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FACTORS ASSOCIATED WITH SLEEP QUALITY AND DURATION AMONG BEIRUT ARAB UNIVERSITY STUDENTS

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FACTORS ASSOCIATED WITH SLEEP QUALITY AND DURATION AMONG BEIRUT ARAB UNIVERSITY STUDENTS

Abstract

Sleep is part of the everyday physiological rhythm that is vital for enhancing wellness and appropriate body functions. University students are vulnerable to sleep disturbance due to many factors that affect their sleep–wake behavior. No study has so far evaluated the association between sleep quality and duration and the health and nutritional status of Lebanese college students. Thus, the present study was designed to evaluate the sleep quality and duration of Beirut Arab University (BAU) students in North Lebanon and to examine associations with their nutritional status, sociodemographic, eating behaviors, lifestyles and health characteristics. To do so, a cross-sectional study was conducted among a sample of 288 students (168 males and 120 females) aged between 17 and 25 years who were registered in the Fall of 2018–2019 in Tripoli Campus, and randomly selected from the different faculties. Students completed a multi-component questionnaire. According to this study, more than half of BAU students had poor sleep quality (64.2%) and short sleep duration (71.5%). The multiple regression analysis revealed that employed students were 82% less likely to have poor sleep quality (ORadj: 0.181; 95% CI: 0.062–0.528) (P

Keywords

sleep quality, sleep duration, nutritional status, college students

1. INTRODUCTION

Sleep pattern encompasses sleep quality and sleep duration. Sleep quality is a subjective indicator of how the nightly sleep was experienced and the perceived satisfaction once awake. On the other hand, sleep duration reflects the actual hours of sleeping per night (Pilcher et al., 1997). Human beings spend around one-third of their life asleep (Bayon et al., 2014). Any lack of sleep will result in different health consequences such as increasing the risk of many chronic diseases as well as increasing the rates of developing obesity (Medic et al., 2017). The intentional deprivation of total sleeping hours as well as the decrease in sleep quality have affected different ages groups (CDC, 2019). The most important age groups targeted for habits change are the young adults between 18 and 24 years. College is a period of life characterized by greater freedom from familiar control (Ruthig et al., 2009). At the same time, it is a crucial phase in the development of healthy eating habits that inform potential food choices in adulthood (Chen Yun et al., 2018). College students tend to experience an increase in their body weight. This is due to a combination of influences such as decreased levels of physical activity as well as high consumption of empty-calorie foods (Vadeboncoeur et al., 2015).

Along with the increased incidence of developing obesity, an alteration in sleeping patterns has been reported among college students. Different researchers have demonstrated the role of sleep deprivation in the development of obesity. Complex mechanisms participate in this issue, including changes in appetite and glucose regulation, excessive food consumption, and decreased energy expenditure (Zhu et al., 2019). Sleepers with very short sleep duration (less than five hours) recorded a marginally higher energy intake but less food diversity relative to long-duration sleepers (nine or more hours) ($P<0.001$) (Grandner et al., 2013). Various studies have indicated that sleep deprivation will result in higher consumption of sugar and simple carbohydrates, along with a lower intake of proteins when compared to normal sleep duration (Grandner et al., 2013; Kant & Graubard, 2014). In a sleep observational study, sleep restriction was found to have a detrimental impact on participants' overall dietary profile, in addition to an increase in the likelihood of unhealthy behaviors such as snacking. The macronutrient content of their diet also changed, **and affecting their sleep pattern**. (St-Onge et al., 2016). In addition to macronutrients, micronutrient intakes differ between sleeping categories. Short sleepers (less than five hours) have been found to have slightly lower vitamin C, lycopene and selenium intakes (Grandner et al., 2010).

No study has so far evaluated the association between sleep pattern and sociodemographic and economic status, physical activity and anthropometrical measurements, lifestyle and eating behaviors, and dietary intake among university students in North Lebanon, thus, the aim of the current study was to investigate this association. The findings of this study will contribute to the existing literature on sleep and dietary, health, and lifestyle factors and will be important for the development of health and nutrition intervention programs that target college students.

2. METHODOLOGY

2.1 Study Design and Participants

A cross-sectional study was conducted between January and May 2019. The target population was BAU undergraduate students aged between 17 and 25 years who were registered for the Fall and Spring of 2018–2019 in Tripoli campus. According to a previously published study, a sample size of 300 students was required, based on a prevalence of 47.3% of good-quality sleepers with a 95% confidence interval (Assaad et al., 2013). A representative sample was randomly selected according to a stratified proportional sampling from the five faculties where the students were registered: Architecture (N= 45, male=19, female=26), Business (N=48, male=29, female=19), Health Sciences (N=32, male=5, female=27), Engineering (N=135, male=112, female=23) and Sciences (N=40, male=10, female=30). The study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Institutional Review Board of Beirut Arab University (date: 15/1/2019, Nb: 2019H-0062-HS-M-0317).

2.2 Data collection

All participants were interviewed using a comprehensive multi-component questionnaire composed of 52 questions which included sleep quality and duration, sociodemographic and economic characteristics, physical activity and anthropometrical measurements, lifestyle, and eating behaviors. The questionnaire was piloted in advance and was followed by anthropometric measurements.

2.3 Measures

2.3.1. Sleep quality and duration

The sleep quality of the participants was assessed using the Pittsburgh sleep quality index (PSQI). The PSQI is a standardized, quantitative measure of sleep quality with high levels of reliability and validity (Backhaus et al., 2002; Spira et al., 2012). It is an effective instrument, mainly employed to identify the quality of sleeping patterns over the previous month. It is composed of 19 self-reported questions categorized into seven domain scores. Each of the seven components is evaluated equally on a 0–3 scale, with a higher score reflecting progressively worsening problems as follows: (1) subjective sleep quality (very good to very bad); (2) sleep latency (15 to more than 60 minutes); (3) sleep duration (seven to less than five hours); (4) sleep efficiency (85% to more than 65% hours sleep/hours in bed); (5) sleep disturbances (not during the past month to three times per week); (6) use of sleeping medications (none to three times a week); and (7) daytime dysfunction (not a problem to a very big problem). These seven components are then summed up to give a total score from 0 to 21. The final result was then dichotomized by using a cut-off point of "5", with a score of more than 5 denoting poor sleep quality (Buysse et al., 1989). Based on the recommended hours of sleep for this age group, students were divided into two groups: "Short sleepers" (less than seven hours) and "Normal sleepers" (seven hours or more) (National Sleep Foundation, 2018). The Arabic version of the PSQI was used in the current study (Suleiman et al., 2010).

2.3.2. Sociodemographic and economic status

The sociodemographic characteristics measured included: age; gender; employment (yes, no); and major (Architecture, Business, Health Sciences, Sciences, and Engineering). The different majors were regrouped into two categories: health majors (Sciences and Health Sciences) and non-health majors (Business, Architecture, and Engineering).

2.3.3. Lifestyle and eating behaviors

Lifestyle and eating behaviors were evaluated by asking participants to specify the types of snacks consumed daily (empty calorie foods like chips, chocolate etc., and nutrient-dense foods like fruits, vegetables, nuts, milk etc.), frequency of fast food consumption, alcohol intake, and smoking habits. Adherence to the Mediterranean diet (MD) was evaluated according to the PREDIMED score. This tool is a 14-item questionnaire that asks about the frequency and the intake of olive oil, chicken and turkey, and fish, as well as the consumption of beans, vegetables, fruit, and nuts, and takes into account the total consumption of sweets, red meat, and alcohol. For each question answered, students obtained one point, depending on whether their answer met the criteria or not. The final scores ranged from 0 to 14 and were divided into three categories: "≤5" (poor adherence to the MD), "6–9" (moderate adherence), and "≥10" (optimal adherence to the MD) (Martínez-González et al., 2012).

2.3.4 Physical activity and Anthropometrical measurements

The level of physical activity of the participants was assessed using the short form of the international physical activity questionnaire (IPAQ). The IPAQ is a valid and reliable tool that categorizes physical activities as low, moderate, and high levels. Three types of activities undertaken in the last seven days were assessed: walking; moderate activities such as cycling at a regular pace, doubles tennis, or carrying light loads; and vigorous activities such as heavy lifting, aerobics, digging, or fast cycling. The intensity, frequency and duration of each were recorded. Scoring was obtained by multiplying each activity by a standard number specific for each type. The number of days of walking and duration in minutes was multiplied by 3.3; moderate activity was multiplied by 4; while vigorous activity was multiplied by 8. Students were classified as being inactive if they had a sum of fewer than 600 minutes per week; moderately active if they scored between 600 and 3,000 minutes; and vigorously active if the sum was more than 3,000 minutes per week (Fan et al., 2005).

Weight, height, and waist circumference (WC) were measured for each student in duplicate using standardized techniques, and the average of both results was taken if the two measures differ. Height was assessed in a standing position without shoes to the nearest 0.1cm using a "Tanita" wall-mounted height rod (Stewart & Marfell-Jones, 2011). Feet were fastened against the vertical board of the stadiometer, with buttocks, heels, scapulae, and back of the head measured during maximum expiration. Participants' weight was measured to the nearest 0.1 kg wearing light indoor clothing using an electronic digital calibrated scale. Body mass index (BMI) was then calculated based on the following formula: weight (kg)/ height (m)2. The WC was measured with a non-stretchable flexible tape in a standing position. The value was recorded to the nearest 0.1cm, and values greater than 80cm and 94cm were considered as elevated for females and males respectively (World Health Organization, 2011).

2.3.5. Dietary intake

The dietary intake of participants was assessed by an 83-item food frequency questionnaire (FFQ) that measured food intake over the past six months. The FFQ has been validated among the Lebanese population (Fakhoury-Sayegh et al., 2017), and comprises three sections: food list, portion size, and frequency response. For each food item listed on the FFQ, standard portion size was indicated and nine frequency choices were given: "never or less than once per month", "one to three times per month", "once per week", "two to four times per week", "five to six times per week", "once per day", "two to three times per day", "four to five times per day" and "six or more times per day". For data entry, the software program "Nutritionist Pro" was used (Nutritionist Pro, Axxya Systems, San Bruno, CA, version 5.1.0, 2014). Within the Nutritionist Pro, the United States Department of Agriculture (USDA) database was selected for analysis. A simple mathematical conversion was used to obtain the daily intake of micronutrients and macronutrients that were associated with sleep patterns (Grandner et al., 2014; Grander et al., 2010). Macronutrients and food groups intakes were expressed as percent of total energy intake (% EI). Micronutrients intakes were presented as means ± SE, as well as percent of the population meeting 2/3rd of the Recommended Daily Allowance (RDA) (Mahan et al., 2017). Missing or incomplete dietary intakes as well as participants having intakes below 500 kcal and above 4,000 kcal per day were excluded (Jackson et al., 2011).

2.4 Ethical Considerations

The study design was reviewed and approved by the Institutional Review Board of Beirut Arab University, and all participants gave their informed written consent for the use of their anonymous personal data.

2.5 Statistical Analysis

The statistical analysis was carried out using SPSS 23 for Windows (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, version 20.0. IBM Corp.). Descriptive data were generated for socioeconomic factors, lifestyle, dietary factors, anthropometric variables, and sleep quality and duration. Results were expressed as means and standard deviations for continuous variables and as frequencies and percentages for categorical variables.

A bivariate analysis was performed (chi-square, independent sample T-test) to assess the association between sleeping quality and duration and each of the following variables: sociodemographic, eating behaviors, physical activity, anthropometrical measurements, and dietary intakes. Multiple logistic regression analysis was also used to investigate associations between specific variables that were found to be significantly associated with sleep quality and sleep duration in the bivariate analysis. A P-value < 0.05 was considered statistically significant.

3. RESULTS

3.1 Sleep Quality and Duration of the Participants

This study included 300 participants, out of whom 12 had under- or over-reported energy intakes. Thus, the final sample size consisted of 288 students. The results of the PSQI are presented in Table 1. The mean global PSQI score was 7.10 (SD ± 0.2), with 64.2% of the participants experiencing poor sleep quality (>5). In terms of sleep duration, the majority of students were short-duration sleepers, representing 71.5% of the study sample.

Table 1: Sleep quality of the participants according to the Pittsburg Sleep Quality Index (PSQI) (N=288)

Variables	n (%)
Sleep pattern	
GQS (≤5)	103 (35.8)
PQS (>5)	185 (64.2)
Sleep duration	
Short sleep duration (<7 hours)	206 (71.5)
Normal sleep duration (≥7 hours)	82 (28.5)

GQS good quality sleeper; *PQS* poor quality sleeper

3.2 Factors Associated with Sleep Quality of the Participants (Bivariate Analysis)

The sample consisted of 168 males (58.3%) and 120 females (41.7%). The mean age of the participants was 19.9 years (SD± 1.76). The majority of the students were unemployed (92.7%). More females than males were poor-quality sleepers (P=0.013). In addition, employed students enjoyed a better sleep quality compared to their unemployed peers (P<0.001) (Table 2).

Regarding lifestyle and eating habits, more than half of the participants (64.9%) relied on empty calories foods such as chocolate, chips and carbonated beverages as their daily snacks. Around one-third (31.3%) were smokers. Despite Lebanon being a Mediterranean country, only 6.9% of students had an optimal adherence to the Mediterranean diet (Table 3). No significant correlation was found between these variables and the sleep quality of the participants.

Concerning health factors, the prevalence of overweight and obesity among the participants was 39%. Central obesity was more prevalent among female students, with 85.8% having a waist circumference above normal based on criteria of >80cm (World Health Organization, 2011). According to the IPAQ score, around one-third (34.4%) of participants were inactive. It appears that being inactive was significantly associated with poor sleep quality among the participants (P=0.009) (Table 4).

Finally, the analysis of the food frequency questionnaire in terms of daily dietary intake revealed that all BAU students had an intake of saturated fat exceeding the recommendations. Regarding caffeine, around 95.8% of the students had a caffeine intake below 400 mg/day. In terms of association with sleep quality, it seems that a higher intake of beta carotene was significantly associated with better sleep quality (P=0.015). Similarly, vitamin C, as well as fiber intakes in male students, were significantly higher among good quality sleepers (P=0.015 and P=0.034, respectively) (Table 5).

Table 2: Association between Sociodemographic and Sleep Quality among the Participants (N= 288)

Variables	Total (n=288)	Sleep quality n(%) Good quality sleeper (≤5)	Poor quality sleeper (>5)	P-value
		103 (35.8)	185 (64.2)	
Gender				
Males	168 (58.3)	70 (41.7)	98 (58.3)	**(0.013)**
Females	120 (41.7)	33 (27.5)	87 (72.5)	
Age				
Mean (SD)	19.90 (1.76)	20.17 (1.8)	19.75 (1.8)	(0.704)
Employment				
Yes	21 (7.3)	16 (76.2)	5 (23.8)	**(<0.001)**
No	267 (92.7)	87 (32.6)	180 (67.4)	
Faculty				
Health majors	68 (23.6)	21 (30.9)	47 (69.1)	(0.337)
Non-health majors	220 (76.4)	82 (37.3)	138 (62.7)	

Bolded numbers are significant at P < 0.05

Table 3: Associations between Lifestyle and Eating Behaviours of the Participants and Sleep Quality of the Participants (N= 288)

Variables	Total (n=288)	Sleep quality n(%) Good quality sleeper (≤5)	Poor quality sleeper (>5)	P-value
		103 (35.8)	185 (64.2)	
Snack types				
Empty calories	187 (64.9)	65 (34.8)	122 (65.2)	(0.628)
Nutrient dense foods	101 (35.1)	38 (37.6)	63 (62.4)	
Fast food consumption				
Yes	244 (85.1)	86 (35.1)	159 (64.9)	(0.577)
No	44 (14.9)	17 (39.5)	26 (60.5)	
Frequency of fast food consumption/week				
Average (SD)	2.31 (1.2)	2.2 (1.0)	2.38 (1.5)	(0.466)
Alcohol consumption				
Yes	11 (3.8)	3 (27.3)	8 (72.7)	(0.56)
No	277 (96.2)	99 (35.9)	177 (64.1)	
Smoking				
Yes	90 (31.3)	31 (34.4)	59 (65.6)	(0.75)
No	198 (68.8)	72 (36.4)	126 (63.6)	
Adherence to the Mediterranean Diet				
Poor adherence (≤5)	112 (38.9)	39 (34.8)	73 (65.2)	(0.314)
Moderate adherence (6-9)	156 (54.2)	53 (34.0)	103 (66.0)	
Optimal adherence (≥10)	20 (6.9)	11 (55.0)	9 (45.0)	

Bolded numbers are significant at P < 0.05

Table 4: Associations between physical activity, anthropometrical measurements and sleep quality of the participants (N=288)

Variables	Total (n=288)	Sleep quality n(%)		P-value
		Good quality sleeper (≤5)	Poor quality sleeper (>5)	
		103 (35.8)	185 (64.2)	
BMI				
Underweight (<18.5 kg/m²)	9 (3.1)	2 (22.2)	7 (77.8)	(0.89)
Normal (18.5-24.9 kg/m²)	168 (58.1)	61 (36.3)	107 (63.7)	
Overweight (25-29.9 kg/m²)	85 (29.9)	33 (38.8)	52 (61.2)	
Obese (≥30 kg/m²)	26 (9)	7 (26.9)	19 (73.1)	
Mean (kg/m²) (SD)	24.52 (4.4)	24.52 (4.4)	24.40 (4.1)	(0.829)
WC among females (n=120)				
Normal (<80 cm)	17 (14.2)	6 (35.3)	11 (64.7)	(0.211)
High (≥80 cm)	103 (85.8)	27 (26.2)	76 (73.8)	
Mean (cm) (SD)	72.37 (9.2)	72.37 (9.2)	71.86 (7.4)	(0.752)
WC among males (n=168)				
Normal (<94 cm)	133 (79.2)	61 (45.9)	72 (54.1)	(0.438)
High(≥94 cm)	35 (20.8)	9 (25.7)	26 (74.3)	
Mean (cm) (SD)	84.64 (10.9)	84.64 (10.9)	85.47 (10.4)	(0.616)
IPAQ score				
Inactive	99 (34.4)	28 (28.3)	71 (71.7)	**(0.009)**
Moderately active	135 (46.9)	48 (35.6)	87 (64.4)	
Vigorously active	54 (18.7)	27 (50.0)	27 (50.0)	

BMI body mass index; *WC* Waist Circumference; *IPAQ* international physical activity questionnaire
Bolded numbers are significant at P < 0.05

Table 5: Associations between dietary intake and sleep quality of the participants (N=288)

Variables	Total (n=288)	Sleep quality n(%)		P-value
		Good quality sleeper (≤5)	Poor quality sleeper (>5)	
		103 (35.8)	185 (64.2)	
Energy (Mean ±SD)	2724 (420.45)	2810.50 (450.0)	2675.85 (390.5)	(0.313)
Protein (%EI)	14.5 (0.51)	14.64 (0.45)	14.36 (0.71)	(0.711)
Carbohydrates (%EI)	55.75 (0.28)	58.61 (0.32)	54.13 (0.12)	(0.136)
Fat (%EI)	32.07 (0.55)	32.44 (0.71)	31.86 (0.62)	(0.743)
SFA				
≥ 2/3rd RDA	288 (100)	103 (35.8)	185 (64.2)	(0.179)
Mean (g) (±SD)	26.91 (2.0)	26.41 (6.3)	27.18 (6.2)	(0.644)
Beta carotene intake				
≥2/3rd RDA	288 (100)	103 (35.8)	185 (64.2)	(0.455)
Mean (mcg) (SD)	6471.35 (601.5)	7644.73 (703.2)	5818 (546.8)	**(0.015)**
Lycopene intake				
≥2/3rd RDA	286 (99.3)	102 (35.7)	184 (64.3)	(0.673)

Variables	Total (n=288)	Sleep quality n(%) Good quality sleeper (≤5)	Poor quality sleeper (>5)	P-value
		103 (35.8)	185 (64.2)	
Mean (mcg) (SD)	21248.33 (185.2)	17790 (238.0)	23173 (131.0)	(0.611)
Selenium intake				
≥2/3rd RDA	124 (43.1)	47 (37.9)	77 (62.1)	(0.510)
Mean (mcg) (SD)	62.27 (8.2)	65.14 (8.8)	60.65 (6.7)	(0.361)
Vitamin C intake among females (n=120)				
≥2/3rd RDA	103 (85.8)	29 (28.2)	74 (71.8)	(0.457)
Mean (mg) (SD)	265.12 (19.1)	273.77 (28.4)	261.84 (19.9)	(0.769)
Vitamin C intake among males (n=168)				
≥2/3rd RDA	154 (91.6)	66 (42.9)	88 (57.1)	(0.464)
Mean (mg) (SD)	286.52 (18.2)	326 (21.2)	257 (16.0)	**(0.015)**
Iron intake among females (n=120)				
≥2/3rd RDA	36 (30)	9 (25.7)	27 (74.3)	(0.456)
Mean (mg) (SD)	16.24 (2.8)	15.58 (5.0)	16.49 (6.2)	(0.708)
Iron intake among males (n=168)				
≥2/3rd RDA	157 (93.5)	66 (42.0)	91 (58.0)	(0.464)
Mean (mg) (SD)	18.69 (4.6)	16.45 (4.0)	20.3 (5.0)	(0.439)
Fiber intake among females				
<25 g	50 (41.7)	13 (26)	37 (74)	(0.875)
≥25 g	70 (58.3)	20 (28.6)	50 (71.4)	
Mean (g) (SD)	38.34 (2.9)	39.65 (6.4)	37.85 (5.6)	(0.770)
Fiber intake among males				
<38 g	102 (60.7)	35 (34.3)	67 (65.7)	**(0.034)**
≥38 g	66 (39.3)	35 (53)	31 (47)	
Mean (g) (SD)	39.12 (3.1)	44.74 (6.2)	35.10 (5.0)	**(0.014)**
Caffeine consumption				
≤400 mg/day	276 (95.8)	100 (36.2)	176 (63.8)	(0.427)
>400 mg/day	12 (4.2)	3 (25)	9 (75)	

EI energy intake; *SFA* saturated fatty acid

Bolded numbers are significant at P < 0.05

3.3. Factors Associated with Sleep Duration Among the Participants (Bivariate Analysis)

Sleep duration showed no significant association with the sociodemographic status and the dietary intake of the participants (Table 6). In addition, students who consumed fast food and alcohol demonstrated a significant association with sleep duration, specifically exhibiting a short duration of sleep (P = 0.021 and 0.037, respectively) (Table 7). In terms of anthropometrical measurements, male students with a higher WC exhibited a short sleep duration (P=0.011) (Table 8). None of the dietary factors was associated with sleep duration (Table 9).

Table 6: Association between sociodemographic, economic status and sleep duration among the participants (N= 288)

Variables	Total (n=288)	Sleep duration n(%)		P-value
		Short Sleep duration (<7 hours)	Normal Sleep duration (≥7 hours)	
		209 (72.6)	79 (27.4)	
Gender				
Males	168 (58.3)	123 (73.2)	45 (26.8)	(0.772)
Females	120 (41.7)	86 (71.7)	34 (28.3)	
Mean Age (SD)				
	19.90 (1.75)	19.95 (1.8)	19.77 (1.9)	(0.226)
Employment				
Yes	21 (7.3)	17 (81.0)	4 (19.0)	(0.371)
No	267 (92.7)	192 (72)	75 (28.0)	
Faculty				
Health majors	68 (23.6)	161 (73.2)	59 (26.8)	(0.675)
Non-health majors	220 (76.4)	48 (70.6)	20 (29.4)	

Bolded numbers are significant at P < 0.05

Table 7: Association between lifestyle and eating behaviors with sleep duration among the participants (N=288)

Variables	Total (n=288)	Sleep duration n(%)		P-value
		Short Sleep duration (<7 hours)	Normal Sleep duration (≥7 hours)	
		209 (72.6)	79 (27.4)	
Snack types				
Junk foods	187 (64.9)	133 (71.1)	54 (28.9)	(0.454)
Nutrient dense foods	101 (35.1)	76 (75.2)	25 (24.8)	
Fast food consumption				
Yes	244 (85.1)	184 (75.1)	61 (24.9)	**(0.021)**
No	44 (14.9)	25 (58.1)	18 (41.9)	
Frequency of fast food consumption/week				
Mean (SD)	2.31 (2.0)	2.488 (2.0)	1.873 (1.7)	**(0.02)**
Alcohol consumption				
Yes	11 (3.8)	11 (100)	0 (0)	**(0.037)**
No	277 (96.2)	197 (71.4)	80 (28.6)	
Smoking				
Yes	90 (31.3)	67 (74.4)	23 (25.6)	(0.631)

Variables	Total (n=288)	Sleep duration n(%)		P-value
		Short Sleep duration (<7 hours)	Normal Sleep duration (≥7 hours)	
		209 (72.6)	79 (27.4)	
No	198 (68.8)	142 (71.7)	56 (28.3)	
Adherence to the Mediterranean Diet				
Poor adherence (≤5)	112 (38.9)	83 (74.1)	29 (25.9)	(0.188)
Moderate adherence (6-9)	156 (54.2)	115 (73.7)	41 (26.3)	
Optimal adherence (≥10)	20 (6.9)	11 (55.0)	9 (45.0)	

Bolded numbers are significant at $P < 0.05$

Table 8: Associations between physical activity, anthropometrical measurements and sleep duration of the participants (N=288)

Variables	Total (n=288)	Sleep duration n(%)		P-value
		Short Sleep duration (<7 hours)	Normal Sleep duration (≥7 hours)	
		209 (72.6)	79 (27.4)	
BMI				
Underweight (<18.5 kg/m^2)	9 (3.1)	6 (66.7)	3 (33.3)	(0.378)
Normal (18.5-24.9 kg/m^2)	168 (58.1)	117 (69.6)	51 (30.4)	
Overweight (25-29.9 kg/m^2)	85 (29.9)	64 (75.3)	21 (24.7)	
Obese (≥30 kg/m^2)	26 (9)	22 (84.6)	4 (15.4)	
Mean (kg/m^2) (SD)	24.52 (4.4)	24.65 (4.4)	23.90 (3.7)	(0.181)
Waist Circumference among females (n=120)				
Normal (<80 cm)	103 (85.8)	75 (72.8)	28 (27.2)	(0.492)
High (≥80 cm)	17 (14.4)	11 (64.7)	6 (35.3)	
Mean (cm) (SD)	72.37 (9.2)	71.91 (7.9)	72.23 (8.2)	(0.842)
Waist Circumference among males (n=168)				
Normal (<94 cm)	133 (79.2)	94 (70.7)	39 (29.3)	**(0.011)**
High (≥94 cm)	35 (20.8)	29 (82.9)	6 (17.1)	
Mean (cm) (SD)	84.64 (10.9)	86.20 (10.6)	82.2 (10.0)	**(0.03)**
IPAQ score				
Inactive	99 (34.4)	72 (72.7)	27 (27.3)	(0.525)
Moderately active	135 (46.9)	101 (74.9)	34 (25.1)	
Vigorously active	54 (18.7)	36 (66.7)	18 (33.3)	

BMI body mass index; *WC* waist circumference; *IPAQ* international physical activity questionnaire

Bolded numbers are significant at $P < 0.05$

Table 9: Associations between dietary intakes and sleep duration of the participants (N=288)

Variables	Total (n=288)	Sleep duration n(%)		P-value
		Short Sleep duration (<7 hours)	Normal Sleep duration (≥7 hours)	
		209 (72.6)	79 (27.4)	
Energy (Mean ±SD)	2724 (420.45)	2737.34 (425.6)	2688.72 (370.6)	(0.472)
Protein intake (%EI)	14.5 (0.51)	14.48 (0.54)	14.41 (0.92)	(0.933)
Carbohydrate intake (%EI)	55.75 (0.28)	56.19 (0.17)	54.38 (0.23)	(0.565)
Fat intake (%EI)	32.07 (0.55)	32.1 (0.74)	32.07 (0.75)	(0.998)
SFA intake				
≥2/3rd RDA	288 (100%)	209 (72.6)	79 (27.4)	(0.103)
Mean (g) (SD)	26.91 (2.0)	27.04 (4.7)	26.55 (4.4)	(0.786)
Beta carotene intake				
≥2/3rd RDA	288 (100)	209 (72.6)	79 (27.4)	(0.538)
Mean (mcg) (SD)	6471.35 (61.5)	6435.8 (427.1)	6565.3 (383.8)	(0.873)
Lycopene intake				
≥2/3rd RDA	286 (99.3)	207 (72.4)	79 (27.6)	(0.383)
Mean (mcg) (SD)	21248.33 (185.2)	22824.0 (200.0)	17079.7 (231.6)	(0.613)
Selenium intake				
≥2/3rd RDA	124 (43.1)	94 (75.8)	30 (24.2)	(0.284)
Mean (mg) (SD)	62.27 (8.2)	62.5 (5.8)	61.7 (4.8)	(0.889)
Vitamin C intake among females (n=120)				(0.291)
≥2/3rd RDA	103 (85.8)	72 (69.9)	31 (30.1)	(0.595)
Mean (mg) (SD)	265.12 (19.1)	259.1 (19.5)	280.4 (20.2)	(0.595)
Vitamin C intake among males (n=168)				
≥ 2/3rd RDA	154 (91.6)	112 (72.7)	42 (27.3)	(0.636)
Mean (mg) (SD)	286.52 (18.2)	28 (14.4)	293.5 (17.1)	(0.765)
Iron intake among females (n=120)				
≥2/3rd RDA	36 (30)	27 (75.0)	9 (25.0)	(0.831)
Mean (mg) (SD)	16.4 (2.8)	16.8 (2.9)	15.0 (2.2)	(0.459)
Iron intake among males (n=168)				
≥2/3rd RDA	157 (93.5)	115 (73.2)	42 (26.8)	(0.970)
Mean (mg) (SD)	18.69 (4.6)	19.5 (3.7)	16.4 (2.0)	(0.577)
Fiber intake among females				
<25 g	50 (41.7)	36 (72)	14 (28)	(0.956)
≥25 g	70 (58.3)	50 (71.4)	20 (28.6)	
Mean (g) (SD)	38.34 (2.9)	38.5 (5.6)	38 (4.6)	(0.937)

Variables	**Total (n=288)**	**Sleep duration n(%)**		**P-value**
		Short Sleep duration (<7 hours)	**Normal Sleep duration (≥7 hours)**	
		209 (72.6)	79 (27.4)	
Fiber intake among males				
<38 g	102 (60.7)	74 (72.5)	28 (27.5)	0.809
≥38 g	66 (39.3)	49 (72.2)	17 (25.8)	
Mean (g) (SD)	39.12 (3.1)	39.3 (9.7)	38.7 (8.6)	(0.906)
Caffeine consumption				
≤400 mg/day	276 (95.8)	199 (72.1)	77 (27.9)	(0.393)
>400 mg/day	12 (4.2)	10 (83.3)	2 (16.7)	
Mean (mg) (SD)	93.7 (13.2)	98.8 (14)	80 (10.8)	(0.283)

EI energy intake; *SFA* saturated fatty acid

Bolded numbers are significant at P < 0.05

3.4. Factors Associated with Sleep Quality of the Participants: Multiple Regression Analysis

After adjusting for all significantly associated variables in the bivariate analysis, most of the data in terms of physical activity and anthropometrical measurements lost their associations with the quality of sleep. The variable that remained significantly associated with sleep quality among BAU students was employment. The multivariate logistic regression analysis revealed that employed students were 82 % less likely to have poor sleep quality (ORadj: 0.181; 95% CI: 0.062–0.528) compared with their peers (Table 10).

Table 10: Factors associated with sleep quality among students: Multiple Regression Analysis

Variables	**OR Adjusted (95%CI)**	**P-value**
Gender (male/female)	0.711 (0.416-1.217)	(0.214)
Employment (employed/unemployed)	0.181 (0.062-0.528)	**(<0.001)**
IPAQ (1) (inactive/moderately active)	2.069 (1-4.282)	(0.05)
IPAQ (2) (inactive/vigorously active)	1.497 (0.763-2.938)	(0.240)
Fiber intake among males (below/ normal)	0.991 (0.969-1.015)	(0.468)
Mean intake of Beta carotene	1	(0.286)
Mean intake of vitamin C among males	0.999 (0.996-1.002)	(0.475)

Bolded numbers are significant at P < 0.05

3.5. Factors Associated with Sleep Duration of the Participants: Multiple Regression Analysis

When all significant determinants were taken into account, the variables that remained significantly associated with sleep duration were fast food consumption and waist circumference among males students. Students who consumed fast food were 50 % less likely to enjoy a normal sleep duration (ORadj: 0.490; 95% CI: 0.250–0.959), and those with a higher WC (≥94cm) were 4% less likely to exhibit normal sleep duration (ORadj: 0.961; 95% CI: 0.927–0.997) (Table 11).

Table 11: Factors associated with sleep duration among students: Multiple Regression Analysis

Variables	OR Adjusted (95%)	P-value
Alcohol consumption(Yes/Never)	0	(0.999)
Fast-food consumption (Yes/never)	0.490 (0.250-0.959)	**(0.037)**
Waist circumference among males (Normal/high)	0.961(0.927-0.997)	**(0.032)**

Bolded numbers are significant at $P < 0.05$

4. DISCUSSION

The results of the present study revealed that employed students had better sleep quality than unemployed students. Furthermore, our results indicated that males with central obesity (WC≥94cm) had a shorter sleep duration when compared to their peers with normal waist circumference. In addition, students with higher fast-food consumption also experienced shorter sleep duration.

The general public often ignores the importance of having adequate sleep and neglects its effects on human health. A healthy sleep pattern encompasses good sleep quality and appropriate sleep duration (Bin, 2016). The prevalence of sleep quality among BAU students showed that more than half of the students had poor sleep quality (64.2%). Ford and Kameraw (1989) have highlighted the effects of adequate sleep on psychiatric health. Furthermore, many studies have indicated that sleep quality can be even more important than sleep duration (Anothaisintawee et al., 2016; Kohyama, 2021). Nowadays, due to stress, social media, and night shifts at work, the rates of poor sleep quality are increasing widely worldwide. In Ethiopia, a study conducted among adults revealed that more than half (65%) experienced poor sleep quality (Berhanu et al., 2018). Furthermore, a study conducted among 20,000 participants (≥12 years) in the Netherlands revealed that around a quarter of the participants had sleep problems (Nielen et al., 2015). Another study conducted among 2,195 elderly Chinese participants revealed that this problem was prevalent among 33.8% of the participants (Wang et al., 2020). This problem is also widespread in Arab countries. A study conducted in Saudi Arabia with medical students revealed that 76% of them had poor sleep quality (Siddiqui et al., 2016). The same issue was seen among a different age group in Lebanon: more than three-quarters (76.5%) indicated dissatisfaction with their sleep quality in a study sample of 500 high school teenagers in Beirut (Chahine et al., 2018). This last finding agrees with those of another study conducted among different universities in Lebanon. This result reflected an alarming problem and indicated that more than half of Lebanese college students (aged 18 to 25 years) had poor sleep quality (Assaad et al., 2013).

With regard to sleep duration, BAU students revealed that the majority of them (71.5%) had less than seven hours of sleep each night. International surveys have revealed many discrepancies in prevalence rates; however, they all indicate an alarming alteration in sleep duration. According to the Centers for Disease Control and Prevention (CDC), 35% of adults in the United States reported short sleep duration (less than seven hours of sleep) in 2014 (CDC, 2019). In addition, short sleep duration, like poor sleep quality, is also prevalent in Arab countries. The results of a cross-sectional study conducted among Saudi Arabian adults showed that one in every three citizens slept for less than seven hours each night (Ahmed et al., 2017). This finding is not far removed from the situation in Lebanon. The results of a study conducted among adults in two different regions (Beirut and Mount Lebanon) indicated that 39% of the participants suffered from short sleep duration, and had less than six hours of sleep each night (Chami et al., 2020).

Contrary to our expectations, employed students had a better sleep quality than their unemployed peers. This finding was in contradiction to a study conducted among Nigerian college students. The study reported that students with part-time jobs had poor sleep quality and often reported only a few sleeping hours caused by their night shifts or due to the stress that altered their sleep quality (Tobi Seun-Fadipe et al., 2017). However, another study among Lebanese college students reported no significant association between sleep quality and employment (Kabrita et al., 2014). This can be explained by the differences in time management between employed and unemployed students. The results of our study can be explained by the fact that employed students had a higher sense of responsibility and managed their time better when compared to unemployed students. Therefore, this can affect their daily routine and activities and ensure that they leave adequate time for everything (Wang et al., 2010). Axelsson et al. (2004) found that some workers were able to tolerate the alteration in their sleep patterns, while, in contrast, a study conducted among 424 workers revealed that night-shift workers were more likely to experience poor sleep quality when compared to their peers (Thach et al., 2020).

The results of our study indicate that students who consume fast-food have a short sleep duration (less than seven hours of sleep). Similar results have been obtained by other studies (Ferranti et al., 2016; Mozaffarian et al., 2020; Kruger et al., 2014; Min et al., 2018; Ogilvie et al., 2018; Weiss et al., 2010). Sleep duration and fast food intake are linked in two different ways. First, a healthy lifestyle may encompass adequate sleep duration and a balanced diet, which limits the intake of fast and empty-calorie foods (Khan & Uddin, 2020; Shochat, 2012). On the other hand, sleep deprivation contributes to an alteration in the secretion of orexigenic and anorexigenic hormones. The secretion of leptin, an anorexigenic hormone, begins to decrease, accompanied by an increase in the secretion of ghrelin, an orexigenic hormone, the day after a single night of sleep deprivation (Benedict et al., 2011; Kim et al., 2015). This phenomenon can result in a higher energy intake and lead to obesity over time (Garaulet et al., 2011; Gonnissen et al., 2013; Klok et al., 2007; Schmid et al., 2009; Taheri et al., 2004). Sleep deprivation is associated with a tendency to increase portion size and self-reported hunger (Hogenkamp et al., 2013). Furthermore, this will lead to a higher tendency to seek high-fat foods (Min et al., 2018), which was indicated by our findings. According to Sato-Mito et al. (2011), this will also affect a person’s healthy choices and contribute to lowering their intake of fruit, vegetables, and fibers.

The results of this study confirmed a strong association between waist circumference and short sleep duration among men but not among women. Some other studies, however, have reported no correlations at all (St-Onge et al., 2010; Yan et al., 2017). On the other hand, we could not find any association between waist circumference and sleep quality among either sex. The finding of a meta-analysis conducted among 56,259 participants revealed a negative correlation between total sleeping hours and waist circumference ($P<0.001$), with those with shorter sleep durations having a higher waist circumference when compared to their peers, regardless of their gender (Sperry et al., 2015). In addition, the finding of a study conducted among 133,608 participants revealed that males and females who slept for less than six hours per night had a 15% and 9% increase in their waist circumference, respectively (Kim et al., 2018). A study conducted among Chinese children (aged nine to 12 years) indicated an inverse relationship between waist circumference and sleep duration, but not with sleep quality (Wang et al., 2017). This can be explained through the bidirectional relationship between obesity and sleep patterns (Tan et al., 2018). Males and females exhibit metabolic and hormonal differences. Males, because of their testosterone hormones, are more prone to experiencing short sleep duration (Liu et al., 2008). This will increase their total time of eating and thus increase the secretion of the orexigenic hormone ghrelin, which increases hunger and total energy intake, associated with central obesity (Calvin et al., 2013; Gonnissen et al., 2013). In addition, a lack of sleep will lead to a shortage in levels of physical activity, which may contribute to the development of obesity (Benedict et al., 2011; Kline et al., 2014). In turn, central obesity reflects an image of an unhealthy lifestyle, which will also lead to the alteration of sleep patterns and result in short sleep duration (Shochat, 2012).

5. CONCLUSION

Based on the analysis of the collected data, it was concluded that the prevalence of poor sleep quality and short sleep duration were alarmingly high among BAU students. The current findings add to the literature that employed students benefit from a better sleep quality (PSQI≤5) when compared to unemployed students, and that those with short sleep duration (less than seven hours of sleep) have a higher fast food intake and waist circumference (males in particular) when compared to their peers.

This study had several strengths and limitations. To our knowledge, this is the first study that has assessed the association between sleep patterns and several factors including sociodemographic, economic, lifestyle and, in particular, health characteristics and dietary intake at the same time in North Lebanon. Furthermore, the high prevalence of poor sleep quality and short sleep duration in BAU students could highlight the importance of developing interventional studies among college students to promote healthy sleeping hygiene habits that might have a beneficial effect on the students' psychological and physical wellbeing.

Similar to other studies, this study has several limitations. First, this study was a cross-sectional study, which inhibits the investigation of causal relationships. Another limitation is that the study was only representative of students that were registered in the Fall of 2018 in one location (North Lebanon), which does not allow the generalization of the current findings. Third, most of the data were collected during the final exam period. This highlighted the presence of stress, which could be a confounding factor and might affect the results. According to Zunhammer et al. (2014), examination stress has a direct effect on sleep patterns. Finally, and due to the limited resources, all of the methods used to assess sleep quality, sleep duration, adherence to MD, physical activity, and dietary intake, despite their validity and reliability, were subjective. Each of these methods relies on retrospective information, which may add some memory bias to our findings.

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