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Association between the DASH dietary pattern with sleep duration and sleep quality in Iranian employees

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Abstract

Background The association between the dietary approach to stop hypertension (DASH) and sleep status is well-documented. Nevertheless, a consistent relationship with employees population has yet to be known. Thus, we aimed to investigate the relationship between the DASH diet and sleep quantity/quality among Iranian employees of both genders.

Methods We enrolled 337 persons whose Sleep status was assessed through the Pittsburgh Sleep Quality Index. A validated Food Frequency Questionnaire was used to measure the DASH diet score. Analysis of variance and covariance, chi-square, and multinomial logistic regression tests were used as appropriate.

Results Our findings demonstrated that, even after adjusting for multiple potential confounders the odds of poor sleep quality were not significantly related to the higher DASH diet adherence (OR = 0.69, 95% CI: 0.38–1.27). However, participants in the highest tertiles of DASH had lower chances of experiencing short sleep duration compared to those in the lowest one (OR = 0.53; 95% CI: 0.30–0.96).

Conclusions The present study indicated that Iranian employees with a higher adherence to the DASH diet had considerably lower odds of having short sleep; however DASH adherence has no significant effect on sleep quality. More prospective and controlled investigations are required to confirm these findings.

Keywords DASH diet, Sleep quality, Sleep duration, Cross-sectional

Background

Typically, individuals spend about a third of their day in the work, which can often lead to the development of unhealthy behaviours [1]. These habits can contribute to health issues, increased absenteeism, and decreased work performance [2]. In particular, sleep problems are linked to lower work efficiency, higher absentee rates, and more frequent use of sick leave [3]. The National Institute of Health (NIH) suggests that adults should aim for 7 to 8 h of sleep each night [4]. Approximately 30% of people worldwide and 40% of individuals in Iran experience sleep problems [5, 6], with prevalence typically rising as they age and being more common in women than

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men [7, 8]. Compelling evidence indicates a potential link between inadequate sleep and poor sleep quality with chronic illnesses like type 2 diabetes [9], obesity [10], cardiovascular disease [10], metabolic syndrome [11], and frailty [12].

Changes in lifestyle and environmental conditions, such as dietary choices, exercise habits, and body weight, can affect the length and quality of our sleep [13, 14]. Prior research has demonstrated associations between certain diets and how well and long we sleep [15–17]. Studies indicate that individuals who sleep for longer durations typically adhere to healthier dietary patterns, which include high consumption of vegetables, mushrooms, potatoes, seaweeds, soy products, and eggs [18, 19]. High sleep quality has been associated with improved dietary habits, which typically involve a wider variety of food choices and a lower intake of fats [20–22]. One well-known dietary pattern is the Dietary Approaches to Stop Hypertension (DASH) diet, which encourages the consumption of whole grains, nuts, fruits, vegetables, low-fat dairy, and lean meats while discouraging saturated fats, red meat, sweets, and sugary drinks [23]. The DASH diet has reduced levels of overall fat, saturated fat, and cholesterol, but includes higher levels of fiber, magnesium, potassium, calcium, and protein [24, 25]. It was initially designed for managing hypertension, but research has also shown its positive impacts on cholesterol levels, diabetes, gestational diabetes, cardiovascular disease, mood, depression, and sleep status [26–36].

Some recent articles have found an association between the DASH diet and sleep status [36–39]. Yet, as far as we know, no research has specifically investigated this relationship in employees. Given that work-related stress, irregular schedules, and occupational demands significantly influence sleep patterns, findings from the general population may not be directly applicable to employees [40]. Additionally, many studies examining the DASH diet and sleep disorders have primarily focused on female populations. Therefore, this study aims to examine the association between the DASH diet with sleep quantity/quality among employees of Iranian society.

Materials and methods

Study design and participants In 2020, a cross-sectional study was conducted involving employees of the Water and Power Organization in Ahvaz, located in southwest Iran. Considering a prevalence of 35% for lack of sufficient sleep duration and sleep quality among Iranian adults [41], a confidence of 95%, and precision (d) of 5.1%, 337 subjects were approximately needed for this investigation. The inclusion criteria were individuals aged between 18 and 60, from either gender, employed in any administrative role, and willing to participate in the survey. Those excluded were (1) employees with a history of stroke, heart disease, diabetes, or other conditions affecting eating habits, (2) pregnant or lactating women, and (3) individuals who followed specific weight loss or weight gain diets in the past six months. Additionally, participants who left blank items on the food frequency questionnaire were also excluded.

Assessment of dietary intakes We assessed the usual dietary intake of the participants with a validated Willett format semi-quantitative 168-item food frequency questionnaire (FFQ) [42]. A trained dietitian guided the study participants in filling out the FFQ, where they indicated the frequency and amount of each food item they had eaten in the previous year. The portion sizes of the foods they consumed were then measured using standard home measurements and converted to grams per day [42, 43]. All food items were then entered into Nutritionist IV software to calculate the daily intake of nutrients and energy.

Assessment of adherence to DASH In order to evaluate participants' adherence to the DASH diet, we developed the DASH diet score based on eight dietary components including high consumption of fruits, vegetables, dairy products, nuts, and legumes, along with low consumption of grains, sodium, sugary drinks and sweets, and red or processed meats [44]. For this study, we treated refined and whole grains as a single group of grains. While whole grains were initially given a high score in the original DASH diet scoring, we did not consider total grain intake as a healthy food choice due to the low consumption of whole grains in the Iranian population (< 10 g/day) [35]. Initially, we determined energy-adjusted intakes of these foods and nutrients using the residual method [45]. Following this, individuals were sorted into deciles based on their energy-adjusted intakes. Those in the top decile for fruits, vegetables, dairy products, legumes, and nuts received a score of 10, while those in the bottom decile were assigned a score of 1. Conversely, individuals in the top decile for total grains, red and processed meats, sugar-sweetened beverages, sweets, and sodium were given a score of 1, and those in the lowest decile received a score of 10. Finally, the DASH diet score for each participant was computed by summing the scores from all the foods and nutrients. As a result, participants had a DASH diet score ranging from 8 to 80.

Assessment of outcomes The Pittsburgh Sleep Quality Index (PSQI) was used to assess both the quality and quantity of sleep experienced by participants over the previous month [46, 47]. This index consists of 7 questions that cover different aspects of sleep, such as quality, latency, duration, efficiency, disturbances, medication use, and daytime dysfunction. Each question is scored from 0 to 3, with a total score range of 0 to 21. Based on previously validated criteria a PSQI score lower than 6 indicates good sleep quality, while 6 or higher suggests poor sleep quality [48]. Specifically, the fourth question on the PSQI was used to determine sleep duration, asking "How many hours do you sleep per night?" Participants who reported sleeping less than 6 h per night were classified as having short sleep [49].

Assessment of other variables Participants' height and weight were measured while they stood in minimal clothing and without shoes. Height was measured with a wall-mounted tape meter to the nearest 0.5 cm, and weight was assessed with a body composition analyzer (Type: GLAMOR GBF-830, China). Body mass index (BMI) was calculated by dividing weight (in kg) by height (in m) squared. A self-reported questionnaire was used to gather information on various confounding variables such as age, sex, marital status, education, smoking habits, home ownership, and other socio-economic factors, as well as medical history. Additionally, the validated International Physical Activity Questionnaire (IPAQ) was used to assess participants' physical activity levels [50].

Statistical analysis The Kolmogorov–Smirnov test was used to evaluate the normality of data. Participants' characteristics were compared using chi-square tests for categorical variables and analysis of variance (ANOVA) for continuous variables. Results for categorical variables are reported as percentages, while continuous variable results are presented as means with standard deviations (SD). The participants' dietary intakes across DASH tertiles were assessed using analysis of covariance (ANCOVA). Energy and macronutrient intakes were adjusted for age and sex, while other dietary intakes were adjusted for age, sex, and energy intake. Binary logistic regression was conducted to determine the odds ratios (OR) and 95% confidence intervals (CI) for short sleep duration (< 6 vs. ≥ 6 h) and poor sleep quality (score ≥ 6 vs. < 6) within different tertiles of DASH diet in both crude and adjusted models. Based on previous literature [51, 52] in this regard, age, sex, and energy intake were adjusted in the first model. The second model included additional adjustments for marital status, physical activity, smoking status, and education level, while the final model was further adjusted for BMI. The first tertile of the DASH diet score served as the reference category in all models. All statistical analyses were performed using SPSS version 16.0, with statistical significance set at $P < 0.05$.

Ethical approval and consent to participate Written consent was obtained from all participants, and the study protocol was approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.REC.1398.795).

Results

This study was conducted on 337 participants, consisting of 101 females and 236 males, whose average age was 43.6 ± 7.99 years. It was found that 62.3% of participants had poor sleep quality and 39.16% had short sleep duration.

Table 1 displays the general characteristics of the study participants based on their DASH diet score tertiles in detail. Participants in the highest tertile of the DASH diet score had lower weight compared to those in the lowest tertile. Additionally, there were significant differences in gender and education status among the tertiles of the DASH diet score. No other significant difference was observed in age, BMI, marital status, physical activity levels, and smoking status across the DASH diet score tertiles.

Table 2 illustrates the age, gender, and energy-adjusted dietary intakes of the study participants based on their tertiles of DASH diet score. Participants in the highest tertile consumed higher amounts of fruits, vegetables, dairy, legumes and nuts, dietary fiber, calcium, magnesium, vitamin B6, and vitamin B9 compared to those in the lowest tertile. Conversely, those in the highest tertile consumed lower amounts of meat, grains, SBS, sodium, proteins, and vitamin B12 (all *P*-values < 0.05). There were no significant differences in the distribution of fat and carbohydrates among the tertiles of the DASH diet score.

Figure 1 illustrates the prevalence of participants with poor sleep quality and short sleeping within energy-adjusted tertiles of the DASH diet. Poor sleep quality was found in 68.2%, 54.7%, and 64.6% of participants among DASH diet tertiles respectively, with no statistically significant difference ($P = 0.09$). Furthermore, no difference was observed in the prevalence of short sleeping across tertiles of the DASH diet (45.7%, 40.1%, and 31.8%, $P = 0.1$).

Table 3 shows the Crude and multivariable-adjusted ORs for short sleeping and poor sleep quality based on different levels of DASH diet adherence. The study found that the highest adherence to the DASH diet score was not significantly related to the odds of having poor sleep quality in the crude (OR = 0.85, 95% CI: 0.48–1.49) and full-adjusted models (OR = 0.69, 95% CI: 0.38–1.27). There was also no significant trend in poor sleep quality across tertiles of the DASH diet score ($P_{trend} = 0.25$).

However, participants who ranked highest in DASH diet adherence had lower chances of experiencing short sleep duration (less than 6 h per night) compared to those in the lowest tertile in the initial analysis (OR = 0.55; 95% CI: 0.32–0.96, $P_{trend} = 0.03$). This association remained significant even after adjusting for potential confounders (OR = 0.53; 95% CI: 0.30–0.96, $P_{trend} = 0.04$).

Table 1 General characteristics of study participants across energy-adjusted tertiles of the DASH diet score ($n=337$)[1]

	Tertiles of energy-adjusted DASH diet			P_{value}[2]
	T_1 (*n* = 107) (8–39)[3]	**T_2 (*n* = 117) (40–48)[3]**	**T_3 (*n* = 113) (49–80)[3]**	
Age (year)	44.07 ± 7.47	43.71 ± 7.89	43.28 ± 8.60	0.76
Weight (kg)	80.63 ± 17.17	76.25 ± 11.60	75.98 ± 13.93	0.03
Body mass index (kg/m^2)	26.75 ± 5.23	26.08 ± 3.10	25.90 ± 3.59	0.26
Sex, female (%)	20.6	29.9	38.9	0.01
Education status (%)				0.03
Bachelor or less	57	59.8	52.2	
Master	39.3	39.3	38.1	
PhD	3.7	0.9	9.7	
Marital status (%)				0.56
Single	10.3	13.7	15	
Married	89.7	86.3	85	
Physical activity (Met min day^{-1})	1396.48 ± 298.25	1379.34 ± 272.22	1322.18 ± 361.75	0.18
Smoking status (%)				0.39
No	93.5	92.3	96.5	
Yes	6.5	7.7	3.5	

[1]For continuous variables, values are Mean ± SD

[2]Obtained from ANOVA for continuous variables and chi-square test for categorical variables. *P* value is statistically significant at $P<0.05$

[3]DASH score range

n: number of participants

Table 2 Multivariable-adjusted intakes of DASH diet components and selected nutrients of study participants across energy-adjusted tertiles of the DASH diet score ($n=337$)[1]

	Tertiles of energy-adjusted DASH diet			P_{value}[2]
	T_1 (*n* = 107) (8–39)[3]	**T_2 (*n* = 117) (40–48)[3]**	**T_3 (*n* = 113) (49–80)[3]**	
Energy (Kcal/d)	3755.80 ± 137.40	3281.64 ± 130.48	2863.01 ± 133.65	< 0.001
Food groups (g/day):				
Fruits	340.01 ± 60.06	589.65 ± 56.08	733.43 ± 58.33	< 0.001
Vegetables	487.85 ± 28.00	506.09 ± 26.15	625.16 ± 27.20	0.001
Dairy	25.20 ± 4.24	34.00 ± 3.96	52.98 ± 4.12	< 0.001
Legumes and nuts	89.62 ± 10.69	115.46 ± 9.98	132.86 ± 10.38	0.018
Meat	176.65 ± 7.98	139.18 ± 7.46	116.49 ± 7.76	< 0.001
Refined grains	768.55 ± 19.90	589.86 ± 18.58	518.69 ± 19.33	< 0.001
Sugar-Sweetened Beverages	236.35 ± 11.99	234.49 ± 11.20	172.82 ± 11.65	< 0.001
Other nutrients:				
Proteins (% of energy)	12.70 ± 0.23	11.37 ± 0.22	10.90 ± 0.23	< 0.001
Fats (% of energy)	34.90 ± 1.21	37.89 ± 1.15	36.89 ± 1.18	0.20
Carbohydrates (% of energy)	54.96 ± 1.11	53.36 ± 1.05	54.83 ± 1.08	0.50
Dietary fiber (g/d)	2.44 ± 0.55	5.10 ± 0.52	5.94 ± 0.54	< 0.001
Calcium (mg/d)	1422.72 ± 63.57	1485.91 ± 59.36	1707.72 ± 61.74	0.004
Magnesium (mg/d)	626.05 ± 21.84	664.18 ± 20.39	717.85 ± 21.21	0.013
Sodium (mg/d)	6495.04 ± 169.12	5180.93 ± 157.93	4597.08 ± 164.26	< 0.001
Vitamin B_6 (mg/d)	3.12 ± 0.12	3.50 ± 0.12	4.09 ± 0.12	< 0.001
Vitamin B_9 (mcg/d)	836.19 ± 18.54	844.82 ± 17.32	910.53 ± 18.01	0.008
Vitamin B_{12} (mcg/d)	4.87 ± 0.34	5.19 ± 0.31	3.47 ± 033	< 0.001

[1]All values are means ± standard error (SE); energy intake and macronutrients are adjusted for age and gender; all other values are adjusted for age, gender and energy [2]Obtained from ANCOVA. *P* value is statistically significant at $P<0.05$

[3] DASH score range

n: number of participants

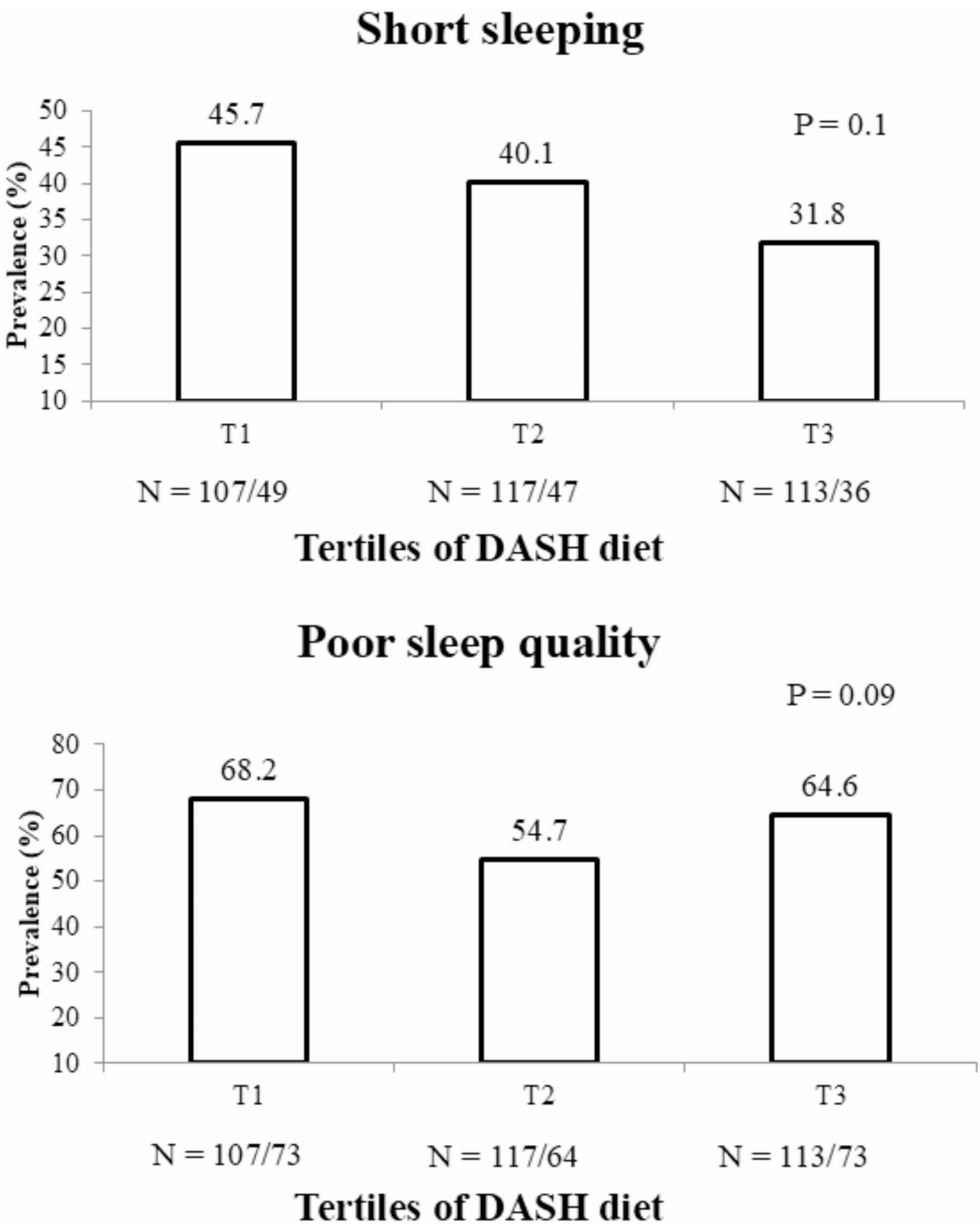

Fig. 1 The prevalence of short sleeping and poor sleep quality in study participants across tertiles of DASH diet. *P*-value Obtained from chi-square test

Table 3 Multivariable-adjusted odds ratio for short sleeping and poor sleep quality across energy-adjusted tertiles of the DASH diet score ($n=337$)[1]

	Tertiles of energy-adjusted DASH diet			P_{trend}[2]
	T_1 (8–39)[3]	T_2 (40–48)[3]	T_3 (49–80)[3]	
Poor sleep quality				
Participants/Cases (n)	107/ 73	117/ 64	113/ 73	
Crude	1.00	0.56 (0.33–0.97)	0.85 (0.48–1.49)	0.60
Model 1	1.00	0.52 (0.30–0.91)	0.74 (0.41–1.34)	0.35
Model 2	1.00	0.48 (0.27–0.86)	0.69 (0.38–1.27)	0.25
Model 3	1.00	0.48 (0.27–0.86)	0.69 (0.38–1.27)	0.25
Short sleeping				
Participants/Cases (n)	107/ 49	117/ 47	113/ 36	
Crude	1.00	0.79 (0.47–1.35)	0.55 (0.32–0.96)	0.03
Model 1	1.00	0.76 (0.44–1.31)	0.51 (0.29–0.92)	0.02
Model 2	1.00	0.74 (0.42–1.28)	0.53 (0.30–0.96)	0.04
Model 3	1.00	0.74 (0.42–1.28)	0.53 (0.30–0.96)	0.04

[1] All values are odds ratios and 95% confidence intervals by using binary logistic regression

Model 1: Adjusted for age, gender, energy intake. Model 2: More adjustments for physical activity levels, education status, marital status, socioeconomic status, and smoking status. Model 3: Further adjustment for BMI

[2] P trend was obtained by considering the tertiles of DASH diet as an ordinal variable. *P* value is statistically significant at $P<0.05$

[3] DASH score range

n: number of participants

Discussion

The current study examined how the DASH diet is related to the amount and quality of sleep in both male and female workers. Results showed a significant link between following the DASH diet and getting enough sleep, although no significant association was found with sleep quality.

Adequate sleep is closely linked to a reduction in chronic diseases and contributes to an improved quality of life as well as increased productivity at work [2]. Our findings, supported by previous studies, suggest that following the DASH diet can lead to longer sleep duration [36, 38, 39]. Given these results, clinicians may consider recommending a DASH diet to improve individuals' sleep health.

Epidemiological research has shown that higher consumption of high-calorie foods and refined carbohydrates is associated with shorter sleep [53, 54]. Shiraseb et al. [39] study shows that the DASH diet, which focuses on the consumption of healthier foods such as whole grains, nuts and legumes, vegetables, fruits, and dairy products, and prohibits excessive consumption of red meat, simple carbohydrates, and fizzy drinks, is associated with better sleep quality. However, our study did not yield any significant results for sleep quality. This discrepancy may be attributed to our study population, which included both male and female employees, whereas the previously mentioned study focused solely on obese and overweight women. Additionally, we assessed the grains group negatively in the DASH scoring because most Iranian households primarily use refined grains [55]. Research conducted by Pahlavani et al. [37] and Liang et al. [38] has examined the relationship between adherence to the DASH diet and sleep status, and both studies revealed a significant positive relationship. Additionally, another study found that higher adherence to the DASH diet was linked to a significantly lower prevalence of poor sleep. Their study revealed that individuals in the top quartile of DASH diet adherence had about a 30% reduced risk of poor sleep compared to those in the lowest quartile [56]. In contrast, in a case-control study on individuals recovering from COVID-19, reported no significant relationship between DASH diet adherence and sleep quality or insomnia [57]. Daneshzadeh et al. [36] investigated the effects of the DASH diet on sleep among women with type 2 diabetes, finding that sleep duration increased after 12 weeks of intervention. The DASH diet is abundant in proteins, antioxidants, and micronutrients, which can enhance the body's overall function [58]. DASH diet has a relatively significant amount of Tryptophan, an amino acid that produces serotonin and may play a role in the quality and duration of sleep [58]. On the other hand, the vegetables included in the DASH diet are rich in folate and magnesium. These micronutrients are essential for the production of various neurotransmitters, such as serotonin, dopamine, and norepinephrine, and may positively impact brain function and sleep quality [59, 60]. Additionally, some research revealed that the length of sleep was connected to the metabolites like tyrosine and phenylalanine. It is possible that consuming large quantities of animal proteins, which we can't see in dash diet, could lower the balance of tryptophan and tyrosine in the blood, disrupting the production of sleep-related neurotransmitters and resulting in lower sleep quality [61]. Furthermore, studies have indicated a positive association between certain isoflavones, which are abundant in the fruits and vegetables of the DASH diet, and improved sleep quality [62].

The current study has a number of advantages. As far as we know this is the first study examining the association between DASH diet and sleep quality and quantity in employees. Furthermore, we use modified DASH diet scoring, which is more suited to the daily diet of Iranian society and can give us thoughtful results. However, this investigation had several limitations. First, due to the cross-sectional nature, it is impossible to conclude a causal relationship between the DASH diet and sleep quality and quantity. Secondly, there may have been a potential for self-report bias since data on diet and sleep were obtained through questionnaires. Third, residual confounding may have existed due to unmeasured or unknown factors, such as consumption of snacks before bedtime, and use of medications and supplementation. Additionally, the participants in our study are Ahvazian employees. As a result, the current study may not be easily extrapolated to all populations and it is important to exercise caution when extending our results to the larger population. Future research should focus on longitudinal and intervention studies to establish a causal link between DASH diet adherence and sleep outcomes. Subgroup analyses can identify variations based on demographics or lifestyle factors, while examining specific dietary components may clarify which nutrients contribute most to sleep health. Additionally, comparing the DASH diet with other dietary patterns could reveal the most effective diet for improving sleep quality and duration.

Conclusions

In conclusion, this population-based cross-sectional study showed that higher adherence to the DASH diet is associated with a decrease in the probability of sleep deprivation in Iranian employees, but no correlation was seen with sleep quality. Further research with diverse populations is necessary to confirm our findings on the relationship between adherence to the DASH diet and sleep status.

Abbreviations

FFQ	Food frequency questionnaire
SPSS	Statistical package for the social sciences
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
OR	Odds ratios
95% CI	95% confidence interval
SD	Standard deviation
BMI	Body mass index
IPAQ	International Physical Activity Questionnaire
PSQI	Pittsburgh Sleep Quality Index

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Author contributions

AM, SK, SK, and MZ contributed in conception, design, data collection, data interpretation, manuscript drafting, approval of the final version of the manuscript, and agreed to all aspects of the work.

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Data availability

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

Declarations

Ethics approval and consent to participate

All participants provided an informed written consent. The study protocol was approved by the local Ethics Committee of Ahvaz Jundishapur University of Medical Sciences.

Consent to participate

Informed consent was obtained from all participants involved in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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