

Association between Body Mass Index and Sleep Quality: A Study among Indian College Students**Shital M. Bamanian¹, Hinaben K Banker², Shilpa K. Menat³, Chhaya A Saraf⁴**¹Assistant Professor, Department of Physiology, Dr. M. K. Shah Medical College and Research Center, Ahmedabad, Gujarat, India²Assistant Professor, Department of Physiology, GMERS Medical College, Vadnagar, Gujarat, India³Assistant Professor, Department of Physiology, Dr. M. K. Shah Medical College and Research Center, Ahmedabad, Gujarat, India⁴Professor and Head, Department of Physiology, Dr. D Y Patil Medical College, Hospital and Research Centre, Dr. D Y Vidyapeeth, Pimpri, Pune, Maharashtra, India

Received: 25-07-2022 / Revised: 25-08-2022 / Accepted: 22-09-2022

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Conflict of interest: Nil

Abstract**Introduction:** The prevalence of sleep deprivation is rising globally as is that of obesity. The association between the two is also gaining much evidence. The college students may be specifically affected due to decreased sleep duration.**Aims and Objectives:** The aim is to study the association between decreased sleep duration and sleep quality with obesity by means of body mass index (BMI).**Materials and Methods:** This is a cross-sectional study among 150 college students. Weight and Height was measured and BMI was calculated from it. The participants reported their sleep duration and sleep quality was determined and assessed by using Pittsburgh Sleep Quality Index (PSQI). The correlation between BMI and selected variables was determined using chi square, and $P < 0.05$ was considered statistically significant.**Results:** About 24% of the participants had a BMI >25 kg/m². Sleep duration of <6 h per night was observed among 58.3% obese and 37.5% overweight students. The duration of sleep was significantly associated with BMI ($p < 0.05$). Extremely poor sleep quality as per PSQI score was found most common among obese (25.0%) student ($p < 0.05$).**Conclusion:** Present study found significant negative association between decreased sleep duration and sleep quality with overweight and obesity in college students.**Keywords:** Body Mass Index, Obesity, Overweight, Sleep quality

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Introduction

According to recent estimates, the worldwide prevalence of obesity has doubled since 1980. [1] The prevalence of overweight and obesity, measured as Body Mass Index (BMI ≥ 25), has increased

dramatically over the past decade. [2–4] This increase in BMI has been observed across all ages, with overweight and obesity in children and adolescents reaching 31.8% in 2010. [4] Similarly elevated rates have been estimated among

college students; with over one-third reporting BMI \geq 25. [5]

This obesity epidemic has been paralleled in modern society by a trend of reduced sleep duration. [6] Poor sleep quality, which is often associated with overall sleep loss, has also become a frequent complaint. [6] Sleep 'is a restorative process of the brain, by the brain, and for the brain', [7] but it is now clear that sleep is important for health of the entire body. The decrease in sleep duration and increase in sleep complaints in modern society [6] raise concerns for a negative impact of chronic sleep disturbances on health in general, not only mental health.

Humans have consolidated sleep in periods of 7-9 hours. It has been shown that during normal sleep, glucose utilization and glucose production drop simultaneously during the first part of the night and raise simultaneously during the predawn hours. [8] When subjects are maintained at rest but sleep-deprived, the pattern of glucose utilization is altered, and glucose levels become constant throughout the night. [8] A number of studies have shown that the metabolic changes associated with interference of normal sleep patterns may contribute to the development of obesity, cardiovascular disease, insulin resistance, and diabetes. [9-11]

College is a time marked by change, when many students experience autonomy and freedom from direct supervision for the first time. They go through lifestyle changes in terms of extensive electronic media use and academic demands, which can potentially lead to insufficient sleep and poor sleep quality. [12] Recently, great attention has been given to sleep duration and sleep quality associated with BMI. While some studies have shown a negative association between sleep duration and BMI, [13] others have found U-shaped [14] or even no association. [15] Also, inconsistent results have been found for the association between sleep quality and BMI, with some studies showing that poor

sleep quality is associated with an increased likelihood of being overweight/obese, [16] while others reporting no association. [17]

The prevalence of sleep deprivation is rising globally [6-8] as is that of obesity. [4][18] The decrease in sleep duration has also been observed in India; here, 93% of urban population in 35-65 years of age were found to be getting less than the 8 h of sleep per night. [19] Likewise, the 2004-2007 National Health Interview Survey had found approximately 28.3% of adults sleeping 6 h or less per night. [20] Over the past decade, short sleep duration is increasingly being found as a risk factor for weight gain and obesity by reducing physical activity, and increasing caloric intake. [21] The present study was designed to study the associations between sleep duration and sleep quality with overweight/obesity by means of body mass index (BMI) among young adults.

Materials & Methods

This is a cross-sectional study among college students to assess the relationship between sleep quality and obesity by means of BMI at medical college of Gujarat. A total of 150 students from the age groups 18 to 24 years were selected for study. The subjects were screened for major diseases and psychological problems. Subjects having serious disorder were excluded from the study. Informed consent was obtained from participating students.

Obesity was determined by calculating the BMI (weight in kg divided by height in meter squared). Weight was measured in light clothing and recorded to the nearest kg. Height was measured to the nearest centimeter without shoes. The nutritional status categories of WHO was followed here. [22] Sleep requirements for an average adult are approximately 8 h regardless of environmental or cultural differences. [23] Thus, the same was considered here. Sleeping patterns along

with, latency, duration, habitual sleep efficiency, sleep disturbances and daytime dysfunction was determined and assessed by using a standardized and validated questionnaire: Pittsburgh Sleep Quality Index. [24]

The data was analyzed using trial version of SPSS. The relation between BMI code and various parameters was studied. The correlation between BMI and selected variables was determined using chi square. Statistical significance was chosen at p value <0.05.

Results

A total of 150 college students were assessed for BMI and self-reported sleep duration. Age of the participants ranged between 18 and 24 years and most of them were males (54.6%). Most of the participants 95 (63.3%) were in normal category (18.5-22.9 kg/m²) and 19 participants (12.7%) were underweight (<18.5 kg/m²). About 24% of the participants had a BMI >25 kg/m², constituted by 16% (*n* = 24) overweight and 8% (*n* = 12) obese. BMI rates varied by sex; with more females reporting BMI ≥ 25 than males (26.5% vs. 22%). (Table 1)

Table 1: Gender-wise case distribution with relation to BMI

BMI (kg/m ²)	Females	Males	Total
<18.5	8 (11.8%)	11 (13.4%)	19 (12.7%)
18.5-24.9	42 (61.8%)	53 (64.6%)	95 (63.3%)
25-29.9	11 (16.2%)	13 (15.9%)	24 (16.0%)
>30	7 (10.3%)	5 (6.1%)	12 (8.0%)
Total	68 (100%)	82 (100%)	150 (100%)
Chi square = 0.94, P value = 0.813			

Of all the obese students, 58.3% were sleeping <6 h per night. Of all the overweight students, 37.5% were having sleep duration of < 6 h per night. While 3.5% student in both normal weight and underweight group were having sleep duration of <6 h per night. The duration of sleep was significantly associated with BMI (p value <0.05). (Table 2)

Table 2: Association of BMI and duration of sleep

BMI (kg/m ²)	Duration of sleep in hours per night			Total
	<6	6-8	≥8	
<18.5	1 (5.3%)	13 (68.4%)	5 (26.3%)	19 (100%)
18.5-24.9	5 (5.3%)	68 (71.6%)	22 (23.2%)	95 (100%)
25-29.9	9 (37.5%)	12 (50.0%)	3 (33.3%)	24 (100%)
≥30	7 (58.3%)	4 (33.3%)	1 (8.3%)	12 (100%)
Chi square = 36.6, P value <0.0001				

Table 3: Relation between BMI and PSQI Code

BMI (kg/m ²)	PSQI Code			Total
	≤5	5 to 8	≥8	
<18.5	12 (63.2%)	5 (26.3%)	2 (10.5%)	19 (100%)
18.5-24.9	77 (81.1%)	13 (13.7%)	5 (5.3%)	95 (100%)
26-30	14 (58.3%)	7 (29.2%)	3 (12.5%)	24 (100%)
>30	5 (41.7%)	4 (33.3%)	3 (25.0%)	12 (100%)
Total	108 (72.0%)	29 (19.3%)	13 (8.7%)	150 (100%)
Chi square = 13.35, P value = 0.0377				

PSQI results are presented in Table 3. Among all the 150 participants, 29

(19.3%) participants experienced poor sleep quality (>5 PSQI <8), and 13 (8.7%)

participants experienced extremely poor sleep quality (PSQI ≥ 8). Poor sleep quality was found common among obese (33.3%) and overweight (29.2%) student. Extremely sleep quality was also found most common among obese (25.0%) student. PSQI score was significantly associated with BMI (p value < 0.05).

The most important components contributing to poor sleep quality included: long sleep latency, poor sleep efficiency, restricted sleep time and daytime dysfunction. Overall, most students reported restricted sleep; only 20.6% of students reported the recommended eight or more hours of sleep, and 14.6% reported six hours or less per night. Perhaps as a consequence of the poor quality of sleep, 23.6% of the students reported daytime dysfunction at least once a week. None of the students was reported taking sleep medication. Of the students who reported "other" reasons for sleep disturbances, the most common was "stress-related".

Discussion

Sleep curtailment has become a common behavior and an increasing number of young people report sleep complaints in modern society. Multiple epidemiological studies have linked short-sleep duration and poor-sleep quality to obesity risk. With the growing prevalence of chronic sleep loss, any causal association between sleep alterations and obesity would have important public health implications. The present study showed significant association between sleep duration and BMI (p < 0.05). Rathod et al. [25] found that there is a significant negative association between duration of sleep per night in medical college students and overweight and obesity. While, Mirdha et al. [26] showed no significant association between sleep duration and BMI. A meta-analysis of 18 studies in 604509 adults demonstrated a pooled obesity odds ratio (OR) of 1.55 for less than 5 h of sleep and a dose effect of sleep duration such that for

each additional hour of sleep BMI decreased by 0.35 kg/m². [27] Buxton and Marcelli [28] demonstrated a 6% increase in the probability of obesity in US adults with a wide age range (18–85 years) for self-reported sleep duration of less than 7 h per night. Anic et al. [29] in a cohort of adult women demonstrated that the effect of short sleep duration was even stronger for extreme obesity for < 6 h of sleep.

We used the PSQI global score to examine the relationship between the sleep quality and overweight/obesity. We found association between BMI and sleep disturbances which was significant. Pilcher et al. [30] observed that college students experienced poor sleep quality as measured by the PSQI in addition to short sleep duration. Mirdha et al., [26] showed that irrespective of sleep duration, sleep disturbance may have significant influence on BMI and weight. Others studies also showed that poor sleep quality and short sleep duration were associated with increased BMI. [31][32]. Sleep restrictions alter the circulating levels of hormones such as leptin and ghrelin which affects glucose homeostasis and appetite regulation. [33] Poor-quality of sleep is associated with many health problems and it can also lead to obesity which leads to increased risk of diabetes, cardiovascular diseases and some cancer.

Although it is well established that an imbalance between caloric intake and physical activity are key factors responsible for the current obesity problem; [34] there is growing interest in studying the environmental and behavioral factors that may be contributing to the problem. [35] Emerging evidence suggests an association between body weight and problems in sleeping patterns, particularly its duration and quality. [36–38]

All in all, may it be day or night, weekday or weekend, short sleep duration at any time has a remarkable influence on the weight status of adolescents as it is a crucial period of life for obtaining

autonomy, enhancing socialization, and developing a burning desire to adapt the modern lifestyle. Which cumulatively result in sleep curtailment, tiredness, reduced time for physical activities and eventual consumption of energy dense foods in the additional wake times among the youth. [39] These seem to notably complement the previously hypothesized mechanisms within the body, such as hormonal dysregulation, metabolic pathway alteration, daytime sleepiness and fatigue, through which sleep deprivation ultimately results in higher energy consumption, lower energy expenditure, adoption of unhealthy behavioral lifestyle, and eventual weight gain. [40,41,42]

Conclusion

This study observed that BMI are significantly linked to sleep quality and sleep duration. Awareness regarding healthy sleeping habits among college students should be created, which in turn can build good health and well-being. Students should also be encouraged for increasing physical activity and healthy eating habits.

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