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The Relationship Between Sleep Quality and Body Composition in Women: Findings from the PERSIAN Organizational Cohort Study

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Abstract

Background: Sleep disorders are more prevalent in women than in men, particularly among working women. Changes in body composition are associated with disturbances in sleep quality and quantity, which, in turn, diminish overall quality of life. Furthermore, evidence focusing specifically on the female workforce, who navigate unique occupational and domestic stressors, remains scarce.

Objectives: The purpose of this study was to investigate the relationship between sleep quality and body composition in women referred to the PERSIAN Organizational Cohort Study in Mashhad, Iran.

Methods: In the current cross-sectional study, 760 women referred to the PERSIAN Organizational Cohort Study in Mashhad participated. Data were collected from the Pittsburgh Sleep Quality Questionnaire(PSQI) and body composition indicators were measured using the InBody770 device. SPSS version 25 was used to enter and analyze the data. Pearson and Spearman correlation coefficients were used to determine the relationship between variables.

Results: The average age of the women was 40.68 ± 5.96, and the mean sleep quality score was 4.86 ± 2.37. 256 women had sleep disorders (34%). The results of Pearson's correlation coefficient showed that Body Mass Index (BMI) (P<0.001, r=0.146), Percentage of body fat (PBF) (P=0.007, r=0.099), Abdominal circumference (AC) (P<0.001, r=0.144), and Body fat mass (BFM) (P=0.002, r=0.113) had a significant relationship with sleep duration. BMI (P=0.001, r=0.119), PBF (P=0.003, r=0.108), Waist-Hip ratio (WHR) (P=0.031, r=0.080), AC (P=0.001, r=0.127), and BFM had significant relationships with sleep disturbances. BMI (P=0.037, r=0.077), AC (P=0.021, r=0.085), and BFM showed significant relationships with the total sleep quality score.

Conclusion: The results showed that body composition indicators, such as body fat mass and body fat percentage, as well as BMI, PBF, WHR, AC, and BFM, an anthropometric index, are correlated with sleep quality. These results suggest that poor sleep quality is associated with higher anthropometric indices of obesity and highlight the importance of considering sleep hygiene as a potential factor in weight management programs for women in organizational settings.

Keywords: Sleep Quality, Body Composition, Body Mass Index, Women.

1. Introduction

People's health depends on their body composition. Body composition includes the percentage of fat, bone, water, and muscles (1). Any changes in body composition are associated with decreased quality of life and increased mortality risk and impose a significant burden on individuals' and society's health (2). All health advisors agree that dyslipidemic disorders and high levels of blood cholesterol threaten people's health and quality of life. A high body fat percentage is associated with problems such as hypertension, elevated cholesterol, diabetes, and sleep disorders (3). Of course, body composition is influenced by a variety of factors that interact in complex ways to shape an individual's health status. Key factors, including genetics, age, gender, physical activity, sleep, diet, and stress, significantly

impact body fat distribution, muscle mass, and bone density (4). Studies also show that the menopausal transition affects body composition, leading to significant increases in total body fat and abdominal fat. Some studies have shown that body size and distribution parameters change during menopause, but these are largely explained by age. (5)

Sleep is a natural process in the human body that allows the body and brain to rest and recover. It has been shown that sleep affects body composition (6). Irregular sleep patterns, poor sleep quality, and insufficient sleep play an important role in determining health status. Sleep quality is not only an indicator of health but also a key component of quality of life. One factor affecting sleep quality is body composition, including fat mass and fat-free mass (7,8). Many studies show a close relationship between body composition and sleep duration and quality. (9-11)

The results of various studies have shown that the amount of body mass index in people with sleep apnea is significantly higher than that of those without sleep apnea, so in people with a body mass index of 25-28 kg/m2, sleep apnea with mild intensity increases by 20% and sleep apnea with moderate and severe intensity increases by 7% (12-14). The study by Hsu et al. also showed that reduced sleep duration and quality are associated with increased body weight and obesity (15). Also, studies conducted on sleep and body composition in Saudi teenagers show that there is an inverse relationship between sleep duration (less than 7 hours per day) and obesity and overweight. (16)

There are different methods for determining body composition indicators. However, in most studies, only body mass index (BMI) has been used. Although BMI is considered a method for measuring body composition and obesity based on height and weight, it cannot distinguish between fat mass and fat-free mass. In addition, it does not determine body fat percentage or overweight status, limiting its application. (17,18)

Therefore, to investigate the relationship between body composition and sleep, a method that can distinguish fat weight and fat-free weight is needed. This can be achieved by using the In Body 770 device. This device can distinguish between fat-free mass and fat mass (19,20). In fact, the main advantage of using a body analyzer instead of weight or BMI is that you can measure body fat percentage and other indicators, which are considered among the main causes of many diseases, such as sleep disorders .

The biological cycle of sleep and wakefulness, along with its physiological functions in light and darkness, is affected by work schedules. Among the jobs that involve shift work and sleep disturbance are those of nurses, midwives, and physicians. Due to the stressful nature of their jobs and shift work, these people seem to have poor sleep quality (21,22). Low sleep quality reduces caution and precision in this group's work, leading to increased waste and lost working time. It can also affect their job satisfaction, mental and general health, and seriously disrupt their professional performance, the quality of services provided, their personal life, and the performance of other roles. (23,24)

Overall, given the limitations of BMI in assessing body composition, the high prevalence of sleep disturbances among women and the working population (25), the present study was conducted to determine the association between sleep quality and body composition indices among women participating in the Mashhad PERSIAN Organizational Cohort Study.

2. Methods

This descriptive study has been approved with the ethics code: IR.MUMS.NURSE.REC.1400.066 in the ethics committee of Mashhad University of Medical Sciences. In this study, all employed clinical women at Mashhad University of Medical Sciences who referred to the university's PERSIAN Organizational Cohort in Mashhad (POCM) in 2023 and met the study's inclusion criteria were included through census. Written informed consents were obtained from all participants.

The inclusion criteria were: being Iranian and working at Mashhad University of Medical Sciences, age 18-60 years, minimum literacy, not having uncontrolled medical or complicated diseases[1], diseases in which hot flash is one of their symptoms, do not have mental diseases[2], do not use any chemical medication that affects sleep[3], the occurrence of a severe stressful death incident (parents, spouse or child), divorce, severe conflicts with spouse, sick person in the family, dismissal and bankruptcy within the last 6 months, do not use tobacco, drugs, and alcohol.

For data collection, the researchers began sampling after obtaining permission from Mashhad University of Medical Sciences. The researcher then visited the University Cohort Center and selected the research units from the information registered there. Data collection tools included the demographic characteristics questionnaire and the Pittsburgh Sleep Quality Questionnaire (PSQI). Furthermore, a form to record body composition indicators was used.

[1] Uncontrolled hypertension (>140/90 mm/Hg), asthma, restless leg syndrome, kidney failure, liver disease, uncontrolled diabetes, chronic disease, seizures, Parkinson's, epilepsy, arthritis, cancer

[2] Delirium, schizophrenia, Alzheimer's

[3] Medications like clonidine, antidepressants, tamoxifen, raloxifene, anticonvulsants such as gabapentin, sedatives simultaneously

The Pittsburgh Sleep Quality Index, developed by Buysse et al. in 1989, is a widely used tool for assessing sleep quality. The Pittsburgh Sleep Quality Index consists of 19 questions, rated on a 4-point Likert scale from 0 to 3. This questionnaire has seven subscales, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The total score of this questionnaire ranges from 0 to 21, with scores above 5 indicating poor sleep quality (26).

In Iran, the reliability and validity of the Persian version of the PSQI were evaluated by Mezerji et al. Content validity index, scale content validity index, and Cronbach's alpha coefficient were ≥0.78, ≥0.90, and 0.65, respectively. Factor analysis confirmed that the Persian version of the PSQI had acceptable validity and reliability (27).

Body composition indicators were checked by using the InBody 770 device. South Korea's InBody Company is the largest and most prominent manufacturer of body composition analyzers worldwide, and the FDA has approved its products in the USA. This device sends a weak alternating electric current (50-1000 kHz) along the body. Different tissues of the body reflect different parts of the waves depending on the tissue type. The device's sensors measure the reflected waves, and the mass of different body parts is calculated from these measurements. Finally, it shows body composition, including fat mass and fat-free mass. In this way, you can determine the exact amounts of body water, fat, and muscle by dividing each into different areas.

Data were analyzed by SPSS software (version 25). After ensuring the data entry was correct, data analysis was performed using the following statistical tests. Descriptive statistics, including central and dispersion indices (mean and standard

deviation), and frequency distributions were used to describe the characteristics of the research unit. To investigate the relationship between sleep quality and body composition indices, Pearson's correlation test was used. In all tests, a confidence level of 95% and a significance level of 0.05 were used.

3. Result

A total of 760 subjects participated in this study. The mean age of the subjects was 40.68 ± 5.96 years in the range of (24-60 years). Among them, 420 subjects (55%) had a bachelor's degree, and 611 (80%) were married (Table 1). The average total sleep score was 4.86 ± 2.37, and 256 subjects (34%) had sleep disorders. Descriptions of the sleep quality dimensions and body composition indicators are presented in Table 2.

Table 1. Demographic characteristics of the participants

variable	Categories	Number (percentage)
level of education	Diploma	61(8)
	Bachelor's degree	420(55)
	Master's degree and higher	279(37)
Marital status	Single	113(15)
	Married	611(80)
	Widowed or divorced	36(5)

Table 2. Description of sleep quality dimensions in women

variable	Categories	Mean ± SD
Sleep Quality	subjective sleep quality	0.90±0.64
	sleep latency	0.86±0.78
	sleep duration	0.70±0.80
	sleep efficiency	0.11±0.40
	sleep disturbances	0.99±0.46
	use of sleep medication	0.10±0.37

The results of the Pearson's correlation coefficient showed that BMI was significantly associated with sleep duration, sleep disturbances, and the total sleep quality score. The percentage of body fat (PBF) showed significant relationships with sleep duration, sleep disturbances, and the total sleep quality score. Waist-hip ratio (WHR) was significantly associated with delayed sleep onset, sleep disturbances, and total sleep quality score. Abdominal circumference (AC) was significantly associated with sleep duration, sleep disturbances, and the total sleep quality score (Table 3). Body fat mass (BFM) had a significant relationship with sleep duration (P=0.002, r=0.113) and sleep disturbances (P=0.002, r=0.116)

Table 3. Relationship between body composition indicators and sleep quality in women

variable	Mean ± SD	sleep duration	sleep disturbances	total score of sleep quality
body mass index (BMI)	26.39±4.02	P<0.001, r=0.146	P=0.001, r=0.119	P=0.037, r=0.077
Percentage of body fat (PBF)	38.57±5.98	P=0.007, r=0.099	P=0.003, r=0.108	P=0.063, r=0.068
Waist-Hip ratio (WHR)	0.91±0.05	P=0.051, r=0.072	P=0.031, r=0.080	P =0.050, r=0.072
Abdominal circumference (AC)	31.38±3.12	P<0.001, r=0.144	P=0.001, r=0.127	P=0.021, r=0.085

4. Discussion

The results showed that body composition indicators, such as BMI, PBF, WHR, AC, and BFM, are correlated with low sleep quality. Low quality of sleep can affect work efficiency, work quality, and people's health.

The results of the present study also showed that sleep quality is associated with indicators of body composition among women who have worked at Mashhad University of Medical Sciences. Body composition indices, including BMI, PBF, WHR, AC, and BFM, were associated with sleep duration, sleep disorders, and total sleep quality. According to the findings, people with the shortest sleep duration (less than 5 hours per night) had the highest BMI, PBF, WHR, AC, and BFM. Those with the highest fat mass reported the highest sleep disorders (three times a week).

In several studies, an inverse relationship between sleep duration and body mass index has been shown (28). Deficits in sleep quality and quantity disrupt neural and hormonal signaling of appetite. Such impairments are associated with an elevated desire for food and a lack of satiation, even when the body does not require additional caloric intake (29). Studies on sleep and body composition among adolescents in Saudi Arabia also showed an inverse relationship between sleep duration (less than 7 hours per day) and BMI, consistent with the present study's results. Research has shown that sleep is an important regulator in many physiological functions, including energy balance, appetite, and weight maintenance (30).

Insufficient sleep is closely linked to overweight and obesity, potentially due to complex biological mechanisms, including hormonal regulation, genetic susceptibility, gut microbiome changes, and inflammatory responses. First, sleep can regulate body weight by affecting energy metabolism and the levels of appetite-regulating hormones. Specifically, reduced sleep duration is associated with decreased leptin (the satiety hormone) and increased ghrelin (the hunger hormone), leading to an increase in Body Mass Index (BMI) (31).

Yazdanpanah et al. showed that people who sleep more than 7 hours a night have a lower BMI compared to those who sleep less than 7 hours a night. The results of the aforementioned studies are consistent with those of the present study. A decrease in sleep duration is associated with lower leptin (satiety hormone) levels, higher ghrelin (hunger hormone) levels, and, consequently, higher BMI (32).

In the current study, the inverse relationship between sleep duration and body fat percentage was also shown.

Rontoyanni et al. in their study reported a negative correlation between sleep duration and fat percentage in healthy women (33), which supports the fact that sleep duration is significantly related to body fat; since short sleep duration is associated with appetite regulators' hormones levels (serotonin, hypocretin, leptin and ghrelin) and fat metabolism (cortisol and growth hormones), any changes in these hormones will be a mediator for shortening sleep duration and increasing body fat (32,33).

However, it should be noted that a direct and significant relationship was observed between fat percentage and sleep disorder in the present study. The findings of the other study also show a positive relationship between poor sleep quality and body fat percentage. It should be added that poor sleep quality through various mechanisms (for example, disorder in eating habits, hormonal disorder, etc.) and changes in circadian rhythms increase the possibility of obesity. Poor sleep quality can disrupt melatonin secretion, a key mediator of energy balance and body weight regulation, and is directly associated with increased body fat and obesity (34). Also, low leptin and high ghrelin, which likely increase appetite and the risk of obesity, also affect sleep quality (35). Studies show that poor sleep quality reduces adiponectin levels and is inversely associated with obesity. Healthy people who have poor sleep quality are more resistant to insulin and face the risk of increased fat storage. Poor sleep quality, through all the mechanisms mentioned, can be associated with increased fat storage and increased risk of obesity (34).

The present study also showed that the waist-to-hip circumference ratio was significantly associated with sleep disorder parameters and total sleep duration. In another study, the waist-to-hip ratio was inversely associated with total sleep score and sleep efficiency (36). The findings of the Jurado-Fasoli et al. study showed that the total score of the questionnaire was not related to the WHR index, This difference can be related to the low sample size and the difference in the demographic characteristics of the research units in the Jurado-Fasoli et al study, in their study, 74 (39 women) middle-aged sedentary adults (40–65 years old) were investigated but in the present study 760 women aged (18-60 years old) were investigated. WHR is used to assess obesity, along with other anthropometric indicators such as body mass index and waist circumference. WHR is a quick and easy way to assess body composition and is a common measure of abdominal fat. Of course, due to the limitations of the BMI index in considering the different distribution of body fat: general, abdominal, and neck, as well as its disproportion in different ethnicities and races, the use of the WHR index, which takes into account the physical differences of people, has been suggested (34).

Studies suggest that neck-to-height ratio (NHR) and waist-to-height ratio (WHR) may better predict obesity patterns in individuals at risk for obstructive sleep apnea (37).

The present study showed a direct relationship between abdominal circumference and sleep duration, sleep disorders, and total sleep score. Abdominal circumference is a simple, accurate, and reliable determinant of visceral and abdominal obesity and predicts obesity-related risk and health outcomes. Research shows that the abdominal circumference index is a better indicator of health than BMI. Increased fat deposition in the abdominal area is associated with a high risk of obesity-related health conditions (38). Borowska et al. in their study showed that too long or too short sleeping increases

the risk of developing metabolic syndrome by increasing the possibility of abdominal obesity and weight gain (39). Short sleep duration is associated not only with total fat tissue but also with its distribution, and chronic sleep deprivation is a cause of abdominal obesity and associated health risks (40).

A limitation of this study was the lack of access to objective sleep assessment tools, such as Polysomnography, to measure sleep quality. Therefore, data collection was limited to subjective self-reports (or the PSQI questionnaire) provided by the participants."The other notable limitation of this study was the inability to account for all covariates that affect sleep and body composition. Given the diverse range of physiological, environmental, and lifestyle factors involved, controlling for every possible interfering variable was beyond the practical capacity of the current research.

5. *Conclusion*

The results showed that body composition indicators, such as body fat mass and body fat percentage, as well as BMI, PBF, WHR, AC, and BFM, an anthropometric index, are correlated with sleep quality. These results suggest that poor sleep quality is associated with higher anthropometric indices of obesity and highlight the importance of considering sleep hygiene as a potential factor in weight management programs for women in organizational settings.

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Availability of data and materials: The data supporting the current study's review findings are available from the corresponding author upon reasonable request.

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Authors' contributions: Conception and design: MS and FZK, Literature search, Data acquisition, Analysis: MS and FZK, Interpretation of data and drafting the manuscript: MS and FZK, Critical revision of the manuscript: MS and FZK

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