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RESEARCH

Association of sleep quality with nutritional status and body mass index in adults

Yetişkinlerde uyku kalitesinin beslenme durumu ve beden kütle indeksi ile ilişkisi

Mehmet Arif İçer[1], Makbule Gezmen Karadağ[2]

[1]Department of Nutrition and Dietetics, Faculty of Health Sciences, Amasya University, Amasya, Turkey
[2]Department of Nutrition and Dietetics, Faculty of Health Sciences, Gazi University, Ankara, Turkey

Abstract

Purpose: Identifying the factors that affect sleep quality will help minimize potential health risks. This study aimed to evaluate the association of sleep quality with dietary habits, nutritional status and body mass index (BMI) in adults.
Materials and Methods: This study was conducted on 576 healthy individuals, 293 males and 283 females, aged between 18-65 years. The study did not include individuals with chronic diseases, pregnant and lactating women. The participants' descriptive information, dietary habits, and some anthropometric measurements were questioned. Additionally, Pittsburgh Sleep Quality Index (PSQI) was applied to the participants and 24-hour dietary recalls were recorded.
Results: In both male and total participants, the rate of good sleep quality of those with a BMI between 18.50-24.99 kg/m² was lower than those with a BMI ≥25 kg/m². The number of cigarette smoked in a day and the total PSQI score of the male and total participants were positively correlated. Additionally, there was a positive correlation between the percentage of saturated fatty acids in the diet and the total PSQI scores in female and total participants, while a negative relationship was found between dietary niacin (mg) and copper (mg) intakes and total PSQI scores in female.
Conclusion: The results of the study indicate that there is a relationship between sleep quality and nutritional status, and BMI. It can be concluded that some lifestyle modifications such as smoking cessation/reduction and the acquisition of healthy eating habits can be used to improve sleep quality.

Keywords:. Sleep quality, pittsburgh sleep quality index, nutritional status, nutrient intake, body mass index

Öz

Amaç: Uyku kalitesini etkileyen faktörlerin belirlenmesi, olası sağlık risklerinin minimalize edilmesine fayda sağlayacaktır. Bu çalışmada yetişkin bireylerde uyku kalitesi ile beslenme alışkanlıkları, beslenme durumu ve beden kütle indeksi (BKİ) arasındaki ilişkinin değerlendirilmesi amaçlanmaktadır.
Gereç ve Yöntem: Bu çalışma yaşları 18-65 yıl arasında değişen 293 erkek ve 283 kadın olmak üzere toplam 576 sağlıklı birey üzerinde yürütülmüştür. Kronik hastalığı olan bireyler, hamileler ve gebeler çalışmaya dahil edilmemiştir. Tüm katılımcıların tanımlayıcı bilgileri, beslenme alışkanlıkları, bazı antropometrik ölçümleri sorgulanmıştır. Ayrıca bireylere Pittsburgh Uyku Kalite İndeksi (PUKİ) uygulanmış ve bireylerden 24 saatlik geriye dönük hatırlatma yöntemi ile besin tüketim kayıtları alınmıştır.
Bulgular: Hem erkek hem de toplam katılımcılarda BKİ 18.50-24.99 kg/m² aralığında olanların iyi uyku kalitesine sahip olma oranları BKİ ≥25 kg/m² olanlardan daha düşüktür. Erkek bireylerde ve toplam katılımcılarda sigara kullanım sayısı ile PUKİ toplam puanı arasında pozitif bir korelasyon bulunmuştur. Ayrıca çalışmada, kadın bireyler ve toplam katılımcıların diyette doymuş yağ asitleri yüzdesi ile PUKİ toplam puanları arasında pozitif bir korelasyon tespit edilmişken, kadın bireylerin diyetle niasin (mg) ve bakır (mg) alımları ile PUKİ toplam puanları arasında ise negatif bir korelasyon saptanmıştır.
Sonuç: Çalışma sonuçları, uyku kalitesi ile beslenme durumu, yeme alışkanlıkları ve BKİ arasında bir ilişki olduğuna işaret etmektedir. Sigara kullanımının sonlandırılması/kullanım sayısının azaltılması ve sağlıklı beslenme alışkanlıklarının edinimi gibi bazı yaşam tarzı değişikliklerinin uyku kalitesinin iyileştirilmesi çabaları içinde önemli bir yere sahip olduğu sonucuna varılabilir.

Anahtar kelimeler: Uyku kalitesi, pittsburgh uyku kalite indeksi, beslenme durumu, besin ögesi alımı, beden kütle indeksi

Address for Correspondence: Mehmet Arif İçer, Amasya University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Amasya, Turkey E-mail: m.arif.icer@gmail.com
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INTRODUCTION

While healthy sleep requires adequate duration, quality, appropriate timing and regularity, and the absence of sleep disturbances[1], insufficient sleep (short sleep duration and/or poor sleep quality) is becoming more and more common in modern societies[2,3]. Although there are many factors responsible for the decrease in sleep time over the years, this situation is mostly attributed to the modern lifestyle (artificial light, caffeine use, screen time late at night, parental attitudes, etc.)[4]. Although reducing sleep time is considered a good strategy to deal with time constraints, it is known to negatively affect health[5]. Determining which factors affect sleep quality on health will help to better understand the mechanisms and minimize possible health risks. Some of these factors are thought to be eating habits, nutritional status, and body mass index (BMI)[5].

Inadequate sleep is associated with many health problems, among which body weight gain and obesity have an important place[6,7]. Inadequate sleep increases our vulnerability to overeating in the current obesogenic environment[8]. It is stated that sleep restriction may cause differences in the secretion levels of appetite hormones[9]. Having more time and opportunity to eat while awake is another reason for changes in food consumption[5]. Furthermore, some findings suggest that there may be bidirectional effects, such as inadequate sleep causing body weight gain and obesity causing inadequate sleep, hence creating a setting for a vicious circle[5,10]. In addition to the possible effects of sleep on food choices (short-term sleepers are more likely to consume energy-dense foods), it is stated that consumption of certain foods may also affect sleep status[5]. However, the connection between good sleep and nutritional status as well as weight management is still not well understood.

Nutrition plays a significant role in maintaining healthy sleep patterns[11]. It is mentioned that nutrition is effective in the regulation of sleep health through different mechanisms. The first of these mechanisms is the direct effect of certain foods and nutrients on one's ability to get to sleep[12]. Caffeine, which is found in beverages like coffee and tea, has been linked to a variety of negative sleep outcomes, including a delay in falling asleep and a decrease in sleep quality[13]. The second possible mechanism is that many dietary metabolites may play a role in sleep regulation, either directly or by influencing the activity of other factors[12]. For instance, dietary changes can have a sizable impact on the composition of gut microbiota, which in turn can modify metabolite production[12]. Another possible mechanism is that long-term dietary habits have effects on sleep quality through their effects on the inflammatory process[12]. For instance, the gut microbiota can also produce various metabolites like the short-chain fatty acids (SCFAs) to communicate with the central nervous system[14].

Considering all these data obtained from the literature, determining the relationship between sleep quality and eating habits, nutritional status, and BMI is important for improving sleep quality and thus general health. The essential hypotheses of the study are that socio-demographic characteristics, nutritional status, and anthropometric measurements are effective on sleep quality. By testing these hypotheses with the data obtained from the study, significant contributions will be made to the literature in terms of determining possible dietary and behavioral changes to improve sleep quality. To that end, the purpose of this research is to assess the connection of adults' sleep quality with dietary habits, nutritional status, and BMI.

MATERIALS AND METHODS

Participants

A total of 576 healthy participants (including 293 men and 283 women) between the ages of 18 and 65 years were included in the study. Study data were collected in Ankara and Amasya. As a result of the power analysis using the GPower 3.0.10 program, at least 500 samples were sufficient with 80% power and 5% margin of error. Individuals with chronic diseases (such as kidney diseases, diabetes, neurological diseases), pregnant and lactating women were not included in the study. Accordingly, 600 individuals were reached, but 15 individuals were excluded due to lack of information and 9 individuals due to their existing chronic diseases.

Procedure

A questionnaire form was applied to the participants through face-to-face interviews. Each person participating in the study was given a number (1,2,3, etc.) and recorded in this way. The data of the participants were not used for any purpose other than the study. Forms such as questionnaires obtained from the participants were stored in a safe place in a locked cabinet, and these data transferred to the computer were stored in the computer data memory with encryption protection. Participants were asked to provide information about their demographic characteristics (age, gender, marital status, level of education, body weight, and height), smoking-alcohol use, and dietary habits through this questionnaire form. Additionally, participants' dietary intake was recorded using the 24-hour dietary recall method, and their sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI). The "body weight/height^2 (kg/m^2)" formula was used to determine BMI[15].

Approval was obtained from the Gazi University Ethics Committee under approval number E.547302 (date: 30.12.2022). The study was conducted in accordance with the principles outlined in the Helsinki Declaration, and all participants provided written informed consent.

Evaluation of sleep quality: Pittsburgh Sleep Quality Index (PSQI)

The PSQI was designed by Daniel J. Buysse as a standardized, self-administered questionnaire for assessing sleep quality and disturbances over the previous month[16]. Agargün et al. conducted a reliability and validity analysis of the Turkish PSQI[17]. The PSQI consists of 19 self-rating questions, each of which is graded from from 0 to 3 and grouped into seven subcategories[18]. The total PSQI score is the sum of the scores for the seven subscales. The subcategories are subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction. The total score can range from 0 to 21, and a high value indicates poor sleep quality[16,18]. When the total PSQI score is 5 or less, it is considered to be of "good sleep quality," while a score above 5 indicates the opposite ("poor sleep quality")[19].

Nutritional assessment

Twenty-four-hour dietary recall were taken by the researcher for determining participants' daily dietary energy and nutrient intake. The book "Yemek ve Besin Fotoğraf Katalogu: Ölçü ve Miktarlar" was used to assist the participants in determining the portion amounts of foods[20]. For the determination of food quantities and the amounts included in the portions of the meals "Toplu beslenme servisi yapılan kurumlar için standart yemek tarifeleri" and "Türk Mutfağından Örnekler" was used[21,22]. The average energy and nutrient values of daily consumed foods were calculated using the Nutrition Information System (BeBis) software 9.0 full version[23].

Statistical analysis

SPSS, a statistical analysis program, version 23.0 was used to conduct the tests. The chi-square test was utilized to compare the categorical data. Mann-Whitney U test was used to compare the means ($\overline{X}$) and standard deviations (SD) of qualitative data from two separate groups that did not share a common distribution. The correlations between two values were analyzed using either a Pearson test (if both values had a normal distribution) or a Spearman test (if at least one measurement value had an abnormal distribution). The cutoff for statistical significance was set at $p<0.05$.

RESULTS

The distribution of the general characteristics of the participants in the study is given in Table 1. It was determined that 77.2% of the males, 86.3% of the females and 81.6% of the total participants were between the ages of 18-25 years. The mean age of the individuals was 24.50±7.66 years for males, 23.14±7.55 years for females, and 23.84±7.63 years for total participants. Age distribution and median age were different between the groups ($p<0.05$).

Participants' BMI was significantly different between the males, females, and total participants ($p<0.05$). The rate of those with BMI ≥ 25 kg/m^2 was 43.7% in males, 17.0% in females, and 30.6% in total participants. The rate of males with BMI ≥25 kg/m^2 was higher than the females and total participants (Table 1).

The percentage of participants who were married also varied significantly differently between the groups ($p<0.05$). It was determined that 86.3% of men, 91.5% of women, and 88.9% of total participants declared that they were single. The rate of being single is highest among women with 91.5% (Table 1).

Cigarette smoking, alcohol use rate, and number of cigarettes smoked per day were 40.6%, 41.3%, and 13.13±8.01 in males, respectively; 21.9%, 13.8%, 9.03±6.70 units in females, respectively; 31.4%, 27.8%, 11.72±7.81 in total participants. The male population as a whole had significantly higher rates of smoking and alcohol use, as well as higher average daily cigarette consumption (p<0.05) (Table 1).

Table 1. Distribution of general characteristics of the participants

	Male (n=293)		Female (n=283)		Total Participants (n=576)			
	n	%	n	%	n	%	x^2	p
Age (years)								
18-25	226	77.2	244	86.3	470	81.6	8.763	**0.013***
26-45	52	17.7	27	9.5	79	13.7		
46-60	15	5.1	12	4.2	27	4.7		
Average age (years) ($\bar{X}$±SD)	24.50±7.66		23.14±7.55		23.84±7.63		U=32.447	**p=0.000***
BMI (kg/m²)								
BMI: 18.50-24.99	165	56.3	235	83.0	400	69.4	48.455	**0.000***
BMI: ≥ 25	128	43.7	48	17.0	176	30.6		
Marital status								
Married	40	13.7	24	8.5	64	11.1	3.898	**0.048***
Single	253	86.3	259	91.5	512	88.9		
Educational status								
Primary school	3	1.0	2	0.7	5	0.9	5.319	0.256
Middle School	0	0.0	1	0.3	1	0.2		
High school	81	27.6	60	21.2	141	24.5		
University	201	68.7	215	76.0	416	72.2		
Postgraduate	8	2.7	5	1.8	13	2.2		
Smoking status								
Yes	119	40.6	62	21.9	181	31.4	23.376	**0.000***
No	174	59.4	221	78.1	395	68.6		
Amount of cigarettes smoked (per day)								
1-4 pcs	13	4.4	20	7.1	33	5.7	14.410	**0.002***
5-9 pcs	21	7.2	13	4.6	34	5.9		
10-19 pcs	45	15.4	19	6.7	64	11.1		
≥20 pcs	214	73.0	231	81.6	445	77.3		
Amount of cigarettes smoked pcs/day ($\bar{X}$±SD)	13.13±8.01		9.03±6.70		11.72±7.81		U=2516 **p=0.000***	
Alcohol use								
Yes	121	41.3	39	13.8	160	27.8	54.329	**0.000***
No	172	58.7	244	86.2	416	72.2		

* $p<0.05$, Chi-square and Mann-Whitney U test, BMI: Body mass index

The distribution of dietary habits according to the BMI of the participants is given in Table 2. While the habit of consuming three main meals in males was 56.4% in those with a BMI of 18.50-24.99 kg/m², it was 60.2% in those with a BMI of ≥25 kg/m² ($p<0.05$). In total participants, three main meal consumption habits are 46.0% in those with a BMI of 18.50-24.99 kg/m², while it is 56.8% in those with a BMI ≥25 kg/m² ($p<0.05$) (Table 2).

Among the total participants, 38.5% of those with BMI between 18.50-24.99 kg/m² had two snacks a day, and those with BMI ≥25 kg/m² had a habit of consuming one snack a day with a rate of 30.7% ($p<0.05$) (Table 2).

It was determined that 27.7% of females with BMI between 18.50-24.99 kg/m² and 6.2% of females with BMI ≥25 kg/m² skipped breakfast ($p<0.05$). Among the total participants, 26.7% of the participants with BMI between 18.50-24.99 kg/m² and 18.2% of those with BMI ≥25 kg/m² skipped breakfast ($p<0.05$). The rate of skipping breakfast in both female and total participants with BMI in the range of 18.50-24.99 kg/m² was higher than those with BMI ≥25 kg/m² (Table 2).

It was found that 55.2% of male individuals with BMI between 18.50-24.99 kg/m² and 66.4% of those with BMI ≥25 kg/m² had good sleep quality ($p<0.05$). Among the total individuals, 56.5% of those with a BMI between 18.50-24.99 kg/m² and 66.5% of those with a BMI of ≥25 kg/m² had good sleep quality ($p<0.05$). The rate of good sleep quality in both male and total participants with BMI in the range of 18.50-24.99 kg/m² was lower than those with BMI ≥25 kg/m² (Table 2).

Table 2. Distribution of dietary habits and PSQI assessments according to the BMI of the participants

	Male (n=293)			**Female (n=283)**			**Total Participants (n=576)**		
	BMI: 18.50-24.99	**BMI: ≥25**		**BMI: 18.50-24.99**	**BMI: ≥25**		**BMI: 18.50-24.99**	**BMI: ≥25**	
	n (%)	n (%)	p_1	n (%)	n (%)	p_2	n (%)	n (%)	p_3
Main meal habits									
1	4 (2.4)	10 (7.8)		3 (1.3)	2 (4.2)		7 (1.7)	12 (6.8)	
2	68 (41.2)	41 (32.0)	**0.045***	141 (60.0)	23 (47.9)	0.155	209 (52.3)	64 (36.4)	**0.000***
3	93 (56.4)	77 (60.2)		91 (38.7)	23 (47.9)		184 (46.0)	100 (56.8)	
Snacking habits									
0	54 (32.7)	46 (35.9)		25 (10.6)	4 (8.3)		79 (19.8)	50 (28.4)	
1	42 (25.5)	36 (28.1)	0.696	74 (31.5)	18 (37.5)	0.743	116 (29.0)	54 (30.7)	**0.026***
2	46 (27.9)	28 (21.9)		108 (46.0)	19 (39.6)		154 (38.5)	47 (26.7)	
3	23 (13.9)	18 (14.1)		28 (11.9)	7 (14.6)		51 (12.7)	25 (14.2)	
Breakfast skipping									
Yes	42 (25.5)	29 (22.7)	0.579	65 (27.7)	3 (6.2)	**0.002***	107 (26.7)	32 (18.2)	**0.027***
No	123 (74.5)	99 (77.3)		170 (72.3)	45 (93.8)		293 (73.3)	144 (81.8)	
Lunch skipping									0.727
Yes	33 (20.0)	28 21.9)	0.695	75 (31.9)	22 (45.8)	0.064	108 (27.0)	50 (28.4)	
No	132 (80.0)	100 (78.1)		160 (68.1)	26 (54.2)		292 (73.0)	126 (71.6)	
Dinner skipping									0.667
Yes	2 (1.2)	4 (3.1)	0.252	9 (3.8)	2 (4.2)	0.912	11 (2.7)	6 (3.4)	
No	163 (98.8)	124 (96.9)		226 (96.2)	46 (95.8)		389 (97.3)	170 (96.6)	
PSQI Assessments									
Good sleep quality	91 (55.2)	85 (66.4)	**0.050***	135 (57.4)	32 (66.7)	0.237	226 (56.5)	117 (66.5)	**0.025***
Poor sleep quality	74 (44.8)	43 (33.6)		100 (42.6)	16 (33.3)		174 (43.5)	59 (33.5)	

* $p<0.05$, Chi-square test, PSQI: Pittsburgh sleep quality İndex; BMI: Body mass index.
p_1: It shows the difference between male individuals with BMI between 18.50-24.99 and those with BMI ≥25.
p_2: It shows the difference between female individuals with BMI between 18.50-24.99 and those with BMI ≥25.
p_3: It shows the difference between total participants with BMI between 18.50-24.99 and those with BMI ≥25.

The evaluation of participants' sleep duration, falling asleep, and total PSQI scores according to BMI is shown in Table 3. Male and total participants with BMI between 18.50-24.99 kg/m² had higher total PSQI scores than those with BMI ≥25 kg/m² ($p<0.05$). There was no significant difference between females with BMI between 18.50-24.99 kg/m² and with BMI (kg/m²) ≥25 kg/m² in terms of total PSQI scores ($p>0.05$). Additionally, neither the sleep duration nor the falling asleep time of the participants differs significantly between the groups ($p>0.05$) (Table 3).

Table 3. Sleep duration, falling asleep, and total PSQI scores of participants according to body mass index

	Male (n=293)			**Female (n=283)**			**Total Participants (n=576)**		
	BMI: 18.50-24.99	BMI: ≥25		BMI: 18.50-24.99	BMI: ≥25		BMI: 18.50-24.99	BMI: ≥25	
	$\bar{X}$±SD [Min-Max]	$\bar{X}$±SD [Min-Max]	p_1	$\bar{X}$±SD [Min-Max]	$\bar{X}$±SD [Min-Max]	p_2	$\bar{X}$±SD [Min-Max]	$\bar{X}$±SD [Min-Max]	p_3
Sleep duration (hours/day)	7.29±1.46 [3-11]	7.38±1.38 [4-11]	0.298	7.36±1.32 [3-11]	7.78±1.32 [3-11]	0.069	7.33±1.38 [3-11]	7.49±1.37 [4-11]	0.141
Falling asleep (minutes)	17.89±15.83 [1-120]	17.44±18.31 [1-120]	0.545	19.77±20.17 [1-120]	21.52±21.03 [1-120]	0.455	19.00±18.51 [1-120]	18.55±19.12 [1-120]	0.470
Total PSQI scores	5.26±2.74 [0-15]	4.58±2.69 [0-15]	0.022*	5.04±3.03 [0-15]	4.81±3.20 [0-15]	0.392	5.13±2.91 [0-15]	4.64±2.83 [0-15]	0.029*

* $p<0.05$, Mann-Whitney U test, PSQI: Pittsburgh sleep quality index; BMI: Body mass index.
p_1: It shows the difference between male individuals with BMI between 18.50-24.99 and those with BMI ≥25.
p_2: It shows the difference between female individuals with BMI between 18.50-24.99 and those with BMI ≥25.
p_3: It shows the difference between total participants with BMI between 18.50-24.99 and those with BMI ≥25.

The relationship between participants' total PSQI scores and the daily energy intake and the amount of intake of some nutrients are given in Table 4. In males, the total PSQI score was positively correlated with dietary niacin (mg) intake ($r=0.130$; $p<0.05$). It was also found that there was a positive correlation between dietary saturated fatty acids (%) intake and total PSQI score in females and total participants (respectively ($r=0.180$; $p<0.05$), ($r=0.088$; $p<0.05$)). On the other hand, a negative significant correlation was found between total PSQI score and dietary niacin (mg) ($r=-0.122$; $p<0.05$) and copper (mg) ($r=-0.134$; $p<0.05$) intake in females (Table 4).

Table 4. The relationship between the total PSQI scores and the daily energy intake and the amount of intake of some nutrients.

	Male (n=293)		**Female (n=283)**		**Total Participants (n=576)**	
Energy and Nutrients	**r**	**p**	**r**	**p**	**r**	**p**
Energy (kcal)	0.004	0.942	-0.065	0.279	-0.031	0.462
Energy (kcal/kg)	0.060	0.306	-0.028	0.639	0.009	0.836
Carbohydrate (g)	-0.042	0.475	-0.084	0.159	-0.060	0.151
Carbohydrate (%)	-0.067	0.256	-0.071	0.231	-0.069	0.098
Total fiber (g)	0.033	0.573	-0.100	0.092	-0.034	0.409
Soluble fiber (g)	0.023	0.699	-0.079	0.183	-0.028	0.503
Insoluble fiber (g)	0.038	0.518	-0.098	0.101	-0.031	0.451
Protein (g)	0.026	0.663	-0.066	0.269	-0.021	0.619
Protein (%)	0.056	0.343	-0.019	0.744	0.013	0.765
Animal protein (%)	0.033	0.569	-0.034	0.568	-0.001	0.972
Vegetable protein (%)	-0.012	0.835	-0.083	0.166	-0.047	0.259
Total fat (g)	-0.053	0.364	-0.020	0.744	-0.036	0.391
Total fat (%)	-0.087	0.136	0.075	0.206	-0.002	0.953
SFAs (%)	-0.020	0.735	0.180	**0.002***	0.088	**0.034***
MUFAs (%)	-0.071	0.228	0.054	0.363	-0.002	0.953

PUFAs (%)	-0.069	0.241	-0.083	0.162	-0.076	0.067
Cholesterol (mg)	-0.052	0.378	0.032	0.593	-0.017	0.691
Omega-3 fatty acids (g)	0.037	0.530	-0.046	0.444	-0.007	0.860
Omega-6 fatty acids (g)	-0.074	0.204	-0.084	0.157	-0.078	0.061
Omega-6/omega-3	-0.023	0.696	-0.024	0.691	-0.023	0.575
Vitamin A (mcg)	-0.004	0.941	-0.020	0.732	-0.008	0.846
Vitamin E (mg)	-0.067	0.254	-0.038	0.521	-0.052	0.212
Vitamin B_1 (mg)	0.060	0.307	-0.058	0.333	-0.001	0.975
Vitamin B_2 (mg)	0.076	0.197	0.001	0.982	0.038	0.362
Niacin (mg)	0.130*	**0.026***	-0.122	**0.039***	0.007	0.865
Vitamin B_6 (mg)	0.084	0.150	-0.069	0.250	0.008	0.844
Vitamin B_{12} (mcg)	0.041	0.488	0.015	0.806	0.028	0.500
Folate (mcg)	0.082	0.162	-0.037	0.538	0.021	0.615
Vitamin C (mg)	0.093	0.111	-0.066	0.268	0.006	0.886
Calcium (mg)	0.036	0.543	0.012	0.844	0.022	0.596
Potassium (mg)	0.109	0.063	-0.091	0.127	0.007	0.869
Phosphorus (mg)	0.080	0.174	-0.077	0.199	0.003	0.952
Iron (mg)	0.010	0.865	-0.067	0.264	-0.029	0.485
Zinc (mg)	0.010	0.867	-0.027	0.653	-0.010	0.808
Copper (mg)	0.053	0.366	-0.134	**0.024***	-0.037	0.380

*p<0.05, Pearson and Spearman correlation test, SFAs: Saturated fatty acids; MUFAs: Monounsaturated fatty acids; PUFAs: Polyunsaturated fatty acids.

The relationship between participants ' total PSQI scores and some parameters is shown in Table 5. While a negative relationship existed between PSQI total score and the number of main meals consumed by male and total participants (respectively (r=-0.180; p<0.05), (r=0.131; p<0.05)), a positive correlation was found between smoking (piece/day) and total PSQI score (respectively (r=0.200; p<0.05); r=0.168 p<0.05)). Furthermore, a negative correlation was found between BMI (kg/m²) (r=-0.087; p<0.05) and total PSQI score in total participants. Another result of the study is that there was a negative correlation between body weight (r=-0.128; p<0.05) and total PSQI score in males (Table 5).

Table 5. The relationship between the total PSQI scores and some parameters

	Total PSQI Scores					
	Male (n=293)		Female (n=283)		Total Participants (n=576)	
	r	p	r	p	r	p
Number of main meals	-0.180	**0.002***	-0.083	0.164	-0.131	**0.002***
Number of snacks	0.082	0.159	-0.012	0.841	0.039	0.349
Smoking (number/day)	0.200	**0.029***	0.156	0.226	0.168	**0.024***
Body weight (kg)	-0.128	**0.029***	-0.066	0.270	-0.073	0.080
BMI (kg/m²)	-0.107	0.068	-0.079	0.184	-0.087	**0.037***

*p<0.05, Pearson and Spearman correlation test, PSQI: Pittsburgh sleep quality İndex; BMI: Body mass index.

DISCUSSION

Many factors (caffeine use, parental attitudes, etc.) affecting sleep quality are known[4]. A full exploration of the factors and mechanisms affecting sleep quality will help prevent poor sleep quality and minimize the associated health risks. Some of these factors are thought to be sociodemographic characteristics, eating habits, nutritional status, and BMI[5]. The results of the current study are expected to help clarify these relationships.

Sociodemographic characteristics are important determinants of general health, including sleep quality[24]. One of the most important sociodemographic factors known is age[25]. In this study, it was found that 77.2% of males and 86.3% of females were between the ages of 18-25 and the mean age was 24.50±7.66 years for males and 23.14±7.55 years for females. These results indicate that the average age of the participants is low and that the participants are mostly young individuals.

There are over 1.9 billion overweight adults worldwide, and over 650 million are obese adults, according to World Health Organization (WHO)[26]. Complex interactions with gender, sociocultural, environmental and physiological factors make obesity a multifactorial disease[27]. Globally, 39.0% of men and 40% of women are overweight, while 11% of men and 15% of women are obese[26]. Also, 42.0% of the 19-64 age group in men are overweight, 23.8% are obese, and 1.3% are morbidly obese (Total proportion of those with BMI ≥ 25 kg/m^2: 67.1%), these rates in women are 28.5%, 33.1%, 6.2%, respectively (Total proportion of those with BMI ≥25 kg/m^2: 67.8%)[28]. In this study, the rate of BMI ≥ 25 kg/m^2 was 43.7% in males, 17.0% in females, and 30.6% in total participants. In the Turkey Nutrition and Health Survey (TNHS)-2019 data, it is seen that there is no difference between genders in terms of BMI ≥ 25 kg/m^2, while in the current study, the status of BMI ≥ 25 kg/m^2 is higher in males. The fact that the classification of overweight, obese, and morbidly obese according to BMI was not made in this study makes it difficult to interpret these results.

The effects of marital status, one of the sociodemographic factors, on general health, including sleep quality, is also an important research topic[29]. According to TNHS-2017 data, 64.8% of male individuals over 15 years and 65.8% of female individuals are married[28]. In this study, it was found that the percentage of being married was higher in males (13.7%) than in females (8.5%), and these rates in both genders were much lower than the TNHS-2019 data. The main reason for this is that a large proportion of the participants are between the ages of 18-25. This precludes reaching a definitive conclusion about whether there is a relationship between marital status and sleep quality. Therefore, new studies should be conducted in which the age ranges of participants are more similar, to better understand the connection between marital status and sleep quality.

It is known that smoking and alcohol use increase the risk of many chronic diseases[30]. According to TNHS -2017 data, while 47.2% of males smoke any tobacco group, this rate is 19.4% for females[31]. According to the results of the Chronic Diseases and Risk Factors Survey in Turkey, 23% of men and 4% of women in our country use alcohol[32]. In this study, smoking and alcohol uses were 40.6% and 41.3% in male individuals, and 21.9% and 13.8% in females, respectively. It is observed that the rates of smoking and alcohol use are higher in males. The results of this study are consistent with the literature and suggest that men may be at greater risk of developing smoking-related diseases. The relationship between smoking and alcohol use and sleep quality was not investigated in the study. Evaluation of these relationships in future studies will help to determine the place of smoking and alcohol use among the factors affecting sleep quality.

In addition to the macro and micronutrient contents of the meals, the frequency of the meals is also an important factor for a healthy diet[33]. Generally, increased meal frequency is considered a strategy for body weight loss[33,34]. There is also evidence that frequent macronutrient intake may benefit anabolism and that frequent consumption of protein-containing meals throughout the day increases protein synthesis and accumulation[34]. However, the common view that it is better to eat more often for body weight control has not been conclusively scientifically proven[33]. For example, there are studies in the literature that show that frequent snacking can cause an increase in body weight[35] and an increase in fat in the abdomen and liver regions[36]. According to the research conducted by Van Der Heijden et al. (2007), eating more than the recommended three meals per day may lead to weight gain[35]. In this study, consumption habits of 3 main meals were found to be higher in the group with BMI ≥25 kg/m^2 in both male and total participants. Furthermore, the rate of skipping breakfast in both female and total participants with BMI between 18.50-24.99 kg/m^2 was higher than those with BMI ≥25 kg/m^2. However, it was determined that those with BMI between 18.50-24.99 kg/m^2 were more likely to consume snacks than those with BMI ≥25 kg/m^2 in total participants. The data obtained from this study and the literature suggest that there is a relationship between the number of meals and BMI. However, new studies are needed to reach definite conclusions about the existence and direction of the relationship. Consumption times of meals are as important as the number of meals. For example, it has been reported that eating late in the evening may adversely affect the medical nutrition therapy for obesity[37]. The fact that meal times were not questioned in the current study prevents the evaluation of this situation. For this reason, the consumption times of meals should also be questioned in new studies to be planned.

A correlation between sleep duration and BMI has been suggested by some research[38,39]. In a systematic review by Patel et al. (2012), short sleep duration was found to be independently associated with body weight gain, especially in younger age groups[38]. Another study found that there was a correlation between short sleep duration and an increased risk of becoming overweight or obese, while no similar relationship was found for sleep quality[39]. In the current study, it was determined that in males and total participants, those with BMI between 18.50-24.99 kg/m^2 had higher total PSQI scores than those with BMI ≥25 kg/m^2. There was no significant difference between any of the groups in terms of sleep duration and falling asleep time of the participants. Additionally, the rates of good sleep quality in those with a BMI between 18.50-24.99 kg/m^2 were lower than those with a BMI ≥25 kg/m^2 in both male and total participants. Another result of the study is that BMI in total participants and body weight in males were negatively correlated with the total PSQI score. Taking this data into consideration, it is thought that there is no relationship between sleep duration and BMI, and there may be a positive relationship between sleep quality and BMI, and body weight. However, considering the results of the studies available in the literature[38,39], the same relationship should be re-evaluated on larger samples by using different cut-off points for BMI (such as BMI ≥30.0 or ≥35.0 kg/m^2) in new studies.

Nutritional status is known to affect sleep quality[40-42]. In addition, it is reported that disorders in sleep duration and quality can trigger obesity, insulin resistance, and diabetes by significantly affecting appetite, nutrition, and energy balance[40]. In general, diets rich in fiber, fruits, vegetables, and anti-inflammatory foods and low in saturated fat (for example, the Mediterranean diet) are associated with better sleep quality[43]. Carbohydrates are an important dietary source of tryptophan, which is a precursor to the production of the sleep-regulating neurotransmitter serotonin and the hormone melatonin[40,43]. Akdevelioğlu et al. (2020) found that people who get a good night's sleep consume fewer carbohydrates as a percentage of their daily caloric intake ($p<0.05$). On the other hand, they found that people who slept well had a greater protein contribution to dietary energy ($p<0.05$). The total PSQI score was positively correlated ($p<0.05$) with dietary carbohydrate (g) intake and carbohydrate-energy ratio percentage, but negatively correlated with protein-energy ratio percentage, according to the same study[40]. In another study, consumption of low amounts of vegetables, fish, and high amounts of sugary drinks was associated with poor sleep quality[41]. High levels of saturated fat in the diet have also been linked to a decline in sleep quality. Jyväkorpi et al. (2021) associated high consumption of saturated fatty acids in the diet with poor sleep quality ($p=0.058$)[44]. In another study, dietary saturated fat intake was associated with worse sleep[45]. Hashimoto et al. (2020) found that people who got poor sleep had lower average intakes of several important nutrients, including vitamins K and B_2, potassium, magnesium, iron, zinc, copper, and tryptophan[46].

In the current study, when the relationship between sleep quality and nutritional status was evaluated, niacin (mg) intake was found to have a positive correlation with total PSQI score among males. In addition, it can be seen that the percentage of dietary energy that comes from saturated fatty acids is positively correlated with both the total PSQI score and the proportion of females who participated. Another result of the study was that the total PSQI score was inversely related to both the niacin (mg) and copper (mg) intakes in the female participants' diets. The literature and the results obtained from this study suggest that increased dietary saturated fat intake and decreased copper intake may adversely affect sleep quality. Considering that increased dietary niacin intake plays a role in releasing more tryptophan to be used for serotonin synthesis[4,42], it can be thought that increased dietary niacin intake with this mechanism may have an effect on sleep quality. The limited number of studies in the literature and some conflicting results in this study make it difficult to interpret the relationship between dietary niacin intake and sleep quality.

Smoking can adversely affect cognitive function, memory, and sleep quality through potential mechanisms such as oxidative stress, inflammation, and atherosclerosis[47]. Liu et al. (2013) found that sleep quality was lower in smokers[47]. Similar to the literature, it was found that the number of cigarettes smoked per day was positively correlated with the total PSQI score. These results indicate that smoking may adversely affect sleep quality. For this reason, smoking cessation, if not, reducing smoking is one of the things that can be done to improve sleep quality.

One of the limitations of the study is that the 3-day food consumption record of the participants was not taken in the study. Furthermore, the fact that the participants in the study were mostly young adults makes it difficult to attribute the results to the general adult population. Another limitation of the study is that analyses such as body fat percentage, body muscle mass, and body water percentage were not performed.

In conclusion, it was found in the study that there is a relationship between sleep quality, nutritional status, and BMI. The results of the study suggest that cessation of smoking/reducing smoking and some dietary modifications (such as reducing the percentage of dietary energy that comes from saturated fatty acids) can be used to improve sleep quality. However, there is a dearth of research in the literature that examines the connection between sleep quality, nutritional status, and BMI. Further studies with larger samples are required to confirm our results. In the new studies to be planned, body analysis of the participants, questioning the meal consumption times, and evaluation of some serum analyses will contribute to revealing the mechanisms by which the factors affecting sleep quality are effective. Furthermore, taking the frequency of caffeine consumption in future studies will allow the evaluation of the relationship between caffeine consumption and sleep quality. It is hoped that our article will help direct future research.

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