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Daytime Sleepiness, Body Mass Index, and Physical Activity Levels Among University Undergraduate Students: Do They Affect Sleep Quality?

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Abstract

BACKGROUND/AIMS: This study aimed to determine the relationship between sleep quality and body mass index (BMI), physical activity level, and daytime sleepiness among university students.

MATERIALS AND METHODS: This study was conducted with 299 undergraduate students. Data were collected using a sociodemographic questionnaire, the International Physical Activity Questionnaire Short Form, the Epworth Sleepiness Scale, and the Pittsburgh Sleep Quality Index. All participants underwent anthropometric measurements.

RESULTS: 55.9% of the students had good sleep quality and 44.1% had poor sleep quality. Sleep quality was not significantly associated with BMI. Poor sleep quality was correlated with excessive daytime sleepiness. Physical activity level was significantly associated with BMI, sleep latency, subjective sleep quality, and sleep disorders.

CONCLUSION: Sleep quality was found to affect daytime sleepiness, with excessive daytime sleepiness observed in students with poor sleep habits. Physical activity and BMI did not affect sleep quality.

Keywords: Body mass index, daytime sleepiness, physical activity level, sleep quality

INTRODUCTION

Sleep is an essential physiological need of humans. A state of physical and mental rest is characterized by reduced body movements and decreased awareness of one's surroundings. Sleep allows the body and brain to slow down and engage in recovery processes. Sleep pattern, duration, and quality are crucial for the overall health and quality of life of individuals.[1] Persons with good sleep quality feel rested and energetic upon waking up in the morning and do not experience excessive sleepiness during the day.[1,2] Excessive daytime sleepiness is characterized by an irresistible urge to sleep and a tendency to drowsiness during the daytime.[3] Excessive daytime sleepiness largely results from poor sleep quality, leading to distraction and poor performance during activities of daily living.[4] Sleep quality is correlated with daytime sleepiness as well as physical activity. Physical activity is defined as any movement produced by skeletal muscle that requires energy expenditure.[5] The need, duration, and depth of sleep are increased after physical activity to allow for tissue regeneration.[6]

Regular physical activity improves sleep quality through its positive effects on total sleep time, sleep latency, slow-wave sleep, and rapid eye movement (REM) sleep.[7] In a study examining the association between physical activity and sleep quality, improved sleep quality and longer time spent in the first and second stages of sleep were reported in

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individuals with increased exercise levels.[6] Persons with a low level of physical activity carry a higher risk of chronic diseases such as obesity.[8] Poor sleep quality can also cause weight gain, which increases the risk of developing chronic conditions due to reduced physical activity levels during the day.[9-11]

The aim of the current study was to examine the association between sleep quality and body mass index (BMI), physical activity level, and daytime sleepiness. The three hypotheses tested in the study were as follows: 1) poor sleep quality leads to excessive daytime sleepiness, 2) increased physical activity improves sleep quality, and 3) increased BMI decreases sleep quality.

MATERIALS AND METHODS

This was a cross-sectional study. The study sample consisted of undergraduate students in all years of undergraduate education at the Department of Nutrition and Dietetics, Near East University Faculty of Health Sciences. Eight students could not be reached because of their absence from school. Overall, the study was conducted with a total of 299 students. All students participated in the study on a voluntary basis and provided informed consent. Ethics committee approval for the study was obtained from the Near East University Scientific Research Ethics and Review Board (approval number: YDU/2016/39-321, date: 22.09.2016).

General Characteristics

Sociodemographic data (e.g., age, gender, health status) were collected through face-to-face interviews using a study-specific questionnaire developed by the study investigators. All participants underwent anthropometric measurements. The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality, the Epworth Sleepiness Scale (ESS) to evaluate sleepiness, and the International Physical Activity Questionnaire-Short Form (IPAQ-SF) to determine physical activity levels. of the subjects.

Anthropometric Measurements

Hip circumference (HC), waist circumference (WC), body weight, and height measurements were obtained for all subjects. Body weight was measured after a 1-day rest (avoiding physical activity) using a portable weighing scale (HAMIDI) with the individual wearing light clothes and shoes taken off. Height measurements were taken using a stadiometer with the head positioned in the Frankfort plane. WC was measured under the midline of the subject's armpit at the midpoint between the lower part of the last rib and the iliac crest using non-stretch measuring tape. WC values were categorized into three health risk groups according to the World Health Organization (WHO) classification: normal, <80 cm for female and <94 cm for male; increased risk, 80-88 cm for female and 94-102 cm for male, and high risk, >88 cm for female and >102 cm for male.[12,13] HC measurements were obtained while standing to the right side of the subject using a non-stretch measuring tape at the level of the maximum protrusion of the buttocks. WC and HC were used to calculate the waist-to-hip ratio. Calculated waist/hip ratios were divided into two groups according to the WHO classification: normal, <0.85 for female and <0.90 for male, and increased risk, ≥0.85 for female and ≥0.90 for male.[12] The subjects were divided into three groups based on waist-to-height ratio: increased risk, <0.4; normal, ≥0.4 to <0.5; and high risk, ≥0.5.[14] BMI values were categorized according to the WHO classification as follows: underweight (<18.5 kg/m^2); normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (≥30.0 kg/m^2).[15]

Assessment of Sleep Quality

Pittsburgh Sleep Quality Index

The PSQI was developed with the aim of determining sleep quality, assessing various sleep disorders that may affect sleep quality, and distinguishing good from poor sleep. The PSQI is a self-reported questionnaire that evaluates sleep quality during the previous month.[16] The reliability and validity of the Turkish version of the PSQI were demonstrated by Ağargün et al.[17] The PSQI consists of a total of 24 questions and seven subscales, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, daytime dysfunction, and use of sleep medication. The scores for each of the 7 subscales range from 0 to 3, with a maximum score of 21 points. An overall score ranging from 0 to 5 points indicates good sleep quality, whereas a score ranging from 6 to 21 point denotes poor sleep quality.[16]

Epworth Sleepiness Scale

The ESS is a self-administered questionnaire with 8 items to assess daytime sleepiness in adults. It is widely used to evaluate sleepiness in sleep disorder research. The ESS measured daytime sleepiness in eight different situations over a 1-month interval. Respondents were asked to rate their sleepiness on a 4-point Likert scale (0=would never doze, 1=slight chance of dozing, 2=moderate chance of dozing and 3=higher chance of dozing). The scores for the eight items were summed to obtain an overall score ranging from 0 to 24. Higher ESS scores indicate greater daytime sleepiness. Individuals with a score >10 are considered to have increased daytime sleepiness. The validity and reliability of the Turkish version of ESS were demonstrated by Izci et al.[18]

Assessment of Physical Activity

The IPAQ is available in both short and long forms. The IPAQ long form evaluates physical activity in several contexts: recreation, work, transport, home, and gardening. The short form consists of 7 questions that assess walking, moderate- and vigorous physical activities, and time spent sitting within the last 7 days.[19,20] Total physical activity is measured in metabolic equivalent (MET), which indicates the intensity of physical activity and energy efficiency.[21] Physical activity is categorized into three levels: Health-enhancing physical activity (HEPA)-active, inactive, and minimally active.[19,20] The reliability and validity of the Turkish version of IPAQ have been demonstrated by Saglam et al.[22]

Statistical Analysis

Quantitative study data are presented as the arithmetic mean ($\bar{x}$), standard deviation, median and minimum-maximum values. Descriptive statistics are summarized as numbers (n) and percentages (%) for qualitative data. The normality of data distribution was checked using Kolmogorov-Smirnov and Shapiro-Wilk tests. The Independent samples t-test (Student's t-test) was used to compare continuous variables between two independent groups, and the One-Way analysis of variance (ANOVA) was used to compare multiple groups. Pearson's chi-square (χ^2) and Fisher's exact (χ^2) tests were employed for the analysis of qualitative and categorical variables. The significance of the relationships between quantitative variables was assessed using Pearson correlation (r). Multiple binary logistic regression analysis was used to evaluate the relationships among sleep quality, daytime sleepiness,

BMI, and physical activity. For the regression analysis, sleep quality was considered the dependent variable. Daytime sleepiness, BMI, and physical activity were independent variables. The SPSS (Statistical Package for Social Sciences), version 20.0 (IBM Corp., Armonk, NY) was used for all statistical analyses. The significance level was set at $p<0.05$.

RESULTS

A total of 299 subjects were included in the study, of whom 223 (74.6%) were female and 76 (25.4%) were male. The mean age of the subjects was 21.1±2.6 years. 84.6% of the students did not have any illness, and 15.4% were diagnosed with at least one disease. Among the students with health conditions, 13.9% had respiratory diseases, 12.6% had gastrointestinal problems, and 10.2% had cardiovascular diseases. Thyroid disease, neurological disorders, or anemia were present with a frequency of 8.5% each. 5.5% were diabetic, and 32.3% had other health problems.

According to the BMI values of the students, 13.7% were underweight, 68.9% were normal, 12.7% were overweight, and 4.7% were obese. A waist/height ratio of <0.4 or >0.5 poses health risk and requires action, which was observed in 16.1% and 18.4% of the subjects, respectively. Furthermore, 65.6% of the subjects had a normal waist/height ratio. Waist/hip ratios were normal in 94.6% and high in 5.4% of the subjects. WC was classified as normal in 82.2%, increased risk (11.4%) and high risk (6.4%) in the subjects (Table 1).

Regarding students' sleep habits, 20.1% reported having a consistent bedtime, 51.5% did not follow a regular sleep schedule, and 28.4% were occasionally going to sleep at the same time every night. Furthermore, 29.5% of the students reported waking up feeling rested, 33.4% reported waking up feeling tired, and 37.1% reported that they sometimes felt rested in the morning. There were no significant differences between genders or among students in different academic years ($p>0.05$). When asked about dozing while studying, 45.2% of the students answered "yes", 24.7% answered "no" and 30.1% answered "sometimes". With respect to dozing while studying, a non-significant difference was found among students in different academic years ($p=0.282$), but the difference between genders was significant ($p=0.029$). Male students were less likely to doze off while studying than female students. In addition, 37.5% of the students reported feeling sleepy, 23.1% reported not feeling sleepy, and 39.5% reported occasionally feeling sleepy in class. The difference between genders was significant ($p=0.022$) but the difference among academic years was non-significant ($p=0.210$) (Figure 1).

The mean ESS scores were 4.9±3.3 for the study population, 4.9±3.2 for the females and 4.9±3.6 for the males. Based on the ESS scores, 93.0% of students exhibited normal daytime sleepiness, whereas 7.0% exhibited increased daytime sleepiness. The difference in total ESS scores among academic years ($p=0.608$) and between genders ($p=0.731$) was not significant (Table 2).

The mean PSQI scores were 5.6±2.9 for the study population, 5.6±3.0 for the males and 5.6±2.9 for the females. Regarding the overall sleep quality of the students, 55.9% of them had good sleep quality and 44.1% had poor sleep quality. However, no significant difference was observed in the total PSQI scores among students in different academic years and between genders (Table 2).

The mean IPAQ-SF scores were 1923.0±1792.4 METs (minutes/week) for the study population, 1539.0±1173.0 METs for the females and 2631.0±2535.9 METs for the males. Regarding the physical activity level of the students, 18.6% were inactive, 35.0% were minimally active, and 46.4% were HEPA-active. The difference in the global IPAQ-SF scores was non-significant among academic years ($p=0.102$) but significant between the genders ($p=0.013$). Male students were found to be physically more active than female students (Table 2).

The relationships of the PSQI subscales with IPAQ-SF, ESS, PSQI scores, and BMI values are presented in Table 3. Although total IPAQ-SF scores were positively correlated with subjective sleep quality, sleep latency, and sleep disorders, no significant correlation was found with other subscales. BMI was not significantly correlated with PSQI subscale scores, but total ESS scores were positively correlated with subjective sleep quality, daytime dysfunction, sleep disorders, and use of sleep medication (Table 3).

When the relationships among IPAQ-SF, ESS, PSQI scores, and BMI values were analyzed, no significant correlation was observed between PSQI and IPAQ-SF scores or BMI; however, total PSQI scores were positively correlated with ESS scores. As the total PSQI scores of the students increased, their total ESS scores also increased. Because higher PSQI scores indicate poor sleep quality and higher ESS scores denote increased daytime sleepiness, students with poor sleep quality experience increased daytime sleepiness. Total ESS scores were not significantly correlated with BMI or total IPAQ-SF scores. A positive correlation was found between total IPAQ-SF scores and the students' BMI. Thus, as the students' physical activity increased, their BMI also increased (Figure 2).

The established regression model is significant. The coefficient of the independent variable X1 (BMI) was not significant ($p>0.05$). On the other hand, the explanatory variable X2 (daytime sleepiness) was statistically significant ($p=0.001$). The regression coefficient of variable X3 (physical activity level) was also significant ($p<0.05$). Consequently, the established regression model was expressed as $y=4.893 + 0.018x1 + 0.178x2 - 0.225x3$. In summary, daytime sleepiness was significantly associated with sleep quality.

Among the students with good sleep quality, 46.9% engaged in HEPA, while 33.3% were minimally active and 19.8% were inactive. In comparison, among students with poor sleep quality, the corresponding figures were 45.7%, 37.1%, and 17.2%, respectively. No significant difference in physical activity levels was observed between the groups ($p=0.781$). Regarding daytime sleepiness, 95.8% of the students with good sleep quality had normal daytime sleepiness, whereas 89.4% of the students with poor sleep quality reported increased daytime sleepiness. The difference between the groups was significant ($p<0.05$), indicating that the students with good sleep quality experienced normal daytime sleepiness. In terms of BMI, 15.0% of the students were underweight, 67.7% were normal, 12.5% were overweight, and 4.8% were obese. For the students with poor sleep quality, the corresponding figures were 12.1%, 70.5%, 12.9%, and 4.5%, respectively. The differences among the groups were not significant (Table 4).

DISCUSSION

Determining students' sleep quality and the factors involved is crucial for improving their sleep quality and well-being in adulthood. Therefore, sleep disorders that may be caused by insufficient or poor-quality sleep can be prevented. Therefore, this study is important for evaluating

Table 1. Distribution of BMI, waist-to-height ratio, waist-to-hip ratio, and waist circumference values of students by gender

	Female		Male		Total	
	n	%	n	%	n	%
BMI classification						
Underweight	34	15.2	7	9.2	41	13.7
Normal	160	71.7	46	60.5	206	68.9
Overweight	20	9.0	16	23.7	38	12.7
Obese	9	4.0	5	6.6	14	4.7
Total	223	100.0	76	100.0	299	100.0
p	0.005[1*]					
Waist/height ratio						
Increased risk of disease requires action	42	18.8	6	7.9	48	16.1
Normal	150	67.3	46	60.5	196	65.6
Increased risk of disease requires action	31	13.9	24	31.6	55	18.4
Total	223	100.0	76	100.0	299	100.0
p	0.001[1*]					
Waist/hip ratio						
Normal	216	96.6	67	88.2	283	94.6
Increased risk	7	3.1	9	11.8	16	5.4
Total	223	100.0	76	100.0	299	100.0
p	0.007[2*]					
Waist circumference						
Normal	183	82.1	63	82.9	246	82.2
Increased risk	26	11.7	8	10.5	34	11.4
High risk	14	6.3	5	6.6	19	6.4
Total	223	100.0	76	100.0	299	100.0
p	0.962[1]					

[1]Pearson's chi-square test (c^2); *p<0.05, [2]Fisher's exact test (c^2); *p<0.05, n: Number of subjects, %: Percentage, BMI: Body mass index.

the sleep quality of university students and the factors affecting sleep quality.

The sleep habits of the students aligned with findings from previous studies. In a study investigating sleep disorders and sleep quality among Gülhane Military Medical Academy students, 42.5% reported going to bed at the same time every night and 37.6% reported waking up feeling refreshed in the morning. Dozing at school was also questioned, and dozing in almost all classes was found in 15.2%, frequent dozing in 31.9%, occasional dozing in 37.9%, infrequent dozing in 12.6%, and no dozing in 1.9% of the students.[23] Similarly, in a study involving 558 university students, 16.3% reported having a consistent bedtime, 43.2% occasionally went to bed at the same time every night, and 40.5% did not follow a routine sleep schedule.[24] Another study on university students found that 57.3% did not have a regular bedtime and 73.0% did not wake up feeling rested in the morning.[25] In a study involving adolescent students, 60.3% reported experiencing sleepiness while studying and 49.3% reported dozing in class.[26]

Individuals with ESS scores above 10 points are typically considered to have increased daytime sleepiness.[18] In this study, both female (4.9±3.2) and male students (4.9±3.6) had ESS scores below 10 points, indicating minimal daytime sleepiness. These findings are consistent with previous reports.[4,24,27,28] Increased daytime sleepiness was found in only 7.0% of the students in the present study. Contrarily, a study from Malaysia involving 201 university students reported increased daytime sleepiness in 64.6% of the students.[29] Likewise, a study among nursing students found that 57.4% were found to have increased daytime sleepiness.[3]

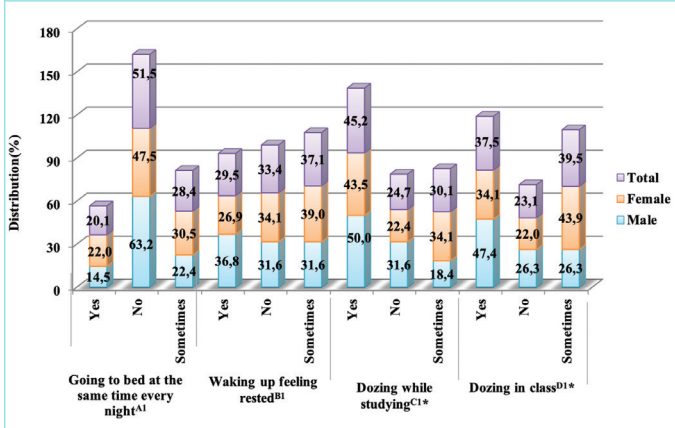

Figure 1. Distribution of sleep habits among students by academic year and gender (%).

[1]Pearson's chi-square test (χ^2); *p<0.05, A1: year (p=0.876[1]), gender (p=0.061[1]); B1: year (p=0.088[1]), gender (p=0.240[1]); C1: year (p=0.282[1]), gender (p=0.029[1*]); D1: year (p=0.210[1]), gender, p=0.022[1*].

Table 2. Distribution of total ESS, PSQI, and IPAQ-SF scores by academic year and gender

			Female		Male		Total		p
			n	%	n	%	n	%	
ESS score	Year 1	Normal daytime sleepiness	61	93.8	28	96.6	89	94.7	0.608[1]
		Increased daytime sleepiness	4	6.2	1	3.4	5	5.3	
	Year 2	Normal daytime sleepiness	73	92.4	24	92.3	97	92.4	
		Increased daytime sleepiness	6	7.6	2	7.7	8	7.6	
	Year 3	Normal daytime sleepiness	44	97.8	8	80.0	52	94.5	
		Increased daytime sleepiness	1	2.2	2	20.0	3	5.5	
	Year 4	Normal daytime sleepiness	30	88.2	10	90.9	40	88.9	
		Increased daytime sleepiness	4	11.8	1	9.1	5	11.1	
	Total	Normal daytime sleepiness	208	93.3	70	92.1	278	93.0	
		Increased daytime sleepiness	15	6.7	6	7.9	21	7.0	
	p		0.731[2]						
PSQI score	Year 1	Good sleep quality	30	46.2	17	58.6	47	50.0	0.557[1]
		Poor sleep quality	35	53.8	12	41.4	47	50.0	
	Year 2	Good sleep quality	46	58.2	14	53.8	60	57.1	
		Poor sleep quality	33	41.8	12	46.2	45	42.9	
	Year 3	Good sleep quality	27	60.0	6	60.0	33	60.0	
		Poor sleep quality	18	40.0	4	40.0	22	40.0	
	Year 4	Good sleep quality	21	61.8	6	54.5	27	60.0	
		Poor sleep quality	13	38.2	5	45.5	18	40.0	
	Total	Good sleep quality	124	55.6	43	56.6	167	55.9	
		Poor sleep quality	99	44.4	33	43.4	132	44.1	
	p		0.883[2]						
IPAQ-SF score	Year 1	Inactive	15	27.8	3	10.3	18	21.7	0.102[1]
		Minimally active	12	22.2	10	34.5	22	26.5	
		HEPA-active	27	50.0	16	55.2	43	51.8	
	Year 2	Inactive	9	13.4	1	4.8	10	11.4	
		Minimally active	29	43.3	11	52.4	40	45.5	
		HEPA-active	29	43.3	9	42.9	38	43.2	
	Year 3	Inactive	11	26.8	0	0.0	11	22.0	
		Minimally active	13	31.7	1	11.1	14	28.0	
		HEPA-active	17	41.5	8	88.9	25	50.0	
	Year 4	Inactive	9	29.0	1	9.1	10	23.8	
		Minimally active	12	38.7	4	36.4	16	38.1	
		HEPA-active	10	32.3	6	54.5	16	38.1	
	Total	Inactive	44	22.8	5	7.1	49	18.6	
		Minimally active	66	34.2	26	37.1	92	35.0	
		HEPA-active	83	43.0	39	55.7	122	46.4	
	p		0.013[2*]						

[1]Pearson's chi-square test (c^2), [2]Fisher's exact test (c^2), n: Number of subjects, %: Percentage, ESS: Epworth Sleepiness Scale, PSQI: Pittsburgh Sleep Quality Index, HEPA: Health-enhancing physical activity, IPAQ-SF: International Physical Activity Questionnaire-Short Form.

A study of 273 medical students reported that 22.3% experienced increased daytime sleepiness.[30] In another study, increased daytime sleepiness was found in 58.1% of dental students.[31] In a study by Muhammad et al.[32] involving individuals aged 18-74 years, 55.3% were identified as experiencing increased daytime sleepiness. In a study involving only male participants, 12.7% reported increased daytime sleepiness.[27] In the present study, a lower prevalence of daytime sleepiness was observed than in previous studies. This may be attributed to a number of factors, including students' adherence to early bedtime routines, getting the recommended amount of sleep daily, and the low prevalence of factors associated with increased daytime sleepiness, such as stress, smoking, alcohol consumption, and unhealthy eating habits.

PSQI score of ≥6 indicates poor sleep quality.[16] In this study, the mean PSQI score of the students was 5.6±2.9, and 44.1% of them were found

Table 3. Relationships of the PSQI subscale scores with BMI, IPAQ-SF, ESS, and PSQI scores

PSQI subscales	IPAQ-SF		ESS		PSQI		BMI	
	r	p	r	p	r	p	r	p
Subjective sleep quality	0.229	0.000[1**]	0.173	0.003[1*]	0.660	0.000[1**]	0.062	0.289
Sleep latency	0.181	0.002[1*]	0.078	0.177	0.640	0.000[1**]	-0.064	0.273
Sleep duration	0.088	0.129	0.006	0.921	0.551	0.000[1**]	0.009	0.874
Sleep efficiency	0.077	0.185	-0.083	0.155	0.431	0.000[1**]	-0.074	0.200
Sleep disorders	0.256	0.000[1**]	0.205	0.000[1**]	0.475	0.000[1**]	0.003	0.963
Use of sleep medication	0.071	0.219	0.118	0.042[1*]	0.324	0.000[1**]	0.083	0.153
Daytime dysfunction	-0.069	0.238	0.153	0.008[1*]	0.586	0.000[1**]	0.078	0.180

[1]Pearson's correlation test, *p<0.05, **p<0.001, IPAQ-SF: International Physical Activity Questionnaire Short Form, ESS: Epworth Sleepiness Scale, PSQI: Pittsburgh Sleep Quality Index, BMI: Body mass index.

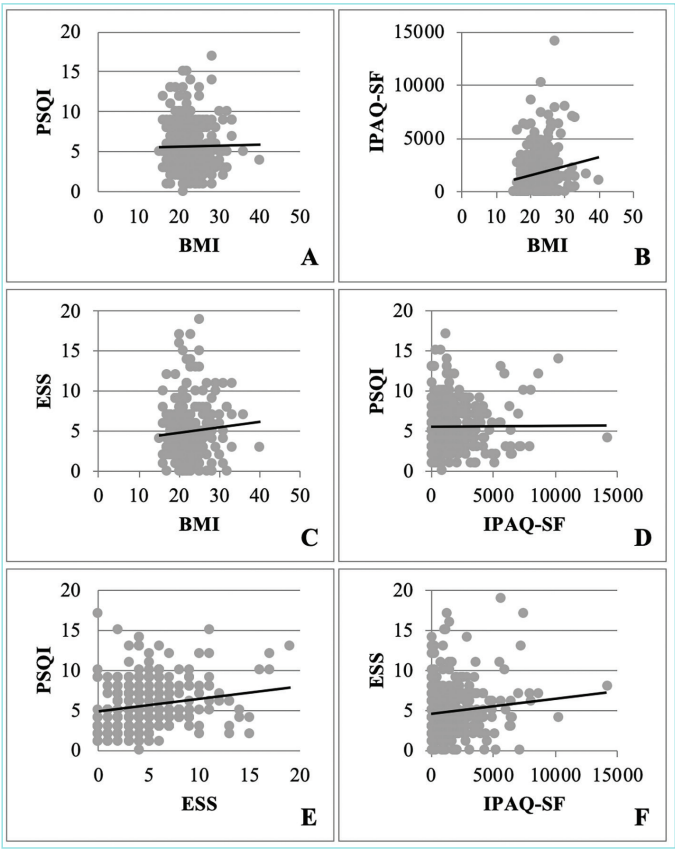

Figure 2. Relationships among IPAQ-SF score, ESS score, PSQI score, and BMI.

(A) r=0.024, p=0.676[1]; (B) r=0.157, p=0.006[1*]; (C) r=0.082, p=0.156[1]; (D) r=0.003, p=0.958[1]; (E) r=0.174, p=0.003[1*]; (F) r=0.109, p=0.061[1].

[1]Pearson's correlation test; *p<0.05, IPAQ-SF: International Physical Activity Questionnaire Short Form, ESS: Epworth Sleepiness Scale, PSQI: Pittsburgh Sleep Quality Index, BMI: Body mass index.

to have poor sleep quality. The difference in sleep quality between genders was not significant. A study conducted at Stanford University with 628 athletes from 29 varsity teams reported average PSQI scores of 5.3±2.4 among the athletes, with 42.4% experiencing sleep disturbances.[33] Similarly, another study involving university students reported average PSQI scores of 6.3±3.0, with 58.2% having poor sleep quality. No significant difference was found between genders in terms of sleep quality.[4] In a separate study of university students, 71.1% had poor sleep quality. In that study, the average PSQI scores were 8.3±2.9 for females and 8.1±3.1 for males, with no significant difference between genders.[31] A previous study investigating sleep quality reported mean PSQI scores of 9.1±4.5 in the study population, 9.2±4.4 among females and 9.1±5.1 among males, with no significant difference between genders.[28] The recommended average sleep duration for adults is approximately 7-8 hours daily.[34] The sleep quality of the university students included in this study may have been influenced by various factors, including being away from home, disruptions to their sleep routines, long hours of studying due to demanding curricula, high academic stress, and changes in dietary patterns.

When analyzing the distribution of the IPAQ-SF scores, 18.6% were found to be inactive, 35.0% were minimally active, and 46.4% engaged in HEPA. There was a significant difference between female and male students, with male students exhibiting higher levels of physical activity than female students. Similarly, in a study of university students, lower physical activity levels were observed among female students than male students.[8] In a study involving 87 medical students aged 18 to 25 years, 40% were inactive, 47% were minimally active, and 13% reported HEPA.[21] In a separate study of 831 university students, 9% were found to be inactive, 32.1% were minimally active, and 58.9% reported performing HEPA. A significant difference was observed between genders in that study (p<0.001), with female students being physically less active than male students.[5] Another study in 255 university students, 11.4% were inactive, 73.7% were minimally active, and 14.9% engaged in HEPA. The difference between genders was significant (p=0.005), with male students having higher levels of physical activity.[35] Collectively, the aforementioned findings are consistent with our results. The higher levels of physical activity observed among male students in our study may be attributed to anorexia or muscle dysmorphia, which are more prevalent among males. A survey conducted by the Turkish Ministry of Health in 2011, titled Chronic Diseases and Risk Factors, revealed inadequate physical activity in 87% of women and 77% of men. According to the survey, individuals with inadequate physical activity face a 20-30% increased risk of death compared with individuals engaging in moderate or vigorous physical activity for at least 30 minutes daily, 4-5 days a week. In adults, 150 min of physical activity per week is associated with a 30% reduction in the risk of ischemic heart disease, 27% reduction in the risk of type 2 diabetes and 20-25% reduction in the risk of breast and colon cancer. Regular physical activity is essential for improving health, preventing the development of chronic diseases, and maintaining body weight.[36]

Table 4. Distribution of physical activity level, sleepiness, and BMI according to sleep quality

	Good sleep quality		Poor sleep quality		Total		p
	n	%	n	%	n	%	
Physical activity level							
Inactive	29	19.8	20	17.2	49	18.6	0.781[1]
Minimally active	49	33.3	43	37.1	92	35.0	
HEPA-active	69	46.9	53	45.7	122	46.4	
Sleepiness							
Normal daytime sleepiness	160	95.8	118	89.4	278	93.0	0.040[2*]
Increased daytime sleepiness	7	4.2	14	10.6	21	7.0	
BMI classification							
Underweight	25	15.0	16	12.1	41	13.7	0.911[1]
Normal weight	113	67.7	93	70.5	206	68.9	
Overweight	21	12.5	17	12.9	38	12.7	
Obese	8	4.8	6	4.5	14	4.7	

[1]Pearson's chi-square test (χ^2), [2]Fisher's exact test (χ^2); *p<0.05, n: Number of subjects, %: Percentage, HEPA: Health-enhancing physical activity, BMI: Body mass index.

In the present study, a significant relationship was observed between physical activity and BMI (p<0.05) (Figure 2). The students' physical activity levels increased in a direct correlation with their BMI values. Despite engaging in physical activity, the students showed increased BMI values, which may be explained by a number of factors such as irregular meal times, altered eating habits, increased prevalence of muscle dysmorphia, increased consumption of fast food due to convenience, accessibility, and affordability, impaired sleep quality, and excessive daytime sleepiness. A study on undergraduate students reported a decrease in physical activity levels with increasing BMI values.[37] Similarly, another study found that reduced physical activity was associated with an increased risk of obesity among students.[38] In a study involving university students (age range, 18-30 years), a significant association was demonstrated between BMI values and physical activity levels (p=0.001).[35] In a study by Gangwisch et al.[39] analyzing NHANES I follow-up studies, a significant relationship was observed between physical activity level and BMI. Additionally, a study on medical students also found a positive correlation between physical activity levels and BMI values (r=0.192, p=0.013), with lower physical activity levels observed in females than in males.[8] However, another study on medical students did not find a significant association between BMI and physical activity levels (p=0.133).[40] The 2020 WHO physical activity guidelines recommend at least 150 minutes of moderate-intensity physical activity per week for adults. Engaging in physical activity improves quality of life and well-being by promoting the prevention of chronic diseases.[41]

The present study revealed a non-significant association between sleep quality and BMI (Figure 2). Consistent with our findings, several studies in the literature have reported no significant relationship between sleep quality and BMI.[28,42,43] Sleep quality and sleep duration are factors that both influence and are influenced by BMI. Many studies have described the association between sleep quality and BMI.[44-49] Poor sleep quality has been shown to contribute to a sedentary lifestyle, inadequate physical activity, unhealthy eating habits, and poor nutrition. Moreover, it can lead to the activation of the sympathetic nervous system and increase hunger hormone levels while decreasing insulin sensitivity, glycolysis efficiency, voluntary muscle contractions, and satiety hormone levels. Through its negative effects on health, poor sleep quality is associated with an elevated risk of chronic diseases, particularly obesity.[50]

This study did not find a significant relationship between physical activity and sleep quality (Figure 2), a finding consistent with that of previous studies. A study on university students also found no significant correlation between physical activity and sleep quality.[51] In a randomized, controlled study involving healthy young adults (n=12) and older adults (n=21), physical activity was non-significantly associated with sleep efficiency in both young adults (r=-0.162, p=0.62) and older adults (r=-0.014, p=0.95).[52] Regular physical activity is known to increase the need for slow- wave sleep and REM sleep, as it promotes tissue regeneration. This increased need, in turn, results in reduced sleep latency, increased total sleep time, and improved sleep quality.[6,7] The lack of regular physical activity observed among the students in this study may, therefore, explain the non-significant association between their sleep quality and physical activity levels.

A positive correlation was found between sleep quality and daytime sleepiness (Figure 2), which is in line with findings reported in previous studies.[3,27,28,33] Increased daytime sleepiness was the most common sleep deprivation problem observed among the students. This finding may be attributed to a number of important factors affecting daytime sleepiness, including demographic characteristics (e.g., gender), sleep patterns, dietary habits, demanding curriculum, and exam stress. Notably, the ESS and PSQI daytime dysfunction scores were positively correlated. Thus, as PSQI daytime dysfunction scores increased, ESS scores also increased, indicating that the ability to perform daily activities decreased as sleepiness increased. Similar results were also reported by Buysse et al.[53] The increased daytime sleepiness observed among university students may be explained by several factors, including living in student accommodation with roommates having different sleep schedules, environmental stimuli (e.g., light, noise), diminished sleep quality in smokers due to the stimulating effects of nicotine, long study hours and demanding curriculum, and increased consumption of caffeinated beverages to stay awake during examination periods.

Study Limitations

A number of limitations should be noted for this study. First, the study included only students from the department of nutrition and dietetics, potentially limiting the generalizability of the findings to a broader population. Second, assessments of sleepiness, sleep, and

physical activity levels relied on patient self-reports. The unequal gender distribution was the third limitation of the study, particularly considering that the study aimed to draw conclusions applicable to the general population. Despite these limitations, the results of this study are consistent with those of previous studies.

CONCLUSION

The results of this study revealed that the majority of the students had normal BMI and daytime sleepiness levels. Female students were physically less active than male students. The students with poor sleep quality experienced increased daytime sleepiness compared to those with good sleep quality. No significant correlations were found between physical activity, BMI, and sleep quality. This study provides important data for future research aimed at understanding factors associated with sleep problems. Further comprehensive studies are warranted to elucidate the risk factors that influence sleep quality more definitively.

MAIN POINTS

- There was a significant relationship between daytime sleepiness and sleep quality. Increased daytime sleepiness decreased sleep quality.
- There was a significant relationship between subjective sleep quality, sleep latency, and sleep disorders and physical activity level.
- There was a significant relationship between physical activity level and body mass index, but no significant relationship was found between sleep quality and body mass index.

ETHICS

Ethics Committee Approval: Ethics committee approval for the study was obtained from the Near East University Scientific Research Ethics and Review Board (approval number: YDU/2016/39-321, date: 22.09.2016).

Informed Consent: All students participated in the study on a voluntary basis and provided informed consent.

Authorship Contributions

Concept: G.Ö., S.Y., Design: G.Ö., S.Y., Data Collection and/or Processing: G.Ö., Analysis and/or Interpretation: G.Ö., Literature Search: G.Ö., S.Y., Writing: G.Ö.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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REFERENCES

1. Peuhkuri K, Sihvola N, Korpela R. Diet promotes sleep duration and quality. Nutr Res. 2012; 32(5): 309-19.
2. Copinschi G, Leproult R, Spiegel K. The important role of sleep in metabolism. Front Horm Res. 2014; 42: 59-72.
3. Isac C, Abraham J. Daytime sleepiness among Omani Nursing Students: Estimate of its determinants and impact on perceived stress. Clin Epidemiol Glob Health. 2020; 8(3): 739-43.
4. El Hangouche AJ, Jniene A, Aboudrar S, Errguig L, Rkain H, Cherti M, et al. Relationship between poor quality sleep, excessive daytime sleepiness and low academic performance in medical students. Adv Med Educ Pract. 2018; 9: 631-8.
5. Ćosić Mulahasanović I, Nožinović Mujanović A, Mujanović E, Atiković A. Level of physical activity of the students at the University of Tuzla According to IPAQ. CEJSSM. 2018; 21(1): 23-30.
6. Wong SN, Halaki M, Chow CM. The effects of moderate to vigorous aerobic exercise on the sleep need of sedentary young adults. J Sports Sci. 2013; 31(4): 381-6.
7. Kredlow MA, Capozzoli MC, Hearon BA, Calkins AW, Otto MW. The effects of physical activity on sleep: a meta-analytic review. J Behav Med. 2015; 38(3): 427-49.
8. Vikawati NE, Sarosa H, Makarim FR, Fasitasari M. Physical activity correlates to body mass index among medical students. Jurnal Kedokteran Brawijaya. 2020; 31(2): 111-5.
9. Halson SL. Nutrition, sleep and recovery. Eur J Sport Sci. 2008; 8(2): 119-26.
10. Yan Z, Chang-Quan H, Zhen-Chan L, Bi-Rong D. Association between sleep quality and body mass index among Chinese nonagenarians/centenarians. Age (Dordr). 2012; 34(3): 527-37.
11. Larcher S, Benhamou PY, Pépin JL, Borel AL. Sleep habits and diabetes. Diabetes Metab. 2015; 41(4): 263-71.
12. Consultation WE. Waist circumference and waist-hip ratio. Report of a WHO Expert Consultation. Geneva: World Health Organization, 2008; 8-11. Available from: https://www.who.int/publications-detailredirect/9789241501491
13. Ashwell M. Charts based on body mass index and waist-to-height ratio to assess the health risks of obesity: A review. Open Obes J. 2011; 311(1): 78-84.
14. Pekcan G. Beslenme durumunun saptanması. Diyet El Kitabı. Hatipoglu Yayınevi. Ankara. 2011: 67-141.
15. Weir CB, Jan A. BMI Classification Percentile And Cut Off Points. 2023.
16. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989; 28(2): 193-213.
17. Ağargün MY, Kara H, Anlar O. Pittsburgh Uyku Kalitesi İndeksi'nin geçerliliği ve güvenilirliği. Turk Psikiyatri Derg. 1996; 7(2): 107-15.
18. Izci B, Ardic S, Firat H, Sahin A, Altinors M, Karacan I. Reliability and validity studies of the Turkish version of the Epworth Sleepiness Scale. Sleep and Breath. 2008; 12(2): 161-8.
19. IPAQ Research Committee. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)–short and long forms. 2005. Retrieved September, 2008:17. http://www.ipaq.ki.se/scoring.pdf
20. Hoca M, Özduran G. Physical activity levels and eating habits of students in different educational levels. Prog Nutr. 2021; 23(3): 1-7.
21. Ashok P, Kharche JS, Raju R, Godbole G. Metabolic equivalent task assessment for physical activity in medical students. Natl J Physiol Pharm Pharmacol. 2017; 7(2): 236-9.
22. Saglam M, Arikan H, Savci S, Inal-Ince D, Bosnak-Guclu M, Karabulut E, et al. International physical activity questionnaire: reliability and validity of the Turkish version. Percept Mot Skills. 2010; 111(1): 278-84.
23. Sahin S, Acikel C, Turker T, Okyay S. An assessment of daytime sleepiness among students of the Gülhane Military Faculty of Medicine using the Epworth sleepiness scale. TAF Prev Med Bull. 2014; 13(1): 7-12.
24. Saygılı S, Akıncı AÇ, Arıkan H, Dereli E. Üniversite öğrencilerinde uyku kalitesi ve yorgunluk. EJOVOC. 2011; 1(1): 88-94.

25. Altıntaş H, Sevencan F, Aslan T, Cinel M, Çelik E, Onurdağ F. HÜTF dönem dört öğrencilerinin uyku bozukluklarının ve uykululuk hallerinin Epworth Uykululuk Ölçeği ile değerlendirilmesi. Sted. 2006; 15(7): 114-20.

26. Şenol V, Soyuer F, Akça RP, Argün M. Adolesanlarda Uyku Kalitesi ve Etkileyen Faktörler. Kocatepe Tıp Dergisi. 2012; 13(2): 93-104.

27. Spira AP, Beaudreau SA, Stone KL, Kezirian EJ, Lui LY, Redline S, et al. Reliability and validity of the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale in older men. J Gerontol A Biol Sci Med Sci. 2012; 67(4): 433-9.

28. Cleator J, Abbott J, Judd P, Wilding JP, Sutton CJ. Correlations between night eating, sleep quality, and excessive daytime sleepiness in a severely obese UK population. Sleep Med. 2013; 14(11): 1151-6.

29. Kumar KA, Othman WA, Jeppu AK. Association of Epworth Sleepiness Score with Anthropometric Measurements in Malaysian University Students. Recent Adv Biol Med. 2020; 6(1): 12456.

30. Gümüştakım RŞ, Kuş C, Uzkar M. Tıp Fakültesi Öğrencilerinde Gündüz Uykululuğunun ve Uyku Hijyeninin Değerlendirilmesi. J Turk Sleep Med. 2020; Suppl: 52-62.

31. Angelin TJ, Mota KR, Santos Júnior VED, Silva LC, Heimer MV. Evaluation of Sleep Quality and Daytime Sleepiness in Dentistry Students. Pesquisa Brasileira em Odontopediatria e Clínica Integrada. 2020; 20(9): 1-7.

32. Muhammad U, Ullah MU, Ansari J, Mustafavi S, Iftikhar R, Raja W, et al. The Effect of Adding Body Mass Index (BMI) and Neck Cırcumference to Epworth Sleepiness Scale (ESS) For Diagnosing Obstructive Sleep Apnea Hypopnea Syndrome in Sleep Clinics. Pak Armed Forces Med J. 2016; 66(1): 57-61.

33. Mah CD, Kezirian EJ, Marcello BM, Dement WC. Poor sleep quality and insufficient sleep of a collegiate student-athlete population. Sleep Health. 2018; 4(3): 251-7.

34. Low DV, Wu MN, Spira AP. Sleep duration and cognition in a nationally representative sample of US older adults. Am J Geriatr Psychiatry. 2019; 27(12): 1386-96.

35. Singh H, Singh S. Prevalence, patterns and associated factors of Physical Activity in Indian University students. Eur J Phys Educ Sport Sci. 2017; 3(10): 76-87.

36. Republic of Türkiye Ministry of Health. Turkey physical activity guide 2014. (4th Edition). Ministry of Health Publication. Kuban Matbaacılık Publishing, Ankara; 2014.

37. Alam S, Khan SB, Khattak QW, Abidin SZU, Farooqi S, Khan Z, et al. Level of physical activity in undergraduate students in Peshawar, Pakistan. Asian J Health Sci. 2021; 7(1): 20.

38. Adi S, Da'i M, Cahyani OD. Level of Physical Activity and Mass Body Index of Students in the Pandemic Period. JUARA: Jurnal Olahraga. 2021; 6(1): 30-8.

39. Gangwisch JE, Malaspina D, Boden-Albala B, Heymsfield SB. Inadequate sleep as a risk factor for obesity: analyses of the NHANES I. Sleep. 2005; 28(10): 1289-96.

40. Yousif MM, Kaddam LA, Humeda HS. Correlation between physical activity, eating behavior and obesity among Sudanese medical students Sudan. BMC Nutr. 2019; 5(1): 1-8.

41. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020; 54(24): 1451-62.

42. Abro SU, Khalid G, Saleem Q, Khan M, Ahmed S, Fatima. Association of body mass index and gender with sleep quality in medical students: A Survey. Prof Med J. 2020; 27(11): 2511-6.

43. Magee CA, Caputi P, Iverson DC. Is sleep duration associated with obesity in older Australian adults? J Aging Health. 2010; 22(8): 1235-55.

44. Beccuti G, Pannain S. Sleep and obesity. Curr Opin Clin Nutr Metab Care. 2011; 14(4): 402-19.

45. Rontoyanni VG, Baic S, Cooper AR. Association between nocturnal sleep duration, body fatness, and dietary intake in Greek women. Nutr. 2022; 23(11): 773-7.

46. Wang J, Chen Y, Jin Y, Zhu L, Yao Y. Sleep quality is inversely related to body mass index among university students. Rev Assoc Med Bras. 2019; 65(6): 845-50.

47. Momeni F, Javadi M, Mohammadi-Zeidi I, Abiri B, Sarbakhsh P, Vafa M. The Association of Sleep Quality with Dietary Intake and Rate of General and Central Obesity among Young Female Students in Qazvin City, Iran. JNFS. 2020; 5(3): 218-26.

48. Bel S, Michels N, De Vriendt T, Patterson E, Cuenca-Garcia M, Diethelm K, et al. Association between self-reported sleep duration and dietary quality in European adolescents. Br J Nutr. 2013; 110(5): 949-59.

49. Tepe SO, Gunes G, Pehlivan E, Genc M. The relationship between body mass index and Pittsburgh sleep quality index Erkan Pehlivan. Eur J Public Health. 2017; 27(suppl_3): 369.

50. Tan X, Chapman CD, Cedernaes J, Benedict C. Association between long sleep duration and increased risk of obesity and type 2 diabetes: A review of possible mechanisms. Sleep Med Rev. 2018; 40: 127-34.

51. Mayda A, Kasap H, Yildirim C, Yilmaz M, Derdiyok Ç, Ertan D, et al. Prevalence of Sleep Disorders in 4-5-6. Class Students of Medical Faculty. Journal of Duzce University Health Sciences Institute. 2012; 2(2): 8-11.

52. Oudegeest-Sander MH, Eijsvogels THM, Verheggen RJHM, Poelkens F, Hopman MTE, Jones H, et al. Impact of physical fitness and daily energy expenditure on sleep efficiency in young and older humans. Gerontology. 2013; 59(1): 8-16.

53. Buysse DJ, Hall ML, Strollo PJ, Kamarck TW, Owens J, Lee L, et al. Relationships between the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and clinical/polysomnographic measures in a community sample. J Clin Sleep Med. 2008; 4(6): 563-71.