

Research Article

Sleep Deprivation, Memory Complaints, and Aggression among Medical Students

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Abstract

Background: Medical education is a stressful academic journey that harms its seekers' cognitive and behavioral functioning. Where one whole night of sleep satiation is crucial for health, sleep deprivation can impair memory of the learned material and emotional regulation.

Objective: This study examined the link of sleep deprivation with memory complaints and aggression among medical students.

Methods: It was a cross-sectional survey of medical students aged between 19 and 22 (M = 20.5, SD = 0.87) from the Abbottabad district in Pakistan. The study involved convenience sampling to gather information on the Epworth Sleepiness Scale, Memory Complaint Scale, and Buss and Perry Aggression Questionnaire.

Results: The descriptive analysis shows that medical students experienced moderate-to-severe sleep problems and moderate levels of memory complaints and aggression. Out of 300 medical students, 48.7% reported having high sleep deprivation, and 42.7% reported having moderate sleep deprivation. While moderate (47.7%) and severe (32.7%) memory complaints were more common, only 3.7% of medical students said they had no memory problems. Sleep deprivation had significant positive correlation with memory issues, and memory issues correlated with aggression. The study's findings demonstrated that lack of sleep was strongly associated with memory complaints and had a negligible effect on the aggressiveness of medical students.

Conclusion: The majority of medical students in Pakistan experience a lack of sleep. They need to value the importance of sufficient sleep for effective cognitive and behavioral functioning. Adequate screening, prevention, and intervention should be administered to at-risk medical students.

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Introduction

Sleep is a daily necessity, and seven to eight hours of sleep at night is crucial for maintaining an indi-

vidual's physical and mental health. Quality sleep is essential for a normal person's cognitive and psychological well-being.¹ Students, particularly medical students, need more sleep intake at night. They go to bed late and wake up early, which causes daytime sleepiness. Student trainees and interns work consecutively for long hours without a holiday. Sleep deprivation not only impairs the personal health and safety of medical students but also increases the risk of accidents. Therefore,



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understanding sleep is essential to prevent the adverse effects of sleep deprivation on learning, memory, and behavioral regulation.¹

Sleep deprivation has two categories based on the duration of sleep deficiency. Acute sleep deprivation lasts a few nights, whereas chronic sleep deprivation refers to insufficient sleep over a prolonged period. Medical students typically sleep less per night for months. Both chronic and acute sleep deprivation were higher among resident physicians than among attendings, which heightened their impulsivity and lowered information-processing time and executive functioning.²

Empirical evidence exists for the high prevalence of sleep problems among undergraduate medical students. A study in Lahore reported that 71.4% of 227 medical students had poor sleep habits, and 52.8% had trouble staying awake during everyday activities.³ Another study with 385 undergraduate medical students found a high prevalence of poor sleep quality (55.3%) and inadequate sleep hygiene (45.19%).⁴ Comparing medical students with students from basic sciences, a study with 281 medical students found that medical students had less sleep duration, poor sleep efficiency, used more sleep medicines, and experienced more daytime sleepiness. Moreover, medical students in the early years of medical school had better sleep quality than those in the advanced years.⁵ A similar study at Sheikh Zayed Medical College and Hospital Rahim Yar Khan, Pakistan, found that 40.8% of 260 (i.e., 102) medical students had sleep problems, among whom 32 were men and 70 were women.⁶

Lack of sleep affects students' academic performance and impairs their psychological health. The academic performance of medical students with low sleep quality was lower than those with better sleep quality in Karachi, Pakistan. Almost 64.24% of 797 (i.e., 512) medical students reported having poor sleep quality, 37.7% had daytime sleepiness, and 29.4% had reduced daily sleep duration of 5-7 hours.⁷ In contrast, empirical evidence also exists for the non-significant effects of the sleeping habits of medical students on academic performance when male and female students reported experiencing equal sleep disturbance.³

Sleep deprivation, in any form, results in slow cognitive processing and memory decline after learning something

new.⁸ Another study revealed that 232 (58% of 400) undergraduate medical students from public/private schools in Karachi reported sleep deprivation as the most salient reason for poor memory and distractions in memorization.⁹ These empirical studies reflect a high prevalence of sleep and memory complaints among medical students.

Sleep quality and quantity affect emotional regulation - poor sleep results in loss of emotional control, including expression of aggression. Empirical studies support the evidence that sleep deprivation is a risk factor for aggressiveness in medical students. Most medical students experienced sleep deprivation that led them to aggression, fatigue, and attentional difficulties. Also, sleep deprivation harmed students' academics, mood, and well-being in their daily routines.¹⁰ A study reported that long-term sleep deprivation reduces the sensitivity of sensory and motor receptors and diminishes neural connections among brain areas. The amygdala is activated and produces a heightened emotional response in a sleep-deprived person who displays more anger and aggression than one who gets sufficient sleep at night.¹¹ The medical students in Karachi who experienced less than 6 hours of sleep had difficulty controlling and managing anger and experienced burnout¹². Another study found that lack of sleep was a significant positive predictor of physical aggression, and psychological distress was a partial mediator in the association between sleep deprivation and physically aggressive behavior among 12 thousands of adolescents.¹³ A meta-analysis of 60 experimental and observational studies support that short sleep duration leads to high aggression.¹⁴

Experiencing sleep deprivation during medical school increases cognitive load and decreases the amount of daily sleep. Students struggle to retain and recall the learned information, mainly when they are sleep-deprived. Motivated by this concern, the present study aims to examine the role of sleep deprivation in predicting memory complaints and aggression among medical students. It is hypothesized that sleep deprivation leads to memory complaints and aggression, and sleep-deprived students experience more memory complaints and aggression than non-sleep-deprived students do. Students' perceptions of acute and chronic sleep deprivation are examined; however, their individual effects

are not separated. Understanding the outcomes of sleep deprivation for medical students will bring the risk factors into the limelight.

Methods

The present study adopts a cross-sectional design with a convenient sampling technique. The self-reported data was gathered at a one-time point from April to June 2022. The sample size calculation was performed to examine the prevalence of memory issues and aggression among the medical student population in Abbottabad. Using the formula $n = (Z^2 \sigma^2) / d^2$ with the z values of 1.96 for a 95% confidence level, the standard deviation for memory issues ($SD = 2.77$), 5% of the type of 1 error and 0.5 precision (d), the required sample size was calculated as 118 participants. The research assistant collected data from 300 currently enrolled students in three medical colleges of District Abbottabad. Therefore, the sample size is sufficient to identify significant differences accurately and precisely.

The inclusion criteria were current enrollment in medical institutes and willingness for study participation. The exclusion criteria was based on non-enrollment in medical institutes or being student of other colleges, non-consent for study, and incomplete demographic and scale data. There were 211 female students and 89 male students. Their age range was 19 to 30 ($M = 20.5$, $SD = 0.87$) years. About 21.7% of the students were between 19 and 22 years old, 49% were between 23 and 26 years old, and 29.3% were between 27 years and above. Concerning academic achievement in terms of CGPA, 68 students (22.7% of 300) had grades between 2.6–3.0, 150 students (50.0% of 300) had grades between 3.1 to 3.5, and 82 students (27.3% of 300) had grades between 3.6 to 4.0. None of them reported having a CGPA of less than 2.00.

The Epworth Sleepiness Scale (ESS), Memory Complaint Scale (MCS) version A, and Buss-Perry Aggression Questionnaire (BPAQ) were used. Murray Johns (1991) constructed the Epworth Sleepiness Scale to assess daytime sleepiness and an average sleep propensity (ASP) in daily life. This self-administered scale consists of reports of falling asleep or dozing off across various situations. ESS has eight items with a 4-point rating scale that are responded to on a 0-3. The total score ranges between 0-24, with the higher score indicating

a person's higher daytime sleepiness.¹⁵

Vale, Balieiro-Jr, and Silva-Filho (2012) developed the Memory Complaint Scale to differentiate normal adults from cognitively demented adults. Version A of the Memory Complaint Scale is a self-report measure that examines the frequency of memory complaints in daily life. It has seven items and a score range of 0-14.¹⁶ The response options include no (0), unsure/doubt (1), and yes (2). An individual is classified as having or not having memory complaints. The scores are interpreted as no memory complaints (0-2), mild memory complaints (3-6), moderate memory complaints,⁷⁻¹⁰ and severe memory complaints.¹¹⁻¹⁴

Buss and Perry (1992) developed a self-report aggression questionnaire with four subscales. The present study used two subscales of verbal aggression and anger, with seven and five items, respectively. A higher score indicates a higher level of aggression.¹⁷

This study was conducted after Institutional approval from the Ethics Review Committee, University of Haripur, KPK Pakistan under protocol number under protocol number UOH/DASR/2022/162. Prior permission for data collection was sought from the respective medical colleges, and one staff member from each college assisted in contacting students for data collection. Students were informed about the research purpose and process to seek their willing participation. They were ensured of anonymity and confidentiality. Participants spent a maximum of 30 minutes responding to the questionnaires. They were debriefed at the end and thanked for their cooperation.

Data collected from participants were entered and analyzed in the Statistical Packages for Social Sciences (SPSS) version 27. The alpha coefficients, descriptive statistics, correlations, frequency, and percentages of sleep deprivation and memory complaints were computed. A regression model was tested in MPLUS 7.4 to examine the predictive effect of sleep deprivation on memory and aggression among medical students.

Results

Table 1 shows that the alpha coefficients for the Epworth Sleepiness Scale and Memory Complaints Scale were acceptable except for the Aggression Scale ($\alpha = .61$). Medical students had moderate-to-severe sleep problems

Table 1: Reliability, Descriptive Statistics, and Correlations for Study Variables (N=300)

Scales	α	<i>M</i>	<i>SD</i>	Range		Skew	Kurt	Memory	Aggression
				Min	Max				
Sleep	.72	15.27	4.21	0	24	-1.04	-.93	.26**	.018
Memory	.70	8.88	2.77	0	14	-1.03	-.44		.17**
Aggression	.61	19.93	6.25	12	84	-.83	-.51		

and moderate memory complaints and aggression levels. It implies that sleep deprivation is linked to memory complaints and aggression among medical students. Hence, the low magnitude of these intercorrelations alludes to the weaker relationship among study variables.

Table 2: Frequency and Percentages for Sleep Deprivation and Memory Complaints

Sleep Deprivation			Memory Complaints		
Groups	<i>F</i>	%	Groups	<i>F</i>	%
Never (0)	2	0.7	No (0-2)	11	3.7
Slight (1-8)	24	8.0	Mild (3-6)	48	16.0
Moderate (9-16)	128	42.7	Moderate (7-10)	143	47.7
High (17-24)	148	48.7	Severe (11-14)	98	32.7

Table 2 shows participants' responses to daytime sleepiness and memory complaints. Overall, most students had high (48.7%) and moderate sleep deprivation (42.7%). Almost one-third (32.7%) had severe memory complaints, and 47.7% had some moderate memory complaints. Only 3.7% reported not having any memory complaints.

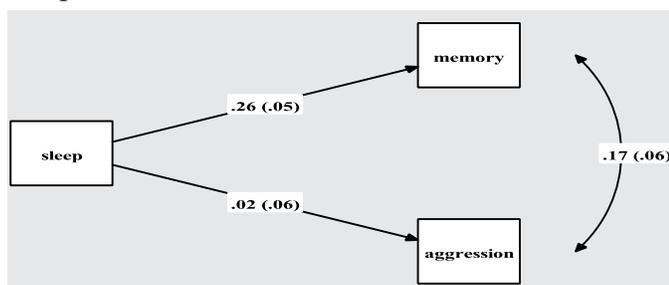
**Figure 1:** Role of sleep deprivation on memory complaints and aggression

Figure 1 shows that sleep deprivation was a positive predictor of memory and represented a .26 unit ($\beta = .26$, $SE = .05$, $p < .00$) increase in memory complaints of medical students with one standard deviation change in the level of sleep deprivation. The standard error shows that the estimate's precision was .05. Whereas the standardized beta value for aggression was 0.02. It was non-significant, with a p-value of .74. In light of Kline's (2023) model fit criteria ($RMSEA \leq .06$, $CFI \geq .95$, & $SRMR \leq .08$),¹⁸ the model achieved a good

fit with the data, and the fit indices were $\chi^2(7) = 4.98$, $p = .66$, $CFI = 0.99$, $RMSEA = 0.05$, $SRMR = 0.02$. The present findings show that sleep deprivation leads to memory complaints but not aggression, thus, partially support the hypothesis.

Discussion

Human beings spend one-third of their life span asleep. Where one whole night of sleep satiation is crucial for adequately performing cognitive and behavioral functions, sleep deprivation can impair memory of the learned material.⁸ The results of the present study confirm that sleep deprivation leads medical students to experience memory complaints, but they are not necessarily aggressive toward others. Above 90% of medical students reported having moderate to high daytime sleepiness and dozing. Few students (i.e., $n = 24$ or 8%) had slight daytime sleepiness, and only two students did not report having sleep problems. These statistics reflect a high rate of sleep deprivation among medical students, in general, irrespective of short-term versus long-term sleep deprivation or acute versus chronic sleep deprivation. This finding supports the hypothesis and is consistent with a study in Lahore³ and Rahim Yar Khan,⁶ which reported prevalence of poor sleep habits and sleep issues among medical students.

Likewise, most medical students reported having moderate-to-severe memory complaints on average, and very few reported no memory complaints. The present findings align with,¹⁹ who found a medium to large effect size ($g = .62$) of sleep deprivation on memory of newly learned material. Sleep deprivation after learning had a small to medium effect size ($g = .28$) on memory. The immediate memory tests after sleep deprivation showed poorer memory scores than those taken after recovery sleep.

Studying and practicing medicine is considered well-reverenced in Pakistani society. Medical students are responsible citizens and are expected to behave ratio-

nally. Their negative emotional outlets are not appreciated. This is probably why medical students did not report behaving aggressively toward others. Medical students scored below average on the measure of aggression. Using the full scale and taking reports such as fellow students, co-workers, or patients and counter-matching them with self-reports of aggressiveness can portray a clear picture of aggressiveness among medical students. This finding refutes the hypothesis and contradicts.¹⁴ Another underlying reason could be medical students' motive to serve humanity and treat others with care because of which they reported no or low aggressiveness.

This study has several strengths. This indigenous study portrays a clear picture of the cognitive and behavioral complaints among medical students who are at risk of sleep deprivation. A contribution of the study in the first place is to target medical students, a highly vulnerable population that experiences numerous daily stressors. The dual focus of the study to examine cognitive (memory complaints) and behavioral (aggression) outcomes provides a more holistic view of the outcomes of sleep deprivation. A large sample of medical students facilitates the generalizability of the findings to similar student populations in the region. Moreover, this study's internal validity is high because it employs reliable and validated measures, such as the Epworth Sleepiness Scale and the Buss and Perry Aggression Questionnaire. These findings can benefit medical administrators in implementing prevention and intervention programs to protect the health and well-being of medical students.

The present study has certain limitations. It is a cross-sectional, non-experimental study with self-reported data that did not examine the causal association or longitudinal effects of sleep deprivation. Future researchers should plan bidirectional longitudinal studies and include other reports to check congruence in participants' reports on the study variables. Another limitation is the sampling only medical students to test the association between these constructs. Including students from various academic backgrounds may portray different effects of sleep deprivation on the outcome variables.

Medical students need sufficient quality and quantity of sleep to meet educational standards and protect their well-being from the adverse effects of sleep deprivation.

The present study has specific implications based on the noted prevalence of sleep deprivation and memory complaints among medical students. It suggests designing educational and training programs to ensure sleep hygiene and rest opportunities to promote medical students' health, academic, and overall life quality. The severely sleep-deprived students should be identified and treated to mitigate the risks of medical errors, memory complaints, and aggression outbursts. Thus, sleep education, counseling, and mental health support services should be provided to at-risk students.

Adequate sleep quality and quantity are intertwined with the health and well-being of medical students.¹ Future physicians can benefit from effective sleep management strategies and avoid the less effective ones. In a survey study, 828 medical students were asked to share their preference for sleep management strategies. The effective sleep strategies were adjusting pre-sleep habits, modifying sleep environment, having regular daytime habits, maintaining a regular sleep-wake cycle, and pharmacologically active treatments. The least preferred strategies were modifying the sleep environment, taking sleep medications, changing pre-sleep and daytime habits, and having a regular sleep-wake cycle.²⁰

Conclusion

Sufficient sleep is crucial for medical students' effective cognitive and behavioral functioning. Efforts should be made to minimize sleep deprivation to maintain adequate sleep, improve memory, and control aggression among future doctors. All students should be provided with sleep education to encourage healthy sleep patterns. Proper screening, preventive treatment, and intervention of at-risk students can protect their psychological health.

Ethical Approval: The Research Ethics/ Bioethics Committee, University of Haripur, Khyber Pakhtunkhwa, Pakistan approved this study vide letter No. UOH/DASRB/2022/162.

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Author's Contribution:

NZ: Conception & design, Acquisition of data, analysis & interpretation of data, drafting of article, critical revision for important intellectual content, final approval

AH: Acquisition of data, analysis & interpretation of data

HA: Drafting of article, critical revision for important intellectual content

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