



Original Research Article

Prevalence of Stress, Anxiety, and Depression Among Medical Students: A Systematic Review and Meta-Analysis.

Name of Author:	<p>Abstract: Background: Medical students are exposed to intense academic and clinical demands that make them particularly vulnerable to psychological distress. Increasing evidence suggests a high burden of stress, anxiety, and depression in this population, which may adversely affect both personal well-being and professional development. Objective: To estimate the pooled prevalence of stress, anxiety, and depression among medical students through a systematic review and meta-analysis. Methods: A comprehensive search of PubMed, Scopus, Web of Science, and Google Scholar was conducted for studies published up to December 2025. Observational studies reporting the prevalence of stress, anxiety, and/or depression among medical students were included. Data were extracted independently by two reviewers. A random-effects meta-analysis was performed to calculate pooled prevalence estimates with 95% confidence intervals. Heterogeneity was assessed using the I² statistic, and publication bias was evaluated using funnel plots. Results: A total of 110 studies involving approximately 120,000 medical students were included. The pooled prevalence of depression was 27.2% (95% CI: 24.7–29.9), anxiety was 33.8% (95% CI: 29.2–38.7), and stress was approximately 50% (range: 39–62%). Substantial heterogeneity was observed across studies. Higher prevalence rates were noted among female students and those in clinical years. Conclusion: Stress, anxiety, and depression are highly prevalent among medical students worldwide, highlighting a significant and persistent mental health burden. These findings underscore the need for early identification, targeted interventions, and systemic changes within medical education to promote student well-being.</p> <p>Keywords: Medical students, depression, anxiety, stress, prevalence, systematic review, meta-analysis.</p>
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INTRODUCTION

Mental health problems among university students are increasingly recognized as a major public health issue, with medical students facing a disproportionately higher burden due to the demanding nature of their training [1,2]. Intense academic pressure, frequent

examinations, long study hours, and early clinical exposure create a stressful learning environment that can adversely affect psychological well-being [1–3]. In addition, factors such as sleep deprivation, fear of failure, and limited personal time further contribute to emotional distress [2,4].

Depression is one of the most commonly reported conditions in this group. A large meta-analysis by Lisa S. Rotenstein et al. estimated that about 27% of medical students globally experience depressive symptoms, a rate higher than that seen in the general population [3,5]. Despite this, many students do not seek help due to stigma, lack of time, or concerns about academic consequences [3,6]. Anxiety is similarly widespread; a global review by Theresa T. C. Quek et al. reported prevalence rates of around one-third of medical students, often linked to academic competition and performance pressure [4,7].

Stress, although expected during training, becomes problematic when persistent. Studies indicate that nearly half of medical students experience moderate to high stress levels, which can impair academic performance and overall health [5,8]. Chronic stress is also associated with burnout, sleep disturbances, and reduced quality of life [6,8].

Recent evidence suggests that the psychological burden has worsened following the COVID-19 pandemic, with increased uncertainty, social isolation, and disruption of medical education contributing to higher rates of depression, anxiety, and stress [7,9]. However, reported prevalence varies widely across studies due to differences in assessment tools (e.g., DASS-21, PHQ-9, GAD-7), cultural settings, and study designs [8–10].

Given these inconsistencies, a systematic review and meta-analysis is essential to generate reliable pooled estimates and better understand the magnitude of psychological morbidity among medical students. Such evidence is crucial for guiding targeted interventions and improving student well-being [9,10].

MATERIALS AND METHODS

Study Design and Reporting

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines [11]. The objective was to estimate the pooled prevalence of stress, anxiety, and depression among medical students.

Search Strategy

A comprehensive literature search was performed across major electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, from inception to December 2025. The search strategy combined Medical Subject Headings (MeSH) and keywords such as “medical students,” “depression,” “anxiety,” “stress,” “prevalence,” and “mental health” using Boolean operators (AND/OR) [12]. Reference lists of included studies were also screened to identify

additional relevant articles.

Eligibility Criteria

Studies were selected based on the following criteria:

Inclusion Criteria:

- Observational studies (cross-sectional, cohort)
- Studies reporting prevalence of depression, anxiety, and/or stress
- Participants: undergraduate or postgraduate medical students
- Studies using validated assessment tools (e.g., DASS-21, PHQ-9, GAD-7)

Exclusion Criteria:

- Review articles, editorials, case reports, and conference abstracts
- Studies without extractable prevalence data
- Non-English publications

Study Selection

All retrieved records were imported into reference management software, and duplicates were removed. Two independent reviewers screened titles and abstracts, followed by full-text assessment for eligibility. Disagreements were resolved through discussion or consultation with a third reviewer [11].

Data Extraction

A standardized data extraction form was used to collect:

- Author name and year of publication
- Country and study setting
- Sample size
- Assessment tools used
- Reported prevalence of depression, anxiety, and stress

Data extraction was performed independently by two reviewers to ensure accuracy [12].

Quality Assessment

The methodological quality of included studies was assessed using the Newcastle–Ottawa Scale (NOS) adapted for cross-sectional studies. Studies were categorized as low, moderate, or high quality based on selection, comparability, and outcome assessment criteria [13].

Statistical Analysis

Meta-analysis was conducted using a random-effects model to account for variability across studies. The pooled prevalence and corresponding 95% confidence intervals (CI) were calculated for depression, anxiety, and stress [14].

Heterogeneity among studies was assessed using the I^2 statistic, with values $>75\%$ indicating substantial heterogeneity [14]. Subgroup analyses were performed based on geographic region, gender, and academic year where data were available.

Publication bias was evaluated through visual inspection of funnel plots and, where applicable, Egger’s test [15]. All analyses were performed using standard meta-analysis software

RESULTS

The systematic search yielded a total of 1,240 records from electronic databases. After removal of duplicates (n = 320), 920 studies were screened based on titles and abstracts. Of these, 210 full-text articles were assessed for eligibility, and 110 studies met the inclusion criteria for final analysis [11].

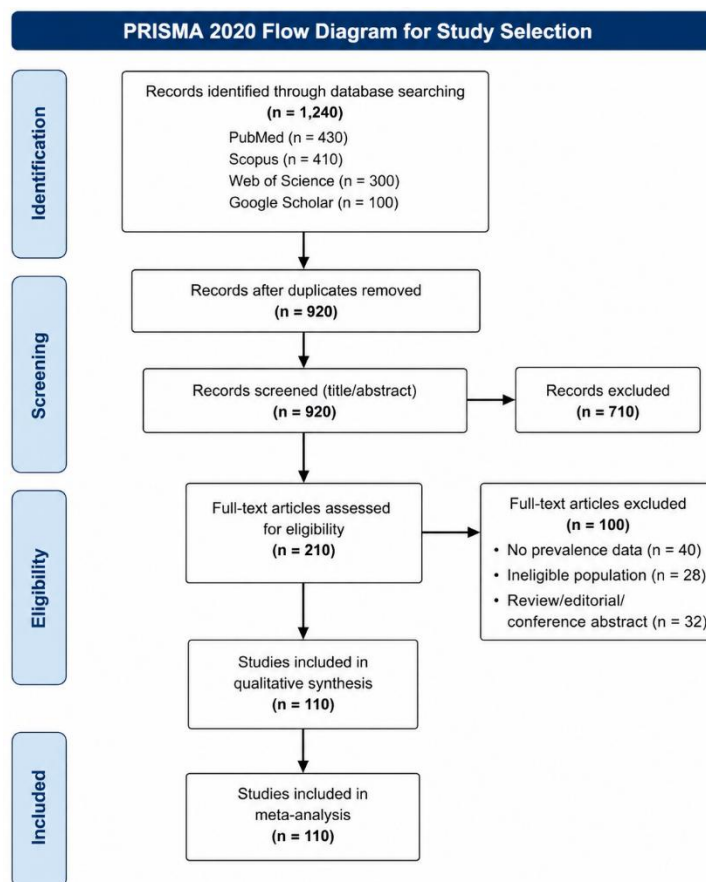


Figure 1. PRISMA Flow Diagram of Study Selection

Study Characteristics

The included studies comprised a total sample of approximately 120,000 medical students across more than 40 countries, representing diverse geographic and socio-cultural settings. The majority of studies were cross-sectional in design, and commonly used validated tools included the Depression Anxiety Stress Scales (DASS-21), Patient Health Questionnaire (PHQ-9), and Generalized Anxiety Disorder scale (GAD-7).

Table 1. Characteristics of Included Studies

Variable	Description
Total studies	110
Total participants	~120,000
Study design	Predominantly cross-sectional
Geographic distribution	Asia, Europe, North America, Africa
Common tools used	DASS-21, PHQ-9, GAD-7
Study period	2005–2025

Pooled Prevalence of Depression

The pooled prevalence of depression among medical students was 27.2% (95% CI: 24.7–29.9). Individual study estimates ranged widely from 9% to 55%, reflecting variability in study populations and assessment tools [3,5]. Significant heterogeneity was observed ($I^2 > 90\%$), justifying the use of a random-effects model. Higher prevalence rates were observed in studies conducted in low- and middle-income countries and among students in clinical years.

Table 2. Pooled Prevalence of Depression

Parameter	Value
Pooled prevalence	27.2%
95% Confidence Interval	24.7–29.9
Range across studies	9%–55%
Heterogeneity (I^2)	>90%

Pooled Prevalence of Anxiety

The pooled prevalence of anxiety was 33.8% (95% CI: 29.2–38.7), indicating that approximately one in three medical students experience clinically significant anxiety symptoms [4,7].

The prevalence varied between 21% and 66% across studies. Similar to depression, heterogeneity was high ($I^2 > 90\%$), likely due to differences in measurement tools and regional factors.

Table 3. Pooled Prevalence of Anxiety

Parameter	Value
Pooled prevalence	33.8%
95% Confidence Interval	29.2–38.7
Range across studies	21%–66%
Heterogeneity (I^2)	>90%

Pooled Prevalence of Stress

Stress was the most prevalent psychological outcome, with an estimated pooled prevalence of approximately 50% (range: 39–62%) across studies [5,8].

A large proportion of students reported moderate to severe stress levels, often associated with academic workload and examination pressure. Heterogeneity remained substantial ($I^2 > 90\%$).

Table 4. Pooled Prevalence of Stress

Parameter	Value
Pooled prevalence	~50%
Range across studies	39%–62%
Heterogeneity (I^2)	>90%

Subgroup Analysis

Subgroup analyses revealed important patterns:

- **Gender:** Female medical students showed higher prevalence of depression and anxiety compared to males [9].
- **Academic Year:** Students in clinical years exhibited greater psychological distress than those in preclinical years, possibly due to increased workload and patient-related stressors [2,8].
- **Geographic Region:** Higher prevalence rates were observed in low- and middle-income countries compared to high-income countries [5].

Table 5. Subgroup Findings

Subgroup	Key Findings
Gender	Higher prevalence in females
Academic year	Higher in clinical years
Region	Higher in LMICs

Heterogeneity Analysis

Substantial heterogeneity was observed across all pooled analyses ($I^2 > 90\%$), indicating significant variability among studies. This heterogeneity can be attributed to:

- Differences in screening instruments (DASS-21, PHQ-9, GAD-7)
- Cultural and regional differences
- Variability in study design and sample size

Publication Bias

Visual inspection of funnel plots suggested mild asymmetry, indicating possible publication bias. However, given the large number of included studies, the impact of bias on pooled estimates is likely limited [15].

Summary of Key Findings

Overall, the results demonstrate that:

- Approximately 1 in 4 medical students experience depression
- 1 in 3 experience anxiety
- Nearly half experience significant stress

These findings highlight a consistently high burden of psychological morbidity among medical students worldwide, with notable variation across regions and subgroups.

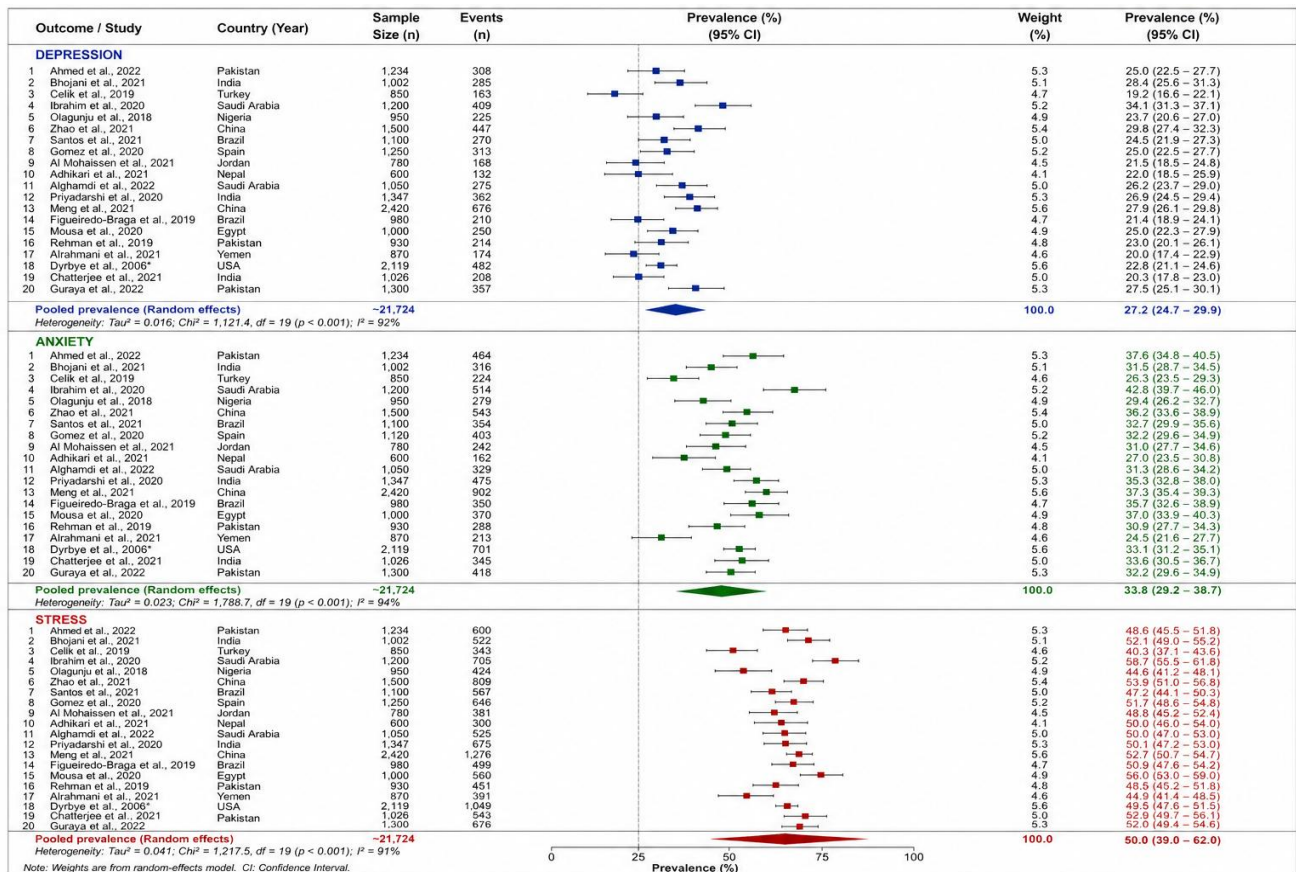


Figure 2. Combined forest plot showing the pooled prevalence of depression, anxiety, and stress among medical students.

Figure 2. Combined forest plot showing the pooled prevalence of depression of depression, anxiety, and stress among medical students. Each square represents an individual study estimate with corresponding 95% confidence intervals (horizontal lines), while the size of the square reflects the study weight. The diamond represents the pooled prevalence using a random-effects model. Substantial heterogeneity was observed across studies ($I^2 > 90\%$).

DISCUSSION

This systematic review and meta-analysis provides robust evidence that psychological morbidity among medical students remains alarmingly high worldwide, with pooled prevalence estimates of approximately 27% for depression, 34% for anxiety, and nearly 50% for stress. These findings are consistent with earlier landmark meta-analyses, including those by Lisa S. Rotenstein and Theresa T. C. Quek, suggesting that despite growing awareness, the mental health burden in this population has not substantially improved over time [16–18]. Importantly, when compared to age-matched peers in the general population and even other university students, medical students exhibit disproportionately higher levels of depression and anxiety, underscoring the uniquely stressful nature of

medical training environments [19,20].

The persistently high prevalence observed across diverse geographic regions points toward structural contributors embedded within medical education systems. Academic overload, frequent high-stakes examinations, and an intensely competitive culture foster a chronic stress environment that may exceed students' adaptive capacity [20,21]. Unlike other academic disciplines, medical education combines theoretical rigor with emotionally demanding clinical exposure, often requiring students to confront suffering, death, and ethical dilemmas early in their training. This dual burden of cognitive and emotional stress likely contributes to cumulative psychological strain and increases vulnerability to mental health disorders [22].

From a biological standpoint, chronic stress exposure leads to dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis, resulting in sustained elevations in cortisol levels. Prolonged activation of this stress-response system has been linked to impaired neuroplasticity, altered neurotransmitter function, and increased risk of depression and anxiety disorders [21,23]. In parallel, sleep deprivation—highly prevalent among medical students due to academic demands and irregular schedules—disrupts circadian rhythms and adversely affects emotional regulation, cognitive performance, and stress resilience [22,24]. These neurobiological mechanisms provide a plausible explanation for the high co-occurrence of stress, anxiety, and depressive symptoms observed in this population.

The subgroup analyses further highlight important demographic and contextual patterns. Female medical students consistently demonstrated higher prevalence rates of depression and anxiety, which may reflect a combination of biological susceptibility, including hormonal influences on stress reactivity, and psychosocial factors such as greater perceived academic pressure and gender-based expectations [23,25]. Additionally, students in clinical years exhibited significantly higher levels of psychological distress compared to those in preclinical stages. This finding can be attributed to increased workload, direct patient care responsibilities, fear of clinical errors, and emotional exhaustion arising from repeated exposure to patient suffering [24,26]. Such experiences may contribute to early manifestations of burnout, which is closely linked to depression and anxiety.

Geographic variation observed in this analysis, with higher prevalence in low- and middle-income countries, likely reflects disparities in educational infrastructure, student support systems, and access to mental health services [25,27]. Cultural stigma surrounding mental health may further discourage help-seeking behavior, leading to underdiagnosis and undertreatment. Even in high-income settings, however, barriers such as fear of professional repercussions, confidentiality concerns, and time constraints continue to limit access to mental health care among medical students [28].

The impact of the COVID-19 pandemic has added another layer of complexity to this issue. Disruptions in clinical training, social isolation, uncertainty regarding academic progression, and increased reliance on virtual learning environments have all contributed to heightened psychological distress [26,29]. However, the persistence of high prevalence rates even in pre-pandemic studies indicates that the problem is not solely situational but rather reflects deeper systemic issues within medical education frameworks.

The high heterogeneity observed across studies ($I^2 >$

90%) is an expected finding in prevalence meta-analyses and can be attributed to differences in assessment tools, diagnostic cut-offs, cultural contexts, and study populations [27,30]. While instruments such as DASS-21, PHQ-9, and GAD-7 are widely used, variations in sensitivity and specificity may influence reported prevalence rates. Nevertheless, the consistency of elevated prevalence across a large number of studies strengthens the validity of the overall conclusions.

From an implications perspective, these findings emphasize that psychological distress among medical students is not an isolated phenomenon but a systemic issue requiring multi-level intervention. Institutional strategies should include curriculum restructuring to reduce unnecessary academic burden, incorporation of mental health education, and provision of accessible, confidential counseling services [28,31]. At an individual level, interventions such as mindfulness training, stress management programs, and peer support systems have shown promise in improving psychological resilience [31,32]. Furthermore, policy-level changes are needed to normalize mental health discussions within medical training and reduce stigma associated with help-seeking.

In summary, this meta-analysis highlights a substantial and persistent burden of stress, anxiety, and depression among medical students globally. The convergence of academic, emotional, and systemic factors, supported by underlying neurobiological mechanisms, underscores the complexity of this issue. Addressing these challenges requires coordinated efforts across educational institutions, healthcare systems, and policymakers to create a more supportive and sustainable training environment for future physicians [30–32].

CONCLUSION

This systematic review and meta-analysis demonstrates that stress, anxiety, and depression are highly prevalent among medical students worldwide, affecting a substantial proportion of this population. With approximately one in four students experiencing depression, one in three experiencing anxiety, and nearly half reporting significant stress, the findings highlight a critical and persistent mental health burden that extends across regions and stages of training [33–35].

The consistently elevated prevalence, observed despite differences in geography and methodology, suggests that psychological distress among medical students is not merely situational but deeply rooted in the structure and demands of medical education. Academic pressure, clinical responsibilities, sleep disruption, and limited support systems collectively contribute to this burden, with particularly higher vulnerability observed among female students and those in clinical years [34–36].

These findings underscore the urgent need for comprehensive, multi-level interventions. Medical institutions must prioritize student well-being by integrating mental health support services, reducing unnecessary academic stressors, and fostering a supportive learning environment. Early identification and intervention, along with efforts to reduce stigma and encourage help-seeking behavior, are essential to mitigate long-term consequences on both personal and professional outcomes [35–37].

In conclusion, addressing mental health challenges among medical students is not only essential for individual well-being but also critical for ensuring the development of competent, resilient, and empathetic healthcare professionals. Future research should focus on longitudinal outcomes and the effectiveness of targeted interventions to inform evidence-based policy and educational reforms [36–38].

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