





Original Article

# Evaluation of Sleep Quality and Related Factors in Community-Dwelling Adults: Ardakan Cohort Study on Aging (ACSA)

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## Abstract

**Background:** Sleep is a necessary physiological process that affects health. The current study aimed to evaluate sleep quality (SQ) and the related factors in Iranian community-dwelling adults.

**Study Design:** A cross-sectional study.

**Methods:** Population-based cross-sectional data from the first wave of the Ardakan cohort study on aging (ACSA) were analyzed. The analytical sample consisted of 5197 community-dwelling adults aged  $\geq 50$ . All data were collected by trained staff. Pittsburgh Sleep Quality Index (PSQI) scores were used to measure SQ. Univariable and multivariable logistic regression were used to identify predictors of SQ.

**Results:** The mean age of the participants was  $62.22 \pm 7.7$  years, and 51.8% were female. About three-quarters of them (76.36%) were found to have poor SQ (PSQI score  $\geq 5$ ). Multivariable logistic regression analysis revealed a relationship between SQ and gender, education, work, and financial level. Furthermore, SQ was found to be associated with self-reported health and physical activity. Regarding comorbidity, SQ had a significant relationship with cardiovascular diseases, musculoskeletal diseases, depression, and anxiety ( $P < 0.05$ ).

**Conclusion:** The prevalence of poor SQ was high in these community-dwelling adults in Iran. These findings highlight the importance of intervention programs for sleep hygiene education and screening for middle-aged and older adults.

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## Background

Aging is a natural biological process, and the global population is aging rapidly. According to the World Health Organization (WHO), one in six people will be aged over 60 by 2030, and two-thirds of the world's older adult population will be living in low- and middle-income countries by 2050.<sup>1</sup> Furthermore, studies predict that the older adult population in Iran, similar to other developing countries, will experience the fastest growth compared to other age groups, and the phenomenon of population aging in Iran is inevitable.<sup>2</sup>

Increasing age can lead to changes in sleep quality (SQ) and patterns, an increase in the total amount of time spent in bed, and a greater percentage of time in stage I sleep. Alternatively, aging is associated with a decrease in sleep duration, a longer latency to Rapid eye movement (REM) sleep, and a decrease in slow-wave sleep percentage.<sup>3,4</sup> Consequently, older adults may experience frequent

complaints due to changes in their sleep patterns and quality.

Poor SQ increases the risk of various physical and mental health problems.<sup>5,6</sup> Numerous studies demonstrated that poor SQ is associated with an increased risk of falls, cognitive disorders, dementia, reduced concentration, and mortality-related outcomes.<sup>7-12</sup> It is important to note that alterations in sleep patterns during the aging process can adversely affect the quality of life.<sup>13-15</sup>

Reduced SQ in adults has been associated with several factors. Research has linked poor SQ to Alzheimer's disease, chronic diseases, musculoskeletal pain, osteoporosis, diabetes, and heart disease in older adults.<sup>16-19</sup> Lifestyle factors, including physical activity, can also affect SQ.<sup>20</sup> Additionally, depression and anxiety are important psychological factors that have been linked to poor SQ.<sup>21,22</sup>

Despite the numerous studies on SQ in developed countries, developing countries require more investigation

on SQ and its determinants. In addition, to the best of our knowledge, no study has evaluated SQ in Iranian community-dwelling adults. Given the potential psychological burden and adverse effects of poor SQ in older adults, large-scale data are needed to evaluate this issue. The present study aimed to address this gap by examining the prevalence of poor SQ and related factors using representative data from a large sample of adults aged 50 years and older.

## Methods

### Study Participants

The data for this study were collected during the first wave of the Ardakan cohort study on aging (ACSA) between 2020 and 2022. ACSA is a subset of the Iranian longitudinal study on aging (IRLSA), the details of which have been published elsewhere.<sup>23</sup> The ACSA study is a longitudinal cohort that began in 2020 to examine different aspects of the health of middle-aged and older adult residents of Ardakan in the central part of Iran, located in the Yazd province. The ACSA used a multi-stage stratified random sampling method to select a sample of over 5000 individuals aged 50 years or older. This cohort included citizens who were 50 years or older and residing in Ardakan. Participants with a diagnosis of dementia, deafness, blindness, mental or psychological disorders such as mental retardation or psychosis, paralysis, and inability to understand and answer the study questions were excluded. All individuals with available sleep data were included in the present study.

### Sleep Quality

The SQ was assessed using the Pittsburgh Sleep Quality Index (PSQI) questionnaire, which has been validated in the Iranian population.<sup>24</sup> The PSQI is a standardized self-administered questionnaire that assesses SQ for the past month. The questionnaire consists of 19 items that are classified into seven categories: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component is scored on a scale of 0 to 3, with higher scores indicating worse SQ. The sum of the scores for the seven components yields the global PSQI score, which ranges from 0 to 21. A global PSQI score higher than 5 indicates poor SQ, while lower scores suggest good SQ.

### Covariates

To measure depression, the Center for Epidemiological Studies Depression Scale (CES-D) questionnaire was used, which was validated and reliable in the Iranian population by Malakouti et al.<sup>25</sup> The CES-D is a self-report questionnaire consisting of 10 items, designed to assess depressive feelings and behaviors experienced within the past week. Each symptom is scored on a 1 to 4 Likert scale, where 1 means “not at all,” 2 means “sometimes,” 3 means “usually,” and 4 means “yes, almost always.” The total score

ranges from 0 to 30, based on the sum of the scores of all the items. Higher scores reflect more depressive symptoms. The Hospital Anxiety and Depression Scale (HADS) is an internationally standardized and reliable instrument used to measure depression and anxiety. It comprises two subscales: depression (HADS-D) and anxiety (HADS-A).<sup>26</sup> For this study, only the HADS-A subscale was used to assess anxiety. HADS-A consists of seven items (with four-choice answers) and a score ranging from 0 to 3. Scores between 0-7 are considered normal anxiety, 7-14 are classified as borderline anxiety, and 14-21 indicate abnormal levels of anxiety. The validity of the questionnaire was confirmed in the Iranian population by Montazeri et al.<sup>27</sup>

The level of physical activity was assessed using the Physical Activity Scale for the Elderly (PASE).<sup>28</sup> The PASE is a self-report questionnaire that measures the level of physical activity over the past week. The overall PASE score ranges from 0 to 400 or more. It comprises 10 items that are classified into three categories: leisure time activity, household activity, and work-related activity.<sup>29</sup>

To examine socioeconomic status, this study considered indicators such as age, gender, marital status, education, employment status, and economic status. Both self-rated health and economic status were evaluated by asking the question, “How would you describe your overall health/economic status?” on a five-point scale. The participants were classified into four categories according to body mass index (BMI): underweight ( $BMI \leq 18 \text{ kg/m}^2$ ), normal ( $18.5 \text{ kg/m}^2 \leq BMI < 25 \text{ kg/m}^2$ ), overweight ( $BMI \geq 25$  and  $< 30 \text{ kg/m}^2$ ), and obese ( $BMI \geq 30 \text{ kg/m}^2$ ). The living arrangements were evaluated based on their response to the question “With whom do you live most of the time?”

Comorbidities were assessed via self-report and categorized into four groups: respiratory diseases (e.g., chronic obstructive pulmonary disease, asthma, and chronic bronchitis), cardiovascular diseases (e.g., heart attack, heart failure, angina pectoris, and hypertension), musculoskeletal diseases (e.g., arthritis and osteoarthritis), and metabolic diseases (e.g., type 2 diabetes, hyperthyroidism, and hypothyroidism).

### Ethical Considerations

This study was conducted in accordance with the ethical principles of the University of Welfare and Rehabilitation Sciences and received approval from the Ethics Committee (code of ethics: IR.USWR.REC.1394.490). All participants provided informed consent after being informed about the study’s objectives and methods.

### Data Analysis

First, descriptive analysis was performed for continuous variables using mean and standard deviation and for categorical variables using frequency and percentage. The outcome variable was entered into the model as a binary variable. A logistic regression model was employed in two steps to evaluate the adjusted association of variables with SQ. Firstly, the univariable model was used to assess the

unadjusted association of each independent variable with SQ, with a significance threshold of 0.2 ( $\alpha$ : 0.2). Then, a multivariable model was fitted using a stepwise backward approach to evaluate the independent effects of each variable adjusted for other covariates, with a significance threshold of 0.05 ( $\alpha$ : 0.05). In the present study, reference levels of interest were selected for multilevel variables such as education level and employment were chosen based on the sample size of each level. In addition, for variables such as economic status and self-reported health, the middle level was used as a reference to provide a more balanced view of the variable's distribution and facilitate meaningful interpretation of the results. STATA Statistical Software version 15 (Stata-Corp., 2017) was used to perform all data analyses.

## Results

Of the 5224 people who completed the PSQI questionnaire by the time of this study, 5197 (99%) had demographic information available and were included in the present study. The mean age of participants was 62.22 (7.7) years, of whom 51.86% were female. The majority of the participants were married (90.94%) and lived with their spouses (94.51%). Out of all the participants, 3969 (76.36%) had low SQ, and most of them (57%) were women. The mean score of PASE was 129.86 (80.89) for the poor SQ group and 156.69 (94.88) for the good SQ group. Half of the individuals with poor SQ reported cardiovascular diseases. Additionally, approximately 32% of those with poor SQ reported abnormal or borderline anxiety, while about 22% experienced depressive feelings in the past week. Further details are presented in [Table 1](#). [Table 2](#) presents the descriptive indices of the SQ components. The mean global PSQI score was 7.90 (4.25). Among the different components, the "sleep efficiency" component had the highest mean score (2.11), while the "use of sleep medication" component had the lowest mean score among the subjects (0.67).

[Table 3](#) displays the results of the univariable logistic regression analysis. The findings revealed that the odds of poor SQ were 65% higher among females than males (odds ratio [OR]=0.35, 95% confidence interval [CI]: 0.30 to 0.40). Similarly, single people had nearly 60% higher odds of poor SQ than married individuals (OR=0.41, 95% CI: 0.30 to 0.54). Participants who lived alone were 60% more likely to have poor SQ than those who lived with others (OR=0.40, 95% CI: 0.28 to 0.58). Additionally, those who rated their health as "good" or "extremely good" had better SQ than those who reported "fair" health status ( $P<0.001$ ). The results also revealed that cardiovascular disease (OR=1.42, 95% CI: 1.24 to 1.61), musculoskeletal disease (OR=2.27, 95% CI: 1.95 to 2.66), metabolic syndrome (OR=1.54, 95% CI: 1.35 to 1.77), respiratory diseases (OR=1.64, 95% CI: 1.22 to 2.21), and depression (OR=13.75, 95% CI: 9.18 to 20.8) were all associated with poor SQ.

[Table 3](#) presents the results of the multivariable logistic

regression models adjusted for covariates. The findings of the study indicated a significant association between poor SQ and gender among participants, with females having 45% higher odds of poor SQ than males, even after adjusting for potential covariates (OR=0.55, 95% CI: 0.46 to 0.66). The odds of having poor SQ were 33% higher for subjects who were working than for those who were not working or retired (OR=0.67, 95% CI: 0.57 to 0.80). Furthermore, compared to participants who reported "fair" self-health-related status, those who reported "good" had 40% lower odds of poor SQ (OR=0.60, 95% CI: 0.51 to 0.70). Similarly, those who reported "extremely good" self-health-related status had 61% lower odds of poor SQ (OR=0.39, 95% CI: 0.67 to 1.24).

The findings showed a significant relationship between physical activity and SQ, where a one-unit increase in PASE score reduces the odds of poor SQ by one percent (OR=0.99, 95% CI: 0.998 to 0.999). Additionally, the odds of poor SQ were 4.61 times higher in individuals with depression than in non-depressed individuals (95% CI: 2.95 to 7.24). Similarly, individuals with borderline and abnormal anxiety had higher odds of poor SQ than normal individuals (OR=3.36, 95% CI: 2.42 to 4.59 and OR=3.44, 95% CI: 2.14 to 5.48, respectively). Compared to participants who reported cardiovascular and musculoskeletal diseases, those who did not report these conditions had better SQ (OR=1.17, 95% CI: 1.01 to 1.35 and OR=1.47, 95% CI: 1.23 to 1.75, respectively).

## Discussion

This study aimed to assess SQ and related factors in Iranian individuals aged 50 years and above. To the best of the authors' knowledge, this is one of the first studies in Iran to investigate SQ among community-dwelling adults. The findings of this study indicated that the majority of participants have poor SQ, and several factors were related to SQ. Furthermore, among the various components of SQ, the participants demonstrated better sleep efficiency.

The present study found that approximately three-quarters of the participants have poor SQ. The prevalence of poor SQ in this study is higher than that reported in some previous studies. For example, a study by Sun et al in China found that 43.6% of the participants have SQ.<sup>30</sup> Moreover, studies conducted in Thailand<sup>31</sup> and China<sup>32</sup> reported a lower prevalence of poor SQ (44% and 29.57%, respectively) than the proportion observed in the present study. However, a study by Malakouti et al conducted on Iranian individuals aged over 60 years found that more than 80% of the participants have poor SQ.<sup>33</sup> However, this study found a very high prevalence of poor SQ, which requires further explanation. These differences may be attributed to variations in the demographic and health condition of study participants as well as differences in cultural and lifestyle factors. A likely explanation is that the majority of participants were either retired or unemployed, which may have contributed to an inactive lifestyle and feelings of low self-worth. These factors

**Table 1.** Baseline characteristics of population under study based on SQ

Variables	Total		Poor SQ		Good SQ	
	Number	Percent	Number	Percent	Number	Percent
<b>Categorical variables</b>						
Gender						
Female	2695	51.86	2295	57.82	400	32.57
Male	2502	48.14	1674	42.18	828	67.43
Marital status						
Unmarried	471	9.00	416	10.48	55	4.48
Married	4726	90.94	3553	89.52	1173	95.52
Education						
No formal education	2478	14.16	620	15.67	114	9.29
Elementary	2478	47.81	1980	50.05	498	40.59
Middle	756	14.59	559	14.13	197	16.06
High School	623	12.02	435	11.00	188	15.32
College	594	11.42	362	9.15	230	18.74
Job status						
Unemployed/retired	3360	64.83	2604	65.82	756	61.62
Working	1106	21.34	756	19.11	350	28.52
Other/housekeeper	717	13.83	596	15.07	121	9.86
Self-expressed financial level						
Highest	22	0.44	15	0.40	7	0.57
High	351	7.00	236	6.23	115	9.43
Middle	2463	49.17	1807	47.69	656	53.77
Low	1244	24.84	968	25.55	276	22.62
Lowest	929	18.55	763	20.13	166	13.61
Self-rated health						
Extremely good	205	3.96	104	2.63	101	8.23
Good	1519	29.35	975	24.70	544	44.34
Fair	2971	57.42	2443	61.62	538	43.85
Poor	396	7.65	354	8.97	42	3.42
Extremely Poor	84	1.62	82	2.08	2	0.16
Living arrangements						
Alone	279	5.49	247	6.37	32	2.66
With others	4800	94.51	3631	93.63	1169	97.34
Respiratory diseases	339	6.52	0.925	0.42	55	4.47
Cardiovascular diseases	2625	50.49	2086	52.56	539	43.82
Musculoskeletal diseases	1652	31.78	1412	35.58	240	19.51
Metabolic diseases	1997	38.41	1618	40.77	379	30.81
Anxiety						
Normal	3686	74.26	2530	67.70	1156	94.22
Borderline	693	13.96	645	17.26	48	3.91
Abnormal	585	11.78	562	15.04	23	1.87
Depression						
Normal	4086	82.73	2887	77.71	1199	97.96
Abnormal	853	17.27	828	22.29	25	2.04
<b>Continuous variables</b>						
	<b>Mean</b>	<b>SD</b>	<b>Mean</b>	<b>SD</b>	<b>Mean</b>	<b>SD</b>
Age	62.22	7.70	62.35	7.80	61.84	7.60
Number of rooms/people in the house	0.922	0.42	0.925	0.42	0.922	0.42
Physical activity	136.16	85.17	129.86	80.89	156.69	94.88

Note. SQ: Sleep quality; SD: Standard deviation.



**Table 2.** Components of PSQI in participants

	Range	Mean	SD
Component 1: Subjective sleep quality	0-3	0.91	0.64
Component 2: Sleep latency	0-3	1.58	1.11
Component 3: Sleep duration	0-3	1.74	1.16
Component 4: Sleep efficiency	0-3	2.11	1.65
Component 5: Sleep disturbance	0-3	0.81	0.53
Component 6: Use of sleep medication	0-3	0.67	1.22
Component 7: Daytime dysfunction	0-3	1.13	1.40
Global PSQI score	0-21	7.90	4.26

Note. PSQI: Pittsburgh sleep quality index; SD: Standard deviation.

could have potentially led to the development of mental health issues such as depression and anxiety, which are known to negatively impact SQ.<sup>34,35</sup> On the other hand, the majority of participants reported being in the middle or lowest financial level. This unsatisfactory financial situation could have contributed to emotional and mental health problems, which could negatively affect SQ.<sup>36,37</sup> Additionally, poor health conditions and co-morbidities in older adults are known to be associated with poor SQ. Among the participants, the prevalence of diseases that affect SQ such as musculoskeletal pain, diabetes, and cardiovascular disease was relatively high.<sup>38-40</sup>

Regarding sleep components, the mean scores of “sleep efficiency” were higher than other components. This finding suggests that the participants were able to use their time in bed more efficiently and were less likely to experience difficulties falling asleep or staying asleep. However, it is important to note that this finding is inconsistent with the results of other studies that have displayed “sleep latency” as the most common sleep problem among the older adults.<sup>31,41</sup> The results also revealed that “use of sleep medication” has the lowest mean score. This could be because older adults may consider a decrease in SQ a natural part of the aging process and therefore may not report it to their doctor. Additionally, cultural attitudes toward sleep medication may be negative among participants, which could also contribute to their reluctance to use medication to improve their SQ.

The present study found that females have significantly poorer SQ compared to males. This is consistent with previous epidemiological studies, which have shown that being female is an independent risk factor for sleep disorders.<sup>42,43</sup> One of the reasons that may affect SQ in females is hormonal changes that occur during menopause.<sup>44</sup> Levels of estradiol decrease during and after menopause, while levels of follicle-stimulating hormone increase. These hormonal changes can lead to problems with sleeping; as a result, SQ may decrease.<sup>45</sup> In addition, there are differences in comorbidities between males and females.<sup>46</sup>

Self-rated health was significantly related to SQ, which is consistent with the findings of previous studies.<sup>47</sup> These results suggest that more attention should be given to improving the SQ of middle-aged and older

adults who perceive their health as poor since they may be experiencing physical or psychological symptoms that negatively impact their SQ.<sup>48</sup> Many people who suffer from chronic pain, depression, anxiety, or other health issues have trouble falling asleep or staying asleep. This can make their health problems worse or lead to new ones. Poor SQ can also affect how they feel about their health.

Interestingly, the study did not find a statistically significant difference between respiratory diseases and SQ, which differs from the findings of other studies.<sup>49</sup> A possible explanation for this might be that respiratory diseases were assessed by self-report in this study; therefore, it is possible that the participants may not have been entirely aware of their breathing problems, which could have affected the results.

This study revealed that SQ is related to depression and anxiety, which is consistent with the findings of the previous study.<sup>21</sup> There may be various reasons to explain the link between poor SQ and depression and anxiety. One possible reason for this is the existence of an overlap in the abnormalities of neurotransmitters and brain structures involved in problems related to the sleep-wake cycle, anxiety, and depression.<sup>50-54</sup> Furthermore, individuals with depression tend to have constant worry and rumination, which can lead to a pessimistic interpretation of existing conditions and negatively impact their ability to sleep.<sup>55</sup> A study by Kaneita et al demonstrated that there are common factors that independently affect sleep, anxiety, and depression.<sup>56</sup> These common factors may influence the relationship between SQ and depression and anxiety. Although the current study was adjusted for the effect of confounding variables, some remaining unmeasured confounding factors may still affect the relationship between perceived SQ with depression and anxiety.

The present study evaluated a relatively large randomly selected sample using validated measures of SQ. However, it is important to note that this study has some limitations. Firstly, the cross-sectional design of the study did not allow for conclusions about the temporal relationships between SQ and its related factors. Secondly, the use of self-reported data may introduce reporting bias, which could lead to misclassification of some participants. However, it is worth noting that self-reported data is a common and widely used method of data collection in sleep research. Despite these limitations, this study provides valuable insights into the factors associated with SQ among middle-aged and older adults and highlights the importance of addressing SQ in this population.

## Conclusion

The findings of this study demonstrate that the prevalence of poor SQ is high among Iranian middle-aged and older adults. To improve SQ, it may be necessary to implement interventions that address the specific factors identified in this study such as health conditions, improving overall health perceptions, depression, and anxiety. Overall, these findings highlight the need for interventions aimed at

**Table 3.** Logistic Regression of Sleep Quality and Related Factors

Variables	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Age (per one year)	1.01 (1.00, 1.07)	0.036	-	-
Gender				
Female	1.00		1.00	
Male	0.35 (0.30, 0.40)	0.001	0.55 (0.46, 0.66)	0.001
Marital status				
Unmarried	1.00			
Married	0.41 (0.30, 0.54)	0.001	-	-
Education level				
Elementary	1.00		1.00	
no-formal education	1.36 (1.09, 1.70)	0.011	1.14 (0.89, 1.46)	0.267
Middle	0.71 (0.59, 0.86)	0.001	0.97 (0.78, 1.20)	0.789
High School	0.58 (0.47, 0.70)	0.001	0.92 (0.74, 1.16)	0.528
College	0.39 (0.32, 0.47)	0.001	0.73 (0.59, 0.92)	0.008
Employment status				
Unemployed/retired	1.00		1.00	
Working	0.63 (0.54, 0.72)	0.001	0.67 (0.57, 0.80)	0.001
Other/housekeeper	1.44 (1.16, 1.70)	0.001	0.83 (0.64, 1.07)	0.157
Self-rated health				
Fair	1.00		1.00	
Extremely Good	0.22 (0.17, 0.30)	0.001	0.39 (0.28, 0.53)	0.001
Good	0.39 (0.34, 0.45)	0.001	0.60 (0.51, 0.70)	0.001
Poor	1.87 (1.34, 2.61)	0.001	1.14 (0.79, 1.66)	0.464
Extremely Poor	9.04 (2.21, 36.8)	0.001	2.90 (0.67, 12.42)	0.151
Self-expressed financial level				
Middle	1.00		1.00	
Highest	0.77 (0.31, 1.90)	0.558	1.62 (0.62, 4.21)	0.319
High	0.74 (0.58, 0.93)	0.016	1.08 (0.82, 1.41)	0.572
Low	1.27 (1.08, 1.49)	0.003	1.24 (1.03, 1.48)	0.017
Lowest	1.66 (1.36, 1.99)	0.001	1.27 (1.03, 1.58)	0.025
Living arrangements				
Alone	1.00			
With others	0.40 (0.28, 0.58)	0.001	-	-
Number of rooms/people in the house	1.07 (0.92, 1.26)	0.354	-	-
Respiratory diseases				
No	1.00		-	
Yes	1.64 (1.22, 2.21)	0.001	-	-
Cardiovascular diseases				
No	1.00		1.00	
Yes	1.42 (1.24, 1.61)	0.001	1.17 (1.01, 1.35)	0.032
Musculoskeletal diseases				
No	1.00		1.00	
Yes	2.27 (1.95, 2.66)	0.001	1.47 (1.23, 1.75)	0.001
Metabolic diseases				
No	1.00		-	
Yes	1.54 (1.35, 1.77)	0.001	-	-
Anxiety				
Normal	1.00		1.00	
Borderline	6.13 (4.45, 8.29)	0.001	3.36 (2.42, 4.59)	0.001

Table 3. Continued.

Variables	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Abnormal	11.16 (7.31, 17.0)	0.001	3.44 (2.14, 5.48)	0.001
Depression				
Normal	1.00		1.00	
Abnormal	13.75 (9.18, 20.8)	0.001	4.61 (2.95, 7.24)	0.001
PASE	0.99 (0.99, 0.99)	0.001	0.99 (0.998, 0.999)	0.009

Note. PASE: Physical activity of elderly; OR: Odds ratio; CI: Confidence interval.

### Highlights

- In Ardakan, Iran, 76.36% of the population above 50 had poor sleep quality (SQ).
- The use of sleep medication has the lowest score compared to other components of the Pittsburgh Sleep Quality Index (PSQI).
- Sleep efficiency was the most common sleep problem among participants.
- Depression and anxiety were factors related to SQ in adults aged  $\geq 50$ .

improving SQ among middle-aged and older adults in Iran and other populations around the world.

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### Authors' Contribution

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### Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

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### References

1. World Health Organization (WHO). Ageing and health. WHO; 2022. Available from: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>. Updated October 1, 2022. Accessed March 28, 2023.
2. Fathi E. The phenomenon of population aging in Iran. IJOSS Iranian Journal of Official Statistics Studies. 2020;30(2):387-413. [Persian].
3. Cooke JR, Ancoli-Israel S. Normal and abnormal sleep in the elderly. *Handb Clin Neurol*. 2011;98:653-65. doi: 10.1016/b978-0-444-52006-7.00041-1.
4. Ohayon MM, Carskadon MA, Guilleminault C, Vitiello MV. Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: developing normative sleep values across the human lifespan. *Sleep*. 2004;27(7):1255-73. doi: 10.1093/sleep/27.7.1255.
5. Karimi R, Mallah N, Scherer R, Rodríguez-Cano R, Takkouche B. Sleep quality as a mediator of the relation between depression and chronic pain: a systematic review and meta-analysis. *Br J Anaesth*. 2023;130(6):747-62. doi: 10.1016/j.bja.2023.02.036.
6. Zheng Z, Wang C, Li C, Wu Q, Chen X, Chen H, et al. Meta-analysis of relationship of sleep quality and duration with risk of diabetic retinopathy. *Front Endocrinol (Lausanne)*. 2022;13:922886. doi: 10.3389/fendo.2022.922886.
7. Kwok CS, Kontopantelis E, Kuligowski G, Gray M, Muhyaldeen A, Gale CP, et al. Self-reported sleep duration and quality and cardiovascular disease and mortality: a dose-response meta-analysis. *J Am Heart Assoc*. 2018;7(15):e008552. doi: 10.1161/jaha.118.008552.
8. Liu Y, Wheaton AG, Chapman DP, Croft JB. Sleep duration and chronic diseases among U.S. adults age 45 years and older: evidence from the 2010 Behavioral Risk Factor Surveillance System. *Sleep*. 2013;36(10):1421-7. doi: 10.5665/sleep.3028.
9. Wennberg AMV, Wu MN, Rosenberg PB, Spira AP. Sleep disturbance, cognitive decline, and dementia: a review. *Semin Neurol*. 2017;37(4):395-406. doi: 10.1055/s-0037-1604351.
10. İleri İ, Borazan FY, Cavusoglu C, Göker B. The relationship between the severity of insomnia and falls in the elderly. *Psychogeriatrics*. 2022;22(1):22-8. doi: 10.1111/psyg.12767.
11. Itani O, Jike M, Watanabe N, Kaneita Y. Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression. *Sleep Med*. 2017;32:246-56. doi: 10.1016/j.sleep.2016.08.006.
12. Porter VR, Buxton WG, Avidan AY. Sleep, cognition and dementia. *Curr Psychiatry Rep*. 2015;17(12):97. doi: 10.1007/s11920-015-0631-8.
13. Hoffman S. Sleep in the older adult: implications for nurses (CE). *Geriatr Nurs*. 2003;24(4):210-6. doi: 10.1016/s0197-4572(03)00213-1.
14. Matsui K, Yoshiike T, Nagao K, Utsumi T, Tsuru A, Otsuki R, et al. Association of subjective quality and quantity of sleep with quality of life among a general population. *Int J Environ Res Public Health*. 2021;18(23):12835. doi: 10.3390/ijerph182312835.
15. Kutner NG, Ory MG, Baker DI, Schechtman KB, Hornbrook MC, Mulrow CD. Measuring the quality of life of the elderly in health promotion intervention clinical trials. *Public Health Rep*. 1992;107(5):530-9.
16. Yuan Y, Heizhati M, Wang L, Li M, Lin M, Gan L, et al. Poor sleep quality is associated with new-onset hypertension in a diverse young and middle-aged population. *Sleep Med*. 2021;88:189-96. doi: 10.1016/j.sleep.2021.10.021.
17. Tang ML, Wei F, Zhang HF, Dai HF, Zhu XQ, Yu ZB, et al. [Association between sleep and prevalence of hypertension in elderly population]. *Zhonghua Liu Xing*

- Bing Xue Za Zhi. 2021;42(7):1188-93. doi: [10.3760/cma.j.cn112338-20200512-00713](https://doi.org/10.3760/cma.j.cn112338-20200512-00713). [Chinese].
18. Chang VC, Chaput JP, Roberts KC, Jayaraman G, Do MT. Factors associated with sleep duration across life stages: results from the Canadian Health Measures Survey. *Health Promot Chronic Dis Prev Can*. 2018;38(11):404-18. doi: [10.24095/hpcdp.38.11.02](https://doi.org/10.24095/hpcdp.38.11.02).
  19. Koyanagi A, Garin N, Olaya B, Ayuso-Mateos JL, Chatterji S, Leonardi M, et al. Chronic conditions and sleep problems among adults aged 50 years or over in nine countries: a multi-country study. *PLoS One*. 2014;9(12):e114742. doi: [10.1371/journal.pone.0114742](https://doi.org/10.1371/journal.pone.0114742).
  20. Denison HJ, Jameson KA, Sayer AA, Patel HP, Edwards MH, Arora T, et al. Poor sleep quality and physical performance in older adults. *Sleep Health*. 2021;7(2):205-11. doi: [10.1016/j.sleh.2020.10.002](https://doi.org/10.1016/j.sleh.2020.10.002).
  21. Alvaro PK, Roberts RM, Harris JK. A systematic review assessing bidirectionality between sleep disturbances, anxiety, and depression. *Sleep*. 2013;36(7):1059-68. doi: [10.5665/sleep.2810](https://doi.org/10.5665/sleep.2810).
  22. Clayborne ZM, Dopko RL, Wang C, Betancourt MT, Roberts KC, Capaldi CA. Associations of sleep duration and sleep quality with indicators of mental health among youth and adults: findings from the 2015 Canadian Community Health Survey. *Health Promot Chronic Dis Prev Can*. 2023;43(5):243-59. doi: [10.24095/hpcdp.43.5.04](https://doi.org/10.24095/hpcdp.43.5.04).
  23. Aminisani N, Azimi-Nezhad M, Shamshirgaran SM, Mirhafez SR, Borji A, Poustchi H, et al. Cohort profile: The Iranian Longitudinal Study on Ageing (IRLSA): the first comprehensive study on ageing in Iran. *Int J Epidemiol*. 2022;51(4):e177-e88. doi: [10.1093/ije/dyab272](https://doi.org/10.1093/ije/dyab272).
  24. Farrahi Moghaddam J, Nakhaee N, Sheibani V, Garrusi B, Amirkafi A. Reliability and validity of the Persian version of the Pittsburgh Sleep Quality Index (PSQI-P). *Sleep Breath*. 2012;16(1):79-82. doi: [10.1007/s11325-010-0478-5](https://doi.org/10.1007/s11325-010-0478-5).
  25. Malakouti SK, Pachana NA, Naji B, Kahani S, Saeedkhani M. Reliability, validity and factor structure of the CES-D in Iranian elderly. *Asian J Psychiatr*. 2015;18:86-90. doi: [10.1016/j.ajp.2015.08.007](https://doi.org/10.1016/j.ajp.2015.08.007).
  26. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. *Acta Psychiatr Scand*. 1983;67(6):361-70. doi: [10.1111/j.1600-0447.1983.tb09716.x](https://doi.org/10.1111/j.1600-0447.1983.tb09716.x).
  27. Montazeri A, Vahdaninia M, Ebrahimi M, Jarvandi S. The Hospital Anxiety and Depression Scale (HADS): translation and validation study of the Iranian version. *Health Qual Life Outcomes*. 2003;1:14. doi: [10.1186/1477-7525-1-14](https://doi.org/10.1186/1477-7525-1-14).
  28. Hatami O, Aghabagheri M, Kahdouei S, Nasiriani K. Psychometric properties of the Persian version of the Physical Activity Scale for the Elderly (PASE). *BMC Geriatr*. 2021;21(1):383. doi: [10.1186/s12877-021-02337-0](https://doi.org/10.1186/s12877-021-02337-0).
  29. Washburn RA, Smith KW, Jette AM, Janney CA. The Physical Activity Scale for the Elderly (PASE): development and evaluation. *J Clin Epidemiol*. 1993;46(2):153-62. doi: [10.1016/0895-4356\(93\)90053-4](https://doi.org/10.1016/0895-4356(93)90053-4).
  30. Sun XH, Ma T, Yao S, Chen ZK, Xu WD, Jiang XY, et al. Associations of sleep quality and sleep duration with frailty and pre-frailty in an elderly population Rugao longevity and ageing study. *BMC Geriatr*. 2020;20(1):9. doi: [10.1186/s12877-019-1407-5](https://doi.org/10.1186/s12877-019-1407-5).
  31. Thichumpa W, Howteerakul N, Suwannapong N, Tantrakul V. Sleep quality and associated factors among the elderly living in rural Chiang Rai, northern Thailand. *Epidemiol Health*. 2018;40:e2018018. doi: [10.4178/epih.e2018018](https://doi.org/10.4178/epih.e2018018).
  32. Liu RQ, Bloom MS, Wu QZ, He ZZ, Qian Z, Stamatakis KA, et al. Association between depressive symptoms and poor sleep quality among Han and Manchu ethnicities in a large, rural, Chinese population. *PLoS One*. 2019;14(12):e0226562. doi: [10.1371/journal.pone.0226562](https://doi.org/10.1371/journal.pone.0226562).
  33. Malakouti SK, Foroughan M, Nojomi M, Ghalebani MF, Zandi T. Sleep patterns, sleep disturbances and sleepiness in retired Iranian elders. *Int J Geriatr Psychiatry*. 2009;24(11):1201-8. doi: [10.1002/gps.2246](https://doi.org/10.1002/gps.2246).
  34. Singh B, Olds T, Curtis R, Dumuid D, Virgara R, Watson A, et al. Effectiveness of physical activity interventions for improving depression, anxiety and distress: an overview of systematic reviews. *Br J Sports Med*. 2023. doi: [10.1136/bjsports-2022-106195](https://doi.org/10.1136/bjsports-2022-106195).
  35. Zhang C, Xiao S, Lin H, Shi L, Zheng X, Xue Y, et al. The association between sleep quality and psychological distress among older Chinese adults: a moderated mediation model. *BMC Geriatr*. 2022;22(1):35. doi: [10.1186/s12877-021-02711-y](https://doi.org/10.1186/s12877-021-02711-y).
  36. Fan L, Lei S. Financial well-being, family financial support and depression of older adults in China. *Int J Bank Mark*. 2023;41(6):1261-81. doi: [10.1108/ijbm-05-2022-0214](https://doi.org/10.1108/ijbm-05-2022-0214).
  37. Chai L. Financial strain and psychological distress among middle-aged and older adults: a moderated mediation model. *J Gerontol Soc Work*. 2023;1-13. doi: [10.1080/01634372.2023.2207611](https://doi.org/10.1080/01634372.2023.2207611).
  38. Generala E, Vogelzangs N, Penninx BW, Dekker J. Insomnia, sleep duration, depressive symptoms, and the onset of chronic multisite musculoskeletal pain. *Sleep*. 2017;40(1):zsw030. doi: [10.1093/sleep/zsw030](https://doi.org/10.1093/sleep/zsw030).
  39. Wolk R, Gami AS, Garcia-Touchard A, Somers VK. Sleep and cardiovascular disease. *Curr Probl Cardiol*. 2005;30(12):625-62. doi: [10.1016/j.cpcardiol.2005.07.002](https://doi.org/10.1016/j.cpcardiol.2005.07.002).
  40. Surani S, Brito V, Surani A, Ghamande S. Effect of diabetes mellitus on sleep quality. *World J Diabetes*. 2015;6(6):868-73. doi: [10.4239/wjcd.v6.i6.868](https://doi.org/10.4239/wjcd.v6.i6.868).
  41. Ancoli-Israel S, Ayalon L, Salzman C. Sleep in the elderly: normal variations and common sleep disorders. *Harv Rev Psychiatry*. 2008;16(5):279-86. doi: [10.1080/10673220802432210](https://doi.org/10.1080/10673220802432210).
  42. Gao C, Scullin MK. Longitudinal trajectories of spectral power during sleep in middle-aged and older adults. *Aging Brain*. 2023;3:100058. doi: [10.1016/j.nbas.2022.100058](https://doi.org/10.1016/j.nbas.2022.100058).
  43. Bublitz M, Adra N, Hijazi L, Shaib F, Attarian H, Bourjeily G. A narrative review of sex and gender differences in sleep disordered breathing: gaps and opportunities. *Life (Basel)*. 2022;12(12):2003. doi: [10.3390/life12122003](https://doi.org/10.3390/life12122003).
  44. Krishnan V, Collop NA. Gender differences in sleep disorders. *Curr Opin Pulm Med*. 2006;12(6):383-9. doi: [10.1097/01.mcp.0000245705.69440.6a](https://doi.org/10.1097/01.mcp.0000245705.69440.6a).
  45. Carskadon MA, Dement WC. Normal human sleep: an overview. In: Kryger MH, ed. *Principles and Practice of Sleep Medicine*. Philadelphia: WB Saunders; 1989. p. 3-13.
  46. Faramarzi M, Cheraghi M, Zamani M, Kheirkhah F, Bijani A, Hosseini SR. Gender-specific predictors of depressive symptoms among community elderly. *J Res Health Sci*. 2017;17(2):e00377.
  47. Bazargan M, Cobb S, Assari S, Bazargan-Hejazi S. Physical and mental health quality of life among underserved African American and Latino older adults. *Ethn Health*. 2023;28(2):217-33. doi: [10.1080/13557858.2022.2027886](https://doi.org/10.1080/13557858.2022.2027886).
  48. Vogel CE, Molinari V, Andel R, Barry LC. Self-rated health and mental health among older incarcerated males. *Aging Ment Health*. 2021;25(11):2100-8. doi: [10.1080/13607863.2020.1795621](https://doi.org/10.1080/13607863.2020.1795621).
  49. Ferrando M, Bagnasco D, Roustan V, Canonica GW, Braidò F, Baiardini I. Sleep complaints and sleep breathing disorders in upper and lower obstructive lung diseases. *J Thorac Dis*. 2016;8(8):E716-25. doi: [10.21037/jtd.2016.07.82](https://doi.org/10.21037/jtd.2016.07.82).
  50. Holmes A, Murphy DL, Crawley JN. Abnormal behavioral phenotypes of serotonin transporter knockout mice: parallels with human anxiety and depression. *Biol Psychiatry*. 2003;54(10):953-9. doi: [10.1016/j.biopsych.2003.09.003](https://doi.org/10.1016/j.biopsych.2003.09.003).
  51. Nestler EJ, Carlezon WA Jr. The mesolimbic dopamine reward



- circuit in depression. *Biol Psychiatry*. 2006;59(12):1151-9. doi: [10.1016/j.biopsych.2005.09.018](https://doi.org/10.1016/j.biopsych.2005.09.018).
52. Ouellet MC, Savard J, Morin CM. Insomnia following traumatic brain injury: a review. *Neurorehabil Neural Repair*. 2004;18(4):187-98. doi: [10.1177/1545968304271405](https://doi.org/10.1177/1545968304271405).
  53. Yoshioka M, Matsumoto M, Togashi H, Saito H. Effect of conditioned fear stress on dopamine release in the rat prefrontal cortex. *Neurosci Lett*. 1996;209(3):201-3. doi: [10.1016/0304-3940\(96\)12631-8](https://doi.org/10.1016/0304-3940(96)12631-8).
  54. Silver JM, McAllister TW, Arciniegas DB. *Textbook of Traumatic Brain Injury*. American Psychiatric Association Publishing; 2018.
  55. Ree MJ, Harvey AG, Blake R, Tang NK, Shawe-Taylor M. Attempts to control unwanted thoughts in the night: development of the thought control questionnaire-insomnia revised (TCQI-R). *Behav Res Ther*. 2005;43(8):985-98. doi: [10.1016/j.brat.2004.07.003](https://doi.org/10.1016/j.brat.2004.07.003).
  56. Kaneita Y, Yokoyama E, Harano S, Tamaki T, Suzuki H, Munezawa T, et al. Associations between sleep disturbance and mental health status: a longitudinal study of Japanese junior high school students. *Sleep Med*. 2009;10(7):780-6. doi: [10.1016/j.sleep.2008.06.014](https://doi.org/10.1016/j.sleep.2008.06.014).