was to determine the predictive role of disability and comorbidities in the sleep quality of hospitalized older adults.

Materials and Methods

Design, setting and sample

A cross-sectional, correlational design was utilized to perform the study. A total of 300 hospitalized older adults were recruited in the study by convenience sampling from the medical-surgical departments of three major teaching hospitals of Qazvin province- Iran, in 2023. The inclusion criteria were consent to participate in the study, 60 years of age and older, the ability to communicate verbally, not cognitively impaired, hospitalization only for the diagnosis or treatment of internal diseases, and having a discharge order before sampling.

Exclusion criteria were hospitalization in critical care units, acute stroke, amputation, having a surgery, inability to walk, and use of drugs effective on sleep disorders such as antidepressants, antihistamines, and benzodiazepines.

The sample size was calculated based on the study of Davoudi Boroujerdi et al. (2020), in which the sample size was reported considering the mean and standard deviation of the sleep quality of the elderly equal to 8.29 (3.36) and power = 0.8, $\alpha = 0.05$ and accuracy 0.543 using the following formula. The calculated sample size was 300 people according to the objectives of the current research.

$$n = \frac{Z_{1-\alpha/2}^2 s^2}{d^2}$$

Sampling was done every day of the week. The researcher completed the questionnaires through face-to-face interviews with the older adults.

Instruments

The data were collected using a four-part questionnaire:

Demographic and clinical characteristics form: It consisted of age, gender, marital status, education, employment, smoking and non-opioid analgesics use, duration of hospitalization and comorbidities.

The Charlson Comorbidity Index (CCI): CCI includes 17 medical conditions, which are scored as 1, 2, 3, and 6 based on the severity of the disease as well the risk of mortality. The score of each medical condition is as follows: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular accident or transient ischemic attacks, dementia, chronic obstructive pulmonary disease, connective tissue disease, and peptic ulcer disease as (Yes=1, No=0), liver disease (none=0, mild= 1, moderate to severe= 3), diabetes mellitus (none/ diet-controlled=0, uncomplicated=1, end organ damage=2), hemiplegia (Yes=2, No=0), lymphoma (Yes=2, No=0), AIDS (Yes=6, No=0). Also, due to the correlation between age and survival, the age variable is considered in the calculation of the disease burden score, so that the final score is calculated by adding 1 point for each decade over 40 years (50 to 59 years (+1), 60-69 years (+2), 70-79 years (+3), ≥ 80 years (+4)). The total score of the CCI is a simple sum of the points, with higher scores indicating more severe comorbid conditions (Charlson et al., 1994) . The validity and reliability of the index has been proven in Iranian older adults (Cronbach alpha= 0.77) (Hosseini et al., 2020).

Pittsburgh Sleep Quality Index (PSQI): PSQI is a self-report valid and reliable 19-items index that assesses sleep quality over the past month and examines the following 7 components: subjective sleep quality, latency, duration, efficiency, disturbances, use of sleep medication, and daytime dysfunction. Its questions are scored based on a 4-point Likert scale from 0 (no difficulty) to 3 (severe difficulty). The overall components' scores range from 0 to 21, with a score > 5 indicating poor sleep quality, and ≤ 5 indicating good sleep quality (Buysse et al., 1989). The validity and reliability of the questionnaire has been proven in Iranian elderly (Farrahi Moghaddam et al., 2012; Chehri et al., 2020).

WHO Disability Assessment Schedule 2.0 (WHODAS 2.0): It was used to measure disability levels in older adults. This instrument has 36 items that encompasses six domains: (1) cognition (understanding and communicating; 6 items), (2) mobility (moving and getting around; 5 items), (3) self-care (hygiene, dressing, eating, and being around people; 4 items), (4) getting along (interacting with people; 5 items), (5) life activities (domestic responsibilities, leisure, work, and school; 8 items), and (6) participation (joining in community activities and participating in society; 8 items). The WHODAS 2.0 uses a 5-point Likert scale with responses ranging from 0 (no difficulty) to 4 (extreme difficulty or total inability). At first, the sum of items' scores in each domain was determined and then the sum of the scores of all 6 domains was calculated. Finally, the total scores were converted to 0 - 100 (where 0 = no disability and 100 = complete disability). In other words, lower scores represent less disability (Üstün, 2010). The psychometric properties of the Persian version of the questionnaire have been proven (Salehi et al., 2020; Rajezi-fahani et al., 2019). In the present study, the reliability of the WHODAS 2.0 and PSQI were examined using Cronbach's alpha on 20 hospitalized older adults, and the Cronbach's alpha was 0.78 and 0.85, respectively. These 20 samples were excluded from the final data analysis.

Data analysis

All of the statistical analyses were performed using SPSS.V.26 software. The Kolmogorov-Smirnov test and histogram plots were used to test the normality of the data. Categorical variables were expressed as frequencies and percentages and evaluated with Chi-square or Fisher's exact test. Continuous data were presented as mean \pm standard deviation (SD) and were compared using the two-sample independent t-test. A binary logistic regression test was used to determine the predictors of sleep quality. Statistically significant variables in univariate analysis were included in the regression model. The statistical significance level was considered at $p < 0.05$.

Results

Demographic and clinical characteristics, sleep quality and disability

The mean (SD) age of the participants was 69 (3.63) years, and the majority of them (50.7%) were women, married (81.7%), unemployed (83.3%), and had high school education (60%). The mean (SD) total disability score was 32.36 (9.2). The mean (SD) PSQI score was 6.12 (2.99) and 50% of the older adults had poor sleep quality (PSQI > 5). The highest disability score of the elderly

was reported in the life activities domain (38.23 ± 14.63) and the lowest disability score was reported in the participation domain (12.3 ± 19.91). Of the 300 elderly examined, 43 (14.3%) had mild disability, 240 (80%) had moderate disability, and 17 (5.6%) had severe/very severe disability. The mean (SD) burden of comorbidities was 1.15 (0.37) (Table 1).

Univariate analysis results

In univariate analysis, there was a significant relationship between sleep quality and gender, education, smoking, and drug use, co-morbidities and disability. Male gender ($P < 0.049$), lower education ($P < 0.025$), smoking ($P < 0.019$), non-opioid analgesics ($P < 0.006$), more comorbidities ($P < 0.009$) and higher disability scores ($P < 0.001$) were associated with poor sleep quality. No significant relationship was found between age, marital status, employment, duration of hospitalization and sleep quality (Table 1).

Table1. Comparison of the quality of sleep of hospitalized elderly people based on demographic, clinical and disability characteristics

Categorical Variables	All participants (n=300) Frequency (%)	Good sleep quality (n=150) Frequency (%)	Poor sleep quality (n=150) Frequency (%)	χ^2	P value
Gender				4.321	0.049
male	148 (49.3)	65 (43.3)	83 (55.3)		
female	152 (50.7)	85 (56.7)	67 (44.7)		
Marital Status				1.091	0.371
single	55 (18.3)	24 (16)	31 (20.7)		
married	245 (81.7)	126 (84)	119 (79.3)		
Employment				0.384	0.642
non-employed	250 (83.3)	127 (84.7)	123 (82)		
employed	50 (16.7)	23 (15.3)	27 (18)		
Education				5.556	0.025
high school diploma and college	180 (60)	80 (53.3)	100 (66.7)		
	120 (40)	70 (46.7)	50 (33.3)		
Smoking				6.144	0.019
yes	50 (16.7)	17 (11.3)	33 (22)		
no	250 (83.3)	133 (88.7)	117 (78)		
non-opioid analgesics					
yes	18 (6)	3 (2)	15 (10)	8.511	0.006
no	282 (94)	147 (98)	135 (90)		
Continuous variables	Mean (SD)	Mean (SD)	Mean (SD)	t	P value
Age	69 ± 3.63	68.68 ± 0.3	69.32 ± 3.55	- 1.545	0.224
Hospitalization duration	5.77 ± 0.92	5.7 ± 0.84	5.84 ± 0.99	- 1.248	0.213
Comorbidity score	1.15 ± 0.37	1.09 ± 0.29	1.2 ± 0.43	- 2.637	0.009
Disability total score	32.36 ± 9.2	30.67 ± 6.9	34.05 ± 10.79	- 3.228	0.001
cognition	29.65 ± 12.91	26.54 ± 10.24	32.66 ± 14.54	- 4.146	0.001
mobility	36.52 ± 14.01	34.02 ± 11.78	39.01 ± 15.58	- 3.136	0.002
self-care	26.18 ± 10.79	24.2 ± 7.83	28.16 ± 12.82	- 3.232	0.001
getting along	31.58 ± 10.61	30.02 ± 8.24	33.14 ± 12.37	- 2.569	0.011
life activities	38.23 ± 14.63	36.96 ± 13.09	39.5 ± 15.97	- 1.502	0.134
participation	12.3 ± 19.91	12.3 ± 18.77	12.3 ± 21.05	- 1.969	0.05

Predictors of elderly sleep quality based on multivariate logistic regression results

In the multivariate analysis, there was a statistically significant relationship between burden of comorbidity and the level of disability with poor sleep quality. So that more burden of comorbidity increased the chance of experiencing poor sleep quality in the older adults to the extent of 2.078 times (OR = 2.078, P < 0.044). Also, a higher disability score increased the chance of experiencing poor sleep quality in the older adults to the extent of 1.044 (P < 0.004, OR = 1.044) (Table 2). Contrary to univariate analysis (Table 1), in the multiple regression model, no significant relationship was found between gender, education, smoking, non-opioid analgesics, and sleep quality of hospitalized older patients (Table 2).

Table2. Predictors of sleep quality of hospitalized older adults according to their demographic characteristics, comorbidity and disability scores

Variable	B	SE	Wald	OR	CI (95%)		P value
					lower	upper	
Gender (female)	- 0.365	0.266	1.888	0.694	0.412	1.169	0.169
Smoking (No)	0.345	0.391	0.777	0.708	0.329	1.525	0.378
non-opioid analgesics (No)	- 1.096	0.705	2.418	0.334	0.084	1.330	0.120
Education (diploma/college)	- 0.392	0.250	2.455	0.676	0.414	1.103	0.117
Comorbidity	0.731	0.364	4.039	2.078	1.018	4.240	0.044
Disability	0.043	0.015	8.379	1.044	1.014	1.075	0.004

Statistical test: Binary logistic regression; SE: standard error; OR: odds ratio; CI: confidence interval

Variables included in the binary logistic regression model: gender, smoking, drug use, education, comorbidity and disability.

Discussion

Sleep quality is an important issue in hospitalized older people and is affected by several factors. The current study determined the predictive role of disability and comorbidities in the sleep quality of hospitalized elderly patients.

The findings of the present study showed that half of the hospitalized older adults have suffered from poor sleep quality which is in line with the results of Papi et al.'s study on older adults in daycare centers (Papi et al., 2019). A systematic review study also reported that (70%) of Iranian older adults did not have desirable sleep quality (Mortazavi et al., 2021). Contrary to the present study results, Zhang et al. reported that only (21%) of the older adults suffered from poor sleep

quality. They attributed the low prevalence to the definition of poor sleep quality in their study (PSQI > 7 vs PSQI > 5 recommended by the PSQI developer).

People who are admitted to the hospital usually suffer from disorders such as daytime sleepiness, sleep-wake cycle disruption, and changes in the amount of melatonin hormone secretion due to being confined to bed. Also, hospitalization can be associated with poor sleep quality and reduced sleep duration due to various diseases, stressful conditions or changes in the sleeping environment (Kulpatcharapong et al., 2020).

In our study, the comorbidities positively predicted poor sleep quality among inpatient older adults which was consistent with the findings of earlier research (Idalino et al., 2023; Wang et al., 2020; Chung et al., 2023; Muhammad et al., 2023). Comorbidities can lead to problems such as insomnia, reduced sleep duration, difficult breathing during sleep, snoring and restless legs. These conditions may affect the quality of sleep and cause sleepiness during the day (Appleton et al., 2018). Some chronic diseases may cause changes in the brain regions and neurotransmitters that control sleep. Also, the drugs used to manage comorbidities affect the sleep quality (Muhammad et al., 2023). Psychological distress and anxiety associated with comorbidities, including economic burden (Larkin et al., 2021), destructive effects on family relationships and social interactions, and experiencing more negative and stressful life events can lead to the development and exacerbation of sleep problems (Ren et al., 2021; Gonzalez-Gonzalez et al., 2021; Muhammad et al., 2023). On the other hand, Idalino et al. showed that elderly people with sleep problems had a higher chance of developing chronic conditions. They stated that there may be a bidirectional relationship between chronic conditions and sleep quality (Idalino et al., 2023). In contrast to the current study, a prior study showed that there has been no relationship between comorbidities and sleep quality in hospitalized elderly people (Kulpatcharapong et al., 2020). Therefore, early identification and optimizing the management of comorbidities, especially by implementing non-pharmacological interventions, awareness of side effects of medications that aggravate sleep problems, and emphasis on safe nursing care in hospitalized older adults seem necessary to improve the sleep quality of this group (McCarthy, 2021; Rashvand et al., 2016).

A prior study suggest that multiple comorbidities and clinical conditions are key elements that should be addressed in the relationship between sleep quality and disability in older adults (Oliveira et al., 2022). In our study, the highest level of disability was related to the domains of life activities and mobility and the lowest level of disability was related to the participation domain. In a previous study, the highest level of disability was reported in the domains of life activities and

mobility, and the lowest level of disability was related to the self-care domain (Adib-Hajbaghery and Akbari, 2009). In another study, the highest level of disability was reported in the domain of interacting with people and mobility (Ghasemi et al., 2022). The discrepancy in the findings of the studies can be attributed to the differences between the questionnaires, the study setting and the demographic and clinical characteristics of the participants.

Moreover, our research found a significant positive relationship between disability and sleep quality in inpatient older adults. This finding was similar to the previous studies (Arakaki et al., 2022; Oliveira et al., 2022; Chien and Chen, 2015). In support of the present study, Mazzotti et al. found that higher levels of disability in the older adults have reduced the sleep quality and ability to perform daily activities (Mazzotti et al., 2012). It seems that older persons with poor sleep quality suffer from fatigue, sleepiness and lack of concentration during the day. This may reduce their abilities to perform life activities (Safa et al., 2015). A prior study reported that the older adults with a healthier aging process were able to create a more regularity in sleep pattern, which may have a positive effect on their physical ability (Friedman et al., 2019). Yang et al. suggested that there may be a bidirectional causal relationship between disability and sleep quality in the elderly. Poor sleep quality may have a negative effect on physical performance by causing mental fatigue. Also, older persons with moderate and severe disabilities stay longer in bed, and this can increase the duration of sleep and impair sleep quality (Yang et al., 2023). A review study showed that lack of physical activity affects the quantity and quality of sleep in Iranian older adults. Physical activity increases energy consumption and improves sleep quality by endocrine secretions (Mortazavi et al., 2021). Physical activity relieves stress and is associated with good sleep quality in the older adults. Encouraging the elderly to exercise and physical activity helps to improve their sleep quality (Song et al., 2020). Strategies to promote healthy sleep, including having a regular sleep schedule, exercise, and avoiding excessive use of electronic devices before bed, were considered key elements in improving disability associated with sleep disorders in older adults. A healthy and regular sleep pattern may help reduce the risk of developing or worsening chronic conditions in older adults (Idalino et al., 2023; Aliasgharpour and Eybpoosh, 2011).

The strength of the present study was the multicenter sampling that increased the generalizability of the findings. However, the cross-sectional nature of the study, limits the ability to determine causality. It is suggested that future studies be conducted with a longitudinal design in order to more clearly understand the predictors of sleep quality in hospitalized older adults. Also, self-reported measurement of sleep quality did not allow objective assessment of sleep quality. It is

suggested that future studies use objective methods of sleep quality assessment such as polysomnography.

Conclusion

The present study added to the existing knowledge regarding the predictors of sleep quality in the older adults. Half of the hospitalized older adults had poor sleep quality in our study. Comorbidities and disability were the most important predictors of sleep quality in hospitalized older adults. In order to promote the sleep quality, health care providers should educate the older adults to report different degrees of disability and symptoms of comorbidities immediately. Also, monitoring the older adults for comorbidities and disabilities seems necessary. It is essential to design and implement interventional studies to investigate the effect of physical activity and exercise on the sleep quality and disability levels among the older adults. Moreover, it is important to identify possible mechanisms (mediating factors) of how comorbidities and disabilities are associated with sleep quality in older population.

Ethical Considerations

Complying with ethical guidelines

The present study was approved by the ethics committee of Qazvin University of Medical Sciences (ethics code: IR.QUMS.REC.1402.033). Written informed consent was obtained from the participants after explaining the purpose of the study and ensuring confidentiality and anonymity.

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Authors Contribution

Conceptualization, methodology, statistical analysis, supervision, writing –original draft: Maryam Momeni and Farnoosh Rashvand; Data collection and writing –original draft: Fatemeh Safari Alamuti and Neda Shahsavari

Final approval: All the authors

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Conflict of interest

There is no conflict of interest.

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