Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Gender can modify the association between sleep duration, quality, and adiposity markers in elderly populations: Findings from the Neyshabur Longitudinal Study on Ageing (NeLSA)

Ali Gholami
Neyshabur University of Medical Sciences
Mitra Hariri
Neyshabur University of Medical Sciences
Mahdie Dehnavi
Neyshabur University of Medical Sciences
Hossein Sanaie
Neyshabur University of Medical Sciences
Nilofar Marofi
Neyshabur University of Medical Sciences
Asiye Amini
Neyshabur University of Medical Sciences
Hasan Ghodsi
ghodsih1@nums.ac.ir

Neyshabur University of medical Sciences

Research Article

Keywords: Sleep Duration, Sleep Quality, Anthropometric Indices, Elderly Population

Posted Date: April 8th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8484272/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Gender can modify the association between sleep duration, quality, and adiposity markers in elderly populations: Findings from the Neyshabur Longitudinal Study on Ageing (NeLSA)

Ali Gholami[1, 2], Mitra Hariri[1, 3], Mahdie Dehnavi[4], Hossein Sanaie[4], Nilofar Marofi[5], Asiye Amini[6], Hasan Ghodsi[3, 4*]

Noncommunicable Diseases Research Center, Neyshabur University of Medical Sciences, Neyshabur, Iran
Workplace Health Research Center, Neyshabur University of Medical Sciences, Neyshabur, Iran
Healthy Ageing Research Centre, Neyshabur University of Medical Sciences, Neyshabur, Iran
Department of Nursing and Midwifery, Neyshabur University of Medical Sciences, Neyshabur, Iran
Students Research Committee, Neyshabur University of Medical Sciences, Neyshabur, Iran
Department of Epidemiology, School of Public Health, Neyshabur University of Medical Sciences, Neyshabur, Iran

* Corresponding author: Hasan Ghodsi Email address: ghodsih1@nums.ac.ir

Abstract

Background: The global elderly population is rapidly expanding, and Iran is no exception to this demographic trend. Sleep disorders- as a common problem in the elderly- are associated with changes in body composition. However, limited studies have comprehensively examined the relationship between sleep parameters and detailed anthropometric indices in elderly populations.

Aim: This study aimed to investigate the associations of sleep duration and quality with anthropometric indices in an elderly Iranian population.

Methods: This cross-sectional study utilized data from the Neyshabur Longitudinal Study on Ageing (NeLSA), including 3,452 participants aged ≥60 years. Sleep duration and quality were assessed using the Pittsburgh Sleep Quality Index (PSQI). Anthropometric measurements included body fat mass (BFM), fat-free mass (FFM), visceral fat area (VFA), and waist-to-hip ratio (WHR). Multiple linear regression models were employed to examine associations, adjusting for demographic, socioeconomic, and health-related covariates.

Results: Poor sleep quality was significantly associated with higher BFM (β=1.17, p=0.040), VFA (β=7.70, p=0.012), and WHR (β=0.0097, p=0.021) in women, but not in men. Short sleep duration (<7 hours) was unexpectedly associated with lower BFM (β=-1.29, p=0.023) and VFA (β=-6.54, p=0.034) in women.

Conclusions: Sleep disturbances are highly prevalent among Iranian elderly. Poor sleep quality was specifically associated with adverse adiposity markers in women, while associations in men were absent. These findings underscore the necessity for gender-specific health strategies for healthy aging.

Keywords: Sleep Duration, Sleep Quality, Anthropometric Indices, Elderly Population

Introduction

According to the World Health Organization (WHO) report, the global elderly population will double by 2050, reaching 2.1 billion people, Notably, more than 80% of these older adults will live in low- and middle-income countries (1). Iran has experienced a significant rise in its elderly population, from 7.22% in 2006 to 12.0% in 2023. Projections indicate this trend will accelerate, with older adults expected to constitute 30.4% of the population by 2050(2).

This demographic transition presents substantial public health challenges, including escalating healthcare costs and increased demand for social support systems(3). Consequently, identifying modifiable risk factors for age-related health decline is paramount for promoting healthy aging and mitigating this socioeconomic burden.

Sleep, which is a crucial biological process for maintaining health and well-being, undergoes significant changes with age(4). Older adults frequently experience a high prevalence of sleep disturbances, including insomnia, fragmented sleep architecture, and a phase advance of the circadian rhythm(5,6). These alterations are not merely inconveniences; they are underpinned by complex physiological mechanisms that can profoundly impact health. Disrupted sleep impairs glucose metabolism and insulin sensitivity(7), promotes a pro-inflammatory state through elevated cytokine levels(8), and dysregulates key appetite controlling hormones specifically increasing ghrelin and decreasing leptin(9). Furthermore, it disrupts the restorative functions of sleep, including cellular repair and metabolic clearance(10).

These hormonal changes stimulate appetite, lower metabolic rate, and can lead to insulin resistance. This combination encourages fat accumulation, particularly of unhealthy visceral fat(11,12). While Body Mass Index (BMI) is widely used, other measures like body fat mass (BFM), visceral fat area (VFA), and waist-to-hip ratio (WHR) give a more complete picture of body composition. These measures are also better at predicting heart disease risk, illness, and death in older adults than BMI alone (13,14). Despite this, most prior research has focused narrowly on BMI, leaving a gap in our understanding of how sleep affects these specific and critical fat depots.

While existing literature confirms a link between sleep and general obesity(14,15),comprehensive studies examining the relationship between both sleep duration and quality with a detailed panel of anthropometric indices in elderly populations, particularly in the Middle East, are scarce. Given the high prevalence of sleep problems among Iranian seniors(15) and the unique interplay of genetic, lifestyle, and environmental factors in this region, population-specific investigations are crucial. Therefore, this study was designed to address this research gap by comprehensively investigating the association between sleep parameters and detailed anthropometric measures in a representative sample of the Iranian elderly population. The findings will provide valuable insights for developing targeted interventions to improve body composition and overall health in this rapidly growing demographic.

Methods

Design and samples

The data for this research were extracted from the Neyshabur Longitudinal Study on Ageing (NeLSA), the enrollment phase of which was conducted between 2016 and 2018(16). This study is the first cohort research on aging in Iran, implemented with the participation of individuals aged 50 and above from the city of Neyshabur (located in Khorasan Razavi province, northeastern Iran). The study's objective was to evaluate various aspects of aging and monitor health changes in the elderly through interviews, questionnaires, clinical assessments, and biochemical tests. In total, 7,462 individuals aged 50 to 94 years participated in this study. The inclusion and

exclusion criteria for the participants were defined according to the main study protocol(16). However, for the present research, only data from participants aged 60 and above (3,452 individuals) were analyzed.

Indices

Independent Variables

This study utilized the Persian version of the Pittsburgh Sleep Quality Index (PSQI), a standard sleep quality questionnaire whose validity and reliability have been confirmed in the Iranian population(17). This 19-item instrument is divided into seven components, scored on a Likert scale from 0 to 3: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The global score ranges from 0 to 21, with a total score of less than 5 indicating good sleep quality and a score greater than 5 suggesting poor sleep quality.

To categorize sleep duration, we adhered to the guidelines established by the National Sleep Foundation. According to these guidelines, adults require 7 to 9 hours of sleep per night(18). Consequently, sleep duration was classified into three categories: insufficient (less than 7 hours), optimal (7 to 9 hours), and excessive (more than 9 hours).

Dependent Variable

Anthropometric indices, including height, weight, BMI, VFA and FFM were measured using an automated bioelectrical impedance analyzer (In Body 770, BIOSPACE, Korea). The assessment adhered to the manufacturer's guidelines: participants first remained in a standing position for five minutes. For the measurement, they stood barefoot on the scale, positioning their feet on the designated electrodes, and simultaneously held the handgrip electrodes to complete the electrical circuit. Essential parameters including age, sex, and height were entered into the device's software. While the subject maintained a still posture, the device automatically captured body weight and calculated the body composition indices.

WHR (Waist-to-Hip Ratio) was calculated manually using the standard formula: WHR = WC/HC. Waist circumference (WC) was measured at the midpoint between the lowest rib and the iliac crest. Hip circumference (HC) was measured at the point of maximal gluteal protrusion. All measurements were taken using a steel tape.

Other variables

Several demographic variables—including age (<70years vs ≥70 years), sex (female vs male), marital status (living alone vs living with someone), education level (literate vs illiterate), current occupational status (full or part-time employment, housewives, and retired/unemployment/unable to work), income level (no problem, sufficient for basic needs, and having difficulties), current smoking (no vs yes), alcohol consumption (no vs yes), depression (normal vs have significant depressive symptoms), Opium Use (no vs yes), diabetes (no vs yes), hypertension (no vs yes), and physical activity (based on physical activity tool for elderly (PASE)) were included as covariates in the analysis of the relationship between the independent and dependent variables.

Statistical analysis

Data analysis was performed using STATA software, version 14. Descriptive statistics for the study population were presented using frequency, mean, and standard deviation.

Initially, a univariate linear regression model was employed to examine the association between the subjects' characteristics and the anthropometric indices. Subsequently, a multiple linear regression model was used to

determine the relationship of the independent variables (sleep duration and sleep quality) with the anthropometric indices. The normality of continuous data was assessed using the Kolmogorov-Smirnov test. A significance level of $P < 0.05$ was adopted for all statistical tests.

Result

Descriptive statistics for the study are provided in Table 1. The average age of participants was 68.0 ± 6.7 years. The sample was nearly evenly divided by gender, and a large majority of participants (over 85%) lived with another person. Most respondents were younger than 70 years, and literacy was reported by almost two-thirds of the sample. Concerning socioeconomic status, a significant proportion of participants (62.5%) reported that their income was sufficient for basic needs, yet nearly one in five experienced financial hardship. The health profile revealed several prominent concerns. More than half of the participants exhibited depressive symptoms (57.0%) and poor sleep quality (52.4%), with a corresponding majority sleeping less than seven hours per night. Hypertension was also highly prevalent, affecting nearly half of the sample. In contrast, the use of tobacco and alcohol was reported by less than 12% of the population. Notably, over two-thirds (69.1%) of the elderly participants were classified as either overweight or obese.

The average Physical Activity Scale for the Elderly (PASE) score was 81.4 (SD = 76.36). Participants had a mean social support score of 25.7 (SD = 3.15). Regarding body composition, the mean body fat mass BFM was 25.5 kg (SD = 9.09), and the mean FFM was 43.2 kg (SD = 8.08). The mean VFA was 133.4 cm² (SD = 51.50), while the mean WHR was 0.95 (SD = 0.07).

Table 1- Body Composition Metrics by Demographic and Health Characteristics

Variables	Number (%)	BFM Mean (SD)	P-value	FFM Mean (SD)	P-value	VFA Mean (SD)	P-value	WHR Mean (SD)	P-value
Gender									
Male	1811(52.5)	22.47 ± 8.49	<0.001	48.85± 6.53	<0.001	110.04 ± 45.25	<0.001	0.949 ± 0.07	0.407
Female	1,641(47.5)	28.69 ± 8.59		37.42 ± 4.69		157.56 ± 46.16		0.951 ± 0.06	
Age Groups									
<70 years									

	2,338(67.7)	26.29 ± 9.10	<0.001 43.96 ± 8.13	<0.001 136.14 ± 51.69	<0.001 0.953 ± 0.066
≥70 years	1,114(32.3)	23.74 ± 8.83	41.56 ± 7.69	126.97 ± 50.51	0.943 ± 0.074
Marital Status*					
Live with someone	2,933(85.7)	25.20 ± 9.07	<0.001 44.23 ± 8.04	<0.001 130.36 ± 51.15	<0.001 0.950 ± 0.06
Live alone	490(14.3)	27.44 ± 8.87	37.31 ± 5.38	151.35 ± 49.21	0.947 ± 0.06
Education					
Literate	2,201(63.8)	25.47 ± 9.04	0.670		

45.18 ± 7.99

<0.001
130.51 ± 51.15

<0.001
0.950 ± 0.06

0.935

Illiterate
1,251(36.2)

25.62 ± 9.18

39.79 ± 7.01

138.48 ± 51.74

0.950 ± 0.06

Job Status

Employed
735(21.3)

22.61 ± 8.47

<0.001
48.55 ± 7.09

<0.001
110.43 ± 45.62

<0.001
0.948 ± 0.07

0.189

Housewives
1,423(41.2)

28.70 ± 8.60

37.22 ± 4.61

158.08 ± 46.10

0.952 ± 0.06

Retired/Unemployed
1,294(37.5)

23.56 ± 8.87

47.09 ± 7.17

118.26 ± 48.52

0.948 ± 0.07

Weight Status*						
Underweight 48(1.4)	7.97 ± 2.56	<0.001	35.26 ± 6.35	<0.001	41.14 ± 13.23	<0.001
					0.835 ± 0.35	
Normal 981(29.4)	16.46 ± 4.31		41.72 ± 7.33		82.79 ± 26.50	
					0.901 ± 0.05	
Overweight 1,433(43.0)	25.67 ± 4.05		44.01 ± 8.24		135.29 ± 30.08	
					0.959 ± 0.05	
Obese 871(26.1)	36.59 ± 5.98		44.12 ± 8.25		193.06 ± 30.63	
					0.996 ± 0.06	
Income Status*						
No problem 606(17.8)						

26.38 ± 8.92

<0.004
45.22 ± 8.36

<0.001
135.83 ± 49.79

0.070
0.954 ± 0.07

0.088

Sufficient
2,132(62.5)

25.60 ± 8.99

42.86 ± 7.93

134.11 ± 51.17

0.950 ± 0.06

Have difficulties	671(19.7)	24.54 ± 9.53		42.66 ± 8.08		129.06 ± 54.16		0.945 ± 0.07	
Current Smoking*									

No
2,898(90.9)

26.09 ± 8.85

<0.001
42.84 ± 8.00

<0.001
136.94 ± 50.42

<0.001
0.952 ± 0.06

<0.001

Yes
292(9.1)

20.94 ± 9.97

47.92 ± 7.72

103.43 ± 52.15

0.934 ± 0.07

Alcohol Consumption*

No
2,809(88.1)

25.96 ± 9.05

<0.001

	42.50 ± 7.93
	<0.001 136.57 ± 51.43
	<0.001 0.950 ± 0.06
	0.636
	Yes 381(11.9)
	23.02 ± 8.97
	49.42 ± 6.72
	113.40 ± 47.29
	0.952 ± 0.07
Opium Use*	
	No 2,584(81.0)
	26.29 ± 8.89
	<0.001 42.56 ± 8.00
	<0.001 138.30 ± 50.55
	<0.001 0.952 ± 0.06
	0.003
	Yes 606(19.0)
	22.56 ± 9.32
	46.70 ± 7.73
	113.76 ± 50.99
	0.943 ± 0.07
Depression*	
	Normal 1,450(43.0)
	25.35 ± 8.93
	0.239 43.80 ± 8.16
	<0.001 131.75 ± 51.01

						0.084		
						0.950 ± 0.06		
						0.943		
	Significant symptoms							
	1,924(57.0)							
	25.75 ± 9.23							
	42.83 ± 8.02							
	135.14 ± 51.93							
	0.950 ± 0.06							
Diabetes								
	No							
	2,785(80.7)							
	24.97 ± 9.11							
	43.23 ± 8.18					<0.001		
	130.24 ± 51.70					0.947		
	0.947 ± 0.06					<0.001		
						<0.001		
	Yes							
	667(19.3)							
	27.99 ± 8.60							
	43.26 ± 7.59							
	147.33 ± 48.24							
	0.960 ± 0.06							
Hypertension*								
	No							
	1,663(51.0)							
	23.82 ± 8.92							
	43.96 ± 8.12					<0.001		
	122.59 ± 50.86					<0.001		
	0.941 ± 0.06					<0.001		

Yes 1,600(49.0)						
27.69 ± 8.80						
42.71 ± 7.98						
146.50 ± 49.05						
0.960 ± 0.06						
Sleep Quality*						
Good 1,559(47.6)						
24.87 ± 9.07						
<0.001 44.70 ± 8.16						
<0.001 127.53 ± 50.33						
<0.001 0.948 ± 0.06						
0.090						
Poor 1,716(52.4)						
26.32 ± 9.06						
41.98 ± 7.77						
139.83 ± 51.97						
0.952 ± 0.06						
Sleep Duration*						
<7 hours 1,883(57.3)						
25.71 ± 8.92						
0.663 43.16 ± 8.10						
0.222 134.65 ± 51.36						
0.309 0.950 ± 0.06						
0.909						
7-9 hours 1,275(38.8)						
25.51 ± 9.28						

	43.66 ± 8.08
	132.57 ± 51.56
	0.950 ± 0.06
≥9 hours 130(4.0)	
	24.95 ± 9.66
	42.76 ± 7.82
	131.6 ± 53.47
	0.953 ± 0.06

***Some data were missing**

Abbreviations: BFM: Body Fat Mass**; FFM:** Fat-Free Mass**; VFA:** Visceral Fat Area**; WHR:** Waist-to-Hip Ratio**; CI:** Confidence Interval

Table 2: Adjusted associations of sleep duration with anthropometric indices, stratified by gender

Anthropometric indices	Gender	Sleep Duration (Ref: 7-9 hours)	β	95% CI	p-value
BFM (kg)	Female	<7 hours	-1.29	-2.42, -0.18	**0.023**
		≥9 hours	-1.23	-3.97, 1.50	0.377
	Male	<7 hours	0.13	-0.90, 1.18	0.790
		≥9 hours	0.65	-1.89, 3.20	0.610
FFM (kg)	Female	<7 hours	-0.10	-0.70, 0.50	0.753
		≥9 hours	-0.39	-1.86, 1.07	0.599
	Male	<7 hours	0.17	-0.61, 0.96	0.668
		≥9 hours	0.43	-1.48, 2.35	0.657
VFA (cm^2)	Female	<7 hours	-6.54	-12.60, -0.48	**0.034**
		≥9 hours	-4.81	-19.62, 9.99	0.524
	Male	<7 hours	-0.02	-5.61, 5.56	0.994
		≥9 hours	4.07	-9.52, 17.66	0.557
WHR	Female	<7 hours	-0.002	-0.01, 0.006	0.610
		≥9 hours	0.010	-0.008, 0.02	0.269
	Male	<7 hours	-0.003	-0.01, 0.005	0.447
		≥9 hours	0.004	-0.15, 0.02	0.662

Abbreviations: BFM: Body Fat Mass**; FFM:** Fat-Free Mass**; VFA:** Visceral Fat Area**; WHR:** Waist-to-Hip Ratio**; CI:** Confidence Interval

Multiple linear regression models revealed a gender-specific relationship between short sleep duration and body composition, with statistically significant associations observed exclusively in female participants (Table 2). Among females, short sleep duration (<7 hours) was significantly associated with lower adiposity indices compared to the reference group (7-9 hours). Specifically, there was a significant reduction in BFM (β = -1.29, 95% CI: -2.42, -0.18, p=0.023) and a significant decrease in VFA (β = -6.54, 95% CI: -12.60, -0.48, p=0.034). In contrast, long sleep duration (≥9 hours) showed no significant associations with any anthropometric indices in females. For male participants, no significant associations were found between either short or long sleep duration and any of the anthropometric indexes, including BFM, FFM, VFA, and WHR.

Anthropometric indices	Gender	Sleep Quality (Ref: Good)	β	95% CI	*p*-value
BFM (kg)	Female	Poor	1.17	0.05, 2.28	**0.040**
	Male	Poor	-0.55	-1.70, 0.558	0.341
FFM (kg)	Female	Poor	0.11	-0.49, 0.70	0.721
	Male	Poor	-0.22	-1.08, 0.63	0.612
VFA (cm^2)	Female	Poor	7.70	1.68, 13.71	**0.012**
	Male	Poor	-2.89	-9.00, 3.21	0.353
WHR	Female	Poor	0.0097	0.001, 0.017	**0.021**
	Male	Poor	-0.001	-0.010, 0.007	0.784

Table 3: Multiple linear regression analysis of sleep quality in relation to anthropometric indices, by gender

Abbreviations: BFM: Body Fat Mass**; FFM:** Fat-Free Mass**; VFA:** Visceral Fat Area**; WHR:** Waist-to-Hip Ratio**; CI:** Confidence Interval

Adjusted for sex, age, marital status, education, current job status, income status, house ownership, current smoking, alcohol consumption, opioid use, weight status, depression, and hypertension.

Multiple linear regression models (Table 3) revealed a clear, gender-specific relationship between sleep quality and anthropometric indices, with all statistically significant associations observed exclusively in female participants. Among elderly women, poor sleep quality showed significant positive associations with several adiposity markers. Most notably, it was associated with a larger VFA ($\beta = 7.70$, $P = 0.012$), indicating substantially increased abdominal adiposity. Significant associations were also found with greater BFM ($\beta = 1.17$, $P = 0.040$) and a higher WHR ($\beta = 0.0097$, $P = 0.021$). In contrast, no significant association was observed with FFM.

In contrast, no significant associations were detected between sleep quality and any anthropometric indices in elderly males. All coefficients showed negative but non-significant trends, with confidence intervals crossing zero and p-values substantially above the significance threshold ($p>0.05$).

Discussion

The objective of the current research was to assess the associations of both sleep duration and sleep quality with anthropometric indices in an elderly Iranian population. Our results showed a high prevalence of sleep disturbances, with more than half reporting poor sleep quality (52.4%) and 57.3% obtaining less than seven hours of sleep per night. This aligns with prior national studies (19, 20), though global prevalence rates vary widely, from 25% to 76% (21, 22), highlighting contextual differences.

A principal finding was the distinct gender-specific pattern in the relationship between sleep parameters and adiposity markers. While poor sleep quality was significantly associated with adverse adiposity (BFM, VFA, WHR) in women, these relationships were absent in men. Furthermore, an inverse association between short sleep duration (<7 hours) and lower adiposity was observed exclusively in women. These results suggest elderly women may be more susceptible to the metabolic consequences of sleep disturbances.

This pattern finds support in longitudinal research linking poor sleep quality to visceral fat accumulation, particularly in women (20, 23). However, this appears unexpected given that men usually have a unhealthier abdominal fat pattern linked to metabolic health risks (24). This difference may be due to how women's bodies work. Women naturally have more body fat and burn fat differently than men, partly because their hormones work in distinct ways (25). Consequently, when poor sleep disrupts metabolic pathways, the more extensive and dynamic adipose tissue in postmenopausal women may render them more susceptible to detrimental effects on fat distribution (26). Thus, the association in elderly women likely reflects an interaction between sleep-related metabolic disturbances and the unique biology of female adipose tissue.

Beyond sleep quality, our findings regarding sleep duration revealed a more complicated picture. We found a complex and gender-specific relationship; in women, short sleep duration (<7 hours) was significantly associated with lower BFM and VFA, whereas no significant associations were observed in men. These results partially align with those of Theorell-Haglöw et al. (27) but contrast with much of the existing literature, such as the findings reported by Cappuccio et al. (28).

Several factors could explain this unexpected result. First, reverse causality must be considered: in elderly populations, underlying pathological conditions such as subclinical inflammation (29, 30), age-related anorexia (31, 32), or chronic diseases may simultaneously cause both weight loss and sleep fragmentation. Second, the unique physiological context of postmenopausal women may be key. The decline in estrogen levels alters both sleep architecture and metabolic regulation (33, 34). While estrogen deficiency typically promotes central adiposity, its interaction with sleep deprivation may manifest differently in this population (35), potentially leading to a distinct metabolic response. Third, behavioral factors specific to our study population could play a role. Elderly women with short sleep duration might exhibit different patterns of physical activity or dietary intake compared to those with recommended sleep duration (e.g., decreased appetite or increased unintentional activity due to restlessness).

These counterintuitive findings highlight the complexity of sleep-metabolism interactions in elderly populations and underscore the necessity of considering gender-specific analyses in sleep research.

Several limitations warrant consideration when interpreting our findings. The cross-sectional design precludes the establishment of temporal or causal relationships between the variables, as data were collected at a single time point. Furthermore, although the Pittsburgh Sleep Quality Index questionnaire are well-validated instrument, the reliance on self-reported measure for sleep parameters may introduce recall or reporting bias. Finally, the subjective nature of the Pittsburgh questionnaire must be acknowledged.

This study also possesses notable strengths, including a substantial sample size and comprehensive data on potential mediators and confounders. The assessment of sleep quality was conducted using PSQI, a validated and widely employed instrument in sleep research. To our knowledge, this investigation represents one of the first endeavors to examine the association between sleep duration, sleep quality and anthropometric indices within an Iranian elderly population.

Conclusion

This study reveals a fundamental difference between genders in the sleep-body composition relationship among the elderly. Poor sleep quality was specifically linked to adverse adiposity in older women, while an unexpected inverse association with short sleep duration was also observed. These findings highlight elderly women's unique metabolic vulnerability to sleep disturbances.

Clinically, this underscores the necessity for gender-specific screening and interventions targeting sleep health in geriatric care. For research, our study addresses a key gap in data from elderly Middle Eastern populations. Future longitudinal studies employing objective sleep measures and biomarkers are essential to elucidate the distinct mechanisms at play in aging.

Declarations

Abbreviations

WHO: World Health Organization

NelSA: Neyshabur Longitudinal Study on Ageing

PSQI: Pittsburgh Sleep Quality Index

BMI: Body Mass Index

BFM: Body Fat Mass

FFM: Fat-Free Mass

VFA: Visceral Fat Area

WHR: Waist-to-Hip Ratio

CI: Confidence Interval

PASE: Physical Activity Scale for the Elderly

Ethics approval and consent to participate

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Neyshabur University of Medical Sciences (Date: 06.05.2025 /No: IR.NUMS.REC.1404.005).

Consent for publication

Not applicable

Availability of data and materials

The data that support the findings of this study are available on request from the corresponding author.

Competing Interests

Authors declare that they have no conflict of interest.

Funding

Funding for the present work was provided by Neyshabur University of Medical Sciences (Grant number: 14030516).

Authors' contributions

All authors contributed to the conception and design of the study.All authors reviewed, edited, and approved the submitted version of the manuscript.

Acknowledgments

We would like to express our thanks to all individuals who participated in this study. Also, we gratefully acknowledge of Neyshabur Healthy Ageing Research Centre.

References

1. World population ageing 2019. Highlights. New York City (NY): United Nations, Department of Economic and Social Affairs; 2019 (ST/ESA/SER.A/430) (https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf, accessed November 2019).

2. Demographic Changes in Asia and the Pacific. Available at: https://www.population-trends- Asia pacific. Org / data /IRN

3. Khan HTA, Addo KM, Findlay H. Public Health Challenges and Responses to the Growing Ageing Populations. Public Health Chall. 2024 Jul 21; 3 (3):e213. doi: 10.1002/puh2.213. PMID: 40496520; PMCID: PMC12039680.

4. Irwin MR. Why sleep is important for health: a psychoneuroimmunology perspective. Annu Rev Psychol. 2015 Jan 3; 66: 143-72. doi: 10.1146/annurev-psych-010213-115205. Epub 2014 Jul 21. PMID: 25061767; PMCID: PMC4961463.

5. 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. PMID: 21056216; PMCID: PMC3142094.

6. Tatineny P, Shafi F, Gohar A, Bhat A. Sleep in the Elderly. Mo Med. 2020 Sep-Oct; 117(5):490-495. PMID: 33311760; PMCID: PMC7723148.

7. Reutrakul S, Punjabi NM, Van Cauter E. Impact of Sleep and Circadian Disturbances on Glucose Metabolism and Type 2 Diabetes. In: Diabetes in America. 3rd ed. National Institute of Diabetes and Digestive and Kidney Diseases (US), Bethesda (MD); 2018. PMID: 33651564.

8. Garbarino, S., Lanteri, P., Bragazzi, N.L. et al. Role of sleep deprivation in immune-related disease risk and outcomes. Commun Biol 4, 1304 (2021). https://doi.org/10.1038/s42003-021-02825-4.

9. Dzaja A., Dalal M. A., Himmerich H., Uhr M., Pollmächer T., Schuld A. Sleep enhances nocturnal plasma ghrelin levels in healthy subjects. The American Journal of Physiology—Endocrinology and Metabolism. 2004; 286(6):E963–E967. doi: 10.1152/ajpendo.00527.2003.

10. Davinelli, S., Medoro, A., Savino, R. et al. Sleep and Oxidative Stress: Current Perspectives on the Role of NRF2. Cell Mol Neurobiol 44, 52 (2024). https://doi.org/10.1007/s10571-024-01487-0.

11. Jurado-Fasoli, L., Amaro-Gahete, F. J., De-la-O, A., Dote-Montero, M., Gutiérrez, Á. & Castillo, M. J. (2018). Association between Sleep Quality and Body Composition in Sedentary Middle-Aged Adults. Medicina, 54(5), 91. https://doi.org/10.3390/medicina54050091.

12. Rahe C, Czira ME, Teismann H, Berger K. Associations between poor sleep quality and different measures of obesity. Sleep Med. 2015 Oct; 16(10):1225-8. doi: 10.1016/j.sleep.2015.05.023. Epub 2015 Jul 13. PMID: 26429750.

13. Tsapanou A, Gu Y, O'Shea DM, Yannakoulia M, Kosmidis M, Dardiotis E, Hadjigeorgiou G, Sakka P, Stern Y, Scarmeas N. Sleep quality and duration in relation to memory in the elderly: Initial results from the Hellenic Longitudinal

Investigation of Aging and Diet. Neurobiol Learn Mem. 2017 May; 141:217-225. doi: 10.1016/j.nlm.2017.04.011. Epub 2017 Apr 26. PMID: 28455107.

14. Hariri M, Shamshirgaran SM, Amini A, Abasi H, Gholami A. Sleep duration and quality are associated with health-related quality of life in adults aged 60 years and older. Ir J Med Sci. 2024 Aug; 193(4):1929-1937. doi: 10.1007/s11845-024-03656-y. Epub 2024 Mar 15. PMID: 38489125.

15. Boozari B, Saneei P, Safavi SM. Association between sleep duration and sleep quality with sugar and sugar-sweetened beverages intake among university students. Sleep Breath. 2021 Jun; 25(2):649-656. doi: 10.1007/s11325-020-02155-5. Epub 2020 Jul 27. PMID: 32720017.

16. Aminisani N, Azimi-Nezhad M, Shamshirgaran SM, Mirhafez SR, Borji A, Poustchi H, Sezavar SH, Ansarin K, Kolahi S, Javadpor A, Rezaei A, Hooshmand E, Maroufi N, Tabaei S, Eghtesad S, Hyde M, Kenny RA, Raina P, Stephens C, Malekzadeh R. Cohort Profile: The IRanian Longitudinal Study on Ageing (IRLSA): the first comprehensive study on ageing in Iran. Int J Epidemiol. 2022 Aug 10; 51(4):e177-e188. doi: 10.1093/ije/dyab272. PMID: 35137100.

17. 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 Mar; 16(1):79-82. doi: 10.1007/s11325-010-0478-5. Epub 2011 May 26. PMID: 21614577.

18. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L, Hazen N, Herman J, Katz ES, Kheirandish-Gozal L, Neubauer DN, O'Donnell AE, Ohayon M, Peever J, Rawding R, Sachdeva RC, Setters B, Vitiello MV, Ware JC, Adams Hillard PJ. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. Sleep Health. 2015 Mar; 1(1):40-43. doi: 10.1016/j.sleh.2014.12.010. Epub 2015 Jan 8. PMID: 29073412.

19. MIRZAEI, MASOUD, GHOLAMREZAEI, ENSIEH, BIDAKI, REZA, FALLAHZADEH, HOSSEIN, & RAVAEI, JAFAR. (2017). QUALITY OF SLEEP AND METHODS OF MANAGEMENT OF SLEEP DISORDERS IN ELDERLY OF YAZD CITY IN 2016. JOURNAL OF SHAHID SADOUGHI UNIVERSITY OF MEDICAL SCIENCES, 25(6), 467-475. SID. https://sid.ir/paper/36751/en.

20. Kohanmoo A, Kazemi A, Zare M, Akhlaghi M. Gender-specific link between sleep quality and body composition components: a cross-sectional study on the elderly. Sci Rep. 2024 Apr 6; 14(1):8113. doi: 10.1038/s41598-024-58801-5. PMID: 38582755; PMCID: PMC10998859.

21. Zaidel C, Musich S, Karl J, Kraemer S, Yeh CS. Psychosocial factors associated with sleep quality and duration among older adults with chronic pain. Popul. Health Manag. 2021; 24(1):101–109. doi: 10.1089/pop.2019.0165.

22. Lorber M, Kmetec S, Davey A, Mlinar Reljić N, Fekonja Z, Kegl B. Associations between sleep quality, frailty, and quality of life among older adults in community and nursing home settings. Int. J. Environ. Res. Public Health. 2023; 20(6):4937. doi: 10.3390/ijerph20064937.

23. Sweatt SK, Gower BA, Chieh AY, Liu Y, Li L. Sleep quality is differentially related to adiposity in adults. Psychoneuroendocrinology. 2018 Dec; 98:46-51. doi: 10.1016/j.psyneuen.2018.07.024. Epub 2018 Jul 25. PMID: 30098512; PMCID: PMC6204309.

24. Power ML, Schulkin J. Sex differences in fat storage, fat metabolism, and the health risks from obesity: Possible evolutionary origins. Br. J. Nutr. 2008; 99(5):931–940. doi: 10.1017/S0007114507853347.

25. Moreira-Pais A, Ferreira R, Neves JS, Vitorino R, Moreira-Gonçalves D, Nogueira-Ferreira R. Sex differences on adipose tissue remodeling: From molecular mechanisms to therapeutic interventions. J. Mol. Med. (Berl.) 2020; 98(4):483–493. doi: 10.1007/s00109-020-01890-2.

26. Schindler LS, Subramaniapillai S, Barth C, Meer D van der, Pedersen ML, Kaufmann T, et al. Associations between abdominal adipose tissue, reproductive span, and brain characteristics in post-menopausal women. NeuroImage Clin. 2022; 36:103239.

27. Theorell-Haglöw J, Lemming EW, Michaëlsson K, Elmståhl S, Lind L, Lindberg E. Sleep duration is associated with healthy diet scores and meal patterns: results from the population-based EpiHealth study. J Clin Sleep Med. 2020 Jan 15; 16(1):9-18. doi: 10.5664/jcsm.8112. Epub 2019 Nov 26. PMID: 31957658; PMCID: PMC7052994.

28. Cappuccio FP, Taggart FM, Kandala NB, Currie A, Peile E, Stranges S, Miller MA. Meta-analysis of short sleep duration and obesity in children and adults. Sleep. 2008 May; 31(5):619-26. doi: 10.1093/sleep/31.5.619. PMID: 18517032; PMCID: PMC2398753.

29. Michaud M, Balardy L, Moulis G, Gaudin C, Peyrot C, Vellas B, Cesari M, Nourhashemi F. Proinflammatory cytokines, aging, and age-related diseases. J Am Med Dir Assoc. 2013 Dec; 14(12):877-82. doi: 10.1016/j.jamda.2013.05.009. Epub 2013 Jun 20. PMID: 23792036.

30. Morley JE, Thomas DR. Cachexia: new advances in the management of wasting diseases. J Am Med Dir Assoc. 2008 May; 9(4):205-10. doi: 10.1016/j.jamda.2008.02.006. PMID: 18457793.

31. Landi F, Calvani R, Tosato M, Martone AM, Ortolani E, Savera G, Sisto A, Marzetti E. Anorexia of Aging: Risk Factors, Consequences, and Potential Treatments. Nutrients. 2016 Jan 27; 8(2):69. doi: 10.3390/nu8020069. PMID: 26828516; PMCID: PMC4772033.

32. Morley JE. Pathophysiology of the anorexia of aging. Curr Opin Clin Nutr Metab Care. 2013 Jan; 16(1):27-32. doi: 10.1097/MCO.0b013e328359efd7. PMID: 23041615.

33. Palmer BF, Clegg DJ. The sexual dimorphism of obesity. Mol Cell Endocrinol. 2015 Feb 15; 402:113-9. doi: 10.1016/j.mce.2014.11.029. Epub 2015 Jan 8. PMID: 25578600; PMCID: PMC4326001.

34. Jeffery E, Wing A, Holtrup B, Sebo Z, Kaplan JL, Saavedra-Peña R, Church CD, Colman L, Berry R, Rodeheffer MS. The Adipose Tissue Microenvironment Regulates Depot-Specific Adipogenesis in Obesity. Cell Metab. 2016 Jul 12; 24(1):142-50. doi: 10.1016/j.cmet.2016.05.012. Epub 2016 Jun 16. PMID: 27320063; PMCID: PMC4945385.

35. Lizcano F, Guzmán G. Estrogen Deficiency and the Origin of Obesity during Menopause. Biomed Res Int. 2014; 2014:757461. doi: 10.1155/2014/757461. Epub 2014 Mar 6. PMID: 24734243; PMCID: PMC3964739.