



Correlation of various sleep indices with body mass index in young adults.

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Abstract

Objectives: This study aimed at determining the correlation of various sleep indices with body mass index in young adults. Sleep indices includes multiple sleep measures such as timing in bed, variability and sleep quality. **Study design & setting:** This cross-sectional study was conducted in the Department of Physiology at Liaquat National Hospital and Medical College, Karachi, from 15th January 2021 to 15th July 2021. **Methodology:** A total of 162 healthy medical students both genders with ages between 18-25 years were included in the study. Height and weight of each participant was measured using the standard techniques and their body mass index was calculated. Sleep indices were evaluated using the Pittsburgh Sleep Quality Index (PSQI). Participants were divided into three groups: normal weight, overweight and obese and each group were correlated with various sleep indices using multiple logistic regression analysis. **Results:** In this study, about 52.6% of obese students were identified with potential sleep problems with >5 PSQI scores. Participants with normal body mass index showed significant positive correlation with quality of sleep ($r=0.82$). However, highly significant positive association was reported among students with BMI > 25 kg/m² and various sleep indices (sleep disturbances=0.88, use of hypnotics=0.60 and daytime dysfunction=0.67). **Conclusion:** The present study revealed that students



who have poor sleep quality developed increased weight gain. Sleep indices such as quality of sleep, sleep latency and number of hours slept had an inverse correlation with BMI in overweight and obese students. Life style modification and improving the quality of sleep can reduce the body mass index.

Keywords: Body mass index; Sleep; Obesity

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Introduction

Sleep plays a very important role in both mental and physical health. Sleep deprivation leads to malfunctioning of various physiological processes including immunity, metabolism, endocrine, emotional and cognitive functions. Moreover, it also poses a major risk towards obesity, diabetes and cardiovascular comorbidities, leading to adverse health outcomes and increased mortality.

Disruption in sleep is a consequence of multiple metabolic dysfunctions with profound anabolic and catabolic hormonal imbalances. The underlying pathophysiological mechanisms of increased weight gain due to poor sleep include dysregulation of glucose metabolism, irregularities in the orexigenic pattern with increase in the ghrelin hunger hormone and reduced leptin levels. A disturbance in appetite regulation and neuroendocrine control of food intake promotes unhealthy and untimely food choices such as increased consumption of fatty and sugary meals¹.

Inadequate sleep can increase the risk of developing various disorders such as diabetes mellitus, coronary artery disease, overweight and obesity and is associated with shortened lifespan. Therefore, sleep should be considered as precious too and should not be traded with some precious hours of wakefulness².

Anecdotal evidence from recent meta-analysis has reported negative association between sleep duration and BMI³.

In addition, studies have found a duplex correlation between decreased sleep duration and excess adiposity. This suggests the existence of a "vicious circle," in which short

sleep may initially lead to weight gain, and excess adiposity would then cause sleep disturbances, resulting in a further reduction in total sleep time⁴.

Sleep quality is a complicated phenomenon that includes both objective characteristics of sleep, such as depth or restfulness, and subjective characteristics of sleep, such as sleep duration and latency⁵.

There is a great impact of sleep problems on the daily life of the students such as their routine activities, academic performances and exam results. As a result, the purpose of this study is to continue promoting healthy sleep for everyone. Sleep is not a waste of time, and it should be treated in the same way that healthy eating and exercise are. However, it is not a good idea to intentionally restrict sleep for an extended period of time—also known as chronic sleep deprivation—as this can have an effect on health and safety. Obesity is greatly influenced by sleep deprivation or shortness of sleep.

The aim of this study was to find out the correlation of various sleep indices with body mass index in young adults.

Methodology

This cross-sectional study was conducted in the department of Physiology from January 2021 to July 2021 after approval from the Research Committee and Ethical Review Committee (App # 0584-2020 LNH-ERC)of Liaquat National Hospital and Medical College, Karachi. Sample size was calculated using the open-epi sample size calculator. (P=21%, CI=95%, Power=80%, N=162)⁶



A total of 162 medical students were selected for the study by convenient purposive sampling technique. Young, healthy and both male and female students with ages between 18-25 years were included in the study. Students with history of any neurological or mental disorder or medication history including anxiolytics or anti-depressants were excluded from the study. The Pittsburgh Sleep Quality Index (PSQI)⁷ was utilized for the evaluation of sleep indices. The following items are open to the public: typical times to go to bed and wake up, total sleep time in minutes, and sleep latency in minutes. Items 5 through 18 are four-point Likert scale responses regarding the frequency of problems: not in the preceding month (0);less often than once per week (1);twice or more per week (2);and "at least three times per week." "Item 19 is a rating of overall sleep quality on a four-point Likert scale: "Excellent (0);Fairly Bad (2); "Fairly Good (1)"Very Poor (3)

BMI	Categories
<18.5	Underweight
18.5-22.9	Normal
23-24.9	Overweight
> 25	Obese

Basic descriptive statistics of the study participants are presented as mean \pm SD, frequencies and percentages. Co-relation of various sleep indices with BMI was analyzed by using multivariate linear regression analysis.

Results:

A total of 162 healthy medical students, both male (37.6%) and female (62.3%) with ages between 18-25 years participated in the research.

In the present study, 25% of the normal weight, 34.2% of overweight and 52.6% of obese students were identified with potential sleep problems with >5 PSQI scores. Normal BMI participants showed significant positive

The Global Score is between 0 and 21. The scores for each component range from 0 to 3. Score interpretation.

Poorer sleep quality is indicated by higher Global Scores. Poor sleepers and good sleepers are distinguished by an empirically derived cutoff score of 5. A subject with a Global Score of 5 reports moderate difficulties in more than three areas or severe difficulties in at least two domains.

Height and weight of each participant was measured using the standard techniques. Body mass index was calculated by dividing weight in kilograms with height in meter square. Participants were categorized into three groups according to the Asian-Pacific cutoff points⁸ : normal weight (18.5–22.9 kg/m²), overweight (23–24.9 kg/m²), and obese (\geq 25 kg/m²) and correlated with various sleep indices.

correlation with quality of sleep ($r=0.82$) and negative correlation with disturbances in sleep, utilization of sleeping aids and disorder during the day ($r= - 0.60, -0.45, 0.38$) respectively.

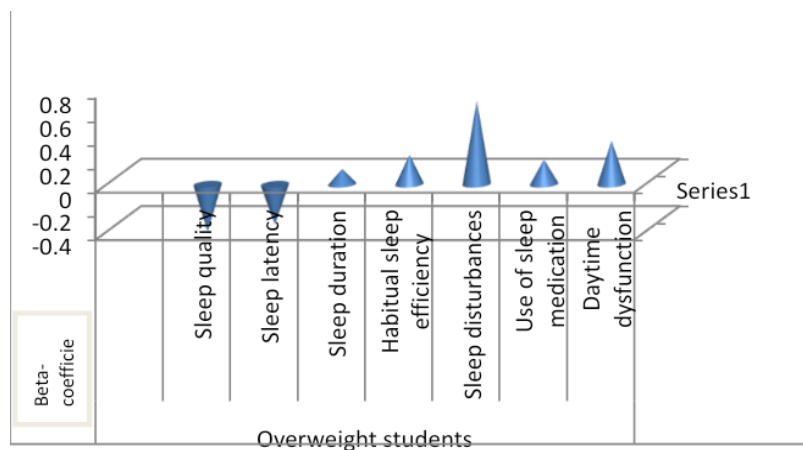
However, overweight students with BMI between 23-24.9 kg/ m² showed slight negative association between number of hours slept and positive correlation with disturbances in sleep, use of hypnotics and disorder during the day. Inverse significant relationship with $p\text{-value} < 0.05$ among obese students with BMI >25 kg/m² and components of quality of sleep, latency and duration were reported.



Characteristics	Frequency (%)
Male	61 (37.6)
Female	101 (62.3)

Total score of sleep indices (0-21)	Normal weight N % (88)	Overweight N % (35)	Obese N % (19)
<5	40	10	3
=5	26	13	6
>5	22 (25)	12 (34.2)	10(52.6)

Dependent variable	Independent variables	Beta coefficient (r)	p-value
Students with normal weight	Quality of Sleep	0.82	0.001
	Latent period	0.06	0.34
	No. of hours slept	0.09	0.45
	Habitual effectiveness of sleep	0.05	0.56
	Disturbances in sleep	-0.6	0.002
	Utilization of sleep aids	-0.3	0.04
	Disorder during the day	-0.2	0.02



Dependent variable	Independent variables	Beta coefficient (r)	p-value
Obese students	Quality of Sleep	-0.70	0.01
	Latent period	-0.34	0.02
	No. of hours slept	0.78	0.01
	Habitual effectiveness of sleep	0.25	0.56
	Disturbances in sleep	0.88	0.02
	Utilization of sleep aids	0.60	0.01
	Disorder during the day	0.67	0.01

Discussion:

In the present study, we investigated the correlation of various sleep indices with BMI in our young population. Approximately, 52.6 % of obese students reported PSQI scores of >5 suggestive of potential sleep problems and poor sleep quality. These findings were closely related to the study conducted in Croatia on university students. They reported 44.7% of their study participants having poor sleep quality (>5 points) and was associated with a greater

BMI⁹. Another concurrent study conducted by Kwame Yeboah et al found 54.1% of poor sleep quality in young adults of Ghana as measured by PSQI¹⁰.

Our study results reported inverse correlation of sleep duration with increased BMI. This was in concordance with the cross sectional study conducted in Korea. They investigated sleep patterns of 22,906 Korean adolescents aged 12-18 years and found that short sleep duration was associated with obesity. Negative correlation was found between BMI and

average sleep duration (B = -0.15, 95% CI -0.19 - -0.11)¹¹.

A study by Spiegel K. et al. found that young, healthy men who were poor sleepers, had lower levels of leptin, higher levels of ghrelin, and more hunger and appetite¹².

Moreover, study conducted by Meyer et al and Peltzer et al also reported positive association between short sleep duration and BMI^{13,14}

Markwald et al. study was in agreement with our results. According to him, inadequate sleep for five days reduced the gut responses to leptin satiety hormone and high levels of hunger hormone ghrelin. These changes lead to increased demand for energy, increased appetite and weight gain in poor sleepers¹⁵.

Consistent with our study, in a recent meta-analysis, Fatima et al reported positive associations of poor sleep quality with obesity in children, adolescents and young adults¹⁶.

The results of Vargas et al were not in agreement with our study findings. According to him, no association was found between sleep quality and body mass index in college students¹⁷.



Another large sample size study conducted by Hung et al also found a significant association of self-reported sleep quality with overweight and obese subjects. According to his study results, there was 40-60% increased risk of being poor sleepers among participants with high body mass index¹⁸.

A concurrent multiethnic study conducted by Oligvie et al found that subjects with less sleeping hours (< 6 hours/night) had significantly increased anthropometric measurements compared to those with >7-8 hours of sleeping. Participants categorized as poor sleepers (<5 hours/night) had had 16% higher prevalence of higher body mass index and 9% increased visceral body fat¹⁹.

Gupta et al study was also in agreement with the findings of our results. He concluded that short duration of sleep and poor quality of sleep was associated with increased BMI > 23-30 kg/m² among young adults²⁰.

Limitations: The limitations of this study included small sample size and possibility of reverse causation as increased BMI of students must have led to sleep disturbances and inversely, poor sleepers had gained more weight. Future recommendations for longitudinal studies are required to minimize the reverse causality.

Conclusion: In conclusion, the present investigation revealed a connection between the body mass index and a variety of sleep indices among young adults. In overweight and obese students, quality of sleep, sleep latency, and number of hours slept, all had an inverse correlation with BMI. Utilization of sleep aids, daytime dysfunction, and sleep disturbances were all positively correlated. Subjects who were overweight or obese were found to have lower quality of sleep overall, as evidenced by higher global scores.

References:

- 1- Grandner MA, Schopfer EA, Sands-Lincoln M, Jackson N, Malhotra A. Relationship between sleep duration and body mass index depends on age. *Obesity* (Silver Spring). 2015;23(12):2491–2498. doi:10.1002/oby.21247.
- 2- A resource from the Division of Sleep Medicine at Harvard Medical School.
- 3- Knutson KL and Van Cauter E. Associations between sleep loss and increased risk of obesity and diabetes. *Ann N Y Acad Sci*. 2008; 1129: 287–304. doi:10.1196/annals.1417.033.
- 4- Morselli LL, Guyon A & Spiegel K. Sleep and metabolic function. *Pflugers Arch*. 2012;463(1):139–160. doi:10.1007/s00424-011-1053-z.
- 5- Lund HG, Reider BD, Whiting AB, Prichard JR. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Health*. 2010 Feb; 46(2): 124–132.
- 6- Khan ZN, Assir MZ, Shafiq M, Chaudhary Ae, Jabeen A. High prevalence of preobesity and obesity among medical students of Lahore and its relation with dietary habits and physical activity. *Indian J Endocr Metab* 2016;20:206-10.
- 7- Buysse DJ, Reynolds CF, Monk TH, Berman SR, & Kupfer DJ. The Pittsburgh Sleep Quality Index (PSQI): A new instrument for psychiatric research and practice. *Psychiatry Research*. 1989;28(2): 193-213.
- 8- Global database on body mass index. WHO 2006, Retrieved July 27, 2012.
- 9- Krističević T, Štefan L, Sporiš G. The Associations between Sleep Duration and Sleep Quality with Body-Mass Index



- in a Large Sample of Young Adults. *Int J Environ Res Public Health*. 2018;15(4):758. doi: 10.3390/ijerph15040758.
- 10- Yeboah K, Dodam KK, Agyekum JA, Oblitey JN. Association between Poor Quality of Sleep and Metabolic Syndrome in Ghanaian University Students: A Cross-Sectional Study. *Sleep Disorders*. 2022 Oct 12;2022.
- 11- Sunwoo JS, Yang KI, Kim JH, Koo DL, Kim D, Hong SB. Sleep duration rather than sleep timing is associated with obesity in adolescents. *Sleep Medicine*. 2020 Apr 1;68:184-9.
- 12- Spiegel K, Tasali E, Penev P & Van Cauter E. Brief Communication: Sleep Curtailment in Healthy Young Men Is Associated with Decreased Leptin Levels, Elevated Ghrelin Levels, and Increased Hunger and Appetite. *Ann Intern Med*. 2004;141(11):846-850.
- 13- Meyer KA, Wall MM, Larson NI, Laska MN, Neumark-Sztainer D. Sleep duration and BMI in a sample of young adults. *Obesity*. 2012 Jun;20(6):1279-87.
- 14- Peltzer K, Pengpid S. Sleep duration, sleep quality, body mass index, and waist circumference among young adults from 24 low-and middle-income and two high-income countries. *International journal of environmental research and public health*. 2017 Jun;14(6):566.
- 15- Markwald RR, Melanson EL, Smith MR, Higgins J, Perreault L, Eckel RH, Wright Jr KP. Impact of insufficient sleep on total daily energy expenditure, food intake, and weight gain. *Proceedings of the National Academy of Sciences*. 2013 Apr 2;110(14):5695-700.
- 16- Fatima Y, Doi SA, Mamun AA. Sleep quality and obesity in young subjects: a meta-analysis. *Obesity reviews*. 2016 Nov;17(11):1154-66.
- 17- Hung HC, Yang YC, Ou HY, Wu JS, Lu FH, Chang CJ. The association between self-reported sleep quality and overweight in a Chinese population. *Obesity*. 2013 Mar;21(3):486-92.. doi: 10.1002/oby.20259.
- 18- Vargas PA, Flores M, Robles E. Sleep quality and body mass index in college students: the role of sleep disturbances. *Journal of American college health*. 2014 Nov 17;62(8):534-41.doi: 10.1080/07448481.2014.933344.
- 19- Ogilvie RP et al. Actigraphy Measured Sleep Indices and Adiposity: The Multi-Ethnic Study of Atherosclerosis (MESA). *Sleep* 39, 1701–1708 (2016).
- 20- Gupta P, Srivastava N, Gupta V, Tiwari S, Banerjee M. Association of sleep duration and sleep quality with body mass index among young adults. *Journal of Family Medicine and Primary Care*. 2022 Jun 1;11(6):3251-6. doi: 10.4103/jfmpc.jfmpc_21_21

