

Original Research Article

ASSOCIATION BETWEEN BODY MASS INDEX, SLEEP QUALITY AND ACADEMIC PERFORMANCE AMONG FIRST-YEAR MEDICAL UNDERGRADUATES

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ABSTRACT

Background: Many physical and psychological aspects affect medical undergraduates' academic performance. Sleep quality and body mass index (BMI) are acknowledged as important markers of general health and cognitive function. The purpose of this study was to investigate the connections between first-year medical students' academic achievement, BMI and sleep quality.

Materials and Methods: The present cross-sectional study was conducted on 132 first-year medical undergraduates in the department of Physiology of Mahatma Gandhi Medical College and Hospital, Jaipur. After gathering the anthropometric and demographic information, the Global Pittsburgh Sleep Quality Index (PSQI) questionnaire was filled out by participants to assess the sleep quality. Cumulative internal evaluation scores were used to evaluate academic success. Data were analyzed using IBM SPSS Statistics, employing descriptive data like frequency, percentage, mean and standard deviation (SD). Pearson's correlation for numerical data, Spearman's correlation for categorical variables, Chi-square test for categorical comparisons and ANOVA for assessing variable effects were employed. A significance level of 0.05 (p-value) was adopted.

Results: 37.1% participants reported to have poor quality, while 24.24% were falling in the range of overweight and obese category out of 132 participants. Participants with higher BMI and poor sleep quality were not significantly associated with reduced academic performance. However, students who had a normal body mass index and slept well performed slightly better than those who had an abnormal BMI and slept poorly.

Conclusion: BMI and sleep quality may serve as the predictors of academic performance among first-year medical students. Targeted interventions to promote weight management and sleep hygiene could enhance academic outcomes and student well-being.

Keywords: BMI, Sleep Quality, Academic Performance, PSQI, Medical Students.

INTRODUCTION

Sleep, which is marked by autonomic regulation, decreased muscle activity and altered consciousness, is a basic physiological process that is necessary for

the best possible brain function. Emotional stability, cognitive function, physical recuperation and general health are all supported by getting enough sleep, which is normally 7-8 hours each night for healthy adults.^[1] Homeostatic processes and circadian

rhythms control the duration, minimal awakenings and timely commencement of quality sleep.^[2] While sleep deprivation is linked to decreased intellectual and physical capacity, memory problems and decreased concentration, sleep plays a critical role in academic performance by supporting learning, memory consolidation and focus.^[3] Medical undergraduates, facing rigorous academic schedules, often experience irregular sleep patterns, leading to exhaustion, daytime drowsiness and impaired cognitive function.^[4] Globally, approximately 150 million individuals suffer from sleep disorders, with 17% residing in low-income countries, highlighting the public health significance of this issue.^[5]

Medical education is widely regarded as one of the most demanding academic disciplines. First-year students encounter challenging curricula, high expectations and a transition to greater independence, which can adversely affect their physical and mental health, ultimately impacting academic achievement.^[6] BMI, a standard measure of nutritional health, is linked to cognitive outcomes. Obesity and overweight are associated with neurocognitive impairments, including reduced attention, memory issues and executive function deficits, mediated by insulin resistance, inflammation and altered neurotransmission.^[7,8] Medical students, with their irregular schedules, poor dietary habits and sedentary lifestyles, are particularly susceptible to these effects.^[9] Concurrently, chronic sleep deprivation increases the risk of anxiety, depression and poor academic performance.^[10,11] Common contributors of these issues among medical students include stress, prolonged screen time and late-night study sessions.^[12]

Although BMI and sleep quality have been extensively studied separately, less is known about how they interact to affect academic performance, particularly for first-year medical undergraduates. The results of earlier research are mixed, with some highlighting sleep quality as a reliable predictor,^[13] and others finding no significant association between BMI and academic achievement.^[14]

The present study assesses the association between BMI, sleep quality and academic performance among first-year medical students at Mahatma Gandhi Medical College and Hospital, Jaipur in order to resolve these discrepancies and the lack of local data. The primary objective is to identify modifiable risk factors and suggest remedial measures that enhance academic success and student well-being.

MATERIALS AND METHODS

The present cross-sectional study was conducted at Mahatma Gandhi Medical College and Hospital, Jaipur, on 132 first-year medical undergraduate students spanning from October 2022 to March 2023 in the department of Physiology. The study was approved by the institutional ethics committee vide number MGMC&H/IEC/JPR/2022/821 dated 30th

June 2022. Participation was voluntary and informed consent was obtained from all the participants. Those with chronic diseases, long term medication and diagnosed case of insomnia were excluded from the study. Participants completed the self-administered Global Pittsburgh Sleep Quality Index (PSQI) questionnaire, a validated tool assessing sleep quality over the past month.^[15] The PSQI questionnaire consists of 19 self-assessed questions and 5 questions assessed by the roommate, based on availability. For scoring purpose only self-assessed questions are considered. The scoring includes seven components which are formed by incorporating the 19 self-assessed questions. Likert scale ranging from 0-3 were used for scoring, “0” indicates no problem at all, while a score of “3” indicates very big problem. Final score of global PSQI is achieved by adding the seven component scores which may range from 0-21. A global PSQI score of “5” or less than “5” indicates good sleepers and score of more than “5” suggests poor sleepers.^[15]

Demographic data (age, gender), anthropometric measurements (height, weight, BMI) and blood pressure [systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP)] were recorded using standardized protocols. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively, with BMI calculated as weight (kg)/height (m²). Blood pressure was measured using a digital sphygmomanometer after a 5-minute rest. Academic performance was evaluated based on cumulative internal assessment scores in Anatomy, Physiology and Biochemistry expressed as percentages.

Data collected were compiled on Microsoft Office excel worksheet and was subjected to statistical analysis using IBM Statistical Package for the Social Sciences (SPSS) Statistics version 29.0.2.0(20). Descriptive statistics included frequency (n) and percentage (%) for categorical data, while mean and SD for numerical data were employed. Pearson's correlation was used for numerical data, Spearman's correlation for categorical variables, Chi-square test for categorical comparisons and one-way ANOVA to assess the level of significance of the associated variables. The significance level was set at $p < 0.05$.

RESULTS

The present study which was performed on 132 first year medical students didn't find significant association between global PSQI score and academic achievement. Also, there was non-significant negative correlation between BMI and academic score. Though we found a significant correlation between BMI and blood pressure.

Of the 132 participants, 70 (53%) were female and 62 (47%) were male, reflecting a slight female predominance. [Table 1] The mean age was 19.73 ± 1.08 years. Average height, weight and BMI were 167.49 ± 10.57 cm, 63.35 ± 15.09 kg and 22.51 ± 4.60

kg/m², respectively. Mean SBP, DBP and MAP were 111.03 ± 12.08 mmHg, 65.52 ± 9.46 mmHg and 80.69 ± 9.72 mmHg, respectively. Academic performance was highest in Anatomy (46.93 ± 10.29%), followed by Physiology (44.80 ± 13.57%) and Biochemistry (41.30 ± 10.55%). [Table 2] Of the participants, 20.45% were underweight, 55.31% had normal weight, 14.39% were overweight and 9.85% were obese. [Table 3] Of the 132 participants, 83 (62.9%) were good sleepers (PSQI 0–5), while 49 (37.1%) were poor sleepers (PSQI > 5). The PSQI score ranged from 0 to 11, with the highest frequency (20.5%) at a score of 4. [Table 4] A significant positive correlation was observed between BMI and blood pressure (SBP: r = 0.562, p

< 0.001; DBP: r = 0.453, p < 0.001; MAP: r = 0.527, p < 0.001). Academic performance showed a non-significant negative correlation with BMI, except for Biochemistry (r = -0.175, p = 0.044) which showed significant negative correlation. [Table 5] The Global PSQI score showed non-significant correlation with BMI (r = 0.024, p = 0.784) and academic performance. [Table 6] No significant association was found between sex and PSQI score (χ^2 = 0.529, p = 0.467). [Table 7] Significant correlational effects of BMI were observed for MAP (F = 3.524, p = 0.000), SBP (F = 3.503, p = 0.000) and DBP (F = 3.212, p = 0.000), indicating BMI influences blood pressure parameters. (Table 8)

Table 1: Gender distribution

Gender	Frequency (%)
Female	70(53)
Male	62(47)
Total	132(100)

Table 2: Anthropometric and academic parameters

Parameters	Mean	Standard deviation (SD)
Age (years)	19.73	1.08
Height (cm)	167.49	10.57
Weight (Kg)	63.35	15.09
BMI (Kg/m ²)	22.51	4.60
SBP (mmHg)	111.03	12.08
DBP (mmHg)	65.52	9.46
MAP (mmHg)	80.69	9.72
Anatomy	46.93	10.29
Physiology	44.80	13.57
Biochemistry	41.30	10.55

Table 3: Body mass index (BMI) distribution

	BMI (Kg/m ²)	Frequency (%)	Percentage
Underweight	< 18.5	27	20.45
Normal weight	18.5-24.9	73	55.31
Overweight	25-29.9	19	14.39
Obese	≥30	13	9.85

Table 4: Global PSQI score and frequency

	Good sleepers (83)						Poor sleepers (49)					
Global PSQI score	0	1	2	3	4	5	6	7	8	9	10	11
Frequency	1	6	8	15	27	26	15	14	7	9	2	2
Percentage	0.8	4.4	6.1	11.4	20.5	19.7	11.4	10.6	5.3	6.8	1.5	1.5

PSQI- Pittsburgh sleep quality index

Table 5: Correlation between BMI, Blood pressure and academic performance

Variables	SBP	DBP	MAP	Anatomy	Physiology	Biochemistry
BMI	0.562 (p< 0.001)	0.453 (p< 0.001)	0.527 (p < 0.001)	-0.050 (p=0.568)	- 0.120 (p= 0.172)	-0.175 (p=0.044)

Table 6: Correlation between Global PSQI score, BMI and Academic performance

Variable	BMI	Anatomy	Physiology	Biochemistry
Global PSQI score	0.024 (p=0.784)	- 0.026 (p=0.763)	-0.009 (p=0.921)	0.038 (p=0.663)

Table 7: Chi-square test (PSQI with Sex)

Sex * PSQI Score					Chi-square value (χ^2)	P-value
		PSQI Score		Total	0.529	0.467
		Good sleepers	Poor sleepers			
Sex	F	42	28	70		
	M	41	21	62		
Total		83	49	132		

Table 8: BMI ANOVA Table

ANOVA		Sum of Squares	df	Mean Square	F-statistic	Sig.
Age	Between Groups	20.396	20	1.020	0.849	0.650
	Within Groups	133.323	111	1.201		
	Total	153.720	131			
MAP	Between Groups	4817.310	20	240.865	3.524	0.000
	Within Groups	7586.872	111	68.350		
	Total	12404.182	131			
Mean score (Anatomy)	Between Groups	1649.766	20	82.488	0.743	0.774
	Within Groups	12324.620	111	111.033		
	Total	13974.386	131			
Mean score (Physiology)	Between Groups	3325.075	20	166.254	0.891	0.599
	Within Groups	20714.107	111	186.614		
	Total	24039.182	131			
Mean score (Biochemistry)	Between Groups	2421.451	20	121.073	1.100	0.360
	Within Groups	12216.208	111	110.056		
	Total	14637.659	131			
SBP	Between Groups	7402.244	20	370.112	3.503	0.000
	Within Groups	11727.634	111	105.654		
	Total	19129.879	131			
DBP	Between Groups	4303.068	20	215.153	3.212	0.000
	Within Groups	7435.864	111	66.990		
	Total	11738.932	131			

df: Degree of freedom

DISCUSSION

The present study was conducted on 132 first year undergraduate medical students of Mahatma Gandhi Medical College and Hospital, Jaipur. The study population comprised 53% female and 47% male students ranging from 18 to 23 years. The prevalence of poor sleep quality (37.1%) in the present study is consistent with other studies among college students, who were found to have sleep disturbances due to stressful schedules highlighting the necessity of focused interventions.^[4,12] The global PSQI score ranged from 0 to 11 indicating variety in sleep habits, with maximum participants (20.5%) receiving a score of 4 which is the threshold for less-than-ideal sleep. This is in line with the study by Gupta S et al conducted on the medical students in the different phases of their medical course and found that the global PSQI score ranged from 0 to 15.^[16] The BMI distribution revealed that 55.31% of students had normal weight, while 20.45% were underweight, 14.39% overweight and 9.85% obese. This heterogeneity reflects diverse nutritional status, potentially influenced by irregular eating patterns and sedentary lifestyles common among medical students.^[9] The significant positive correlation between BMI and blood pressure (SBP: $r = 0.562$, $p < 0.001$; DBP: $r = 0.453$, $p < 0.001$; MAP: $r = 0.527$, $p < 0.001$) supports existing literature linking obesity to cardiovascular risk factors.^[7] The negative correlation between BMI and academic performance was found for all the three subjects of their first phase, however it was significant only for Biochemistry suggesting a subject-specific impact that warrants further investigation. This corresponds to studies reporting no significant BMI-academic performance link,^[13] whereas study by Anderson AS et al on medical students showed significantly negative link between BMI and students' final

scores.^[17] The global PSQI score weak positive correlation with BMI ($r = 0.024$, $p = 0.784$) and non-significant negative correlation with academic performance (Anatomy: $r = -0.026$, $p = 0.763$) (Physiology: -0.009 , $p = 0.921$) may reflect the small sample size or the PSQI's broad scoring range, which may not capture nuanced cognitive effects. This is in agreement with the study by Almalki, A. et al, who also reported no significant association between sleep quality and academic performance among medical students though their study population included all phases of medical students.^[18] This study contradicts the study by Cvejic E. et al, and El Hangouche et al, who reported that poor sleep quality is having a significant impact on academic achievement among medical students.^[19,20] The ANOVA results indicating significant BMI effects on MAP, SBP and DBP ($p < 0.001$) reinforce the physiological interplay between body composition and cardiovascular health, which could indirectly influence cognitive function through stress or fatigue.^[8] The non-significant sex-PSQI association ($\chi^2 = 0.529$, $p = 0.467$) suggests that sleep quality challenges are gender-neutral in this cohort, aligning with Bixler EO et al,^[21] but differing from others reporting gender disparities.^[22] Modifiable lifestyle characteristics are highlighted by the better academic performance of students with normal BMI and good sleep quality. Several studies highlight the importance of sleep for attention and memory consolidation,^[3,10] as well as the influence of BMI on executive function.^[7] As the lack of clear significant statistical association between PSQI scores and academic outcomes, future research should examine the mediating factors like study habits, stress coping strategies or unmeasured variables such as physical activity or nutrition quality.

CONCLUSION

The study suggests that medical students specially first year undergraduates are potentially at risk of poor sleep quality may be due to their sudden shift from school life to professional course. The demanding academic schedule involving prolonged lectures, practical schedules, viva voce, different presentations and periodical examinations may affect the sleep pattern. Although the present study didn't establish a significant correlation between sleep quality and academic performance. These students may be adapting to their academic circumstances by sacrificing their sleep to achieve the desired level. Further, non-significant positive correlation was found between BMI and poor sleep quality, suggesting lifestyle factors may be the determinants of success. The significant BMI-blood pressure correlation further underscores the need for holistic health interventions. Interventions that support weight control, good sleep hygiene and adjusting the curricula may help this susceptible group achieve better health and academic outcomes in the long run.

Limitations

The cross-sectional design, which eliminates causality and the use of self-reported PSQI data, which could add bias, are among the limitations. The use of internal assessments rather than final exams may not accurately reflect academic competency and the sample size ($n = 132$) from a single school restricts generalizability. To confirm these results, future studies should use objective sleep metrics, bigger multi-institutional populations and longitudinal designs.

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