Journal of
Social & Health Sciences

LOGIXS JOURNALS

Original Article

Differences in anxiety and subjective sleep among medical students in two curricular models: a crosssectional comparative study

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Citation: Naqvi SHR, Nazir A, Hamza A, Ahmad K, Mazhar S, Fatima R, et al. Differences in anxiety and subjective sleep among medical students in two curricular models: a crosssectional comparative study. J Soc Health Sci. 2025;4:40-49.

Received: 31 August 2025
Revised: 11 December 2025
Accepted: 27 December 2025
Published: 31 December 2025

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Abstract

Anxiety and poor quality of sleep are common among medical students, and they are affected by exhaustive academic schedules as well as different curricular models at teaching institutions. This study examined differences in the levels of anxiety and sleep experiences among medical students who were registered in two different types of curricula at a private medical college, determined whether curriculum type is related to differences in anxiety and sleep patterns, as well as explored the relationships between anxiety and sleep features among students for each type of curriculum. This cross-sectional comparative study was conducted for six months at Niazi Medical & Dental College (NMDC) and included 184 students, with 92 participants in each curriculum group. A nonprobability quota sampling technique with equal distribution was used, and anxiety and quality of sleep were determined by using the Hamilton Anxiety Rating Scale (HAM-A) and Pittsburgh Sleep Quality Index (PSQI), respectively. The results of the study revealed that most participants were from the 4th year (n = 66, 35.9%), the median HAM-A score was 23.00, and the median PSQI score was 7.00. No statistically significant difference was observed in the levels of anxiety between the two curriculum groups ($p = 0.137$). However, students in the modular curriculum reported significantly poorer quality of sleep ($p = 0.036$) and shorter sleep duration ($p = 0.009$). Anxiety was significantly positively correlated with overall PSQI scores in both the annual ($p < 0.001$) and the modular ($p < 0.001$) curricula. In the modular group, anxiety was significantly associated with overall quality of sleep, sleep latency, sleep disturbance, reduced sleep efficiency, and fewer hours in bed (all $p < 0.05$). The study concluded that anxiety levels did not differ significantly between the two curriculum types. However, students in the modular curriculum experienced poor quality and shorter durations of sleep. Furthermore, anxiety was significantly associated with adverse sleep outcomes.

Keywords

Anxiety; HAM-A; PSQI; Quality of sleep; Medical education; Medical students; Medical curriculum; Healthcare academia

1. Introduction

Medical education is globally recognized as a highly demanding, challenging, and high-pressure process with significant psychological and physiological strain on students [1,2]. Medical students have been reported to experience greater psychological distress (30.6%), with anxiety being among the most prevalent, when compared with general population [3,4]. Performance expectations, a competitive environment, continuous assess-

ments, and early exposure to straining clinical scenarios all contribute to increased vulnerability [5]. Along with psychological effects, anxiety can damage the cognitive abilities of students, decision-making processes, academic performance, and long-term professional development [6].

Poor quality of sleep among students has become an important concern in medical and healthcare education [7]. The rigorous, demanding, and challenging structure of medical training often disrupts the sleep patterns of students, resulting in sleep deprivation and reduced quality of sleep, affecting medical students more than nonmedical students do [8]. Sleep disturbances in such situations are linked to stress, which also contributes independently to worsening anxiety and other mental health issues [9]. This cyclic bidirectional relationship among medical students negatively affects memory consolidation, learning ability, and academic and clinical performance [10]. Furthermore, chronic anxiety and poor quality of sleep are linked to burnout, depression, and diminished empathy, which increase the potential risks to patient safety in clinical settings [11]. Since medical students are considered future healthcare professionals and future experts in the field, their mental and physical health is important not only for themselves but also for patients and for maintaining the integrity of future healthcare services [12].

Scientific evidence suggests that the curriculum structure in medical sciences affects student well-being [13,14]. Traditional, lecture-based academic programs heavily rely on memorization, high-stakes summative assessments, and extensive written examinations, which increase academic stress [15]. In contrast, integrated or problem-based learning (PBL) programs encourage self-directed learning, critical thinking, and formative assessment, which may foster a more conducive academic environment for professional learning [16]. However, in the context of South Asia, limited scientific evidence is available to highlight the differences in educational approaches that impact medical students' anxiety and sleep patterns in terms of external stressors.

The present study is based on the transactional model of stress and coping proposed by Lazarus and Folkman, in which it is suggested that psychological stress results from a person's appraisal of environmental needs relative to their available coping resources [17]. Within medical education, the structure of the curriculum represents an important academic demand that may affect students' perceptions of workload, the frequency of assessments, and learning expectations. These cognitive appraisals may contribute to anxiety, which can ultimately affect behavioral and physiological outcomes, including but not limited to the quality as well as duration of sleep among medical students. Moreover, this framework provides a theoretical basis for observing whether differences in the organization of the curriculum are associated with differences in anxiety and subjective sleep experiences among medical students [17]. Particularly, it compares medical students enrolled in two distinct curricular models—traditional and integrated—in a private medical college in Pakistan [18]. By exploring these relationships, this study aims to contribute to the development of more student-centered medical education models that support psychological strength and academic performance [19]. Therefore, this study explores differences in anxiety levels and sleep experiences, including perceived quality and duration of sleep, among medical students enrolled in two different models of the curriculum at a private medical college. It also aims to determine whether curriculum type is associated with differences in anxiety and sleep patterns. Finally, it explores the relationships between anxiety and sleep characteristics for each curriculum type.

2. Methods

2.1. Study design and setting

This study was a comparative cross-sectional in nature, and was conducted over a six-month period at Niazi Medical and Dental College (NMDC), Sargodha.

2.2. Sample size and sampling technique

In total, 184 participants were enrolled, with 92 students selected from each curriculum group, namely, annual and modular [20]. The sample size was determined pragmatically on the basis of the total number of eligible students available during the study period and the feasibility of data collection within the NMDC. Given the reachable student population, which was registered in both curriculum types, an equal distribution of students between groups was adopted for balanced comparison and to enhance the internal validity of the between-group analyses. A nonprobability quota sampling technique was used, with an equal distribution of students across the annual and modular curriculum groups.

2.3. Eligibility criteria

Students who were currently enrolled in the specific academic year of either the annual or the modular curriculum type, who were able to understand the study instrument, and who provided verbal as well as written informed consent to participate were included in the study. Students who self-reported a previous diagnosis of sleep disorders or severe mental health problems; who used medications for anxiety or sleep; or who had experienced major emotional or psychological events within the past three months were excluded from the study.

2.4. Study instruments

The study employed two validated instruments for data collection. The Hamilton Anxiety Rating Scale (HAM-A), which is a clinician-rated 14-item scale for determining both the physical and the somatic symptoms of anxiety among participants [21], was converted into an online self-administered tool because of the Google Form data collection approach adopted by the study [22]. Furthermore, the Pittsburgh Sleep Quality Index (PSQI), which is a self-reported 19-item questionnaire used to determine subjective sleep quality over the previous month, was used [23]. English versions of the HAM-A and PSQI were used in this study, as English is the official medium of instruction in Pakistani medical colleges, and it was assumed that all participants were proficient in English and were able to comprehend the questionnaire items without requiring translation.

2.5. Study measures

The HAM-A was used to measure mental stress, psychological distress, and physical symptoms associated with anxiety among the participants. Each item on the instrument was scored on a 5-point Likert scale ranging from 0 (not present) to 4 (severe), with total scores ranging from 0–56 points; higher scores indicate greater severity of anxiety. The PSQI measures quality of sleep through seven-element scores, highlighting subjective quality of sleep, habitual sleep efficiency, sleep latency, sleep disturbances, sleep duration, daytime dysfunction, and use of sleep medication. These element scores, when summed, ranged from 0–21 points, with higher scores highlighting poorer quality of sleep.

2.6. Data collection procedure

Ethical approval for the purpose of the study was obtained from the Institutional Research Advisory Board (IRAB) [No. DRC/0261/04/ERC-(25)], and permission to collect data and gain access to students was obtained from the concerned heads and offices of the institution. Students were equally divided into two groups: those registered in curriculum type A (annual) and those registered in curriculum type B (modular). Furthermore, for the purpose of data collection, students were contacted through official channels of the institution during regular academic sessions to avoid academic assessment or examination-related stress.

An online survey was distributed among the eligible students via Google Forms, along with informed consent and instructions for the participants to record their responses on Google Forms. The responses obtained were continuously monitored to identify any incomplete submissions. After the data collection was completed, the responses obtained from Google Forms were exported to Microsoft Excel for final data analysis.

2.7. Data analysis

Data analysis employed SPSS version 29.0 and used descriptive statistics for demographic characteristics, anxiety scores, and sleep metrics, which are reported as medians, IQRs and ranges. The Mann–Whitney U test was used to compare anxiety, quality of sleep, and duration of sleep among medical students registered in two different types of curricula (annual and modular), where effect sizes (r) were calculated and interpreted according to Cohen's criteria; multiple linear regression was used to examine the association of the two different types of curricula (annual and modular) with the study outcome variables. Spearman's correlation was used to determine the relationships between the anxiety and sleep characteristics of medical students in each curriculum group. A significance level of $p \leq 0.05$ was used.

3. Results

The study included 184 medical students across five academic years at an institution. Most of the participants were from the 4th year (n = 66, 35.9%), followed by the 2nd year (n = 46, 25.0%), 3rd year (n = 32, 17.4%), 5th year (13.0%) (n = 24, 13.0%), and 1st year (n = 16, 8.7%).

The median HAM-A anxiety score (23.00) and median PSQI score (7.00) are shown in Table 1. Furthermore, the HAM-A demonstrated excellent internal consistency (α = 0.93), and the PSQI showed acceptable reliability (α = 0.74). Self-reported sleep duration was 5.3 hours.

Table 1. Descriptive analysis of anxiety and sleep-related measures.

Variables	Median (IQR)	Range (Min – Max)	Cronbach Alpha (α)
Overall Hamilton Anxiety Scale score	23.00 (18.00)	0-56	0.93
Overall PSQI score	7.00 (5.00)	0-21	0.74
Bed time	02:00 am (4:00 hours)	-	-
Minimum time taken to fall asleep (in minutes)	20.00 (28.00)	-	-
Wake-up time	07:00 am (1:00 hour)	-	-
Subjective quality of sleep	1.00 (1.00)	0-3	-
Sleep latency	2.00 (2.00)	0-6	-
Sleep duration (in hours)	5.33 (2.46)	-	-
Hours in bed (in hours)	6.00 (2.50)	-	-

Variables	Median (IQR)	Range (Min – Max)	Cronbach Alpha (α)
Sleep efficiency, N (%)	93.51 (9.24)	0-100	-
Sleep disturbance	6.00 (9.75)	0-27	-
Use of sleep medication	0.00 (1.00)	0-3	-
Daytime dysfunction	2.00 (2.00)	0-6	-

Table 2 shows the comparisons of anxiety levels, quality of sleep, and sleep duration among students enrolled in the annual and modular curricula. No significant difference was observed in anxiety scores between the two groups (U = 3694.00; $p = 0.137$). However, students in the modular curriculum reported significantly poorer quality of sleep than did those in the annual system did (U = 3487.50, $p = 0.036$). Additionally, sleep duration was significantly shorter among students following the modular curriculum (U = 3313.00, $p = 0.009$). Table 2 further delineates that all effect sizes were small (r = 0.11–0.19).

Table 2. Comparisons of anxiety levels, quality and duration of sleep among medical students across curriculum types (N = 184).

Indicators	Curriculum Type	n	Mean Rank	U Value	*p* Value	Effect Size	Magnitude
Anxiety	Annual	92	86.65	3694.0	0.137	0.11	Small
	Modular	92	98.35				
Quality of sleep	Annual	92	84.41	3487.5	0.036 *	0.15	Small
	Modular	92	100.59				
Sleep duration	Annual	92	102.49	3313.0	0.009 **	0.19	Small
	Modular	92	82.51				

* $p \leq 0.05$, ** $p \leq 0.01$.

Table 3 shows correlation between anxiety and sleep-related parameters among medical students, stratified by curriculum type. In both the annual and modular groups, anxiety levels were significantly positively related to the overall PSQI score ($p < 0.001$), indicating that higher anxiety was associated with poorer overall quality of sleep. Similarly, anxiety was significantly correlated with greater sleep disturbance in both groups. Sleep latency was also more strongly positively associated with anxiety in the annual group ($\rho = 0.411$; $p < 0.001$) than in the modular group ($\rho = 0.241$; $p = 0.020$). In the modular curriculum, anxiety was negatively correlated with hours spent in bed ($\rho = –0.283$; $p = 0.006$) and sleep efficiency ($\rho = –0.272$; $p = 0.009$), whereas these associations were not statistically significant in the annual curriculum.

Table 3. Correlation between anxiety and sleep parameters among medical students by curriculum type (N = 92 per group).

Sleep Variables	Spearman's ρ (Annual)	*p* Value (Annual)	Spearman's ρ (Modular)	*p* Value (Modular)
Overall PSQI score	0.461	< 0.001 **	0.550	< 0.001 **
Sleep latency (minutes)	0.411	< 0.001 **	0.241	0.020 *
Total hours in bed	–0.025	0.813	–0.283	0.006 **
Sleep efficiency (%)	–0.196	0.061	–0.272	0.009 **
Sleep disturbance score	0.582	< 0.001 **	0.579	< 0.001 **

* $p \leq 0.05$, ** $p \leq 0.01$.

The association between sleep outcomes and anxiety scores among students in the annual curriculum is shown in Table 4. Anxiety was significantly associated with overall PSQI score ($p < 0.001$; $R^2 = 0.203$), sleep latency ($p < 0.001$; $R^2 = 0.153$), and sleep disturb-

ance ($p < 0.001$; $R^2 = 0.310$). However, anxiety was not significantly linked to sleep efficiency ($p = 0.239$) or hours in bed ($p = 0.931$).

Table 4. Associations between sleep outcomes and anxiety scores among students in the annual curriculum (N = 92).

Dependent Variable	β (Standardized)	SE	t	*p* Value	R^2
Overall PSQI score	0.460	0.027	4.919	< 0.001 ****	0.203
Sleep latency (minutes)	0.403	0.013	4.176	< 0.001 ****	0.153
Sleep disturbance score	0.564	0.040	6.477	< 0.001 ****	0.310
Sleep efficiency (%)	-0.124	0.071	-1.187	0.239	0.004
Hours in bed	-0.009	0.014	-0.087	0.931	-0.011

* Independent variable for all models: Hamilton Anxiety Total Score. ** Regression coefficients are standardized (β). *** R^2 shows the variance proportion in the dependent variable accounted for by anxiety. **** Significance threshold set at $p < 0.05$.

Table 5 provides multiple regression results for medical students enrolled in the modular curriculum. Anxiety was significantly associated with overall quality of sleep ($p < 0.001$, $R^2 = 0.301$), sleep latency ($p = 0.027$, $R^2 = 0.043$), and sleep disturbance ($p < 0.001$, $R^2 = 0.269$), indicating that higher anxiety scores were related to poorer subjective sleep outcomes. Additionally, anxiety was significantly associated with reduced sleep efficiency ($p = 0.014$; $R^2 = 0.054$) and fewer hours in bed ($p = 0.017$; $R^2 = 0.052$).

Table 5. Associations between sleep outcomes and anxiety scores among students in the modular curriculum (N = 92).

Dependent Variable	β (Standardized)	SE	t	*p* Value	R^2
Overall PSQI score	0.555	0.026	6.334	< 0.001 ****	0.301
Sleep latency (minutes)	0.231	0.014	2.255	0.027 ****	0.043
Sleep disturbance score	0.526	0.042	5.870	< 0.001 ****	0.269
Sleep efficiency (%)	-0.255	0.089	-2.499	0.014 ****	0.054
Hours in bed	-0.249	0.014	-2.439	0.017 ****	0.052

* Independent variable for all models: Hamilton Anxiety Total Score. ** Regression coefficients are standardized (β). *** R^2 shows the variance proportion in the dependent variable accounted for by anxiety. **** $p \leq 0.05$.

4. Discussion

Medical sciences have traditionally been known to be a challenging discipline of study, and the present study highlights that medical students are inclined to have significant levels of anxiety along with disturbed sleep patterns. While anxiety levels did not differ significantly between students registered in annual and modular curricula, significant differences were observed in the sleep parameters of the students; modular curriculum-registered students reported poor quality of sleep and a shorter duration of sleep, demonstrating a potential association between curriculum structure and sleep-related outcomes. These findings highlight the similar nature of psychological burdens among medical students regardless of curriculum type and that variations in academic organization and assessment patterns may unequally affect students' sleep habits and overall well-being.

The results of the current study revealed that most of the participants had mild anxiety, while approximately sixty percent reported symptoms of higher levels of anxiety. These findings are in line with those of a study conducted in Sudan on mental health challenges among medical students [24]. Previous studies have highlighted that the extreme demands of medical studies, anxiety about professional exams, busy study schedules, and difficulties encountered in clinical settings could be the primary sources of

stress among medical students [25,26,27]. Additional contributing factors include insufficient guidance, especially during clinical years, a lack of feedback, peer pressure, limited time for leisure activities, unsuitable learning environments, and disorganized clinical training patterns [28]. These factors make it challenging for medical students to function in an environment that is free from anxiety and stress [25]. These findings are supported by and interpreted through the transactional model of stress and coping, which proposes that individuals experience psychological stress according to their environmental demands rather than the demands themselves [29].

The present study demonstrated relatively better quality of sleep among students, as reflected by below-average PSQI scores. These findings are consistent with previous scientific evidence reporting similar quality of sleep scores among medical students [30]. The average bedtime of these medical students was found to be at 02:00 a.m., and the mean wake-up time was observed to be 07:00 a.m. These findings support the results of another study conducted on undergraduate medical students in India regarding their sleep, stress, and academic performance [31]. The low prevalence of sleep medication use in the current study was also consistent with the results reported in an earlier study [28]. Furthermore, eating habits, culture and male sex can affect the level and frequency of stress among medical students [32,33,34].

The results of the inferential statistics highlighted a nonsignificant difference in the anxiety scores of medical students based on their curriculum type. These findings highlight that, regardless of the curriculum structure, medical students frequently face significant stress and anxiety stemming from the inherent challenges of the medical profession. A study conducted at Helwan University showed that approximately 55% of participants reported experiencing moderate to high levels of anxiety, primarily because of academic, teaching, social, and intrapersonal circumstances, resulting in diminishing potential impact of the type of curriculum [35]. These results were also in line with a study conducted at Karachi Medical College to determine differences in knowledge among students enrolled in annual and modular medical programs and reported no difference in overall knowledge scores, making it inappropriate to state that one type of curriculum model is better than the other [36]. This could be attributed to the familial pressure to pursue a career in medicine, which is a dominant source of stress for medical students in Pakistan, reflecting the tendency of families to amplify stress and anxiety [37]. These findings align with those of another study demonstrating that external stressors, when interacting with inherent vulnerabilities, contribute to psychological outcomes such as anxiety and sleep disturbances [38].

Significant differences in quality of sleep were observed among medical students on the basis of their curriculum type, which may be attributed to the higher academic burden among students enrolled in modular systems because of rigorous class schedules and frequent assessments [39]. Modular academic programs are generally topic focused, with academic content covered over shorter periods of time and frequent quizzes and examinations, which may contribute to sustained academic stress [40]. Research on the effects of the modular medical education system on medical students is relatively scarce. However, the hectic schedule at medical colleges and rising academic demands contribute to the poor quality of sleep experienced by medical students [41].

Quality of sleep may also be affected because medical students frequently experience stress due to clinical rotations, examinations, and overnight work without sufficient rest. This lack of rest can decrease social interactions and personal relations and heighten the likelihood of anxiety and depression, which may lead to extreme fatigue and insomnia. Encountering depressive or stressful situations can activate neuroendocrine and behavioral responses of the body, which can result in alterations to the activities and

functioning of the immune system and hypothalamo-pituitary-adrenal axis of a human being. This can lead to sleep disturbances, disrupt slow-wave sleep, and contribute to poor quality of sleep [42].

A modular curriculum requires a classroom environment in which students are actively engaged in constructing knowledge and shifting the role of a teacher from merely delivering knowledge to facilitating student learning. Additionally, modularization demands the ongoing monitoring and assessment of students' progress throughout the module. It is believed that effective continuous assessment allows instructors to adjust their teaching and learning strategies on the basis of the evidence gathered from assessments [43]. Therefore, the increased responsibility for learning, late-night studying required by modular schedules, hinders consistent bedtime habits and social life [44].

When students need to stay awake at night because of educational demands, they tend to consume caffeine, which raises concerns about their sleep hygiene practices. Research has indicated that individuals with poor sleep patterns report higher levels of caffeine intake than those who sleep well. If caffeine is consumed in large quantities, it can disrupt sleep patterns. Depending on the dosage, it can have both positive and negative effects on behavior and cognitive performance. The intake of caffeinated beverages significantly decreases sleep duration, delays the time it takes to fall asleep, and overall undermines quality of sleep [45].

The study used two validated scales, the HAM-A and the PSQI, and a diathetic-stress model to assess medical students' anxiety and quality of sleep, which strengthened the scientific integrity of the study. In the present study, HAM-A, a clinician-administered instrument, was employed as a self-administered online questionnaire via Google Forms in accordance with previous scientific evidence, which may have introduced measurement bias and should be considered when the findings are interpreted. The data were acquired from only a single healthcare academic institution, highlighting a considerable limitation of the study. Furthermore, the study did not consider objective sleep measures or longitudinal assessments among medical students for targeted healthcare academic institutions. Moreover, regression analyses did not adjust for potential demographic variables (e.g., age, sex, and academic year), which may have affected the observed associations between variables. Therefore, future studies should use multivariable regression models that account for these potential confounding factors.

5. Conclusions

The results revealed that there was no significant difference between the level of anxiety among medical students and the type of curriculum, and medical students who registered in the modular type of curriculum experienced poor quality and duration of sleep. Higher anxiety scores were significantly associated with impaired sleep parameters, especially among medical students who were registered in the modular type of curriculum. These findings highlight the potential effects of the curriculum structure on the mental well-being of medical students.

Author contributions: Conceptualization, SHRN, AN, AH, KA, SM, RF, and ZI; methodology, SHRN, and AN; software, AN; validation, SHRN; formal analysis, AN, AH, KA, SM, RF, and ZI; investigation, AH, KA, SM, RF, and ZI; resources, SHRN; data curation, AN; writing—original draft preparation, AH, KA, SM, RF, and ZI; writing—review and editing, SHRN, and AN; visualization, AN; supervision, SHRN; project administration, AN. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no specific grant from the public, commercial, or not-for-profit funding agencies.

Ethics statement and consent to participate: Ethical approval for the study was obtained from the Institutional Research Advisory Board (IRAB) [No. DRC/0261/04/ERC-(25)], and permission to collect data and access students was obtained from the concerned heads and offices of the institution. An online survey was subsequently distributed among eligible students via Google Forms, accompanied by an informed consent form, confirming that all participants provided written informed consent prior to participation.

Consent to publication: Not applicable.

Data availability: The data supporting this study's findings are available from Syed Hyder Raza Naqvi upon reasonable request.

Acknowledgments: None.

Conflicts of interest: The authors declare no conflicts of interest.

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