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How are university students' sleep quality affected by different Variables during COVID-19 remote learning?

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Abstract

Background: Severe restrictive measures during the COVID-19 pandemic had negatively affected many health and lifestyle behaviors, including sleep quality, which was correlated to several variables.
Aims: To examine the association between sleeping quality, gender, smoking, and body mass index during remote learning periods among university students.
Methodology: an online cross-sectional study, that included undergraduate and graduate university students, aged 18-30 years old. A self-reported questionnaire was used. Sleep quality was assessed using a validated Arabic version of the Pittsburgh Sleep Quality Index (PSQI).
Results: there was a significant weak correlation between gender and sleep disturbance. While smoking had a significantly weak correlation with subjective sleep quality (r =0.114, p=0.005), and sleep latency (r =0.115, p=0.005). Body mass index had significantly no correlation with sleep latency (r =0.008, p=0.045). However, most of the participants who had low to high sleep disturbance were females (p=0.002), and the participants who had very good subjective sleep quality and no sleep latency were non-smokers (90.0% and 89.2%, respectively). The underweight participants had a higher percentage of very bad subjective sleep quality (20.7%).
Conclusion: a weak correlation between sleeping quality component with gender and smoking. no correlation between BMI and the sleeping quality component. Females had higher sleep disturbance and non-smokers had very good subjective sleep quality and no sleep latency. The underweight body mass is associated with very bad subjective sleep quality, and normal weight is associated with fairly good subjective sleep quality.

Keywords: sleep quality; remote learning; university students; correlation; smoking; body mass index.

1. Introduction

As a result of the Coronavirus-2019 (COVID-19) pandemic, all countries around the world followed preventive restriction procedures such as closing non-vital companies, preventing cultural and community events, home quarantine, segregation social events, and lockdown to avoid disease spread and outbreak (Lippi *et al*., 2020). Also, all educational institutions including schools and universities were closed and replaced with online remote learning (Al Hourani *et al*., 2021). These severe restrictive measures had led to negatively affected many health and lifestyles behaviors (Lopez-Bueno *et al*., 2020) including physical activity (PA), social habits, dietary habits, sleeping hours and quality, body weight, and mental health (Ammar *et al*., 2020; Wang *et al*., 2020; Rubin & Wessely, 2020; Jalal *et al*., 2021).

The COVID-19 pandemic has been associated with poor sleep quality in many countries like Italy (Casagrande *et al*., 2020) and China (Xiao *et al*., 2020). Highly poor sleep quality has been reported among students in COVID-19 lockdown, which was linked to lifestyle changes such as behavioral and dietary changes, and body mass index (BMI) (Salehinejad *et al*., 2020). It has been proved that sleep quality is affected by many variables such as gender, cigarette smoking, and BMI. Manzar *et al*., (2015) found that females were more affected by sleeping problems (51.67% vs. 48.33% in males) at an early bedtime. Also, the prevalence of circadian rhythm sleep disorder (11.6% vs. 9.5%) and delayed sleep phase syndrome (4.5% vs. 2.7%) was slightly higher in males (Manzar *et al*., 2015). Sleep latency was found to be increased with age in females, while sleep efficiency decreased with age in both genders (Luca *et al*., 2015). Significant differences were shown between male and female students among the seven components of sleep quality, sleep duration, and the use of sleep medication, accompanied by an obvious correlation between sleep quality and body mass index in females who took hypnotic drugs (Wang *et al*., 2019). The results about the correlation between poor sleep quality and BMI were inconsistence, however, among medical Saudi students, a significant negative correlation was found between body mass index and sleep duration (Aldahash *et al*., 2019). Furthermore, Krističević and colleagues (2018) concluded that both short and long time spent in bed and poor sleep quality were associated with overweight and/or obese young adults (Krističević *et al*.,2018). While an independent association between body weight and sleep quality among children was reported (Hassan *et al*., 2011), also sleep disturbances, instead of sleep duration, were predicted in overweight young adults (Vargas *et al*., 2014). Cigarette smoking was reported to impair memory and adversely influence sleep quality (Liu *et al*., 2011). Moreover, the global score was approved to be poorer in the individuals with a history of one-month cigarette smoking and suggested a worsened sleep quality by increasing the number of cigarettes smoked per day and increasing the period of smoking (Asghari *et al*., 2015). Jaehne *et al*., (2012) reported that smokers had a shorter sleep period time, longer sleep latency, higher rapid eye movement sleep density, more sleep apneas, and leg movements in sleep than non-smokers (Jaehne *et al*., 2012). On other hand, Cohen *et al*., (2019) reported that smokers' self-reported sleep quality, sleep time, and sleep onset were similar to that of non-smokers, while smokers' sleep continuity was decreased (Cohen *et al*., 2019). There were no reports or data about the sleeping quality correlated variables after COVID-19 quarantine in Jordan or other countries in the Arab region. So, this study aims to examine the association between sleeping quality, gender, smoking, and body mass index during remote learning periods among university students.

2. Materials and methodology

2.1. Study Design

The study was an online cross-sectional study, that included university students; both undergraduate and graduate students, who were 18-30 years old. Data were collected from 1st- 30th April 2020. The study was conducted according to the guidelines of Helsinki and ethically approved by the Research Ethics Committee of Al-Balqa Applied University, Faculty of Agriculture, Department of Nutrition and Food Technology. Participants' consent was obtained preceding the start of the study.

2.2. Study sample size

The sample size calculation was determined using Raosoft software (Raosoft, Inc. free online software, Seattle, WA, USA), with a confidence interval of 95%, and a confidence level of 5%. The estimated sample size was 384. However, the recruited participants were 599.

2.3. Data collection

Data were collected using a structured self-reported online Questionnaire, including students' demographic information, anthropometric data, and Pittsburgh Sleep Quality Index (PSQI). The tool was achieved through the Google Forms survey platform. It was transferred through the official channels of Al-Balqa Applied University, Al-salt, Jordan. The anonymous questionnaire was starting with a brief description of the study and objectives.

2.3.1. Demographic data

Information about age, height, weight, sex, marital status, smoking, and living partner were collected. Body mass index (BMI) was calculated (kg/m^2) and categorized (Nyholm *et al*., 2007).

2.3.2. Assessment of Sleep Quality

Sleep quality and duration assessment over the past month was conducted using A validated Arabic version of the Pittsburgh Sleep Quality Index (PSQI) (Soleiman et al., 2010). PSQI contains 7 components, comprising 19 questions of self-evaluation, involving subjective sleep quality, sleep duration in hours during the night, sleep efficiency, sleep disturbances (for several causes), sleep latency (between 0-100%), daytime dysfunction, and use of sleep medications (prescribed by a physician). Each component was scored from zero to 3. The seven components sum gives the total PSQI score (0-21 points); participants who scored >5 considered bad sleep quality, while those who scored ≤5 were considered good sleep quality (Jalal *et al*., 2021).

2.4. Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics 22.0. Differences in categorical data were assessed using the chi-square test. Association between total PSQI scores and its component with gender, body mass index, living partner, and smoking were evaluated using Spearman's correlation coefficient. Statistical significance was assumed at the 5% level.

3. Results

The general characteristics of the study participants were shown in Table 1. The majority of participants were females (72.1%), single (96.3%), within the 18-21 years age group (80.6%), living with family (96.7%), nonsmokers (80.8%), and with normal range body weight (60.6%).

As presented in Table (2), there was only a significant weak correlation between gender and sleep disturbance, which is the fifth PSQI component ($r = 0.145$, $p<0.001$). Smoking had a significantly weak correlation with subjective sleep quality ($r = 0.114$, $p=0.005$), and sleep latency ($r = 0.115$, $p=0.005$). BMI had only a significant no-correlation with sleep latency ($r = 0.008$, $p=0.045$).

Table (1): General Characteristics (n=599)

Variables	**Mean ± SD**
Body mass index (kg/m^2)	23.77 ± 9.11
	n (%)
Gender	
Male	167 (27.9)
Female	432 (72.1)

Age	
18-21 years	483 (80.6)
22-25 years	105 (17.5)
26-30 years	11 (1.8)
Marital status	
Single	577 (96.3)
Married	17 (2.8)
Divorced	5 (0.8
Living partner	
Student accommodation with friends	11 (1.8)
Student accommodation alone	9 (1.5)
With family	579 (96.7)
Smoking	
No	484 (80.8)
Yes	115 (19.2)
Body mass index categories	
Underweight (<18.5 kg/m^2)	70 (11.7)
Normal weight (18.5-24.9 kg/m^2)	363 (60.6)
Overweight (25.0-29.9 kg/m^2)	120 (20.0)
Obese (30 or more kg/m^2)	46 (7.7)

Table (2): Spearman's rho correlation of Sleeping quality questionnaire with different variables.

		Gender	Living partner	Smoking	BMI categories
Component 1: Subjective sleep quality	Spearman's rho	-0.023	-0.081	**0.114****	-0.108
	p-value	0.575	0.047	**0.005**	**0.008**
Component 2: Sleep latency	Spearman's rho	0.015	-0.004	**0.115****	**0.049***
	p-value	0.722	0.921	**0.005**	0.230

Component 3: Sleep Duration	Spearman's rho	-0.039	-0.065	0.016	0.032
	p-value	0.346	0.114	0.700	0.429
Component 4: Sleep efficiency	Spearman's rho	0.059	-0.015	-0.051	-0.049
	p-value	0.154	0.708	0.211	0.233
Component 4: Sleep efficiency	Spearman's rho	0.046	-0.040	-0.045	-0.064
	p-value	0.300	0.362	0.305	0.149
Component 5: Sleep disturbance	Spearman's rho	**0.145****	0.013	0.047	-0.041
	p-value	**<0.001**	0.755	0.252	0.315
Component 6: Use of sleep medication	Spearman's rho	0.019	-0.046	0.022	0.025
	p-value	0.642	0.263	0.589	0.540
Component 7: Daytime dysfunction	Spearman's rho	0.069	-0.034	-0.016	-0.087
	p-value	0.093	0.409	0.698	0.033
Global PSQI score categories	Spearman's rho	0.041	-0.065	0.052	-0.066
	p-value	0.359	0.143	0.240	0.137

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

More than half of the participants who had no sleep disturbance were males (56.3%), while most of the participants who had low to high sleep disturbance were females (Table 3) (p=0.002). For PSQI association with smoking (Table 4), the participants who had very good subjective sleep quality and no sleep latency were non-smokers (90.0% and 89.2%, respectively). While the participants who had fairly to very bad subjective sleep quality and low to high sleep latency were smokers (p=0.019, p=0.007; respectively).

Table (3): Total Sleeping Quality Score and its Component Association with Gender.

Variables		**Gender**		***p*-value****
		Male	**Female**	
Global PSQI score	Good sleeping quality	47 (29.7)	111 (70.3)	0.358
	Poor sleeping quality	92 (25.8)	264 (74.2)	
	Very good	20 (25.0)	60 (75.0)	0.097

Component 1: Subjective sleep quality	Fairly good	86 (29.0)	211 (71.0)	
	Fairly bad	38 (23.2)	126 (76.8)	
	Very bad	23 (39.7)	35 (60.3)	
Component 2: Sleep latency	0 (No sleep latency)	19 (25.7)	55 (74.3)	0.615
	1-2 score	49 (31.8)	105 (68.2)	
	3-4 score	50 *(25.8)	144 (74.2)	
	5-6 (High sleep latency)	49 (27.7)	128 (72.3)	
Component 3: Sleep Duration	>7 hours	94 (26.3)	263(73.7)	0.311
	6-7 hours	52 (31.1)	115 (68.9)	
	5-6 hours	8 (20.5)	31 (79.5)	
	<5 hours	13 (36.1)	23 (63.9)	
Component 4: Sleep efficiency	>85%	85 (29.8)	200 (70.2)	0.139
	75-85%	23 (20.0)	92 (80.0)	
	65-74%	11 (21.6)	40 (78.4)	
	<65%	20 (31.7)	43 (68.3)	
Component 5: Sleep disturbance	0 (No sleep disturbance)	9 (56.3)	7 (43.8)	**0.002**
	1 (low)	127 (30.0)	291 (69.6).	
	2 (moderate)	31 (19.0)	132 (81.0)	
	3(High sleep disturbance)	0 (0.0)	2 (100.0)	
Component 6: Use of sleep medication	Not during the past month	143 (28.3)	263 (71.7)	0.911
	Less than once a week	16 (25.4)	47 (74.6)	
	Once or twice a week	5 (23.8)	16 (76.2)	
	Three or more times a week	3 (33.3)	6 (66.7)	
Component 7: Daytime dysfunction	0 (No dysfunction)	40 (35.1)	74 (64.9)	0.274
	1-2	81 (26.9)	220 (73.1)	
	3-4	37 (24.7)	113 (75.3)	
	5-6 (High dysfunction)	9 (26.5)	25 (73.5)	

*Data are presented as n (%); **Significant at the $p<0.05$

Table (4): Total Sleeping Quality Score and its Component Association with Smoking.

Variables		Smoking No	Smoking Yes	*p*-value*
Global PSQI score	Good sleeping quality	133 (84.2)	25 (15.8)	0.239
	Poor sleeping quality	284 (79.8)	72 (20.2)	
Component 1: Subjective sleep quality	Very good	72 (90.0)	8 (10.0)	**0.019**
	Fairly good	242 (81.5)	55 (18.5)	
	Fairly bad	130 (79.3)	34 (20.7)	
	Very bad	40 (69.0)	18 (31.0)	
Component 2: Sleep latency	0 (No sleep latency)	66 (89.2)	8 (10.8)	**0.007**
	1-2 score	125 (81.2)	29 (18.8)	
	3-4 score	164 (84.5)	30 (15.5)	
	5-6 (High sleep latency)	129 (72.9)	48 (27.1)	
Component 3: Sleep Duration	>7 hours	289 (81.0)	68 (19.0)	0.317
	6-7 hours	137(82.0)	30 (18.0)	
	5-6 hours	33 (84.6)	6 (15.4)	
	<5 hours	25 (69.4)	11 (30.6)	
Component 4: Sleep efficiency	>85%	225 (78.9)	60 (21.1).	0.362
	75-85%	99 (86.1)	16 (13.9)	
	65-74%	43 (84.3)	8 (15.7)	
	<65%	50 (79.4)	13 (20.6)	
Component 5: Sleep disturbance	0 (No sleep disturbance)	13 (81.3)	3 (18.8)	0.534
	1	343 (82.1)	75 (17.9)	
	2	126 (77.3)	37 (22.7)	
	3(High sleep disturbance)	2 (100.0)	0 (0.0)	
Component 6: Use of sleep medication	Not during the past month	411 (81.2)	95 (18.8)	0.729
	Less than once a week	48 (76.2)	15 (23.8)	
	Once or twice a week	17 (81.0)	4 (19.0)	
	Three or more times a week	8 (88.9)	1 (11.1)	
	0 (No dysfunction)	87 (76.3)	27 (23.7)	0.264

Component 7: Daytime dysfunction	1-2	251 (83.4)	50 (16.6)
	3-4	117 (78.0)	33 (22.0)
	5-6 (High dysfunction)	29 (85.3)	5 (14.7)

*Data are presented as n (%); **Significant at the p<0.05

In table 5, the association between sleep quality and BMI was presented. There were only significant differences between different BMI categories and different subjective sleep quality levels (*p*=0.029). The underweight participants had a higher percentage of very bad subjective sleep quality (20.7%) compared to other levels. While normal-weight participants had a higher percentage of fairly good subjective sleep quality (92.6%) compared to other subjective sleep quality levels. For overweight participants, a higher percentage was seen for very good subjective sleep quality (27.5%).

Table (5): Total Sleeping Quality Score and its Component Association with Different BMI Levels.

Variables		**BMI categories**				
		Underweight	**Normal weight**	**Overweight**	**Obese**	***p*-value****
Global PSQI score	Good sleeping quality	12 (7.6)	97 (61.4)	38 (24.1)	11 (7.0)	0.373
	Poor sleeping quality	41 (11.5)	223 (62.6)	67 (18.8)	25 (7.0)	
Component 1: Subjective sleep quality	Very good	6 (7.5)	46 (57.5)	22 (27.5)	6 (7.5)	**0.029**
	Fairly good	26 (8.8)	186 (92.6)	66 (22.2)	19 (9.4)	
	Fairly bad	26 (15.9)	99 (60.4)	24 (14.6)	15 (9.1)	
	Very bad	12 (20.7)	32 (55.2)	8 (13.8)	6 (10.3)	
Component 2: Sleep latency	0 (No sleep latency)	8 (10.8)	47 (63.5)	14 (18.9)	5 (6.8)	0.388
	1-2 score	22 (14.3)	94 (61.0)	33 (21.4)	5 (3.2)	
	3-4 score	20 (10.3)	116 (59.8)	42 (21.6)	16 (8.2)	
	5-6 (High sleep latency)	20 (11.3)	106 (59.9)	31 (17.5)	20 (11.3)	
Component 3: Sleep Duration	>7 hours	45 (12.6)	215 (60.2)	73 (20.4)	24 (6.7)	0.418
	6-7 hours	16 (9.6)	103 (61.7)	33 (19.8)	15 (9.0)	
	5-6 hours	8 (20.5)	22 (56.4)	7 (17.9)	2 (5.1)	
	<5 hours	1 (2.8)	23 (63.9)	7 (19.4)	5 (13.9)	
	>85%	25 (8.8)	176 (61.8)	61 (21.4)	23 (8.1)	0.455
	75-85%	15 (13.0)	69 (60.0)	26 (22.6)	5 (4.3)	

Component 4: Sleep efficiency	65-74%	6 (11.8)	37 (72.5)	4 (7.8)	4 (7.8)	
	<65%	7 (11.1)	38 (60.3)	14 (22.2)	4 (6.3)	
Component 5: Sleep disturbance	0 (No sleep disturbance)	1 (6.3)	11 (68.8)	3 (18.8)	1 (6.3)	0.939
	1	47 (11.2)	250 (59.8)	89 (21.3)	32 (7.7)	
	2	22 (13.5)	100 (61.3)	28 (17.2)	13 (8.0)	
	3(High sleep disturbance)	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	
Component 6: Use of sleep medication	Not during the past month	63 (12.5)	303 (59.9)	102 (20.2)	38 (7.5)	0.688
	Less than once a week	4 (6.3)	39 (61.9)	13 (20.6)	7 (11.1)	
	Once or twice a week	3 (14.3)	13 (61.9)	4 (19.0)	1 (4.8)	
	Three or more times a week	0 (0.0)	8 (88.9)	1 (11.1)	0 (0.0)	
Component 7: Daytime dysfunction	0 (No dysfunction)	9 (7.9)	68 (59.6)	28 (24.6)	9 (7.9)	0.349
	1-2	31 (10.3)	187 (62.1)	62 (20.6)	21 (7.0)	
	3-4	23 (15.3)	87 (58.0)	26 (17.3)	14 (9.3)	
	5-6 (High dysfunction)	7 (20.6)	21 (61.8)	4 (11.8)	2 (5.9)	

*Data are presented as n (%); **Significant at the $p<0.05$. BMI: body mass index.

4. Discussion

The preventative measures during the COVID-19 pandemic had contributed to promoting psychological disturbance (Castro-de-Araujo and Machado, 2020), which may lead to disrupted sleep (Altena et al., 2020). Although sleeping quality is a key indicator of health, there are no data examining the sleeping quality among young adults in Jordan. The objective of this study was to examine the association between sleeping quality, gender, smoking, and body mass index during remote learning periods among university students in Jordan.

Women have shown worse sleeping quality in the literature in different populations (Zhang & Wing, 2006; Ohayon & Sagales, 2010; Morin al., 2011; Madrid-Valero et al., 2017). In Zhang and Wing's (2006) meta-analysis, they reported that women are predisposed to suffer from insomnia by 1.41 times more than men at all ages, especially at an advanced age; which may be due to menopause. However, Madrid-Valero and colleagues (2017) showed that menopausal status lost significantly when controlling for age. In the current study, a weak correlation between women and sleep disturbance, although there was no significant difference between men and women regarding age, and women were in their reproductive age, which might be related to hormonal differences and require further investigation.

The results presented in this study showed that active smoking had a weak significant correlation with subjective sleep quality and sleep latency. However, many studies showed a significant association between worsened sleeping quality and active smoking (Liao et al., 2019; Purani et al., 2019; Cohen et al., 2018). This may be related to smoking active ingredients such as nicotine by different proposed mechanisms. Firstly, the physiological desire for additional nicotine during sleeping may cause the smokers to awaken, leading to insomnia. The second mechanism is that nicotine is a simulation by itself, which may increase alertness (Griesar et al., 2002), and being consumed close to bedtime may cause sleep latency. Moreover, smoking was shown to be correlated with an increased risk of snoring and obstructive sleep apnea (Trenchea et al., 2013) and with circadian clock disruption (Hwang et al., 2013).

Findings of epidemiological studies investigating the association between BMI and sleeping quality among young adults were inconsistence. Some studies have reported an inverse association between BMI and sleep duration (Meyer et al., 2012), while others reported a positive association between BMI and short sleep duration, and no association between long sleep duration and BMI (Peltzer & Pengpid, 2017). However, in general, studies consistently reported an association between BMI and sleep duration (Meyer et al., 2012; Peltzer and Pengpid, 2017; Krističević et al., 2018). While in the current study, there was no correlation between any of the sleep quality components and BMI, which may be related, at least in part, to the age group.

A strength of our study was that the study was conducted during the transfer period to remote learning. The PSQI questionnaire may supply a reliable estimate of sleep quality, and its validity has been verified in several studies. Also, far to our knowledge, this is the first study that examines sleeping quality among young adults in Jordan. As limitations of the study are the nature of the study design and the lack of comparison data before the pandemic. Weight and height were self-reported by participants, also causality relationship cannot be determined due to the study's nature. Moreover, there is a response bias that could have influenced the self-reported answers about the sleep quality of the study participants.

In conclusion, the results of the presented study showed that there was a weak correlation between gender and sleep disturbance. As well as, smoking had a weak correlation with subjective sleep quality and sleep latency. Also, no correlation between BMI and sleep latency was shown. Regarding gender, females had higher sleep disturbance than males. Additionally, the result revealed that non-smokers had very good subjective sleep quality and no sleep latency. Where being underweight is associated with very bad subjective sleep quality, and normal weight is associated with fairly good subjective sleep quality. However, further studies are needed to examine the different physiological and psychological factors that can affect the sleeping quality in this age group.

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Conflicts of interest/Competing interests: The authors declare no conflict of interest.

Ethics approval: the study was approved by the research ethics committee (REC) of the Al-Balqa Applied University.

Consent to participate: All participants were informed about the study objectives at the beginning of the questionnaire, then they expressed their informed consent to participate, and their data were anonymous

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