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DOI: 10.4103/jehp.jehp_1381_21

Impact of Covid-19 lockdown on sleep quality, physical activity, and body weight among university students: A retrospective cross-sectional study

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Abstract:

BACKGROUND: Covid-19 lockdown had caused lifestyle changes especially in sleep, physical activity, and body weight. Thus, this study aimed to determine the weight changes before and after the lockdown period and further assessed the association between sleep quality, physical activity, and body mass index (BMI).

MATERIAL AND METHODS: This was a retrospective cross-sectional study involving 107 undergraduate students in Universiti Sains Malaysia. Subjects recalled information during the first lockdown implemented in Malaysia from early March 2020 to July 2020. The questionnaire consisted of socio-demography, anthropometry, and physical activity using International Physical Activity Questionnaire and sleep quality using Pittsburgh Sleep Quality Index. Chi-square analysis was used to determine the association between the variables using Statistical Package for Social Sciences software version 26.0.

RESULTS: There was a significant increase of 1.8 kg in weight before and after the lockdown period. The majority of respondents had poor sleep quality (80.4%) and low physical activity (60.2%), respectively. Almost 29% of the subjects had sleep latency of more than 30 min while 69.1% of them had sleep duration of <7 h. There was no significant association between sleep quality and BMI as well as physical activity and BMI.

CONCLUSION: Our study demonstrated that the prevalence of poor sleep quality and low physical activity among university students was high during Covid-19 confinement. Moreover, youths have a significant increase in body weight during the lockdown period. Thus, university students may adopt exciting leisure activities to keep themselves active such as doing meditation or joining online exercise classes.

Keywords:

Body mass index, Covid-19, lockdown, physical activity, sleep quality

Introduction

Covid-19 lockdown causes lifestyle changes especially among youth. During lockdown, physical activity has shown a rapid decline while sedentary behavior increased tremendously.^[1] Even when lockdown was lifted, youth still preferred to remain indoor due to fear of infection.^[2] Besides that, during the

Covid-19 lockdown, there are significant changes in sleep timing, with longer sleep duration and lower sleep quality.^[3] Physical activity improves sleep quality and promotes weight loss.^[4] However, at least 60% of the world population is sedentary and physical activity is reported to decline from adolescence through adulthood. Ghaffari *et al.* (2013)^[5] have demonstrated that educational intervention is successful in improving knowledge of

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How to cite this article: Vanoh D, Juanis AW. Impact of Covid-19 lockdown on sleep quality, physical activity, and body weight among university students: A retrospective cross-sectional study. *J Edu Health Promot* 2023;12:79.

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Received: 19-09-2021

Accepted: 17-08-2022

Published: 31-03-2023

the health benefits of physical activity among high school students.

The Covid-19 epidemic significantly increased psychological distress among youth which affected their sleep quality.^[6] Poor sleep quality is associated with greater central adiposity and obesity among youths.^[7] Besides that, insufficient sleep causes undesirable mental and physical well-being. Adults aged between 18 and 64 years old are recommended to have 7–9 h of sleep daily.^[8] Sedentary behavior, lack of sleep, and irregular mealtime contributed to weight gain among youth which increases the risk of cardiovascular diseases and all-cause mortality.^[9] Non-communicable diseases such as obesity, cardiovascular diseases, liver diseases, and cancers are due to the inappropriate lifestyle of an individual.^[10]

Therefore, it is critical to determine the weight before and after the lockdown period and further assess the association between sleep quality, and BMI as well as physical activity and BMI during the Covid-19 lockdown period among youths in Universiti Sains Malaysia (USM). University students were chosen as they are vulnerable to various stressors that affect their sleep quality and daily activities which contributes to weight gain.

Materials and Methods

Study design and setting

This was a retrospective cross-sectional study conducted from February 2021 to Jun 2021 among undergraduate students enrolled in the main campus, health campus, and engineering campus in USM.

Study participants and sampling

The participants included in this study were aged 18 years and above and without any self-reported memory impairment. As this was a retrospective study, subjects were required to recall information during the first phase Covid-19 total lockdown in Malaysia beginning from early March 2020 to July 2020. Subject selection was done using the convenience sampling method by distributing the Google form questionnaire link (<https://forms.gle/RfwdExET7NMxn1bh7>) via WhatsApp, email, and telegram. The first page of the Google form was the informed consent which must be answered by the participants. Only participants that provided consent had access to the questionnaires.

The estimated sample size needed for the research was calculated using the standard one proportion calculation as shown below:

$$n = \left(\frac{z}{p} \right)^2 p(1 - p)$$

n = sample size

Z = value representing the desired confidence level

Δ = precision

p = anticipated population proportion

According to Wan Mohamed Radzi *et al.*(2018),^[11] the prevalence of obesity among Malaysian undergraduate students was about 18%. Using the Z-score value of 1.96, Δ value of 0.1, prevalence value of 18%, and confidence level of 95%, the sample size obtained were shown below:

$$n = \left[\frac{1.96}{0.08} \right]^2 0.18(1 - 0.18) = 88.6 \sim 89$$

After applying 20% drop-out rate, the final sample size was 107 as following:

$$\text{Sample size, } n = [(1.96)^2 (0.18(1 - 0.18)) / (0.1)^2] + 20\%$$

$$= 89 + 17.8 = 106.8 \sim 107 \text{ subjects}$$

Data collection tool and technique

Pre-Covid-19 confinement was during early March 2020 and post-Covid-19 quarantine was in July 2020. The questionnaire used in this study had four sections, namely, socio-demography, anthropometry, sleep quality, and physical activity. Socio-demographic data were age, gender, faculty, ethnicity, and living status during Covid-19 confinement. Living status questions was the question asking participants their location of stay during the Covid-19 quarantine.

The second section was the anthropometry section which consists of information on self-reported weight pre- and post-Covid-19 confinement, height, and body mass index (BMI). BMI was calculated based on self-reported body weight (kg) pre- and post-Covid-19 confinement divided by squared height (m²). The classification was based on the World Health Organization (WHO) BMI cut-off points which stated that BMI <18.5 kg/m² (underweight), between 18.5 and 24.9 kg/m² (normal), 25–29.9 kg/m² (overweight) and 30.0 kg/m² or above (obese) (WHO Expert Consultation, 2004).^[12]

The Pittsburgh Sleep Quality Questionnaire (PSQI) was used to assess the sleep quality.^[13] PSQI comprised of 19 questions aggregated into seven major domains, namely, sleep quality (1 item), sleep latency (2 items), sleep duration (1 item), habitual sleep efficiency (3 items), sleep disturbances (9 items), sleep medications (1 item), and daily dysfunction (2 items). For each component, the score ranged from 0 to 3 points where lower point indicated no problem, while higher score indicating worsening problems in following order: (1) subjective sleep quality (very good to

very bad), (2) sleep latency (0: ≤15 min, 1: >15 to ≤30 min, 2: >30 to ≤60 min, 3 >60 min), (3) sleep duration (0: >7 h, 1: 6–7 h, 2: <6 and ≥5 h, 3:<5 h), (4) sleep efficiency (0: ≥85%, 1: <85% and ≥75%, 2: <75% and >65%, 3: <65%), (5) sleep disturbances (0:0, 1: ≥1 and ≤9, 2: >9 and ≤18, 3: >18), (6) use of sleeping medications (0: none during the past month, 1: less than once a week, 2: once or twice a week, 3: three or more times a week) and (7) daytime dysfunction (0:0, 1: 1–2, 2: 3–4, 3: 5–6).^[14] Next, a global PSQI score can be obtained within the range of 0–21 by adding the scores of all the seven domains. Individuals with scores ≤5 had good sleep quality while scores beyond five indicated poor sleep quality. The PSQI had an internal consistency value of 0.83 and was valid to be used in research.^[13]

The final section in the questionnaire was the short form of the IPAQ that was used for this study. IPAQ assessed three types of activities such as walking, moderate and vigorous intensity tasks.^[15] IPAQ had two ways of scoring. First was by reporting as categorical variables of low, moderate, and high activity levels. Second was via expressing as metabolic equivalent (MET) which represented the amount of energy expended when performing physical activity. Walking was given 3.3 METS, moderate physical activity = 4.0 METS, and vigorous physical activity = 8.0 METS. For the purpose of the current study, IPAQ was scored as a categorical variable and was assessed using the formula: MET levels minutes of activity/day x days per week. High physical activity was when vigorous intensity activity was performed on at least 3 days achieving a minimum total physical activity of at least 1500 MET min a week or 7 or more days of any combination of walking, moderate intensity, or vigorous intensity activities achieving a minimum total physical activity of at least 3000 MET min a week. Moderate physical activity was defined as 3 or more days of vigorous intensity activity and/or walking for at least 30 min per day or 5 or more days of moderate intensity activity and/or walking of at least 30 min per day or 5 or more days of any combination of walking, moderate intensity, or vigorous intensity activities achieving a minimum total physical activity of at least 600 MET min a week. Low physical activity means not meeting any of the criteria for either moderate or high physical activity.

Statistical analysis

Data analyses were performed using IBM Statistical Package for Social Sciences version 26.0. Descriptive statistics was used for presenting the socio-demographic characteristics, anthropometry, sleep quality, and level of physical activity of participants. Based on their normality distribution using histogram, weight and BMI changes before and after Covid-19 lockdown was assessed using either the paired-t-test for normally distributed data and

Wilcoxon signed rank test for non-normal distribution. Sleep quality (categorical variable) and level of physical activity (categorical variable) and their association with BMI were assessed using the Chi-square test. The significance level was set at *P* value of <0.05.

Ethical consideration

The study was conducted after obtaining ethical approval from the Human Research Ethics Committee USM (approval code: USM/JEPPEM/21010053). Informed consent had been obtained from each participant recruited in this study.

Results

The participants in this study were mostly female (65.4%), Malay ethnicity (53.3%), and stayed at home during the Covid-19 quarantine (92.5%) [Table 1]. Prevalence of overweight has increased from 15.9% before lockdown to 18.9% after lockdown. There was a significant increment in weight and BMI after the Covid-19 lockdown period (*P* < 0.001) [Table 2].

The majority of the participants reported having low physical activity levels (60.8%) during the Covid-19 lockdown [Table 3].

Almost 80.4% of the respondents had poor sleep quality. Sleep latency of >30 min was reported by 29% of the respondents. Totally 35.5% of the subjects reported having a sleep duration of 6 h or less and 12.1% of them have daytime dysfunction [Table 4].

There is no significant association between sleep quality and level of physical activity with BMI during the Covid-19 confinement [Table 5].

Discussion

This study illustrates how the measures of quarantine and restrictions due to Covid-19 affected the sleep habits

Table 1: Socio-demographic characteristics (presented as *n* (%) or Mean (SD))

Socio-demography	Total, <i>n</i> =107 <i>n</i> (%)	Mean±SD
Age (years)		22.6 (1.1)
Gender		
Male	37 (34.6)	
Female	70 (65.4)	
Ethnicity		
Malay	57 (53.3)	
Chinese	22 (20.6)	
Indian & Others	28 (26.1)	
Living Status during Covid-19 Confinement		
At home	99 (92.5)	
In university hostel	8 (7.5)	

Table 2: Anthropometry of subjects (presented as n (%) or mean (SD))

Socio-demography	Total, n=107 n (%)	Mean (SD)
Pre-lockdown weight (kg)		59.8 (14.0)
Post-lockdown weight (kg)		61.6 (15.4)
Pre-lockdown BMI (kg/m ²)		22.8 (4.4)
Post-lockdown BMI (kg/m ²)		23.5 (4.9)
Height (cm)		161.2 (8.3)
Pre-lockdown BMI		
Underweight	11 (10.3)	
Normal	70 (65.4)	
Overweight	17 (15.9)	
Obese	9 (8.4)	
Post-lockdown BMI		
Underweight	8 (7.5)	
Normal	69 (65.1)	
Overweight	20 (18.9)	
Obese	9 (8.5)	
Weight changes pre and post lockdown		1.8 (4.4)*
BMI changes pre and post lockdown		0.6 (1.6)*

*Significant at P<0.05 using Paired t-test

Table 3: Physical activity among subjects during Covid-19 confinement (presented as n (%) or Mean (SD))

Characteristics	n (%)	Mean (SD)
Level of physical activity		
Low	65 (60.8)	
Moderate	29 (27.1)	
Vigorous	13 (12.1)	
Total Score of IPAQ*		1195.8 (1625.1)

*IPAQ: International Physical Activity Questionnaire

and level of physical activity of undergraduate students. Our study indicated that during the lockdown period, 60.8% of students has low levels of physical activity and 80.4% had poor sleep quality.

Findings of this study showed that there was a significant increase in the weight of the participants after Covid-19 confinement. This result is in accordance with previous studies.^[16,17] Weight gain during the lockdown period can be attributed to unhealthy dietary habits and a sedentary lifestyle during the COVID-19 lockdown period. Pietrobelli *et al.*,^[18] (2020) observed that consumption of unhealthy food such as potato chips, red meat intake, and sugar sweetened beverages increased during lockdown. In addition, time spent on outdoor sports activities was tremendously reduced, while sleep time grew considerably during the lockdown.

In the present study, there were 60.8% of participants who were classified as being low active during the Covid-19 confinement. Similar results have been demonstrated in several studies.^[19,20] Sedentary time especially sitting time has increased during the lockdown period and is

associated with declining individual well-being such as having depressive and anxiety symptoms.^[21] Closure of schools, leisure facilities, sports clubs, and gymnasiums as a measure of reducing the spread of the Covid-19 virus has tremendously affected the physical activity of youth.^[22] Excessive sedentary behavior is associated with risks of overweight, obesity, cardiorespiratory disturbances musculoskeletal damage, and even early mortality.^[23] Weight gain among university students in the current study is also due to changes in the education system during the Covid-19 lockdown. University classes have been converted to the online medium and extra-curricular sports activities are canceled. In fact, during lockdown students residing in the campus hostel were not allowed to use the sports facilities on the campus.

Low level of physical activity may greatly impact the health of the youths as exercise cessation may affect aerobic capacity, increase blood pressure, and cause insulin resistance in muscle tissue which impairs glucose utilization in muscle and affected the attention of an individual.^[24,25] A study conducted among university students in Saudi Arabia observed similar findings with almost 53.9% of the students did not meet the physical activity recommendations and have greater sedentary time during lockdown.^[26] Moreover, even during the non-Covid period, undergraduate students in Malaysia reported having a lack of physical activity due to their busy schedule, feeling exhausted, not being motivated to exercise, and commitment to studies and research.^[27]

Findings from the current study also revealed no significant association between physical activity and BMI during the quarantine period. This is in contrast with the findings from an Italian survey conducted among adults above the age of 18 years old which revealed that individuals who had negative and positive lifestyle changes including physical activity and caloric intake have increased and decreased BMI, respectively.^[28] In fact, obese or overweight individuals are prone to develop severe Covid-19 symptoms if become infected because excessive adiposity diminishes the lung function.^[29]

On the other hand, almost 80.4% of the participants in this study experienced poor sleep quality. Only 30.8% of subjects had sufficient sleep of eight hours or more every night and 29.0% had a sleep latency time of more than 30 min. This is in line with the study conducted among nursing students in Spain which found poor sleep quality in almost 60% of the students, even among students who were residing in their own home during lockdown.^[30] Worsening sleep quality during lockdown can be attributed to increased academic workload following a rapid shift in the higher education

Table 4: Sleep quality of subjects during covid-19 confinement according to domains and presence of changes to sleeping habit among students (presented as n (%) or Mean (SD))

Characteristics	n (%)	Mean (SD)
Component 1: Subjective Sleep Quality		
Very good	18 (16.8)	
Fairly good	56 (52.3)	
Fairly bad	27 (25.2)	
Very bad	6 (5.6)	
Component 2: Sleep Latency		
≤ 15 min	43 (40.2)	
16-30 min	33 (30.8)	
31-60 min	16 (15.0)	
>60 min	15 (14.0)	
Component 3: Sleep Duration		
>7 h	33 (30.8)	
6-7 h	36 (33.6)	
5-6 h	28 (26.2)	
<5 h	10 (9.3)	
Component 4: Habitual Sleep Efficiency		
>85%	73 (68.2)	
75-84%	15 (14.0)	
65-74%	7 (6.5)	
<65%	12 (11.2)	
Component 5: Sleep Disturbances		
Very good	51 (47.7)	
Fairly good	43 (40.2)	
Fairly bad	12 (11.2)	
Very bad	1 (0.9)	
Component 6: Use of Sleeping Medication		
Not during the past month	91 (85)	
Less than once a week	10 (9.3)	
Once or twice a week	3 (2.8)	
Three or more times a week	3 (2.8)	
Component 7: Daytime Dysfunction		
Very good	51 (47.7)	
Fairly good	43 (40.2)	
Fairly bad	12 (11.2)	
Very bad	1 (0.9)	
Sleep Quality		
Good	21 (19.6)	
Poor	86 (80.4)	
Total Score of PSQI		8.87 (3.89)

*PSQI: The Pittsburgh Sleep Quality Questionnaire

system which increased psychological problems among university students. Poor sleep quality especially insomnia is closely associated with mental health problems such as anxiety, depression, fear, emotional distress, and suicidal thoughts.^[3,31] Extensive use of digital media 2 h before bedtime and exposure to blue light due to excessive screen time contributed to sleep disorders.^[32]

The current study findings showed no significant association between sleep quality and BMI. This is in contrast with the findings from the study by Micheletti Cremasco *et al.* (2021)^[33] which found a significant relationship between poor sleep quality and weight gain. Lack of sleep is also associated with eating disorders such as binge eating behavior, night eating syndrome, and consumption of high-calorie food which increases weight. Consumption of food late at night is associated with elevated nocturnal body temperature which may disturb the ability of an individual to fall asleep. Thus, when a person is experiencing sleep deficit, there is a high chance for them to binge eat till they feel sleepy which contributed to increasing BMI.^[34]

The strength of this study is the enabling the researchers to obtain the study data using an inexpensive method. A cross-sectional study also is useful for providing information about the prevalence of poor sleep quality and physical inactivity of undergraduate students in USM and its association with weight during the lockdown period, which is also the novelty of this study. This will enable the institution to plan health promotion strategies for promoting home-based physical training among the students. Moreover, the findings of this study will promote future research using more objective ways of assessing physical activity using an accelerometer or pedometer or performing polysomnography (sleep test) for assessing sleep.

Limitation and recommendation

This study had limitations. First, the cross-sectional nature of the study prohibits causation and definite findings. Second, BMI, physical activity level, and sleep

Table 5: Association between sleep quality, level of physical activity and body mass index among subjects during Covid-19 confinement

Parameter	Body Mass Index				P*
	Underweight n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	
Sleep Quality					0.169
Good	4 (50.0)	13 (18.8)	3 (14.3)	1 (11.1)	
Poor	4 (50.0)	56 (81.2)	18 (85.7)	8 (88.9)	
Level of physical activity					0.442
Low	7 (87.5)	42 (60.9)	12 (57.1)	4 (44.4)	
Moderate	0 (0.0)	20 (29.0)	6 (28.6)	3 (33.3)	
Vigorous	1 (12.5)	7 (10.1)	3 (14.3)	2 (22.2)	

*Tested using Fisher's exact test

evaluation were all self-reported measurements that are susceptible to memory bias, resulting in under-or overestimation. Third, the gender of the sample was not equal, limiting the generalizability of the findings. This study did not obtain the dietary data of the respondents which may be an important factor for weight gain. Future studies may investigate the role of diet in influencing the sleep quality of the participants. The academic scores of the students can be determined as one of the outcomes of the study. Besides that, an intervention study can be conducted to investigate the effectiveness of certain weight loss strategies for improving sleep quality, BMI, and physical activity.

Conclusion

Our study demonstrates that the prevalence of poor sleep quality and low physical activity during Covid-19 confinement was high among students. There is a significant increase in the weight and BMI of students after Covid-19 confinement. We also observed that there was no association between sleep quality/level of physical activity and BMI during the lockdown period. It is important to study the sleep quality and level of physical activity among university students during lockdown. Changes in these lifestyle components may indicate psychological problems or the presence of eating disorders which must be identified and treated early. Besides that, objective approaches to measure sleep quality such as the use of sleep diaries and use of wearables to detect the level of physical activity may be considered in future research. Proper global intervention on sleeping aids is required for managing sleep problems during pandemic. Health ministry may develop more indoor-based exercise videos and health promotion campaigns to enable people to still be physically active despite the pandemic lockdown. University students may adopt exciting leisure activities to keep themselves active such as doing meditation or joining online exercise classes.

Acknowledgements

We would like to thank all the participants who have participated in this study. We would like to express our gratitude to Universiti Sains Malaysia for allowing us to conduct this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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