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SLEEP DEPRIVATION IN MEDICAL STUDENTS AND THE RISK OF ANXIETY DISORDERS

PRIVAÇÃO DO SONO EM ESTUDANTES DE MEDICINA E O RISCO DE TRANSTORNOS DE ANSIEDADE

PRIVACIÓN DEL SUEÑO EN ESTUDIANTES DE MEDICINA Y EL RIESGO DE TRASTORNOS DE ANSIEDAD

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ABSTRACT

Introduction: Sleep deprivation, poor sleep quality, insomnia, and circadian disruption are highly prevalent among medical students and frequently coexist with anxiety symptoms. The demanding characteristics of medical education may intensify this association through academic pressure, irregular schedules, night-time digital behavior, reduced recovery time, and limited access to confidential psychological care.

Objective: The main objective was to evaluate the association between sleep deprivation and anxiety symptoms or anxiety disorders among medical students. Secondary objectives were to characterize the principal sleep disturbances, examine relevant behavioral and academic factors, compare different sleep exposures, assess the certainty of evidence, and identify implications for clinical practice and medical education.

Methods: PubMed, Scopus, Web of Science, the Cochrane Library, LILACS, ClinicalTrials.gov, and ICTRP were searched for studies published within the preceding five years. Human studies evaluating sleep duration, sleep quality, insomnia, chronotype, or sleep-related impairment together with anxiety outcomes in medical students were eligible. Study selection, data extraction, risk-of-bias assessment, narrative synthesis, and GRADE evaluation were planned according to PRISMA principles.

Results and Discussion: Twenty studies were included. Poor sleep quality, insomnia symptoms, short sleep duration, evening chronotype, smartphone addiction, and fear of missing out were consistently associated with greater anxiety symptom burden. The findings were reproduced across several countries and academic stages, but considerable heterogeneity was observed in sleep definitions, anxiety instruments, populations, and statistical analyses. Most studies were cross-sectional and used self-administered screening questionnaires, resulting in low certainty regarding causality and the incidence of formally diagnosed anxiety disorders.

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Conclusion: Sleep disturbance and anxiety symptoms frequently coexist among medical students and should be assessed reciprocally. Medical schools should combine confidential mental-health services, sleep-health education, digital-behavior interventions, curriculum and scheduling review, and access to individualized evidence-based treatment. Prospective studies and randomized trials are required to determine whether improving sleep prevents or reduces clinically significant anxiety.

Keywords: Sleep Deprivation. Anxiety Disorders. Students. Medical. Sleep Quality.

RESUMO

Introdução: A privação do sono, a má qualidade do sono, a insônia e a desregulação do ritmo circadiano são altamente prevalentes entre estudantes de Medicina e frequentemente coexistem com sintomas de ansiedade. As características exigentes da formação médica podem intensificar essa associação por meio da pressão acadêmica, horários irregulares, uso noturno de dispositivos digitais, redução do tempo de recuperação e acesso limitado a cuidados psicológicos confidenciais.

Objetivo: O objetivo principal foi avaliar a associação entre a privação do sono e sintomas ou transtornos de ansiedade em estudantes de Medicina. Como objetivos secundários, buscou-se caracterizar os principais distúrbios do sono, examinar fatores comportamentais e acadêmicos relevantes, comparar diferentes exposições relacionadas ao sono, avaliar o grau de certeza das evidências e identificar implicações para a prática clínica e a educação médica.

Métodos: Foram realizadas buscas nas bases de dados PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e ICTRP para estudos publicados nos cinco anos anteriores. Foram considerados elegíveis estudos com seres humanos que avaliaram duração do sono, qualidade do sono, insônia, cronotipo ou comprometimento relacionado ao sono em conjunto com desfechos de ansiedade em estudantes de Medicina. A seleção dos estudos, extração de dados, avaliação do risco de viés, síntese narrativa e avaliação da qualidade da evidência pelo sistema GRADE foram planejadas de acordo com os princípios da diretriz PRISMA.

Resultados e Discussão: Foram incluídos vinte estudos. Má qualidade do sono, sintomas de insônia, curta duração do sono, cronotipo vespertino, dependência de smartphones e medo de ficar de fora (*fear of missing out* – FOMO) estiveram consistentemente associados a maior carga de sintomas de ansiedade. Os achados foram reproduzidos em diferentes países e etapas da formação médica; entretanto, observou-se considerável heterogeneidade nas definições de sono, instrumentos de avaliação da ansiedade, populações estudadas e análises estatísticas. A maioria dos estudos foi transversal e utilizou questionários de rastreamento autoaplicáveis, resultando em baixo grau de certeza quanto à causalidade e à incidência de transtornos de ansiedade formalmente diagnosticados.

Conclusão: Distúrbios do sono e sintomas de ansiedade coexistem frequentemente entre estudantes de Medicina e devem ser avaliados de forma recíproca. As escolas médicas devem combinar serviços confidenciais de saúde mental, educação em saúde do sono, intervenções voltadas ao comportamento digital, revisão dos currículos e da organização dos horários, além de garantir acesso a tratamentos individualizados e baseados em evidências. Estudos prospectivos e ensaios clínicos randomizados são necessários para determinar se a melhora do sono pode prevenir ou reduzir casos clinicamente significativos de ansiedade.

Palavras-chave: Privação do Sono. Transtornos de Ansiedade. Estudantes de Medicina. Qualidade do Sono.

RESUMEN

Introducción: La privación del sueño, la mala calidad del sueño, el insomnio y la alteración del ritmo circadiano son altamente prevalentes entre los estudiantes de Medicina y con frecuencia coexisten con síntomas de ansiedad. Las características exigentes de la formación médica pueden intensificar esta asociación mediante la presión académica, los horarios irregulares, el uso nocturno de dispositivos digitales, la reducción del tiempo de recuperación y el acceso limitado a servicios confidenciales de atención psicológica.

Objetivo: El objetivo principal fue evaluar la asociación entre la privación del sueño y los síntomas o trastornos de ansiedad en estudiantes de Medicina. Como objetivos secundarios, se buscó caracterizar los principales trastornos del sueño, examinar factores conductuales y académicos relevantes, comparar diferentes exposiciones relacionadas con el sueño, evaluar el grado de certeza de la evidencia e identificar implicaciones para la práctica clínica y la educación médica.

Métodos: Se realizaron búsquedas en las bases de datos PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e ICTRP de estudios publicados en los cinco años previos. Se consideraron elegibles los estudios en seres humanos que evaluaron la duración del sueño, la calidad del sueño, el insomnio, el cronotipo o el deterioro relacionado con el sueño junto con desenlaces de ansiedad en estudiantes de Medicina. La selección de los estudios, la extracción de datos, la evaluación del riesgo de sesgo, la síntesis narrativa y la evaluación de la certeza de la evidencia mediante el sistema GRADE se planificaron de acuerdo con los principios de la guía PRISMA.

Resultados y Discusión: Se incluyeron veinte estudios. La mala calidad del sueño, los síntomas de insomnio, la corta duración del sueño, el cronotipo vespertino, la adicción al teléfono inteligente y el miedo a perderse algo (*fear of missing out* – FOMO) se asociaron de manera consistente con una mayor carga de síntomas de ansiedad. Estos hallazgos se reprodujeron en diferentes países y etapas de la formación médica; sin embargo, se observó una considerable heterogeneidad en las definiciones del sueño, los instrumentos de evaluación de la ansiedad, las poblaciones estudiadas y los análisis estadísticos. La mayoría de los estudios fueron de diseño transversal y utilizaron cuestionarios de cribado autoadministrados, lo que resultó en un bajo grado de certeza respecto a la causalidad y a la incidencia de trastornos de ansiedad formalmente diagnosticados.

Conclusión: Los trastornos del sueño y los síntomas de ansiedad coexisten con frecuencia entre los estudiantes de Medicina y deben evaluarse de manera recíproca. Las facultades de Medicina deberían combinar servicios confidenciales de salud mental, educación sobre higiene del sueño, intervenciones dirigidas al comportamiento digital, revisión de los planes de estudio y de los horarios académicos, además de facilitar el acceso a tratamientos individualizados y basados en la evidencia. Se requieren estudios prospectivos y ensayos clínicos aleatorizados para determinar si la mejora del sueño puede prevenir o reducir la ansiedad clínicamente significativa.

Palabras clave: Privación del Sueño. Trastornos de Ansiedad. Estudiantes de Medicina. Calidad del Sueño.

1 INTRODUCTION

Sleep deprivation among medical students comprises insufficient sleep duration, impaired sleep quality, insomnia symptoms, circadian misalignment, and excessive daytime sleepiness.[1] A worldwide systematic review involving 59,427 medical students found that sleep problems affected a substantial proportion of this population, with poor sleep quality occurring in more than half of the participants.[1] The demanding structure of medical education, including extensive study periods, early academic commitments, clinical duties, examinations, and irregular schedules, creates persistent barriers to restorative sleep.[1] Psychological symptoms are similarly prevalent in medical education and commonly include anxiety, depression, perceived stress, burnout, and reduced psychological well-being.[2]

An umbrella review demonstrated that psychological and behavioral symptoms affect medical students across different countries, educational systems, and stages of training.[2] Sleep disturbance frequently coexists with these symptoms and may function as an exposure, consequence, mediator, or perpetuating factor within a multidirectional model of psychological distress.[2] Recent evidence syntheses have reported anxiety symptoms in approximately 17% to 54% of medical students, although the estimates vary according to geographical region, screening instrument, academic stage, and study period.[3] Poor sleep quality and academic stress have repeatedly been identified as factors associated with greater anxiety severity.[3]

Most available studies use self-administered screening instruments rather than structured psychiatric interviews, making anxiety symptoms more accurately represented in the literature than formally diagnosed anxiety disorders.[3] Meta-analytic evidence from Chinese medical students has also shown a high prevalence of insomnia, poor sleep quality, and excessive daytime sleepiness.[4] These findings indicate that sleep disruption is not confined to a particular educational system and may reflect common characteristics of medical training.[4] Nevertheless, regional differences in curriculum design, living conditions, cultural attitudes toward sleep, financial pressure, and access to psychological support may substantially modify the observed prevalence.[4]

Digital behavior represents an additional mechanism through which academic requirements and lifestyle practices may interfere with sleep.[5] A systematic review and meta-analysis demonstrated a significant association between smartphone addiction and poor sleep quality among medical students.[5] Night-time smartphone use may delay bedtime, increase cognitive and emotional arousal, expose students to light during the biological night, and displace time otherwise available for sleep.[5] Cognitive behavioral therapy for insomnia (CBT-I) improves insomnia severity and psychological outcomes in individuals with comorbid

mental disorders, supporting the clinical relevance of identifying sleep problems when anxiety symptoms are present.[6]

Interventions directed at sleep may reduce emotional distress through improvements in behavioral regularity, perceived control, cognitive arousal, and daytime functioning.[6] However, evidence obtained from clinical populations cannot be directly extrapolated to medical students because the severity, duration, and diagnostic status of their symptoms may differ.[6] The relationship between sleep and anxiety is likely bidirectional, because insufficient or fragmented sleep may increase emotional reactivity, while worry and physiological hyperarousal may delay sleep onset and reduce sleep continuity.[7] Generalized anxiety disorder (GAD) is particularly associated with insomnia symptoms, although most medical-student studies do not establish whether participants meet diagnostic criteria for GAD.[7]

Consequently, associations between poor sleep and positive anxiety screening should not be interpreted automatically as evidence that sleep deprivation causes an anxiety disorder.[7] Regional reviews have nevertheless confirmed that sleep disorders among medical students are consistently associated with stress, depressive symptoms, anxiety symptoms, irregular sleep schedules, electronic-device use, and demanding academic conditions.[8] The predominance of cross-sectional designs limits temporal inference, while self-reported exposure and outcome measures increase the possibility of recall bias and common-method variance.[8] These limitations justify a synthesis that distinguishes sleep duration, sleep quality, insomnia, chronotype, and daytime impairment rather than treating all forms of sleep deprivation as equivalent exposures.[8] Mental-health stigma may further influence the observed relationship by reducing professional help-seeking and encouraging students to normalize persistent symptoms.[9]

Medical students may avoid disclosing anxiety or sleep problems because of confidentiality concerns, perceived expectations of resilience, fear of professional consequences, or uncertainty regarding available services.[9] Institutional strategies therefore require confidential access to care, faculty education, workload evaluation, and preventive programs that do not place the entire responsibility for well-being on individual students.[9] Mindfulness-based interventions may improve selected psychological outcomes among medical students and junior physicians, but the certainty and durability of benefit remain variable.[10] Sleep-focused strategies should consequently be integrated with broader interventions addressing academic pressure, emotional regulation, digital behavior, physical activity, and access to mental-health care.[10] A systematic examination of recent studies is required to determine the consistency, magnitude, methodological quality, and clinical

implications of the association between sleep deprivation and anxiety among medical students.[10]

2 OBJECTIVES

The main objective of this systematic review was to evaluate the association between sleep deprivation and the presence or severity of anxiety symptoms and anxiety disorders among medical students. The five secondary objectives were to determine the prevalence and principal manifestations of sleep disturbance in this population; to compare the associations observed for short sleep duration, poor sleep quality, insomnia symptoms, circadian chronotype, and sleep-related daytime impairment; to identify demographic, behavioral, psychological, and academic factors that may modify or confound the relationship between sleep and anxiety; to assess the methodological quality, risk of bias, heterogeneity, and certainty of the available evidence; and to define implications for screening, institutional prevention, clinical management, and future research in medical education.

3 METHODOLOGY

This systematic review was structured according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations. Searches were conducted in PubMed, Scopus, Web of Science, the Cochrane Library, the Latin American and Caribbean Health Sciences Literature database (LILACS), ClinicalTrials.gov, and the World Health Organization International Clinical Trials Registry Platform (ICTRP). The search strategy combined controlled vocabulary and free-text terms related to medical students, sleep deprivation, sleep duration, sleep quality, insomnia, circadian rhythm, chronotype, anxiety, anxiety symptoms, and anxiety disorders. The principal search window extended from July 27, 2021, to July 27, 2026.

Eligible studies included medical students or samples in which medical-student results could be analyzed separately and assessed at least one sleep-related exposure together with anxiety symptoms, anxiety severity, or an anxiety diagnosis. Observational studies, clinical trials, and longitudinal studies were eligible, with no language restriction. The search window could be expanded to 10 years if fewer than 10 eligible studies were identified, but expansion was unnecessary because 20 recent studies met the eligibility criteria. Small studies were accepted but were considered less precise, while reviews, editorials, commentaries, case reports, studies without an anxiety-related outcome, and studies without separable medical-student data were excluded. Human evidence was prioritized, and any eligible animal or in vitro evidence would have been reported separately; none was included.

Two reviewers were planned to conduct duplicate removal, title and abstract screening, full-text assessment, and data extraction independently, with disagreement resolved through discussion or consultation with a third reviewer. Extracted variables included publication year, country, study design, sample size, academic stage, sleep measurement, anxiety measurement, prevalence estimates, effect measures, adjustment variables, and main conclusions. Multiple reports derived from the same sample were assessed to avoid double counting, and the most complete report was prioritized.

The revised Cochrane Risk of Bias 2 tool (RoB 2) was designated for randomized trials, the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool for nonrandomized intervention studies, and the Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2) tool for diagnostic-accuracy research. Because the included studies were predominantly cross-sectional observational investigations, additional consideration was given to participant selection, measurement validity, control of confounding, missing data, selective reporting, and the directionality of associations. The certainty of the evidence was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework.

A narrative synthesis was selected because the studies differed substantially in populations, countries, sleep definitions, anxiety instruments, statistical models, and reported effect measures. Findings were organized chronologically and then integrated according to sleep quality, sleep duration, insomnia, chronotype, digital behavior, psychological mediation, and academic factors. A new systematic review was justified by the rapid expansion of recent multinational evidence and by the need to differentiate positive anxiety screening from a clinically diagnosed anxiety disorder.

4 RESULTS

Records identified: not reportable from the available working dataset. Records screened after duplicate removal: not reportable from the available working dataset. Records excluded during title, abstract, and full-text assessment: not reportable from the available working dataset. Twenty studies met the eligibility criteria and were included in the qualitative synthesis. All included studies involved human participants, and no eligible animal or in vitro studies were identified.

Table 1

Characteristics and findings of the included studies

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Alrashed et al. published this study in 2021.	Clinical-year medical students in Saudi Arabia completed validated assessments of insomnia and psychological distress, and students with insomnia symptoms were compared with those without clinically relevant symptoms.	The study assessed insomnia prevalence, psychological distress, depressive symptoms, coping strategies, sex, and academic year.	Insomnia affected approximately one-third of participants and was associated with greater psychological morbidity, particularly among female and third-year students.
Olarte-Durand et al. published the study online in 2021 and in its final journal issue in 2024.	Peruvian medical students were evaluated during the coronavirus disease 2019 pandemic, and students with poor sleep quality were compared with those reporting better sleep.	The study assessed Pittsburgh Sleep Quality Index scores and symptoms of anxiety, depression, and stress.	Poor sleep quality was highly prevalent, and anxiety and stress remained relevant correlates in sex-stratified analyses.
de Souza et al. published this study in 2021.	Brazilian medical students were compared with physical-education students during remote teaching associated with the coronavirus disease 2019 pandemic.	The study evaluated physical activity, sedentary behavior, sleep quality, anxiety symptoms, and depressive symptoms.	Medical students had higher anxiety and lower physical activity, while poorer sleep was moderately correlated with anxiety severity.
Mishra et al. published this study in 2022.	Undergraduate medical students in India completed an online survey during pandemic confinement, and poor sleepers were compared with students reporting adequate sleep quality.	The study evaluated sleep quality, anxiety, depression, stress, physical activity, screen exposure, and sociodemographic variables.	Poor sleep affected approximately 45% of participants, and anxiety was independently associated with markedly higher odds of poor sleep.
Chang et al. published this study in 2022.	Medical students at a Chinese university were classified according to morning, intermediate, or evening chronotype.	The study assessed chronotype, sleep-wake preferences, anxiety symptoms, depressive symptoms, and demographic variables.	Evening chronotype was associated with a greater probability of anxiety and depressive symptoms than morning-oriented patterns.
Chen et al. published this study in 2022.	Medical-university students in China completed sleep, depression, and state-trait anxiety assessments, and mediation models were constructed.	The study evaluated sleep quality, depressive symptoms, state anxiety, trait anxiety, and indirect statistical pathways.	Poor sleep was highly prevalent, and state-trait anxiety substantially mediated the association between impaired sleep and depressive symptoms.
Nowakowska-Domagała et al. published this study in 2023.	Polish medical students were evaluated for chronotype, dispositional mindfulness, anxiety, insomnia, and social functioning.	The study assessed chronotype characteristics, anxiety, insomnia, social dysfunction, mindfulness, and an adverse mental-health outcome.	Anxiety and insomnia contributed to the pathways linking rigid chronotype characteristics with poorer psychological functioning.
Nikolic et al. published this study in 2023.	Medical students were classified according to smartphone-addiction severity and compared regarding sleep and mental-health outcomes.	The study evaluated smartphone addiction, sleep quality, anxiety, depression, and stress.	Smartphone addiction was associated with poor sleep quality and approximately doubled the likelihood of clinically relevant anxiety symptoms.

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Huang et al. published this study in 2024.	Medical students completed validated assessments of perceived stress, sleep quality, anxiety, and depression, and mediation models were applied.	The study evaluated direct and indirect relationships between stress, sleep quality, anxiety symptoms, and depressive symptoms.	Anxiety and depression partly explained the association between greater perceived stress and poorer sleep quality.
Al Ani et al. published this study in 2024.	Medical students at Fallujah University in Iraq were compared according to sleep quality and psychological symptom severity.	The study assessed anxiety, depression, stress, sleep quality, and academic performance.	Greater anxiety, depression, and stress were associated with poorer sleep and less favorable academic functioning.
Garmabi et al. published this study in 2024.	First-year medical-science students completed anxiety, depression, and sleep-quality instruments during their transition to university education.	The study assessed the prevalence of anxiety, depression, poor sleep quality, and associations among these outcomes.	Anxiety was common during the first academic year and was significantly associated with impaired sleep quality.
Al Doori et al. published this study in 2024.	Medical students exposed to the transition of the United States Medical Licensing Examination Step 1 to pass-or-fail scoring were evaluated for anxiety, sleep quality, and burnout.	The study assessed anxiety symptoms, sleep quality, burnout, and perceptions of the examination-scoring policy.	The scoring transition did not eliminate elevated anxiety, poor sleep quality, or burnout, indicating the persistence of broader educational stressors.
Oliveira et al. published this study in 2024.	Brazilian medical students were evaluated for fear of missing out, problematic smartphone use, anxiety, and sleep quality.	The study assessed fear of missing out, smartphone behavior, anxiety severity, sleep duration, and Pittsburgh Sleep Quality Index scores.	Greater fear of missing out and anxiety were associated with poorer sleep quality and more problematic digital behavior.
Nahidi et al. published this study in 2024.	Medical students were categorized by mobile-phone-addiction severity and compared regarding psychological and sleep outcomes.	The study evaluated mobile-phone addiction, sleep quality, anxiety symptoms, depressive symptoms, and demographic factors.	Severe mobile-phone addiction was associated with substantially poorer sleep and more severe anxiety and depressive symptoms.
Darshan et al. published this study in 2024.	Three hundred undergraduate medical students in India were compared according to good or poor sleep quality.	The study assessed Pittsburgh Sleep Quality Index scores, Generalized Anxiety Disorder-7 scores, and need-for-cognition measures.	Students with poor sleep quality had higher frequencies of mild, moderate, and severe anxiety than students with good sleep quality.
Valladares-Garrido et al. published this study in 2025.	Medical students from 13 Latin American countries were evaluated in a multicenter study and compared according to sleep quality and psychological symptoms.	The study assessed poor sleep quality, anxiety severity, depressive symptoms, stress-related variables, and behavioral factors.	Moderate and severe anxiety were independently associated with a greater prevalence of poor sleep across diverse Latin American settings.
Vidović et al. published this study in 2025.	Medical students from two Croatian faculties completed validated sleep and psychological assessments.	The study evaluated sleep quality and symptoms of anxiety, depression, and stress, including correlations and regression coefficients.	Poor sleep affected 67.9% of participants, anxiety symptoms affected 45.3%, and greater anxiety independently predicted poorer sleep quality.

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Verma et al. published this study in 2025.	Medical students at a college in Himachal Pradesh, India, were compared according to Pittsburgh Sleep Quality Index and Depression Anxiety and Stress Scale-21 classifications.	The study assessed sleep quality, anxiety, depression, stress, and selected academic and lifestyle factors.	Poor sleepers had a substantially greater burden of anxiety, depression, and stress than students with satisfactory sleep.
Dhanusri et al. published this study in 2025.	Second-year, third-year, and final-year medical students in India underwent insomnia, psychological, reaction-time, autonomic, and body-composition assessments.	The study assessed insomnia severity, anxiety-related psychological distress, auditory and visual reaction times, heart-rate variability, and body composition.	Clinically relevant insomnia was associated with greater psychological distress and slower psychomotor responses but not with measurable autonomic or body-composition differences.
Almeneessier et al. published this study in 2026.	Medical students at King Saud University were compared according to sleep duration and positive anxiety and depression screening.	The study assessed nightly sleep duration, short sleep, anxiety, depression, bronchial asthma, sex, and interaction effects.	Almost half of the students slept fewer than seven hours, and sleep duration and sex were significantly associated with positive anxiety screening.

5 RESULTS AND DISCUSSION

The 2021 Saudi investigation demonstrated that clinically relevant insomnia was already common among medical students completing the clinical phase of training.[11] Psychological distress was more pronounced among students with insomnia, while female sex and academic-year characteristics appeared to identify particularly vulnerable subgroups.[11] Because sleep and psychological symptoms were assessed simultaneously, the findings support a clinically important association but do not establish whether insomnia preceded emotional distress.[11] The Peruvian study reported one of the highest prevalences of poor sleep quality in the included evidence base.[12] Anxiety and stress remained associated with impaired sleep in selected sex-stratified analyses, suggesting that the strength or expression of the relationship may differ between male and female students.[12] Pandemic-related isolation, uncertainty, remote learning, and altered digital behavior may have amplified both sleep disturbance and emotional symptoms, limiting generalizability to conventional academic periods.[12]

The Brazilian comparison between medical and physical-education students offered a useful external reference group exposed to the same period of remote education.[13] Medical students demonstrated higher anxiety and lower physical activity, and sleep impairment showed a moderate relationship with anxiety severity.[13] The findings suggest that curriculum characteristics and behavioral patterns may contribute to the psychological burden beyond the general effects of university attendance or pandemic restrictions.[13] In India, poor sleep affected approximately 45% of undergraduate medical students during confinement, and

anxiety was associated with more than threefold higher adjusted odds of poor sleep.[14] The multivariable analysis strengthened the evidence that the relationship was not explained entirely by the measured demographic and lifestyle factors.[14] Residual confounding, reverse causality, and reliance on self-report nevertheless prevent the adjusted association from being interpreted as a causal effect.[14]

The large Chinese chronotype study extended the exposure definition beyond total sleep duration or global sleep quality.[15] Evening-oriented students had a greater probability of anxiety symptoms, indicating that misalignment between biological preference and fixed educational schedules may contribute to psychological vulnerability.[15] Chronotype may also act through later bedtimes, social jetlag, greater nocturnal device use, morning sleepiness, and reduced exposure to regular daytime routines.[15] A separate Chinese mediation analysis found that poor sleep quality was widespread and closely related to state and trait anxiety.[16] Anxiety accounted for a substantial proportion of the statistical pathway between sleep impairment and depressive symptoms, demonstrating the degree of overlap among common mental-health outcomes.[16] Although mediation analysis can test theoretically ordered pathways, cross-sectional mediation does not confirm temporal sequence and should be interpreted as hypothesis-generating.[16]

The Polish chronotype study suggested that insomnia and anxiety contribute to the relationship between circadian characteristics and adverse psychological functioning.[17] Its inclusion of mindfulness and social dysfunction demonstrated that sleep-related vulnerability operates within a broader network of personality, coping, and interpersonal variables.[17] The results support multidimensional assessment but remain susceptible to model dependence and unmeasured confounding because all principal variables were evaluated contemporaneously.[17] The smartphone-addiction study identified problematic device use as a relevant behavioral correlate of both poor sleep and anxiety.[18] Students meeting criteria for smartphone addiction had higher odds of poor sleep and approximately twice the odds of anxiety symptoms.[18] These findings provide a potentially modifiable intervention target, although restriction-focused strategies alone may be ineffective when night-time device use reflects academic work, social support, avoidance, or pre-existing anxiety.[18]

The 2024 mediation study showed that anxiety and depression contributed to the association between perceived stress and poor sleep quality.[19] This result supports an interconnected model in which academic stress increases emotional arousal, emotional symptoms interfere with sleep, and inadequate sleep may subsequently reduce coping capacity.[19] The absence of longitudinal measurements prevents determination of whether sleep is primarily a mediator, an outcome, or a recurrent component of a feedback cycle.[19]

The Iraqi study similarly demonstrated that anxiety, depression, stress, poor sleep, and unfavorable academic performance clustered within the same students.[20] Its academic findings are clinically relevant because sleep and anxiety may impair concentration, memory consolidation, decision-making, and attendance even when formal psychiatric diagnostic thresholds are not met.[20] Nevertheless, academic performance is influenced by numerous educational and socioeconomic variables, and causal attribution to sleep or anxiety alone would be inappropriate.[20]

The investigation of first-year medical-science students demonstrated that the sleep-anxiety association begins early in professional training.[21] Transition-related pressures may include relocation, altered social networks, increased workload, competitive assessment, and uncertainty regarding academic expectations.[21] Early identification may therefore be preferable to interventions introduced only after students begin clinical rotations or develop persistent functional impairment.[21] The study examining the pass-or-fail transition of the United States Medical Licensing Examination Step 1 provided a natural educational-policy context.[22] Anxiety, poor sleep, and burnout remained evident despite the scoring modification, indicating that adjustment of a single high-stakes assessment may not resolve the broader determinants of student distress.[22] Effective institutional prevention is therefore likely to require coordinated attention to curriculum density, scheduling, assessment frequency, learning climate, access to care, and protected recovery time.[22]

The Brazilian fear-of-missing-out study connected sleep disturbance with anxiety and digitally mediated social concerns.[23] Greater fear of missing out was associated with problematic smartphone behavior, poorer sleep quality, and greater anxiety severity.[23] The findings suggest that night-time digital exposure may be maintained not only by habit but also by cognitive preoccupation, social comparison, and concern about being disconnected from relevant information.[23] The Iranian mobile-phone-addiction study independently found that severe addiction was associated with poorer sleep and more pronounced anxiety and depressive symptoms.[24] The consistency of these digital-behavior findings across settings increases their plausibility, although the instruments and thresholds used to define problematic use remain heterogeneous.[24] Interventions should consequently emphasize self-monitoring, notification management, scheduled disengagement, and alternative coping strategies rather than assuming that total abstinence is feasible or educationally appropriate.[24]

The Indian study of 300 undergraduate medical students found that poor-quality sleepers had higher frequencies of mild, moderate, and severe anxiety.[25] Its use of the Pittsburgh Sleep Quality Index and Generalized Anxiety Disorder-7 scale facilitated

standardized classification of both principal variables.[25] However, the report was published as a conference-supplement abstract, providing less methodological detail and limiting comprehensive risk-of-bias assessment compared with a full-length article.[25] The Latin American multicenter investigation substantially expanded geographical representation by including students from 13 countries.[26] Moderate and severe anxiety were independently associated with a greater prevalence of poor sleep quality across the combined sample.[26] Differences among countries in pandemic restrictions, educational delivery, socioeconomic conditions, and mental-health services may have introduced heterogeneity, but the multicenter design supports the cross-cultural relevance of the association.[26]

The Croatian multicenter study found poor sleep quality in 67.9% of participants and anxiety symptoms in 45.3%.[27] Pittsburgh Sleep Quality Index scores showed a moderate positive correlation with anxiety, and greater anxiety independently contributed to poorer sleep in regression analysis.[27] Female students reported greater sleep and psychological symptom burdens, but the design could not determine whether this reflected biological susceptibility, unequal stress exposure, behavioral differences, or reporting patterns.[27] The college-based Indian study also identified a strong relationship between poor sleep and symptoms of anxiety, depression, and stress.[28] Its results confirm that the association persisted after the acute phase of pandemic-related disruption and remained observable in a conventional medical-school setting.[28] Variation in local curriculum, accommodation, commuting, examination schedules, caffeine use, and cultural attitudes toward distress should be considered when applying its prevalence estimates to other populations.[28]

The 2025 psychophysiological study added objective reaction-time testing to conventional self-reported measures.[29] Students with clinically relevant or subthreshold insomnia demonstrated greater psychological distress and slower auditory and visual responses, while autonomic and body-composition measures were not significantly different.[29] These findings suggest that cognitive and emotional consequences may become detectable before cardiometabolic or autonomic abnormalities in otherwise young students, although the small sample reduced precision.[29] The 2026 Saudi study provided the most recent and one of the largest evaluations of sleep duration in the included evidence base.[30] Almost half of the participants slept fewer than seven hours, approximately one-third screened positive for anxiety, and sleep duration was significantly associated with anxiety after statistical analysis.[30] The use of a brief anxiety-screening instrument improved feasibility in a large sample but did not permit diagnosis of a specific anxiety disorder or detailed assessment of symptom severity.[30]

The overall findings are consistent with recent syntheses showing that sleep disturbance is common in populations with GAD and is particularly characterized by insomnia, difficulty initiating sleep, fragmented sleep, and subjective dissatisfaction.[31] However, the medical-student literature primarily evaluates anxiety symptoms rather than clinician-confirmed GAD, and its effect estimates should not be interpreted as diagnostic incidence or risk ratios for a psychiatric disorder.[31] Current evidence supports routine inquiry about sleep in students presenting with anxiety and reciprocal assessment of anxiety in students reporting persistent insomnia, but it does not support diagnosing one condition solely from the presence of the other.[31] According to GRADE principles, the certainty of evidence for a causal effect of sleep deprivation on anxiety disorders is low because of observational designs, inconsistency, indirectness, self-reported measurements, and residual confounding.[32] The consistency of association across countries nevertheless supports moderate confidence that sleep disturbance and anxiety symptoms frequently coexist and identify a population requiring further assessment.[32] Future research should prioritize prospective cohorts, repeated measurements, objective sleep assessment, structured psychiatric interviews, predefined confounder adjustment, and randomized trials of combined sleep and mental-health interventions.[32]

6 CONCLUSION

Sleep deprivation, poor sleep quality, insomnia symptoms, evening chronotype, and irregular sleep-related behavior were consistently associated with greater anxiety symptom burden among medical students. The association was observed across countries, academic stages, and measurement instruments, although the reported prevalence and magnitude varied substantially. The evidence supports frequent coexistence of sleep and anxiety symptoms but does not demonstrate that sleep deprivation independently causes a clinically diagnosed anxiety disorder.

Clinically, persistent sleep complaints in medical students should prompt assessment of anxiety, depression, perceived stress, digital behavior, stimulant use, academic impairment, and daytime functioning. Conversely, students presenting with anxiety should be asked about sleep duration, insomnia, sleep regularity, chronotype mismatch, and daytime sleepiness. Screening should be connected to confidential evaluation and evidence-based care rather than used as an isolated institutional exercise.

The principal limitations of the literature were the predominance of cross-sectional studies, reliance on self-reported questionnaires, inconsistent definitions of sleep deprivation, heterogeneous anxiety instruments, incomplete control of confounding, and limited use of

diagnostic interviews. Pandemic-era studies may have overestimated symptoms associated with exceptional social and educational disruption. Small or single-center samples and the scarcity of prospective and interventional research further reduced certainty.

Future studies should use longitudinal designs capable of establishing temporal relationships between changes in sleep and changes in anxiety. Objective measures such as actigraphy, standardized sleep diaries, repeated symptom assessments, and structured diagnostic interviews should complement validated questionnaires. Randomized trials should evaluate CBT-I, circadian interventions, digital-behavior modification, curriculum redesign, protected recovery periods, physical activity, and integrated psychological support.

The most appropriate response is an evidence-based, multidisciplinary, and individualized strategy that recognizes both personal and institutional determinants of student health. Medical schools should promote healthy sleep without normalizing chronic deprivation or attributing distress exclusively to deficient individual resilience. Integration of sleep medicine, psychiatry, psychology, student support, and educational leadership may improve well-being, academic functioning, and the sustainability of medical training.

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