# RESEARCH



# The silent strain: a systematic review and meta-analysis on the prevalence of occupational stress among Pakistani nurses



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# Abstract

**Background** Occupational stress in the nursing profession is higher than in many other occupations, significantly impacting nurses' physical and mental health, job satisfaction, and the quality of patient care. It often leads to burnout and the decision to leave the profession. Various studies conducted in Pakistan have reported different findings. Therefore, this systematic review and meta-analysis aimed to estimate the pooled prevalence of occupational stress among nurses in Pakistan.

**Methods** Databases such as Scopus, Medline, Web of Science, EMBASE, and CINAHL were searched, including studies published from 2000 to September 2024. The screening process, article selection, data extraction, and quality assessment were all conducted independently by two authors. Any disagreements were resolved through consultation. Heterogeneity among studies was assessed using the I<sup>2</sup> statistic and Cochran's Q test. Subgroup analysis based on the study location (city) was performed. The relationship between occupational stress prevalence and publication year and sample size was evaluated using meta-regression. Publication bias was assessed using funnel plots and the Egger test. All analyses were conducted using a random-effects model with Stata software version 17.

**Results** Eleven studies with a sample size of 1636 participants were included. The prevalence of mild, moderate, and severe occupational stress was 16% (95% CI: 10–21), 48% (95% CI: 36–61), and 30% (95% CI: 20–41) respectively. The prevalence of mild occupational stress was highest in other cities, moderate stress was most common in Lahore, and severe stress was more prevalent in Karachi. No significant relationship was found between occupational stress was significant, but the trim-and-fill analysis showed no impact on the results. Sensitivity analysis confirmed the stability of the findings.

**Conclusion** This meta-analysis estimates the high prevalence of occupational stress among nurses in Pakistan, with moderate stress being most common. Differences in stress levels between cities may be influenced by local factors. Despite publication bias, the results remain stable and reliable, emphasizing the need for addressing occupational stress to enhance nurse well-being and patient care quality.

Keywords Occupational stress, Nurse, Pakistan, Meta-analysis

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## Introduction

Occupational stress is one of the major challenges in workplaces, with significant impacts on employees' physical and mental health, as well as organizational performance [1]. In the nursing profession, which involves providing continuous and sensitive care to patients, the level of job stress is notably higher than in many other occupations [2]. Nurses are constantly exposed to high levels of stress due to frequent encounters with critical situations, resource shortages, long shifts, and direct interactions with patients and their families. This issue not only compromises the quality of care provided to patients but can also lead to burnout, decreased job satisfaction, and even the decision to leave the nursing profession [3].

Job stress affects not only the mental health of nurses but also has significant consequences for their physical health. Studies have shown that job stress can increase the risk of cardiovascular diseases, hypertension, and gastrointestinal problems [4, 5]. On the psychological side, job stress can lead to anxiety, depression, and reduced work motivation [3]. These factors can directly or indirectly impact the quality of healthcare services provided by nurses and ultimately jeopardize patient health [6]. Job stress in nursing is a multifaceted phenomenon influenced by individual, organizational, and social factors. On an individual level, personality traits, work experience, and coping skills play a significant role in managing stress. From an organizational perspective, factors such as managerial support, fairness in task allocation, access to professional training, and adequate resources are key determinants [7]. In certain socio-cultural contexts, family expectations and economic pressures further exacerbate nurses' job stress. For instance, many female nurses in Pakistan face traditional family-related expectations in addition to their professional responsibilities, making work-life balance particularly challenging for them [8].

In developing countries, Pakistan's healthcare system faces numerous challenges, including workforce shortages, unequal resource distribution, and high pressure on healthcare workers. Nurses, as the backbone of the healthcare system, are particularly vulnerable to job stress due to structural and economic limitations [9]. Furthermore, cultural and social issues such as gender inequality and traditional expectations may exacerbate job-related stress, especially among female nurses [10, 11]. Pakistan is a densely populated country with a strained healthcare system. It requires an efficient and healthy workforce. However, nurses often face excessive workloads and poor working conditions [12]. In such an environment, job stress can have serious implications for nurses' performance and weaken the overall health system. Thus, assessing the prevalence of job stress among Pakistani nurses is important to identifying its different dimensions and providing effective strategies to address it [13].

In Pakistan, several additional factors contribute to job stress. For instance, resource shortages, low wages, and a lack of work-life balance are among the key challenges [14]. Observational studies examining the prevalence of job stress among Pakistani nurses often vary widely in methodology, target populations, and findings. These variations lead to inconsistent results, making it difficult to obtain a clear understanding of the situation [15–17]. Moreover, comprehensive data on the prevalence of job stress among Pakistani nurses remains limited. Existing studies present conflicting results [18, 19]. This inconsistency in findings highlights the need for a more reliable estimate of the true prevalence of job stress among Pakistani nurses, which is essential for policy-making and healthcare planning. Therefore, this meta-analysis aims to bridge this gap by integrating data from multiple studies. By doing so, this study provides a more accurate and reliable estimate of job stress prevalence among nurses in Pakistan [19, 20]. This study is significant because understanding the true extent of job stress will inform policies aimed at improving the working conditions and mental health support for nurses, ultimately benefiting the healthcare system and patient care.

## Methods

## Study protocol

This systematic review and meta-analysis was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency, reliability, and comprehensive reporting [21]. The study protocol was pre-registered on January 20, 2025, in the PROSPERO database (International Prospective Register of Systematic Reviews) under the registration number CRD42025633484.

## Search strategy

To access relevant articles, international databases such as Medline, Scopus, Web of Science, EMBASE, and CINAHL (EBSCOhost) were searched using keywords including Occupational stress, job stress, work-related stress, nurse, nursing staff, nursing personnel, Pakistan. The search was limited to articles published between January 2000 and December 2024 and written in English. The results of the Medline search from the Ovid platform were as follows: (exp Nurses/ or exp Students, Nursing/ or nurs\*.tw, kf.) and (exp Occupational Stress/ or stress\*. tw, kf.) and (exp Pakistan/ or Pakistan\*.tw, kf.). To identify additional relevant articles not retrieved through the initial search, as well as older or inaccessible articles, the reference lists of the selected studies were reviewed to ensure comprehensive coverage.

#### Inclusion and exclusion criteria

All articles meeting the following inclusion criteria were considered for the study: published between January 2000 and December 2024, written in English, conducted specifically with nurses, focused on reporting the prevalence of occupational stress, and providing access to fulltext articles. Exclusion criteria included review articles, qualitative studies, letters to the editor, duplicate studies, studies involving healthcare groups other than nurses, and articles that failed to report essential information such as sample size, methodology, or statistical results.

## **Data extraction**

Two independent authors reviewed the full texts of the eligible articles and extracted essential data using a predesigned table that included variables such as the first author's name, year of publication, sample size, stress measurement tool, study location, methodological quality, and findings. The table ensured that all necessary variables were consistently recorded across the studies. If there were any disagreements or discrepancies between the two authors during the data extraction process, a third author was consulted to resolve the issue and ensure accuracy and consistency in the extracted data. This thorough process allowed for a comprehensive and reliable collection of data across studies.

## Methodological quality of articles

To enhance the accuracy and validity of the meta-analysis results and minimize potential bias, the methodological quality of the included articles was rigorously assessed. The assessment was conducted using the Joanna Briggs Institute (JBI) critical appraisal tool, which evaluates studies across eight key items. Each item is scored as "yes" (score 1), "no" (score 0), "unclear" (score 0), or "not applicable" (score 0), with higher scores indicating better methodological quality. The eight evaluation criteria focus on study inclusion criteria, selection of the target population, measurement of exposure, measurement of outcomes, control of confounding factors, clarity of result reporting, appropriateness of statistical methods, and the relationship between exposure and outcomes [22]. In this study, a score below 3 was considered weak, 3 to 6 was considered moderate, and above 6 was considered strong.

## Statistical analysis

The extracted data were analyzed using STATA version 17. Heterogeneity between studies was assessed using the I<sup>2</sup> index and Cochran's Q test. I<sup>2</sup> values were interpreted as low (25%), moderate (50%), and high (75%) heterogeneity [23], with studies showing high heterogeneity (I<sup>2</sup> > 90%) classified accordingly. A random-effects model was applied for studies with high heterogeneity, based on the assumption that the studies are not all estimating the

same underlying effect and that variation between study outcomes is expected. For studies with moderate ( $I^2$  50%) or low heterogeneity (I<sup>2</sup> 25%), a fixed-effects model was used. This approach ensures that the model accounts for both within-study variance and between-study heterogeneity. The results were presented as pooled standardized scores with a 95% confidence interval along with a forest plot. Publication bias was evaluated visually using a funnel plot and objectively through Egger's linear regression test, and the potential impact of small studies was also assessed using these methods. This test is particularly sensitive to asymmetries in the funnel plot. To investigate whether the two factors-publication year and sample size-could affect the results of occupational stress prevalence, meta-regression was performed. Sensitivity analysis was also conducted to examine the influence of each study on the overall results. This analysis determined whether removing any individual study significantly affected the final meta-analysis outcomes. These analyses were performed for all three levels of occupational stress: mild, moderate, and severe.

## Results

In the initial search, 538 articles were retrieved, of which 270 were duplicates and were therefore removed. Two researchers then examined the title and abstract of the remaining 268 articles and selected the ones that met the inclusion criteria. At this stage, 239 articles were excluded due to irrelevance. The full text of the remaining 29 articles was read independently by the same two researchers. In 17 studies, only raw scores for occupational stress, presented as mean and standard deviation, were reported, and these were excluded from the analysis. One study had been conducted on three different nurse groups, which were considered three separate studies. Thus, the total number of studies analyzed was 11 (Fig. 1).

These studies were conducted in the cities of Lahore, Faisalabad, Karachi, Peshawar, and Islamabad with 1636 nurses between the years 2017 and 2024. In these studies, the prevalence of occupational stress was reported in terms of mild, moderate, and severe levels. The sample size ranged from 75 to 265 participants (Table 1). In terms of methodological quality, one study was excellent [18], one was poor [24], and the rest were average [15, 19, 25–31]. Further details are provided in Table 2.

The results of the meta-analysis using a random effects model showed that the prevalence of mild occupational stress was 16% (95% confidence interval [CI]: 10–21), moderate stress was 48% (95% CI: 36–61), and severe stress was 30% (95% CI: 20–41). Sensitivity analysis revealed that none of the individual studies had a significant impact on the results (Fig. 2).



Fig. 1 Article screening process

The results of the subgroup analysis by study location (Lahore, Karachi, and other cities) showed that the highest prevalence of mild, moderate, and severe stress was observed in other cities (17%, 95% CI: 4–31), Lahore (55%, 95% CI: 28–83), and Karachi (39%, 95% CI: 27–52), respectively. Mild, moderate, and severe job stress did not show any significant differences among these location (Fig. 3).

The results of meta-regression showed that the sample size of the studies and the year of publication was not associated with the reported prevalence of occupational stress. Publication bias was found to be significant for mild (p=0.006) and severe (p=0.0001) occupational stress, but non-significant for moderate stress (p=0.296) (Fig. 4). The trim-and-fill method was used to identify

"missing" studies in the meta-analysis, which were likely excluded due to publication bias (e.g., studies with nonsignificant or negative results that were not published). In this method, hypothetical studies (imputed studies) are added to the model to adjust for the existing bias in the analyzed studies.

## Discussion

The results of this systematic review and meta-analysis provide a concerning picture of the mental health status of nurses in Pakistan. Based on data analysis from observational studies, the prevalence of occupational stress at mild, moderate, and severe levels was estimated to be 16%, 48%, and 30%, respectively. Similarly, a meta-analysis conducted in China, which showed that were closely

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First	Year	Sam-	Location	Scale	Preva	lence (%)		Findings
author		ple size			Mild	Moderate	Severe	
Anwarali [28]	2024	108	1	PSS	8.3	78.7	13	The Perceived Stress Scale indicated moderate stress levels, with an average score of 21.12±4.6. Among the par- ticipants, 8.3% experienced low stress, 78.7% experienced moderate stress, and 13% experienced severe stress.
Yasin [19]	2023	144	Lahore	NIOSH	4.2	76.3	19.5	Most nurses (76.4%) reported experiencing a moderate level of occupational stress, and 43.1% of them provided low-quality patient care. Additionally, there was a significant association between nurses' occupational stress and the quality of care delivered to patients.
Awan [18]	2023	217	Lahore	NSS	7.4	80.2	12.4	Among the 217 nurses who participated in the study, 174 (80.2%) reported moderate stress levels, while 27 (12.4%) experienced high stress levels, and 16 (7.4%) reported low stress levels.
Mazhar [ <mark>27</mark> ]	2022	102	Lahore	ENSS	21.5	40.2	38.3	A statistically significant relationship was observed between stress and factors such as sexual harassment ( $P < 0.001$ ) and abusive behavior from attendants in the workplace ( $P < 0.001$ ).
Saher [15]	2022	139	Islamabad		41.7	55.4	2.9	Workload-related stress was identified as the most common source of stress, affecting 50.4% of nurses.
Tahira [24]	2021	133	Lahore		33.8	24.1	36.1	The majority of participants (40%) agreed that learning new things required by their job was a significant factor contributing to their stress levels.
Fatima [32]	] 2020	100	Peshawar	DASS-21	15	26	13	More than half of the participants (54%) experienced stress, including 13% who reported severe or very severe levels of stress. Stress was more common among younger individuals, women, married participants, and those with less than 5 years of work experience.
Mahmood [26]	2020	75 75	Karachi	NSI	8 12	46.7 68	40 24	The most significant finding was that 86.7% of nurses experienced high stress levels due to inadequate salaries, making it the most prominent stressor among participants.
		75			10.7	25.3	64	
Panhwar [29]	2019	100	Karachi	HCJSSQ	16.3	40.6	35.5	The key finding is that workload was identified as the leading source of stress for nurses, affecting 56% of participants, followed by issues in relationships with subordinate medical staff (51%) and emotional distress from patients (50%).
Yousaf [30]	2019	103	Faisalabad	DASS	6.1	27.1	66.1	The key finding is that 66.1% of nurses experienced severe stress, which negatively impacted their social respon- sibilities and professional skills.
Badil [25]	2017	265	Karachi	SQ	25.3	39.6	35.1	Stress in daily life among nurses was categorized as mild in 25.3%, moderate in 39.6%, and severe in 35.1% of participants.
HCJSSQ: Hc SQ: Stress q	ospital C uestion	Consulta naire; <b>S1</b>	nts" Job Stress & . T <b>OP-D</b> : Screening	Satisfaction Que g Tool of Psychol	stionnair ogical Dis	e; <b>NIOSH</b> : Nal stress	ional institu	te of occupational safety and Health; NSI: Nursing Stress Indicator; NSS: Nursing Stress Scale; PSS: The Perceived Stress Scale;

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Table 2 The methodological quality of the included articles

Author	Year	ltem 1	ltem 2	Item 3	ltem 4	ltem 5	ltem 6	ltem 7	ltem 8	Total
Anwarali [28]	2024	+	+	+	+	U	-	+	+	6
Yasin [19]	2023	+	+	+	+	-	-	+	+	6
Awan [18]	2023	+	+	+	+	+	U	+	+	7
Mazhar [27]	2022	+	+	+	+	-	-	+	+	6
Saher [15]	2022	+	+	+	+	U	-	+	+	6
Tahira [24]	2021	+	+	U	U	U	-	U	+	3
Fatima [32]	2020	+	+	+	-	-	+	+	+	6
Mahmood [26]	2020	+	+	+	-	-	+	+	+	6
Panhwar [29]	2019	+	+	+	-	-	+	+	+	6
Yousaf [30]	2019	+	+	+	-	-	+	+	+	6
Badil [25]	2017	+	+	+	-	-	+	+	+	6

U: Unclear

Item 1: Were the criteria for inclusion in the sample clearly defined? Item 2: Were the study subjects and the setting described in detail? Item 3: Was the exposure measured in a valid and reliable way? Item 4: Were objective, standard criteria used for measurement of the condition? Item 5: Were confounding factors identified? Item 6: Were strategies to deal with confounding factors stated? Item 7: Were the outcomes measured in a valid and reliable way? Item 8: Was appropriate statistical analysis used?

aligned with the present study, indicated 21% mild stress, 46% moderate stress, and 32% severe stress [33]. Additionally, a study by Aberhe in Ethiopia reported that the stress level among nurses was 44.9% [34].

The findings indicate that, based on the random-effects model, moderate stress, at 48%, is the most common level of occupational stress among nurses. This result aligns with previous studies in low- and middle-income countries, which suggest that factors such as high workload, staff shortages, and limited access to resources play a key role in contributing to moderate stress [35, 36]. On the other hand, the prevalence of severe stress (30%) likely reflects the critical conditions in hospital environments in Pakistan, including frequent exposure to patient mortality, job insecurity, and inadequate psychological support for nurses [13, 37]. However, the study by Al Hosis et al., which examined 152 nurses in Saudi Arabia, found that 34.2% of them experienced moderate to severe occupational stress [4]. In a study conducted in India, 87.4% of nurses acknowledged that nursing is a stressful profession, with occupational stress being very severe in 32.2% of nurses. Only 35.7% were willing to choose it as their profession again [38]. Additionally, the prevalence of occupational stress among Iranian nurses was 69% [39]. This result is inconsistent with the present study, possibly due to differing organizational cultures or varying expectations of nurses. In contrast, the relatively low prevalence of mild stress (16%) could indicate that nurses are generally under stress or, when they experience stress, it rapidly escalates to higher levels [11].

Overall, the findings suggest that 77% of nurses in Pakistan experience moderate to severe stress, consistent with a meta-analysis by Mohammadi et al., that reported a general stress prevalence of 60% [40]. In Zheng's study, which focused on nursing students, the stress levels were 24% for low stress, 35% for moderate stress, and 10% for high stress [41]. This suggests that nursing as a profession is inherently stressful due to nurse shortages and heavy responsibilities. In line with this, Glazer's study, which analyzed qualitative stress content among nurses in Hungary, Israel, Italy, the UK, and the USA, found that "task performance" and "type of patients" were consistent stress sources across all five countries. Moreover, nurses in the UK reported "staff skill set" as a stress source, while Hungarian nurses cited "low wages" and "resource shortages" as significant contributors to occupational stress compared to nurses in the other countries included in this study [42]. From an occupational health perspective, nurses, due to their large number, are considered a priority in stress management and addressing the factors that influence its severity [12]. A study by Rai indicates that healthcare workers are exposed to various psychological, social, chemical, and even biological hazards (48%), which impact the safety of their work environment [43]. A noteworthy aspect is the wide confidence intervals, particularly for moderate stress (35–59%), which indicate substantial heterogeneity among the studies included in the meta-analysis. This heterogeneity may stem from differences in stress measurement tools (such as various questionnaires), geographic diversity (large cities versus rural areas), or differences in working conditions between public and private hospitals. Furthermore, variations in cultural perceptions of stress, reporting practices, and healthcare system infrastructure could also contribute to this observed heterogeneity. Nonetheless, the sensitivity analysis confirmed that removing individual studies did not alter the overall direction of the results, which suggests the stability and reliability of the findings. Despite the heterogeneity, the consistent trends highlight the global importance of addressing moderate stress levels among healthcare professionals. Additional subgroup analyses focusing on specific variables-such



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Fig. 2 Forest plot illustrating the prevalence of mild, moderate, and severe occupational stress among nurses in Pakistan

as age, gender, and years of experience—may further elucidate the factors contributing to the observed variability and strengthen targeted interventions.

The results of the publication bias test were significant for mild stress and severe stress, but not for moderate stress. This pattern might suggest a tendency among researchers to publish studies emphasizing extreme levels of stress (mild or severe) [44]. Meanwhile, moderate stress, as the "norm" in high-stress medical environments, tends to receive less attention from the media or journals. On the other hand, reporting bias among nurses is also likely [45]. For instance, some may hide their severe stress due to fear of judgment, while others might accept mild stress as a normal part of their job. These biases affect the accuracy of estimates and require cautious interpretation. The trim-and-fill analysis showed that adding missing studies did not significantly change the results. While the findings seem somewhat

Study		Prevaence of mild stress with 95% CI	Weight (%)
Lahore			
Yasin, 2023		0.04 [ 0.01, 0.07]	8.33
Awan, 2023	-	0.07 [ 0.04, 0.11]	8.29
Mazhar, 2022		0.21 [ 0.14, 0.29]	7.26
Tahira, 2021		0.34 [ 0.26, 0.42]	7.24
Heterogeneity: $\tau^2 = 0.01$ , $I^2 = 94.55\%$ , $H^2 = 18.35$ Test of $\theta_i = \theta_j$ : Q(3) = 55.06, p = 0.01		0.16 [ 0.06, 0.27]	
Karachi			
Mahmood, 2020		0.12 [ 0.05, 0.19]	7.43
Mahmood, 202		0.08 [ 0.02, 0.14]	7.74
Mahmood, 2020		0.11 [ 0.04, 0.18]	7.52
Panhwar, 2019		0.16 [ 0.09, 0.24]	7.46
Badil, 2017		0.25 [ 0.20, 0.31]	7.96
Heterogeneity: $\tau^2 = 0.00$ , $I^2 = 81.75\%$ , $H^2 = 5.48$ Test of $\theta_i = \theta_j$ : Q(4) = 21.92, p = 0.01		0.15 [ 0.08, 0.21]	
Others	_		
Anwarali, 2024		0.08 [ 0.03, 0.14]	7.96
Saher, 2022		0.42 [ 0.34, 0.50]	7.19
Fatima, 2020		0.15 [ 0.08, 0.22]	7.52
Yousaf, 2019		0.06 [ 0.01, 0.11]	8.09
Heterogeneity: $\tau^{*} = 0.02$ , $\Gamma^{*} = 94.92\%$ , $H^{*} = 19.69$ Test of $\theta_{i} = \theta_{j}$ : Q(3) = 59.08, p = 0.01		0.17 [ 0.04, 0.31]	
Overall Heterogeneity: $\tau^2 = 0.01$ , $l^2 = 91.97\%$ , $H^2 = 12.45$ Test of $\theta_i = \theta_i$ : Q(12) = 149.37, p = 0.01	-	0.16 [ 0.10, 0.21]	
Test of group differences: $Q_b(2) = 0.16$ , p = 0.92		5	

Random-effects DerSimonian-Laird model

Study					Prevaence of moderate stress with 95% CI	Weight (%)
Lahore						
Yasin, 2023					0.76 [ 0.69, 0.83]	7.79
Awan, 2023					0.80 [ 0.75, 0.86]	7.86
Mazhar, 2022	-	_			0.40 [ 0.31, 0.50]	7.63
Tahira, 2021					0.24 [ 0.17, 0.31]	7.77
Heterogeneity: $\tau^2 = 0.08$ , $I^2 = 98.39\%$ , $H^2 = 62.05$ Test of $\theta_i = \theta_j$ : Q(3) = 186.15, p = 0.01	_				0.55 [ 0.28, 0.83]	
Karachi						
Mahmood, 2020					0.47 [ 0.35, 0.58]	7.50
Mahmood, 202			_		0.68 [ 0.57, 0.79]	7.55
Mahmood, 2020		-			0.25 [ 0.15, 0.35]	7.61
Panhwar, 2019	-				0.41 [ 0.31, 0.50]	7.62
Badil, 2017					0.40 [ 0.34, 0.45]	7.84
Heterogeneity: $\tau^2 = 0.02$ , $I^2 = 88.81\%$ , $H^2 = 8.94$					0.44 [ 0.32, 0.56]	
Test of $\theta_i = \theta_j$ : Q(4) = 35.74, p = 0.01						
Others				_	0 79 [ 0 71 0 86]	7 74
Saber 2022		-		_	0.55 [ 0.47 0.64]	7 71
Fatima 2020	_	_	_		0.26[0.17, 0.35]	7.69
Yousaf 2019	_	_			0.27 [ 0.19, 0.36]	7.69
Heterogeneity: $\tau^2 = 0.06$ , $I^2 = 97.31\%$ , $H^2 = 37.21$	_				0.47 [ 0.22, 0.72]	1.00
Test of $\theta_i = \theta_j$ : Q(3) = 111.62, p = 0.01						
Overall					0.48 [ 0.36, 0.61]	
Heterogeneity: $\tau^2 = 0.05$ , $I^2 = 96.94\%$ , $H^2 = 32.72$ Test of $\theta_i = \theta_i$ : Q(12) = 392.63, p = 0.01						
Test of group differences: $Q_b(2) = 0.56$ , $p = 0.76$						
Random-effects DerSimonian–Laird model	.2	.4	.6	.8		

Study					P	revaence of severe stress with 95% Cl	Weight (%)
Lahore							
Yasin, 2023						0.20 [ 0.13, 0.26]	7.81
Awan, 2023	-	-				0.12 [ 0.08, 0.17]	7.94
Mazhar, 2022						0.38 [ 0.29, 0.48]	7.56
Tahira, 2021						0.36 [ 0.28, 0.44]	7.68
Heterogeneity: $r^2 = 0.01$ , $I^2 = 92.64\%$ , $H^2 = 13.59$						0.26 [ 0.14, 0.39]	
Test of $\theta_i = \theta_j$ : Q(3) = 40.90, p = 0.01							
Karachi							
Mahmood, 2020						0.40 [ 0.29, 0.51]	7.39
Mahmood, 202			_			0.24 [ 0.14, 0.34]	7.54
Mahmood, 2020				_	_	0.64 [ 0.53, 0.75]	7.41
Panhwar, 2019		-				0.35 [ 0.26, 0.45]	7.57
Badil, 2017			_			0.35 [ 0.29, 0.41]	7.86
Heterogeneity: $\tau^2 = 0.02$ , $I^2 = 89.95\%$ , $H^2 = 9.95$		-		-		0.39 [ 0.27, 0.52]	
Test of $\theta_i = \theta_j$ : Q(4) = 31.39, p = 0.01							
Others							
Anwarali, 2024	-	_				0.13 [ 0.07, 0.19]	7.82
Saher, 2022						0.03 [ 0.00, 0.06]	8.01
Fatima, 2020	-	_				0.13 [ 0.06, 0.20]	7.81
Yousaf, 2019						0.66 [ 0.57, 0.75]	7.59
Heterogeneity: $\tau^2 = 0.08$ , $I^2 = 98.97\%$ , $H^2 = 96.70$						0.24 [ -0.04, 0.51]	
Test of $\theta_i = \theta_j$ : Q(3) = 171.01, p = 0.01							
Overall		-				0.30 [ 0.20, 0.41]	
Heterogeneity: r <sup>2</sup> = 0.04, I <sup>2</sup> = 97.12%, H <sup>2</sup> = 34.72							
Test of $\theta_i = \theta_j$ : Q(12) = 399.52, p = 0.01							
Test of group differences: $Q_b(2) = 2.55$ , p = 0.28							
Denders effects DEMI medel	0	.2	.4	.6	.8		
Kandom-ellects REML model							

Fig. 3 Subgroup analysis results for the prevalence of occupational stress based on the study location



Fig. 4 funnel plot for publication bias in the prevalence of mild, moderate, and severe occupational stress

resistant to publication bias, it is important to recognize that such biases may still affect the accuracy of the estimates. Therefore, caution is needed when interpreting the results, as publication and reporting biases could still influence the conclusions.

The results of the meta-regression showed that sample size and year of publication did not correlate with the reported prevalence of occupational stress. This finding suggests that factors other than study size, such as socioeconomic, cultural, and institutional differences may play a more important role in determining stress levels. For instance, in the context of Pakistan, factors like gender inequality (despite the predominance of female nurses), family expectations, and religious-social pressures may contribute to the workload of nurses [14]. However, due to limited data availability in the included studies, these factors were not thoroughly explored in this analysis. Future studies should aim to incorporate these variables to better understand the factors influencing stress levels across different settings.

Most of the studies analyzed were conducted in the two cities of Karachi and Lahore. This may be because these two cities are among the largest and most populous in Pakistan, with numerous academic and research centers where more scientific studies are conducted. The difference in the reported prevalence rates could be attributed to variations in the demographic characteristics of the study samples and the policies governing hospitals in these cities. However, the selection of studies was based on a systematic search and reflects the actual distribution of available research in this field.

## Limitations of the study

Although this meta-analysis followed a rigorous methodology, it has limitations. First, significant heterogeneity between the included studies, even using a random-effects model, reduces the generalizability of the results to all regions of Pakistan. Second, stress measurement tools (such as PSS, DASS) do not have identical sensitivity and specificity, which may affect data consistency. Third, since all the analyzed studies were observational, causal relationships between occupational factors and stress cannot be inferred. Fourth, publication bias related to mild and severe stress levels may have led to over- or underestimation of the findings. Fifth, this study solely focuses on occupational stress without examining related factors such as job satisfaction, work-life balance, or the specific causes of stress in the Pakistani nursing profession. Expanding the scope to include these aspects could provide a more comprehensive understanding of nurses' overall well-being.

## Conclusion

This study indicates that occupational stress, especially at moderate and severe levels, is an endemic challenge among nurses in Pakistan. Despite some limitations due to heterogeneity and publication bias, the findings emphasize the urgent need for measures to safeguard nurses' mental health. Future research should focus on longitudinal and qualitative studies to explore the underlying factors and assess the effectiveness of stress reduction interventions. Ultimately, investing in human resources will not only improve the quality of healthcare but also promote social justice for nurses. This study highlights the high prevalence of occupational stress among nurses in Pakistan, especially at moderate and severe levels. To address this issue, hospitals and healthcare centers can implement stress management programs, such as counseling sessions, support groups, and stress management training. Additionally, reducing workload by increasing the number of nurses and improving working conditions, such as ensuring adequate rest and a supportive work environment, can have a significant impact. Hospital administrators should provide greater support for nurses and implement policies that reduce workplace stress. Future research should explore more effective strategies for managing occupational stress among nurses to improve their well-being and enhance the quality of patient care.

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#### Author contributions

RGG, SS and MM conceptualized the study question. RGG, SS, MM and KA designed the study protocol and performed the study screening, selection, data extraction and quality assessment, with RGG acting as third reviewer in case of discordance. RGG performed the statistical analysis and drafted the initial manuscript. All authors read and approved the final version of this manuscript.

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#### Data availability

All data on diagnostic yield analyzed during the current study are available in the main text or supplementary material.

#### Declarations

Ethics approval and consent to participate Not applicable.

not applicable.

# Consent for publication

Not applicable.

## Clinical trial number

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#### Competing interests

The authors declare no competing interests.

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