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Sleep Quality as a Predictor of Depression in Preclinical Medical Students

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ABSTRACK

Sleep quality has emerged as a critical determinant of mental health among medical students worldwide. Poor sleep patterns are frequently associated with increased depressive symptoms, particularly in preclinical medical students who face intense academic pressure and limited recovery time. This study aims to examine the relationship between sleep quality and depression and to analyze its psychological implications among preclinical medical students. A literature review approach was employed using articles indexed in PubMed, Scopus, and ScienceDirect published between 2022 and 2026. A total of 13 eligible studies were analyzed based on predefined inclusion criteria focusing on validated instruments such as the Pittsburgh Sleep Quality Index (PSQI) and Patient Health Questionnaire-9 (PHQ-9). The results indicate a consistent and significant association between poor sleep quality and higher levels of depression, with odds ratios ranging from 1.50 to 3.99 across studies. Psychological factors such as anxiety and academic stress were identified as major mediators in this relationship, while behavioral factors such as screen time further exacerbated sleep disturbances. The discussion highlights that sleep quality is not merely a symptom but a significant predictive factor of depression in this population. In conclusion, poor sleep quality significantly increases the risk of depression among preclinical medical students, emphasizing the need for early screening, sleep hygiene interventions, and institutional mental health support programs.

INTRODUCTION

Depression is one of the most prevalent mental health disorders among medical students and has been recognized as a serious public health concern within medical education (Whitehead & Horton, 2025). Heavy academic workloads, intense competition, demanding professional standards, and inadequate recovery time make medical students a structurally vulnerable group for depressive symptoms (Alrashed et al., 2022; Dutta et al., 2023). This vulnerability is particularly pronounced during the preclinical stage, when the entire academic burden is dominated by intensive theoretical learning without direct clinical engagement. Recent studies report the prevalence of depression in this population ranging from 38.3% to 55.8%, figures consistently higher than those observed among students in other disciplines (Garmabi et al., 2024; Sun et al., 2022).

Poor sleep quality is frequently observed among medical students, with prevalence ranging from 28.8% to 86.9% across countries (Gosadi & Shnaimer, 2025; Huang et al., 2024).

The relationship between poor sleep quality and depression has proven consistent and statistically significant; students with poor sleep quality have a nearly fourfold higher risk of depression (OR = 3.99; 95% CI 2.67–5.96), with a strong correlation between Pittsburgh Sleep Quality Index (PSQI) scores and depression scores ($r = 0.61$; $p < 0.001$) (Regli et al., 2024; Shafiee et al., 2024). Mediation studies show that anxiety explains up to 83.79% of the effect of sleep quality on depression, indicating a complex and multilayered mechanism (Acar et al., 2026). Biologically, persistent academic pressure triggers cognitive hyperarousal that deteriorates sleep quality through the stress–sleep–mood pathway, which in turn increases vulnerability to depressive symptoms (Campbell et al., 2022; He et al., 2025).

Although the association between sleep quality and depression among students has been widely reported, existing reviews generally address the general student population without distinguishing educational stages, leaving the unique characteristics of preclinical medical students inadequately represented (Mekonnen et al., 2024). Most prior studies have also treated sleep quality as merely one of many factors associated with depression, without explicitly evaluating the strength of that association (Valladares-Garrido et al., 2025). Furthermore, the role of psychological mediators such as anxiety and academic stress in linking sleep quality to depression has not been thoroughly examined within the context of medical education (Chen et al., 2022). Consequently, no recent evidence-based review (2022–2026) specifically examining sleep quality as a factor strongly associated with depression in preclinical medical students, along with the underlying psychological mediation pathways, is currently available.

Previous empirical studies have consistently demonstrated a statistically significant relationship between sleep quality and depression among medical students. For instance, cross-sectional and cohort studies reported that poor sleep quality can increase the risk of depression nearly fourfold, while insomnia severity shows strong positive correlations with depressive scores. Furthermore, mediation analyses have highlighted the roles of anxiety and stress as psychological pathways that strengthen this association, indicating a complex, multidimensional relationship.

Despite the growing body of literature, several limitations remain evident. Most existing studies focus on general student populations rather than distinguishing preclinical medical students as a unique subgroup. In addition, many studies treat sleep quality as a secondary variable rather than a central predictive factor. There is also limited integration of psychological mediators and behavioral determinants within a unified analytical framework, resulting in fragmented evidence.

The urgency of this issue is underscored by the rising prevalence of mental health disorders among medical students globally, which poses long-term consequences not only for academic success but also for future healthcare workforce sustainability. Sleep disturbance, as a modifiable risk factor, provides a strategic entry point for early intervention. Without targeted attention, the compounding effects of chronic sleep deprivation and depressive symptoms may continue to escalate across medical education systems worldwide.

The novelty of the present study lies in its specific emphasis on preclinical medical students and the positioning of sleep quality as a primary predictor rather than a peripheral correlate. Additionally, integrating psychological mediators such as anxiety and academic stress within the explanatory framework offers a more comprehensive understanding of the

sleep–depression pathway. This approach contributes to a more refined conceptual model that aligns behavioral, psychological, and educational dimensions.

The main purpose of this study is to systematically analyze and synthesize existing evidence regarding the relationship between sleep quality and depression among preclinical medical students. It further aims to examine the strength of this association and explore the role of psychological mediators that may influence or intensify this relationship across different study contexts and populations.

In terms of contribution, this study provides theoretical enrichment by strengthening the conceptual linkage between sleep quality and depressive outcomes within medical education research. Practically, it offers evidence-based insights that can inform curriculum design, student wellness programs, and institutional mental health strategies. It also supports the development of early screening systems that incorporate sleep assessment as a core indicator of psychological risk.

Finally, the research objective is to clarify the extent to which sleep quality functions as a determinant of depression in preclinical medical students and to identify its associated influencing pathways. The expected benefit of this study is to provide actionable evidence for educators, policymakers, and healthcare institutions in designing preventive interventions, improving student well-being, and enhancing academic performance through better sleep management strategies.

METHOD

This study employed a *literature review* approach, with literature searches conducted through three electronic databases PubMed, ScienceDirect, and Scopus covering articles published between 2022 and 2026. The search strategy used combinations of keywords including *sleep quality, depression, medical students, preclinical,* and terms related to measurement instruments such as *Pittsburgh Sleep Quality Index (PSQI), Patient Health Questionnaire-9 (PHQ-9), Depression Anxiety Stress Scale-21 (DASS-21),* and *Insomnia Severity Index (ISI),* connected with Boolean operators AND and OR. The search was limited to English-language articles available in *full-text* format. The initial search yielded a total of 3,302 articles (ScienceDirect: 2,622; Scopus: 480).

Inclusion criteria comprised: (1) original research articles (*original research*); (2) published in English; (3) available in *full-text* format; (4) involving medical students as the study population; and (5) examining the relationship between sleep quality and depression using validated instruments (PSQI, PHQ-9, DASS-21, or ISI). Exclusion criteria included: *review articles*, studies published before 2022, populations not meeting the study criteria, articles not using relevant measurement instruments, and articles without full-text access.

Article selection was conducted independently in two stages: title and abstract screening, followed by *full-text assessment* based on the established criteria. Disagreements between reviewers were resolved through discussion until consensus was reached. Data extraction was performed systematically, covering author name, year of publication, country, study design, sample size, instruments used, and main findings. Through this selection process, 13 articles met all inclusion criteria.

RESULTS AND DISCUSSION

Based on the selection process, 13 articles met all inclusion criteria and were analyzed in this literature review (Table 1). The articles originated from various countries across Asia, Europe, and the Americas, with publication years ranging from 2022 to 2026 (Chen et al., 2022; McKinley et al., 2022; Muyeed et al., 2026; Regli et al., 2024). Twelve articles used a cross-sectional study design, while one used a prospective longitudinal cohort design (McKinley et al., 2022). Sample sizes per study ranged from 197 to 1,284 participants. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) in 12 studies and the Insomnia Severity Index (ISI) in one study (McKinley et al., 2022; Regli et al., 2024). Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9) in 8 studies, the Depression Anxiety Stress Scale-21 (DASS-21) in 4 studies, and the Beck Depression Inventory-II (BDI-II) in one study (Dudo et al., 2022; Nikolic et al., 2023; Vidović et al., 2025).

Table 1. Characteristics of Articles Examining the Relationship Between Sleep Quality and Depression Among Medical Students

No	Author (Year)	Title	Sample	Study Design	Instruments	Main Findings
1	Dudo et al. (2022)	The association of sleep patterns and depressive symptoms in medical students: A cross-sectional study	n = 1,103 medical students (years 1–5)	Cross-sectional study	PSQI, BDI-II	Poor sleep quality significantly increased depressive symptoms risk nearly fourfold (OR = 3.99; 95% CI 2.67–5.96). Higher sleep latency and sleeping pill consumption were also associated with depression.
2	Wiguna et al. (2024)	Mental health disturbance in preclinical medical students and its association with screen time, sleep quality, and depression during the COVID-19 pandemic	n = 1,023 preclinical medical students	Cross-sectional study	PSQI, PHQ-9	Mental health disturbances were significantly associated with higher depression scores and poorer sleep quality ($p < 0.001$). Poor sleep quality found in 61% of participants.
3	McKinley et al. (2022)	Mental health and sleep habits during	n = 197 preclinical	Prospective longitudinal cohort	PSQI + SQ-3, PHQ-9	Depression, anxiety, and sleep quality

		preclinical years of medical school	medical students			displayed cyclical worsening aligned with the academic cycle. Fewer sleep hours significantly increased PHQ-9 and PSQI scores.
4	Chen et al. (2022)	Association of depression symptoms and sleep quality with state-trait anxiety in medical university students in Anhui Province, China: A mediation analysis	n = 1,227 medical university students	Cross-sectional study	PSQI, STAI, SDS	Poor sleep quality (74.3%) and depression (41.4%) were common. State-trait anxiety partially mediated the association between sleep quality and depression (83.79%).
5	Truong et al. (2025)	Sleep quality by clinical training status among medical students and its associated factors: A cross-sectional study in Da Nang, Vietnam	n = 577 medical students	Cross-sectional study	PSQI, PHQ-9, GAD-7, PMSS	Poor sleep quality in 45.8% of students. Depression symptoms independently associated with poor sleep quality (PR = 1.29; 95% CI 1.07–1.57).
6	Nguyen et al. (2025)	Factors associated with sleep quality among medical students in Vietnam: A national cross-sectional study	n = 1,284 participants	Cross-sectional study	PSQI, PHQ-9, EQ-5D-5L, EQ-VAS	Poor sleep quality in 36.6% of participants. Depression (OR = 1.50; 95% CI 1.13–1.99) significantly associated with poor sleep quality.
7	Nikolic et al. (2023)	Smartphone addiction, sleep quality, depression,	n = 761 students	Cross-sectional study	PSQI, DASS-21	Depression (OR = 2.51; p < 0.001) and poor sleep

		anxiety, and stress among medical students				quality remained independently associated in multivariate analysis.
8	Feng et al. (2022)	Mobile phone addiction and depression among Chinese medical students: The mediating role of sleep quality and the moderating role of peer relationships	n = 450 medical students	Cross-sectional study	PSQI, PHQ-9	Poor sleep quality partially mediated the relationship between mobile phone addiction and depression (β = 0.34; p < 0.001).
9	Li et al. (2025)	Sleep quality and its correlates among medical undergraduates in Anhui Province: A cross-sectional study on academic stress, mental health, and lifestyle factors	n = 550 medical undergraduate students	Cross-sectional study	PSQI, DASS-21	37.3% of students had poor sleep quality. Participants with DASS abnormalities had the highest PSQI scores, indicating stronger mental health burden.
10	Muyeed et al. (2026)	Sleep quality and psychological distress among Bangladeshi medical students: Prevalence, predictors, and sex-institutional differences	n = 378 medical students	Cross-sectional study	PSQI, DASS-21	Poor sleep quality in 67.2% of students. Depression increased odds of poor sleep quality (AOR = 2.61; 95% CI 1.37–4.99). Social media use >6 h/day: six times higher odds.
11	Vidović et al. (2025)	Sleep quality and mental health among medical students: A cross-sectional study	n = 386 medical students	Multicentric cross-sectional study	PSQI, DASS-21	Poor sleep quality in 67.9% of students. Depression (β = 0.178; p < 0.001) and anxiety (β = 0.141; p <

						0.001) significantly predicted poorer sleep quality.
12	Huang et al. (2024)	Association of perceived stress and sleep quality among medical students: The mediating role of anxiety and depression symptoms during COVID-19	n = 1,021 medical students	Cross-sectional study	PSS-10, PSQI, GAD-7, PHQ-9	Perceived stress positively associated with poor sleep quality (β = 0.112; p < 0.001). Anxiety and depression mediated 73.08% of the association.
13	Regli et al. (2024)	Psychiatric characteristics, symptoms of insomnia and depression, emotion regulation, and social activity among Swiss medical students	n = 575 medical students	Cross-sectional study	ISI, PHQ-9, ERQ, SASS	Insomnia strongly associated with depression (r = 0.61; p < 0.001). Higher insomnia (β = 0.436; p < 0.001) significantly predicted higher depression scores.

Source: Authors' analysis (2024-2026)

All 13 articles reported a significant association between poor sleep quality and increased depressive symptoms (Chen et al., 2022; Dudo et al., 2022; Huang et al., 2024; Nikolic et al., 2023; Xu et al., 2026). The prevalence of poor sleep quality varied across studies, ranging from 28.8% to 74.3%, with most studies reporting prevalence above 50% (Huang et al., 2024; Nguyen et al., 2025). The prevalence of depression in the same populations ranged from 38.3% to 55.8% (Muyeed et al., 2026; Vidović et al., 2025).

The consistency of this association across diverse national contexts suggests that sleep quality may be a universal determinant of mental health among medical students, although the strength of association is influenced by instrument variability and institutional academic pressures (Dudo et al., 2022; Huang et al., 2024). One study reported that poor sleep quality was associated with a nearly fourfold increased risk of depression (OR = 3.99; 95% CI 2.67–5.96) (Dudo et al., 2022). Other studies reported adjusted odds ratios of 2.61 (95% CI 1.37–4.99), 2.51 ($p < 0.001$), and 1.50 (95% CI 1.13–1.99) (Muyeed et al., 2026; Nikolic et al., 2023; Truong et al., 2025). In addition, a strong positive correlation between insomnia and depression was reported ($r = 0.61$; $p < 0.001$), with insomnia significantly associated with depression in regression analysis ($\beta = 0.436$; $p < 0.001$) (Regli et al., 2024). The strength of association

between poor sleep quality and depressive symptoms was further supported by regression analysis, with β coefficients of 0.178 and 0.637 (both $p < 0.001$) (Huang et al., 2024; Vidović et al., 2025).

Several studies explored the role of mediating variables in the relationship between poor sleep quality and depression (Chen et al., 2022; Li et al., 2025). Anxiety was reported to act as a partial mediator, explaining 83.79% of the total effect of sleep quality on depression (Chen et al., 2022).Additionally, anxiety and depression together mediated 73.08% of the relationship between perceived stress and sleep quality, with depression showing the strongest mediating effect ($\beta = 0.637$; $p < 0.001$) (Huang et al., 2024).Another study demonstrated that poor sleep quality functioned as a partial mediator between mobile phone addiction and depression (Feng et al., 2022). The sole longitudinal study in this review showed that sleep quality and depressive symptoms followed a cyclical worsening pattern aligned with the academic cycle, with shorter sleep duration significantly associated with elevated PHQ-9 and PSQI scores (McKinley et al., 2022; Nikolic et al., 2023)

Prevalence of Poor Sleep Quality Among Medical Students

Poor sleep quality is a widespread problem among medical students across various countries, with prevalence rates varying depending on institutional context, population characteristics, and the measurement instruments used (Dudo et al., 2022; Huang et al., 2024). Several cross-continental studies have reported substantial prevalence rates; for instance, a multicenter study in Latin America found a poor sleep quality prevalence of 62.2% among medical students, with depression and anxiety as the most strongly associated factors (Mishra et al., 2022; Valladares-Garrido et al., 2025). In Africa, meta-analyses indicated that more than one-third of medical students experience depression, contributing to the deterioration of sleep quality (Aldabbour et al., 2025; Mekonnen et al., 2024). In South Asia, the prevalence of depression in similar populations was reported to range from 30% to 60% (Liyanage et al., 2024; M. A. Rahman et al., 2022). Among preclinical students specifically, structural academic pressures encompassing curriculum density, prolonged study hours, high performance demands, and minimal recovery time are consistently associated with high rates of sleep disturbance and depression in this group (Alrashed et al., 2022; Garmabi et al., 2024).

Relationship Between Sleep Quality and Depression

All articles analyzed in this review consistently demonstrated a significant association between poor sleep quality and increased depressive symptoms, with a uniform direction of association across various population contexts, study designs, and instruments, reinforcing the conclusion that sleep disturbance is not merely a secondary manifestation of depression but rather an independent and modifiable risk factor (Selim et al., 2026; Whitehead & Horton, 2025). The relationship between these two variables is known to be bidirectional: existing depression can worsen sleep quality through mechanisms of emotional dysregulation and increased cognitive rumination, while deteriorating sleep quality in turn deepens depressive symptoms a cyclical pattern that appears further amplified by mounting academic pressure, particularly before examination periods (McKinley et al., 2022).Neurobiologically, sleep deprivation is known to activate the hypothalamic pituitary adrenal (HPA) axis, trigger prolonged cortisol secretion, disrupt functional connectivity between the prefrontal cortex and the amygdala (which plays a central role in emotional regulation), and elevate inflammatory

markers such as interleukin-6 (IL-6) that contribute to the emergence of depressive symptoms (Brzostowski et al., n.d.; Whitehead & Horton, 2025).

Psychological Mediating Factors

Anxiety has been shown to act as the primary mediator in the pathway between poor sleep quality and depression, with a mediation proportion reaching 83.79% of the total influence of sleep quality on depression, indicating that the negative impact of sleep disturbance on mental health does not operate directly but is primarily mediated by anxiety responses activated by accumulated academic burden (Chen et al., 2022). In addition, perceived stress has been demonstrated to indirectly worsen sleep quality through the mediation pathways of anxiety and depression, with both variables together mediating 73.08% of the relationship between stress and sleep quality (Huang et al., 2024). The complexity of these layered and mutually reinforcing psychological mechanisms implies that effective interventions must be designed comprehensively, treating sleep, anxiety, and stress as an integrated system rather than as variables to be addressed separately (Shadzi et al., 2024; Valladares-Garrido et al., 2025).

Behavioral and Academic Factors

Mobile phone addiction and excessive digital device use have been shown to be behavioral factors that significantly impair sleep quality and contribute to depressive symptoms through blue light exposure, which suppresses melatonin secretion and delays sleep *onset*, thereby reducing overall sleep duration and quality (Feng et al., 2022; Stanković & Nešić, 2022). Academic factors such as poor academic performance, deficient time management, and intense inter-student competition have likewise been found to be significantly associated with sleep disturbance and depression, with a worsening pattern that follows the academic cycle and peaks before examination periods (Esubalew et al., 2024; McKinley et al., 2022). findings collectively indicate that the structure of the medical education curriculum itself may function as a systemic risk factor that needs to be considered in designing institutional-level student mental health programs.

Implications for Medical Education

Preclinical medical students should be positioned as a priority group in mental health intervention programs, given that the characteristics of academic pressure and sleep disturbance in this group are qualitatively distinct from those of other student populations (Alrashed et al., 2022; Wiguna et al., 2024). The implementation of periodic sleep quality screening using validated instruments such as the *Pittsburgh Sleep Quality Index* (PSQI), particularly at the beginning of semesters and before academic evaluation periods, should be considered an integral component of the student mental health early-detection system (McKinley et al., 2022; Shadzi et al., 2024). Furthermore, *sleep hygiene* education programs, evidence-based stress management interventions, restrictions on digital device use before bedtime, and accessible psychological counseling services need to be systematically integrated into the curriculum and student health policies of medical education institutions as sustained promotive and preventive efforts (M. A. Rahman et al., 2022; Valladares-Garrido et al., 2025; Whitehead & Horton, 2025).

Limitations and Future Research Directions

This review has several limitations that should be considered when interpreting the findings. The predominance of *cross-sectional* designs in the majority of analyzed studies

means that causal relationships between sleep quality and depression cannot be definitively established, so the findings more accurately reflect the strength of association than a cause-and-effect relationship (Mekonnen et al., 2024; M. A. Rahman et al., 2022) The reliance of all studies on *self-reported* instruments also introduces potential *recall bias* and *social desirability bias*, while the heterogeneity of PSQI cut-off values and the variation in population characteristics across studies hinder direct comparison; moreover, not all included studies focused exclusively on preclinical students. Future research should be directed toward longitudinal cohort studies specifically targeting preclinical medical students, accompanied by clinical trials based on *cognitive behavioral therapy for insomnia* (CBT-I), the use of objective instruments such as actigraphy, and multicenter designs involving various medical education institutions in Indonesia, in order to produce stronger and more representative (M. Rahman et al., 2025; Shadzi et al., 2024; Whitehead & Horton, 2025).

CONCLUSION

In conclusion, the evidence synthesized from the reviewed studies consistently demonstrates that poor sleep quality is significantly associated with increased depressive symptoms among preclinical medical students. This relationship is robust across different countries, study designs, and measurement instruments, indicating that sleep quality functions as an important and modifiable risk factor for depression within this population. The association is further strengthened by the presence of psychological mediators such as anxiety and academic stress, as well as behavioral factors including digital device use and academic workload intensity. Although most studies are cross-sectional, limiting causal inference, the overall findings highlight that sleep disturbance is not merely a consequence of depression but an influential factor within a bidirectional and reinforcing cycle of mental health deterioration.For future research, longitudinal and experimental study designs are strongly recommended to establish clearer causal pathways between sleep quality and depression in preclinical medical students. Future studies should also integrate objective sleep measurement tools such as actigraphy or wearable sleep trackers to complement self-reported instruments like the PSQI, thereby improving data accuracy. In addition, more comprehensive models incorporating psychological mediators (e.g., anxiety, stress, emotional regulation) and behavioral determinants (e.g., screen time, academic workload) are needed to better explain the underlying mechanisms. Cross-cultural, multicenter studies, particularly in developing countries and diverse medical education systems, are also essential to improve generalizability. Ultimately, intervention-based research — such as sleep hygiene programs or cognitive behavioral therapy for insomnia (CBT-I) — should be prioritized to evaluate practical strategies for reducing depressive symptoms in this high-risk population.

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