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# *PREVALENCE OF BURNOUT AND MENTAL HEALTH SYMPTOMS AMONG BIOMEDICAL PHD CANDIDATES DURING THESIS STAGES*

Original Article

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**Short Title:** Burnout and Mental Health in Biomedical PhD Candidates

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## Abstract

**Background:** Doctoral education in biomedical sciences is a prolonged and demanding process that frequently places candidates at risk of psychological strain. Burnout, anxiety, and depressive symptoms have been consistently reported at higher rates in PhD populations compared with the general population, yet limited evidence exists from South Asian academic environments.

**Objective:** The study aimed to estimate the prevalence of burnout, anxiety, and depressive symptoms among biomedical PhD candidates in Lahore and to identify academic, supervisory, and workload-related predictors of these outcomes.

**Methods:** A cross-sectional study was conducted over four months among enrolled biomedical PhD candidates in Lahore. Data were collected using a structured questionnaire that included sociodemographic variables, academic characteristics, and validated psychometric instruments: the Maslach Burnout Inventory–Student Survey (MBI-SS), the Generalized Anxiety Disorder-7 (GAD-7), and the Patient Health Questionnaire-9 (PHQ-9). Descriptive statistics were used to estimate prevalence, while logistic regression models identified independent predictors, with results expressed as adjusted odds ratios (AOR) and 95% confidence intervals.

**Results:** Out of 372 candidates approached, 358 provided complete data (response rate 96.2%). Burnout prevalence was 41.1%, with emotional exhaustion in 46.6%, cynicism in 39.4%, and reduced academic efficacy in 28.5%. Anxiety and depressive symptoms were present in 32.4% and 29.1% of candidates, respectively. High workload (>50 hours/week) significantly increased the risk of burnout (AOR 2.34, 95% CI: 1.47–3.71), anxiety (AOR 1.96, 95% CI: 1.15–3.35), and depression (AOR 2.18, 95% CI: 1.23–3.87). Low supervisory support was an independent predictor of burnout (AOR 2.81, 95% CI: 1.72–4.60) and depression (AOR 2.37, 95% CI: 1.34–4.20). Burnout was highest during the data collection stage (49.6%).

**Conclusion:** The study revealed a substantial mental health burden among biomedical PhD candidates, strongly influenced by workload intensity and supervisory support. These findings highlight the urgent need for institutional reforms to reduce excessive academic pressure and strengthen supportive mentorship structures.


**Keywords:** Anxiety, Burnout, Depression, Doctoral Students, Mental Health, Mentors, Prevalence.

## Introduction

Doctoral education in the biomedical sciences is a demanding and prolonged process that requires candidates to navigate complex research tasks, meet high academic expectations, and maintain consistent productivity under conditions of uncertainty (1). While these programs are designed to develop critical scientific expertise, the pressures associated with doctoral studies can exact a significant toll on mental health and wellbeing (2). Burnout, anxiety, and depressive symptoms are increasingly recognized as serious issues among PhD candidates, often emerging during the different stages of thesis development (3). The cumulative workload, extended timelines, financial insecurity, and the challenges of navigating supervisory relationships all contribute to psychological strain (4). Unlike traditional professional training, doctoral research often lacks predictable milestones, exposing candidates to an open-ended and stressful academic trajectory that can threaten both their performance and personal health. Burnout, characterized by emotional exhaustion, depersonalization, and reduced sense of accomplishment, has been widely studied among healthcare professionals and students, but is increasingly reported among graduate researchers (5). The academic environment, with its culture of high competition, pressure to publish, and uncertainty about career prospects, creates conditions conducive to burnout (6). Similarly, symptoms of anxiety and depression are disproportionately common among doctoral candidates compared to age-matched general populations (7). Studies conducted in Europe and North America have shown that more than one-third of PhD students report significant depressive symptoms, with anxiety prevalence often higher (8). The biomedical sciences, in particular, are associated with additional pressures due to laboratory-intensive work, grant dependence, and the need for continuous experimental success, which may amplify mental health challenges compared to other disciplines (9). Supervisory relationships play a critical role in shaping the doctoral experience. Supportive supervision is protective against psychological distress, whereas poor supervisory engagement, unclear expectations, or conflict may exacerbate stress and increase risk for burnout (10). Similarly, workload distribution and the balance between research, teaching, and administrative tasks are key determinants of wellbeing. Excessive workload, tight deadlines, and limited autonomy in task prioritization have been consistently linked with higher levels of mental health symptoms (11). Conversely, environments that promote autonomy, constructive feedback, and manageable work distribution tend to foster resilience and wellbeing among PhD candidates.

The stages of thesis development may represent particularly vulnerable points for mental health difficulties. The early phase often brings challenges of adjusting to independent research and coping with uncertainty, while the mid-phase may involve the grind of repetitive experiments or data collection that is time-consuming and discouraging. Nearing completion, candidates face the pressure of finalizing manuscripts, defending their thesis, and navigating career transitions, all of which can intensify stress (12). Despite this, relatively few studies have examined how mental health symptoms fluctuate across the trajectory of thesis stages in biomedical PhD programs, representing an important knowledge gap (13). The consequences of poor mental health among PhD candidates extend beyond the individual. Burnout, anxiety, and depression can impair concentration, decision-making, and creativity, leading to reduced academic productivity and potentially prolonging the time to degree completion. On a broader scale, high levels of distress contribute to attrition, undermining the efficiency of doctoral training programs and resulting in significant loss of investment for institutions and funding bodies. Addressing these issues is not only a matter of supporting student wellbeing but also of safeguarding the sustainability of academic research systems.

Although the problem is increasingly recognized, interventions remain underdeveloped. Universities have begun to introduce wellbeing programs, counseling services, and stress-management workshops, but these are often underutilized due to stigma or lack of accessibility. Identifying specific predictors of mental health difficulties, particularly those that are modifiable within the academic environment, is essential for designing targeted strategies. Factors such as supervisory quality, academic workload, and the clarity of program expectations are potentially modifiable, and thus hold promise for intervention. Yet, empirical evidence on how these variables specifically relate to burnout, anxiety, and depressive symptoms in biomedical PhD candidates remains limited, especially in low- and middle-income contexts. The rationale for this study lies in the urgent need to better understand the mental health burden faced by biomedical PhD candidates, with a focus on the prevalence of burnout, anxiety, and depressive symptoms, and the academic factors that influence them. By mapping these outcomes across different thesis stages, this study seeks to provide insights into when candidates are most vulnerable, and which elements of the doctoral environment exacerbate or protect against distress. The objective is to estimate the prevalence of these mental health symptoms and to identify academic, supervisory, and

workload-related predictors among biomedical PhD candidates, thereby contributing evidence to inform policies and interventions that support wellbeing throughout the doctoral journey.

## Methods

This investigation was conducted as a cross-sectional study with the primary objective of estimating the prevalence of burnout, anxiety, and depressive symptoms among biomedical PhD candidates, while simultaneously identifying academic, supervisory, and workload predictors associated with these outcomes. The study was carried out in Lahore, where a number of biomedical doctoral programs are clustered within major universities and research institutions. This setting provided a diverse pool of participants across different stages of thesis work. The target population consisted of currently enrolled biomedical PhD candidates engaged in laboratory or clinical research. Inclusion criteria required that participants were registered in a PhD program for at least six months to ensure adequate exposure to academic and supervisory demands. Those on academic leave of absence, having already defended their thesis, or unwilling to provide informed consent were excluded. A sample size was estimated using an assumed prevalence of mental health symptoms of approximately 30%, derived from prior international studies, with a 95% confidence level and 5% margin of error. Applying the single population proportion formula, the minimum sample size calculated was 323. To account for potential non-response or incomplete questionnaires, an additional 15% was added, yielding a target sample size of approximately 370 participants. Recruitment was facilitated through collaboration with university graduate offices and departmental supervisors within participating institutions, who circulated invitations via institutional mailing lists and notice boards. All eligible candidates identified through these channels were approached, and participation remained voluntary. Written informed consent was obtained from each participant prior to data collection. Confidentiality was strictly preserved by assigning unique identification codes, and no identifiable information was stored alongside responses. Ethical approval for the study protocol was obtained from the institutional review board of the principal coordinating university in Lahore, ensuring compliance with national and international ethical standards.

Data collection relied on a self-administered structured questionnaire composed of four sections: sociodemographic characteristics, academic and workload variables, supervisory experiences, and validated mental health instruments. Burnout was assessed using the Maslach Burnout Inventory–Student Survey (MBI-SS), which measures emotional exhaustion, cynicism, and academic efficacy on a Likert scale, with overall burnout classified according to its standard scoring algorithm. Anxiety symptoms were measured with the Generalized Anxiety Disorder-7 (GAD-7) scale, while depressive symptoms were evaluated using the Patient Health Questionnaire-9 (PHQ-9). Both instruments have been widely validated in academic and clinical populations, demonstrating high internal consistency and construct validity. To capture academic and supervisory predictors, items were included on weekly workload hours, number of publications under preparation, frequency of supervisory meetings, perceived supervisory support, clarity of research expectations, and stage of thesis work. All questionnaires were administered electronically through a secure online survey platform, enabling wide accessibility and minimizing data entry errors. The survey remained open for eight weeks, with periodic reminders issued to maximize response rates. Data quality checks were implemented, and incomplete submissions were excluded from final analysis. Data analysis was performed using SPSS version 26. Descriptive statistics summarized participant demographics, academic variables, and prevalence estimates for burnout, anxiety, and depression. Continuous variables such as age and weekly workload hours were presented as means with standard deviations, while categorical variables were expressed as frequencies and percentages. Normality of continuous data was confirmed using the Shapiro–Wilk test, permitting the use of parametric analyses.

Bivariate analyses were conducted to examine associations between mental health outcomes and independent predictors. Independent samples t-tests and one-way ANOVA were employed for continuous normally distributed variables, while chi-square tests were applied for categorical variables. Pearson correlation coefficients were calculated to assess relationships between workload hours, supervisory frequency, and mental health scores. Variables showing significant associations at the bivariate level were further entered into multivariate logistic regression models to identify independent predictors of burnout, anxiety, and depression, adjusting for potential confounders such as age, gender, marital status, and stage of thesis progression. Adjusted odds ratios with 95% confidence intervals were reported to quantify the strength of associations. The outcome measures were prevalence of burnout, anxiety, and depressive symptoms, classified according to established cut-offs for each instrument. For burnout, high

emotional exhaustion or cynicism in combination with low academic efficacy was considered indicative. Anxiety prevalence was defined as a GAD-7 score of ≥10, while depressive symptoms were defined as a PHQ-9 score of ≥10. Supervisory quality was categorized into high, moderate, and low support groups based on participant ratings, and workload was stratified for analysis, including a comparison of those working more than 50 hours per week. All statistical analyses were performed at a 5% significance level. The methodological framework was designed to allow replication by future studies in comparable academic settings and to ensure the robustness of findings. The combination of validated psychometric instruments with rigorous statistical testing provided a reliable basis for estimating the burden of mental health symptoms and identifying modifiable academic predictors among biomedical PhD candidates in Lahore.

## Results

The study recruited 372 biomedical PhD candidates, of which 358 provided complete and analyzable data, yielding a response rate of 96.2%. The mean age of participants was 28.9 ± 3.4 years, with slightly more females (54.2%) than males (45.8%). The majority of respondents were unmarried (62.0%), and over two-thirds were in the laboratory-based research track. Regarding stage of thesis work, 39.9% were in coursework and proposal writing, 36.9% in data collection and experimentation, and 23.2% in the final writing or submission stage. Mean weekly workload was reported as 47.6 ± 9.8 hours, with 42.7% of candidates exceeding 50 hours per week.

Burnout prevalence was found to be substantial, with 41.1% of participants scoring above the threshold on the Maslach Burnout Inventory–Student Survey. Emotional exhaustion was present in 46.6%, cynicism in 39.4%, and reduced academic efficacy in 28.5%. Burnout prevalence was higher in candidates working more than 50 hours weekly (57.3%) compared to those with lighter workloads (28.9%). Anxiety symptoms were identified in 32.4% of participants, with 18.2% in the moderate range and 14.2% in the severe range according to the GAD-7 scale. Depressive symptoms were reported by 29.1%, of which 10.9% had moderate and 7.8% had moderately severe to severe levels on the PHQ-9. Supervisory quality emerged as an important contextual factor. Among candidates reporting high supervisory support, burnout prevalence was 22.8%, compared with 48.7% among those rating their supervisors as offering low support. Similar patterns were observed for anxiety (17.5% vs. 41.3%) and depression (14.2% vs. 37.9%). Stage of thesis also showed differential prevalence: burnout was highest during data collection (49.6%) compared with proposal stage (38.2%) and writing stage (32.5%).

Multivariate logistic regression identified high workload (>50 hours/week) as an independent predictor of burnout (AOR: 2.34, 95% CI: 1.47–3.71), anxiety (AOR: 1.96, 95% CI: 1.15–3.35), and depression (AOR: 2.18, 95% CI: 1.23–3.87). Low supervisory support independently predicted burnout (AOR: 2.81, 95% CI: 1.72–4.60) and depressive symptoms (AOR: 2.37, 95% CI: 1.34–4.20). Stage of thesis in active data collection was associated with a higher likelihood of burnout (AOR: 1.78, 95% CI: 1.05–3.02) compared to those in the proposal stage. Gender and marital status were not significantly associated with mental health outcomes after adjustment. These findings demonstrated that nearly half of biomedical PhD candidates in Lahore experienced burnout, and a considerable proportion faced clinically relevant anxiety and depressive symptoms. Academic workload and supervisory relationships were consistently associated with these outcomes. Detailed demographic characteristics and prevalence data are presented in Table 1 and Table 2, while predictors and regression analyses are displayed in Tables 3 and 4. Figure 1 depicts overall prevalence of burnout, anxiety, and depression, whereas Figure 2 illustrates the adjusted odds ratios for key predictors.

**Table 1: Demographic Characteristics of Participants (n=358)**

| ***Variable*** | ***n (%) / Mean ± SD*** |
|---|---|
| *Age (years)* | 28.9 ± 3.4 |
| *Gender (Male/Female)* | 164 (45.8) / 194 (54.2) |
| *Marital Status (Single)* | 222 (62.0) |

| *Variable* | *n (%) / Mean ± SD* |
|---|---|
| *Research Track* | Laboratory 242 (67.6) / Clinical 116 (32.4) |
| *Stage of Thesis* | Proposal 143 (39.9) / Data collection 132 (36.9) / Writing 83 (23.2) |
| *Weekly Workload (hours)* | 47.6 ± 9.8 |

**Table 2: Prevalence of Burnout, Anxiety, and Depression**

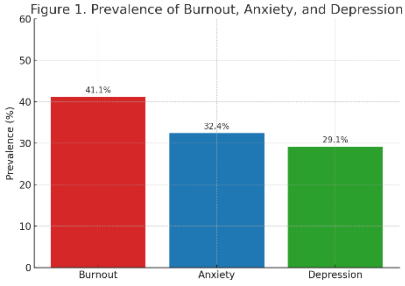
| *Outcome* | *Prevalence (%)* |
|---|---|
| *Burnout (overall)* | 41.1 |
| *Emotional exhaustion* | 46.6 |
| *Cynicism* | 39.4 |
| *Reduced academic efficacy* | 28.5 |
| *Anxiety (GAD-7 ≥10)* | 32.4 |
| *Depression (PHQ-9 ≥10)* | 29.1 |

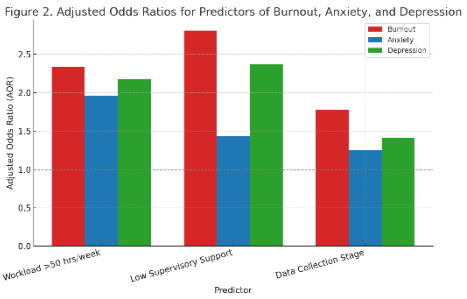
**Table 3: Prevalence Stratified by Supervisory Support**

| *Supervisory Support* | *Burnout (%)* | *Anxiety (%)* | *Depression (%)* |
|---|---|---|---|
| *High* | 22.8 | 17.5 | 14.2 |
| *Moderate* | 37.9 | 29.4 | 23.6 |
| *Low* | 48.7 | 41.3 | 37.9 |

**Table 4: Multivariate Logistic Regression of Predictors**

| *Predictor* | *Burnout AOR (95% CI)* | *Anxiety AOR (95% CI)* | *Depression AOR (95% CI)* |
|---|---|---|---|
| *Workload >50 hrs/week* | 2.34 (1.47–3.71) | 1.96 (1.15–3.35) | 2.18 (1.23–3.87) |
| *Low Supervisory Support* | 2.81 (1.72–4.60) | 1.43 (0.87–2.33) | 2.37 (1.34–4.20) |
| *Data collection stage* | 1.78 (1.05–3.02) | 1.25 (0.71–2.18) | 1.41 (0.76–2.61) |




## Discussion

The findings of this study highlighted that burnout, anxiety, and depressive symptoms were highly prevalent among biomedical PhD candidates in Lahore, with nearly half experiencing burnout and about one-third reporting clinically relevant anxiety and depressive symptoms (14). These results reinforced international evidence demonstrating that postgraduate researchers are at considerable risk of mental health difficulties, particularly within biomedical sciences where prolonged research demands, experimental uncertainties, and extended working hours are common (15). The observed prevalence rates aligned with studies from Europe and North America, which have consistently shown doctoral candidates to be at a two- to three-fold greater risk of poor mental health compared with age-matched general populations (16). However, the present study added context-specific evidence from a South Asian academic environment, where structural and supervisory challenges may differ (17). Workload emerged as a consistent predictor across outcomes, confirming previous research that associates long working hours and blurred boundaries between personal and academic life with mental health deterioration. Participants working more than 50 hours weekly had significantly higher odds of experiencing burnout, anxiety, and depressive symptoms (18). This reflected global discussions on academic overwork, where the culture of extended working hours is often normalized (19). The association between workload and psychological distress emphasized the need for academic institutions to promote work-life balance and implement policies discouraging excessive working demands. Supervisory quality played a critical role, with low supervisory support strongly predicting both burnout and depressive symptoms (20). This finding was consistent with studies showing that effective, supportive supervision not only fosters academic progress but also serves as a protective factor against psychological strain (21). In environments where students reported limited guidance, unclear expectations, or inconsistent feedback, risks of emotional exhaustion and reduced academic efficacy were magnified. Conversely, candidates with supportive supervisory relationships demonstrated substantially lower prevalence rates of adverse mental health outcomes(22). This underscored the importance of training supervisors in mentorship and communication, extending beyond research oversight to include wellbeing support. The stage of thesis progression influenced burnout prevalence, with candidates in data collection phases experiencing higher emotional exhaustion compared with those in proposal or writing stages. This pattern was likely attributable to the intensive demands of laboratory and fieldwork, where failure rates and time pressure accumulate. Similar trends have been noted in international doctoral cohorts, suggesting that certain phases of the PhD trajectory carry heightened psychological risk. Recognition of these vulnerable stages could allow targeted interventions, such as workload redistribution or structured stress management programs, to mitigate adverse effects.

While gender and marital status did not show significant associations after adjustment, the absence of sociodemographic effects may reflect the overwhelming influence of structural academic pressures that cut across demographic boundaries. This finding suggested that institutional reforms targeting workload, supervisory practices, and structural supports may yield broader benefits than demographic-specific interventions. The study carried several strengths, including the use of validated tools such as the Maslach Burnout Inventory, GAD-7, and PHQ-9, which ensured reliability and comparability with international literature. The robust sample size and inclusion of participants across multiple institutions enhanced generalizability within the local context. Additionally, the analytical approach, using multivariate logistic regression, allowed identification of independent predictors while accounting for

confounding factors. Nonetheless, several limitations warranted consideration. The cross-sectional design precluded causal inference, as temporal relationships between predictors and outcomes could not be firmly established. Self-reported measures introduced the possibility of reporting bias, particularly given the stigma around mental health in academic and cultural contexts. The sample was restricted to biomedical PhD candidates, limiting applicability to other disciplines with different academic cultures. Furthermore, unmeasured variables such as financial strain, family expectations, and access to mental health resources may have contributed to outcomes but were not fully captured. Future research should incorporate longitudinal designs to examine changes in mental health symptoms over the course of doctoral studies, as well as qualitative approaches to explore lived experiences and coping strategies. Cross-disciplinary comparisons would also provide valuable insights into whether mental health risks are uniquely heightened in biomedical sciences or extend broadly across academic domains. Institutional interventions, such as structured mentorship programs, workload regulation policies, and confidential counseling services, merit evaluation to determine their impact on student wellbeing.

## Conclusion

This study demonstrated a high prevalence of burnout, anxiety, and depressive symptoms among biomedical PhD candidates, with workload and supervisory factors emerging as key predictors. The results underscored the urgent need for academic institutions to address systemic pressures through enhanced mentorship, workload management, and supportive infrastructures. By prioritizing student wellbeing, universities can foster healthier academic environments, improve doctoral completion outcomes, and safeguard the future of biomedical research.

## AUTHOR CONTRIBUTIONS

| Author | Contribution |
|---|---|
| Shabahat Arain**** | Substantial Contribution to study design, analysis, acquisition of Data<br>Manuscript Writing<br>Has given Final Approval of the version to be published |

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