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The sleep-muscle axis: how poor sleep quality predicts probable sarcopenia in the older adults

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ABSTRACT

Aims: Investigate whether there is a link between the quality of sleep and the likelihood of developing sarcopenia in older adults.
Methods: Among the 498 patients over 65 who enrolled in the internal medicine geriatrics clinic between December 2024 and March 2025, 74 patients with poor sleep quality (group 1) and 110 patients with good sleep quality (group 2) were included in the study. The remaining 314 patients were excluded from the study. Demographic characteristics, body measurements, comprehensive geriatric assessments, potential sarcopenia assessments, and Pittsburgh sleep quality measurements were conducted.
Results: The average age of group 1, consisting of a total of 74 people, is 73.5±5.1 years, and the average age of group 2, consisting of 110 people, is 71.6±5.2 years. A statistically significant difference was detected between the groups in terms of average age distribution (p=0.03). The average body-mass index (BMI) value of group 1 patients was statistically significantly lower than that of group 2 patients (p=0.038). When the comprehensive geriatric evaluation was compared between the groups, the rate of possible sarcopenia was 81 percent in group 1 and 17 percent in group 2 (p<0.034).
Conclusion: Findings suggest a potential link between sleep quality and probable sarcopenia in older adults.
Keywords: Sleep quality, sarcopenia, older adults

INTRODUCTION

The world population gradually ages due to rising life expectancy and decreased fertility.[1] The growing aging of individuals has resulted in an enormous rise in the overall amount of people who will require care in the future.[2] Sleep is crucial for preserving one's health and standard of living. Despite the physiological changes in sleep-wake cycles and structure of sleep that occur during aging, older adults experience the repercussions of a range of difficulties linked to sleep length, difficulty beginning and sustaining sleep, and breathing problems during sleep.[3] Older adults are more likely to suffer from sleep disorders like insomnia and poor sleep quality. About ten percent of aged people have often sleep problems in their habitual existences. This raises older adult's risk of dying as well as lowering their quality of life.[4] Sleep disturbances can trigger a variety of pathways, including sympathetic activation, metabolic abnormalities, and a pro-inflammatory state, they all have a part in sarcopenia evolution.[5,6]

Sarcopenia, which was recently classified as muscular failure, is distinguished by Low muscle mass and strength combined, or changed muscle quality, which raises the risk of death, hospitalization, fractures, falls, and disability.[7,8]

Because sarcopenia and sleep problems share pathophysiology, studying their interactions may help us better understand the mechanisms at work.

Sarcopenia is estimated to affect around the world, 10-16% of older adults.[9] Age-related modifications to the structure of muscles may be a major contributing factor to several poor health outcomes in older adults, such as fractures, falls, cognitive decline, and death.[9,10] To facilitate prompt management and early identification of those at risk for sarcopenia, the Asian Sarcopenia study group (AWGS) 2019 consensus introduced the concept of "probable sarcopenia".[11] Loss of muscle mass or poor physical function, which can be assessed with low-cost, easily applicable techniques for population screening and clinical practice, is referred to as sarcopenia. Therefore, additional studies are needed to determine the etiology and complications associated with sarcopenia. Various factors contribute to the pathogenesis of sarcopenia. Of these; other risk factors should be taken into account, including hormone fluctuations, cardiovascular disease, inflammatory cytokines, resistance to insulin, activity level, gender, heredity, and nutritional condition.[12,13]

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Negative health outcomes in older adults, such as dementia, diabetes, cardiovascular disease, coronary heart disease, obesity, and mortality, are linked to either too little or too much sleep.[14-16] Prior research has connected many aspects of skeletal muscle injury to short sleep duration and poor sleep quality.[17-19] Unbalances in sleep balance have also been linked in recent studies to increased cortisol levels, which can impact muscle, decreased growth hormone and testosterone synthesis, and an increased risk of insulin resistance,[20] lack of sleep can alter the circadian cycle, which can result in abnormalities in the metabolism of skeletal muscles.[21]

An increasing amount of data points to the potential role that sleep disturbances may play in mediating the onset of sarcopenia Compared to sarcopenia, "probable sarcopenia" is a relatively recent term, and its diagnostic standards are less strict. Older adults may be able to prevent and reduce their risk of developing "probable sarcopenia" sooner if the idea is introduced and its relationship to sleep length is examined. In addition, there is presently debate regarding the connection between the length of sleep disturbances and potential sarcopenia in older adults. Verifying this connection could aid in establishing healthy sleep habits and offer practical intervention techniques outside of dietary and physical activity changes.

METHODS

Ethics

The Ankara Bilkent City Hospital Non-interventional Clinical Researches Ethics Committee of our university granted clearance for this investigation (Date: 25.12.2024, Decision No: TABED-2 24-733). All subjects gave their agreement because the study was prospective. The Declaration of Helsinki was followed when conducting the study.

Study Population

The demographic characteristics, body measurements, comprehensive geriatric assessments, probable sarcopenia assessment, and Pittsburgh sleep quality measurements were performed. Patients under the age of 65, those who smoked, had alcohol or drug addiction, Volunteers using prescription antidepressants were also excluded from the study due to the effects of antidepressants on sleep and those who used sleeping pills were excluded from the study. Among 498 patients over the age of 65 who applied to the internal medicine geriatrics outpatient clinic between December 2024 and March 2025, 184 patients who agreed to participate in the study were included in the study. Patients with poor sleep quality (PSQI >5) (group 1) consisted of 74 patients, and patients with good sleep quality (PSQI <5) (group 2) consisted of 110 patients. BMI was calculated as weight/height (kg/m^2). Waist circumference (WC, cm) was calculated by measuring the circumference of the circle passing through the middle of the lines perpendicular to the 10th rib and the anterior superior iliac spine on both sides. Functional status was assessed using the Lawton-Brody instrumental activities of daily living (IADL) and Katz activities of daily living (ADL) scales.[22,23] Nutritional status was evaluated using the Mini-Nutritional Assessment Short Form (MNA-SF).[24] Polypharmacy was defined as the use of ≥5 medications.[25] The same experienced doctor evaluated patients' frailty state using the Clinical Frailty Scale (CFS). Clinical frailty is defined by CFS using a score system that ranges from 1 (extremely fit) to 9 (terminally ill), both living with frailty (CFS ≥4) and being non-frail/robust (CFS <4).[26,27]

Assessment of Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI), offers measures of seven domains: (1) subjective sleep quality, (2) sleep latency, (3) sleep duration, (4) disturbances in sleep, (5) sleep effectiveness, (6) use of sleep aids, and (7) daytime impairment scores, was used to assess the quality of sleep.[28] A 3-point ascending scale is used to rate these domains; a score of 0 indicates optimal sleep quality and a score of 3 indicates subpar sleep quality. The calculation was made using the global PSQI score, which goes from 0 (the highest sleep quality) to 21 (the poorest sleep quality). Over a month, the PSQI evaluates typical sleep patterns, including sleep quality and disruptions. Instead of assessing sporadic episodes of prolonged sleep latency, the PSQI survey assesses regular protracted sleep latency. The questionnaire gives a score between 0 and 3 depending on how long it takes to fall asleep each night (0: falls asleep in ≤15 min, 1: falls asleep in 16-30 min, 2: falls asleep in 31-60 min, and 3: falls asleep in >60 min). A single-item question on the PSQI about the usual length of sleep was used to determine sleep length; sleep length of less than seven hours per night was classified as unhealthy.[29] Poor sleep quality was indicated by a global PSQI score of more than 5, which is in line with established guidelines.[28]

Assessment of Probable Sarcopenia

To measure the muscle strength of the patients, Utilizing the Takei grip strength dynamometer, HGS was measured. For males and women, respectively, poor muscular strength (probable sarcopenia) was defined as HGS <27 kg and <16 kg.[7]

Statistical Analysis

Version 23 of the SPSS software package was used to perform the statistical analyses. Using both analytical (Kolmogorov-Smirnov test) and visual (histograms, probability charts) methods, the variables were assessed for normal distribution. The use of median (IQR) for non-normally distributed numbers, mean±standard deviations (SD) for regularly distributed variables, and percentages for categorical variables marked the introduction of descriptive studies. The study used the chi-square test to evaluate differences between the two types of data and the Mann-Whitney U test to compare continuous variables. Two-sided testing was used to compare each published p-value to a significance level of 5%. Using logistic regression and multivariable binary analysis, the association between sleep quality and probable sarcopenia was demonstrated.

RESULTS

A total of 74 group 1 patients with a mean age of 73.5±5.1 years and a total of 110 group 2 with a mean age of 71.6±5.2 years were included in the study. A statistically significant difference was found between the groups in terms of mean age

distribution (p=0.03). The mean body-mass index (BMI) value of the patients in sleep was 28.2±6.3, statistically significantly lower than the patients in good sleep 30±5.9 (p=0.038). Other demographic and body measurements did not differ significantly between groups (p>0.05) (Table 1).

Table 1. Baseline characteristics of the research population by group. Two groups were created from the study sample groups who poor sleep quality and groups who good sleep quality

	Group 1 (n=74)	Group 2 (n=110)	p
Age, years, mean±SD	73.5±5.1	71.6±5.2	0.03
Marital status, married, n (%),	44 (59)	67 (61)	0.5
Education level, n (%)			
0	34 (46)	65 (59)	
1	21 (28.5)	28 (25)	0.10
2	19 (25.5)	16 (14)	
Height, cm, IQR	158 (10)	15 (11)	0.78
Sex, female, n (%)	46 (62)	69(62)	0.54
Weight, kg, IQR	71.2 (18)	73.5 (20)	0.33
Waist circumference, cm, IQR	96.7 (12)	99.9 (18)	0.53
Hip circumference, cm, IQR	103 (13)	106.5 (13)	0.30
BMI, kg/m^2, mean±SD	28.2±6.3	30±5.9	0.038

*Variables are presented as n (%), mean±SD or median (IQR), BMI: Body-mass index, cm: Cantimeter, kg: Kilogram; kg/m^2: Kilogram/square meters

The components of the CGA are presented in Table 2. In patients group 1, the median Katz ADL score was recorded as 5.0 (1.0), whereas it was 6.0 (1.0) in those group 2, this difference was statistically significant (p=0.02). The median IADL score was recorded as 6.0 (1.0), whereas it was 8.0 (1.0) in those group 2, this difference was statistically significant (p=0.01). The proportion of patients who are frail according to CFS was 90% in patients with group 2 and 72% in patients with group 1 (p=0.001). Furthermore, the median CFS score was 5.0 (1.0) in patients group 1 and it was 3.0 (1.0) in those group 2 (<0.001).

Table 2. Study participants' geriatric syndromes based on their sleep quality

	Group 1 (n=74)	Group 2 (n=110)	p
Katz ADL, median (IQR)	5 (1.0)	6 (1.0)	0.02
IADL, median (IQR)	6 (1.0)	8 (1.0)	0.01
MNA-SF, median (min-max)	12 (6-13)	14 (10-14)	0.001
MNA-SF, categorized, n (%)	56 (75)	41 (37)	<0.001
Handgrip Strength, kg, median (IQR)	17.0 (3.0)	18.0 (6.0)	0.001
Probable Sarcopenia, n (%)	60 (81)	17 (17)	0.034
CFS, median (IQR)	5 (1.0)	3 (1.0)	<0.001
CfS categorized, n (%)	67 (90)	80 (72)	0.001
Incontinence, n (%)	59 (80)	22 (20)	0.002
Polypharmacy, n (%)	61 (82)	24 (21)	0.001

*Variables are presented as n (%), mean±SD or median (IQR), Cm: Cantimeter, kg: Kilogram, ADL: Activities of daily living, CFS: Clinical Frailty Scale, IADL: Instrumental activities of daily living, MNA-SF: Mini nutritional assessment short form

The median score of low muscle strength differed between the two groups [p=0.001, 17.0 (3.0) vs 18.0 (6.0)] in patients with group 2 and group 1, respectively). The median score of MNA-SF was 12 (1.0) in patients group 1 and 14 (1.0) in patients group 2 (p=0.001).

While the incontinence rate was 80 percent in those with group 1, it was 20 in those group 2(p=0.002). Polypharmacy and GDS were also significantly higher between both groups and were respectively (p=0.001, p=0.001).

The binary logistic regression analysis is displayed in Table 3, possible factors affecting sleep. Since there was no difference in univariate analysis, these factors were determined with known factors. Sleep was associated with changes in age, incontinence, and handgrip.

Table 3. Analysis of the sleep using binary regression

	Odds ratio	95% CI	p
Age, years	0.933	0.875-0.994	0.031
Sex	1.179	0.583-2.385	0.647
Married	0.798	0.397-1.602	0.525
MNA-SF	0.188	0.93-0.378	0.001
CFS	0.010	1.353-9.625	0.10

*OR: Odds ratio, CI: Confidence interval, MNA-SF: Mini nutritional assessment short form, CFS: Clinical Frailty Scale

DISCUSSION

This study aimed to look at the connection between sleep quality and probable sarcopenia in older adults. Our findings suggest a strong correlation between inadequate sleep and the higher prevalence of probable sarcopenia in geriatric patients. Specifically, the group with poor sleep quality had a significantly higher percentage of patients diagnosed with probable sarcopenia compared to those with good sleep quality. Moreover, our analysis revealed that sleep quality was associated with other geriatric syndromes, including frailty, functional limitations, and polypharmacy. This may be explained by the high probability of geriatric syndromes in this group, as the most important risk factor for these syndromes is, as expected, advancing age. These results underline the importance of considering sleep quality as a potentially modifiable risk factor for managing and preventing sarcopenia in older adults.

The observed relationship between sleep and sarcopenia in our study aligns with the growing body of evidence suggesting that sleep disturbances may contribute to muscle dysfunction in aging populations.[30,31] Older adults frequently suffer from sleep issues such as insomnia and poor sleep quality and are known to exacerbate various age-related conditions, including sarcopenia.[32,33] The biological mechanisms underlying this connection are multifaceted. Sleep deprivation has been shown to alter the secretion of growth hormone and testosterone, both of which are crucial for maintaining muscle mass and strength. Additionally, disrupted sleep can lead to increased cortisol production, which may promote muscle catabolism and contribute to the loss of muscle mass.[34,35,7]

Our study found that individuals with poor sleep had significantly lower BMI and higher rates of frailty, which is consistent with previous research suggesting that poor sleep may accelerate the decline in physical function and muscle strength.[36,37] The role of frailty, which is often considered a precursor to sarcopenia, is noteworthy in our study. We observed that patients with poor sleep were more likely to be classified as frail, and frailty was strongly associated with the presence of probable sarcopenia. This finding supports the concept that sleep quality may influence both the onset and progression of sarcopenia by contributing to frailty, further emphasizing the importance of addressing sleep in geriatric care.[38,39]

In terms of functional capacity, we found that patients with poor sleep had significantly lower scores on the Katz and Lawton-Brody activities of daily living (ADL and IADL), indicating a greater level of dependency. This finding is in line with research that has shown that poor sleep is associated with decreased physical functioning and an increased risk of disability in older adults.[40,41] Furthermore, our study highlights the impact of poor sleep on handgrip strength, a widely acknowledged indicator of strength of muscles and a key component in diagnosing sarcopenia. The lower handgrip strength observed in patients with poor sleep further reinforces the link between inadequate sleep and muscle dysfunction.

Polypharmacy and incontinence were also significantly more prevalent in the poor sleep group, which may represent an added layer of complexity in managing geriatric patients. The high rate of polypharmacy observed in the poor sleep group may reflect the use of medications, such as sedatives and antidepressants, that can negatively impact sleep quality and potentially worsen sarcopenia. Similarly, incontinence, which is more common in individuals with poor sleep, is another geriatric syndrome that can further impair quality of life and functional independence.[42-44]

Limitations

This study contributes insightful information on the possible processes that connect inadequate sleep to sarcopenia. Perhaps the most important limitation is that we evaluated probable sarcopenia, not sarcopenia. Other methods and physical performance indicators required for a definitive definition of sarcopenia were not evaluated. However, it is important to acknowledge several limitations. First, the study's cross-sectional methodology makes it impossible to establish a causal link between sleep quality and sarcopenia. Longitudinal studies are needed to determine the temporal effects of sleep disturbances on muscle health over time. Additionally, while the Pittsburgh Sleep Quality Index (PSQI) is a widely used tool for assessing sleep quality, it is based on self-reported data, which might be biased. Future studies using objective measures of sleep, such as polysomnography or actigraphy, would provide a more comprehensive understanding of the link between sarcopenia and sleep.

CONCLUSION

In conclusion, our research shows that a higher frequency of likely sarcopenia and other geriatric disorders, including frailty and functional impairments, is linked to poor sleep quality. These findings suggest that improving sleep quality in older adults may be an important strategy for preventing or mitigating the progression of sarcopenia. Future studies ought to investigate the underlying mechanisms of this relationship and investigate whether interventions aimed at improving sleep could help prevent or treat sarcopenia in aging populations. Interventions such as medications, cognitive-behavioral therapy for insomnia (CBT-I), and lifestyle changes that promote better sleep hygiene could hold promise in improving both sleep and muscle health in older adults.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of Ankara Bilkent City Hospital Non-interventional Clinical Researches Ethics Committee (Date: 25.12.2024, Decision No: TABED-2 24-733).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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