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Review Article

Risk factors associated with mental health outcomes and related conditions in graduate students: a systematic review

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This is a preliminary, unedited version of a manuscript that has been accepted for publication in the Brazilian Journal of Psychiatry. As a service to our readers, we are providing this early version of the manuscript. The manuscript will still undergo copyediting, typesetting, and review of the resulting proof before it is published in final form. The final version may present slight differences in relation to the present version.

Risk factors associated with mental health outcomes and related conditions in graduate students: a systematic review

Running Title: Mental health in graduate students

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Abstract

Objective: The primary goal of this systematic review was to identify risk factors linked to mental health outcomes and related conditions, categorized across academic, biological, financial (academic/institutional funding), lifestyle, comorbidities, psychological, and social domains. The secondary goal was to estimate the prevalence of these mental health and related conditions.
Methods: This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This review analyzed

observational studies reporting risk factors associated with mental health outcomes and related conditions.

Results: Multiple factors associated with mental health outcomes and related conditions were identified, with the highest number of reports in the following domains: academic (37.0%; 47 factors) and psychological (19.7%; 25 factors), followed by social (13.4%; 17 factors), comorbidities (12.6%; 16 factors), biological (8.6%; 11 factors), lifestyle (6.3%; 8 factors), and financial (2.4%; 3 factors). Regarding prevalence estimates, perceived stress ranged from 18.6% to 88.0%; anxiety symptoms, from 18.8% to 75.0%; depressive symptoms, from 10.1% to 89.1%; suicide-related outcomes, from 1.8% to 9.9%; and problems with eating behavior, from 5.8% to 29.9%.

Conclusions: The results of this systematic review demonstrate several risk factors associated with mental health outcomes and related conditions, suggesting that multiple aspects influence the mental health of graduate students. These findings, combined with the high prevalence estimates observed, justify the development of university policies to promote mental health in graduate education.

PROSPERO registration: CRD42020203855

Keywords: Anxiety; Depression; Graduate Education; Mental Health; Stress

Introduction

According to the World Health Organization (WHO), mental disorders such as anxiety and depression are among the most prevalent worldwide, affecting approximately 14% of the global population, impacting more than one billion people, and generating substantial economic consequences for healthcare systems[1]. Although these disorders affect individuals of all ages and backgrounds[1,2], graduate students are among those most susceptible to developing mental health-related disorders[3,4].

Mental health outcomes and related conditions such as anxiety, burnout, depression, and stress are among the most common outcomes reported by students[4,5], negatively affecting their quality of life[6] and causing physical and emotional exhaustion[4,7]. These outcomes are also associated with other adverse consequences, including program dropout, reduced work quality, low productivity, and diminished academic performance, ultimately influencing the development of future faculty members and researchers[4,8,9]. In this context, evidence suggests that

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suicide-related outcomes (e.g., suicidal ideation and behavior) is a concerning issue throughout the academic trajectory, negatively affecting academic life, overall health, and society as a whole[1].

Given the growing concern with the mental health of university students, particularly those enrolled in graduate programs[5,10], improving mental health care for this population should be a priority, as they represent one of the pillars of scientific and technological production[4]. Thus, understanding the risk factors associated with mental health outcomes and related conditions across different regions of the world and at different levels of graduate education is essential for developing specific and effective coping and intervention strategies[8].

Previous systematic reviews on mental health problems in university populations have focused on undergraduate students[11] or medical students[12]. Recently, two systematic reviews and meta-analyses involving doctoral students were published. One focused on the prevalence of anxiety, depression, and suicidal ideation[13], and the other examined factors associated with mental health problems, anxiety, and depression[14]. However, both reviews included only doctoral students and did not assess outcomes such as burnout, sleep problems, or eating behavior. Moreover, although they incorporated transnational studies, they did not include searches in Portuguese or Spanish terms, nor did they consult Latin American electronic databases, which would have broadened the scope of the search. Furthermore, the last reviews involving doctoral students were published in 2018[14] and 2019[13].

Therefore, more studies are needed, including those involving master's and doctoral students, with a broader scope of mental health outcomes and related conditions. Additionally, Latin American databases with studies in Portuguese and Spanish, as well as updated data, should be considered. Given these considerations and the importance of the topic for both education and public health, this study presents a systematic review of risk factors associated with mental health outcomes and related conditions in graduate students. As a secondary objective, we also evaluated the prevalence of these outcomes within this population.

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Methods

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[15]. The PRISMA 2020 checklist is available in Supplementary Material S1.

Eligibility Criteria

Inclusion Criteria

This review included observational studies with quantitative or mixed (quantitative-qualitative) analyses that used subjective measures (i.e., questionnaires and psychopathology scales) or clinical interview and reported risk factors associated with mental health outcomes and related conditions (E.g., anxiety symptoms, burnout, depressive symptoms, perceived stress, suicide-related outcomes, sleep problems, and problems with eating behavior) among graduate students (master's and doctoral levels). Scientific articles published in indexed journals and scientific documents derived from dissertations were included. The search was not restricted by language, date, or publication status.

Exclusion Criteria

Studies were excluded if they met any of the following exclusion criteria: (1) studies on other types of mental health-related outcomes (bipolar disorder and related disorders, etc.), (2) studies conducted exclusively with undergraduate students, (3) studies that did not report factors associated with mental health-related outcomes, (4) secondary studies (review studies, letters to the editor, opinion articles, books, etc.), (5) studies that did not separate data between undergraduate and graduate students, (6) studies with only qualitative results, (7) studies without the full-text access, (8) studies conducted with other populations (non-students), (9) studies that did not specify academic level; and (10) studies for which translation was not feasible.

Information Sources

Search strategies were developed specifically for each of the following databases: CINAHL, Lilacs, PsycINFO, PubMed, SciELO, and Web of Science. The search was also conducted in the grey literature (a term frequently used to refer to reports published outside traditional publications) using Google Scholar, Open Grey,

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and ProQuest. Additional articles were identified through manual searches of the reference lists of manuscripts included in the review, and two experts were contacted by email and invited to suggest relevant articles on the topic. The final search date for all databases was May 31, 2020, with an update performed on February 26, 2025.

Searches

The search strategies were adapted according to the electronic databases used. Additional details on the search strategies are available in Supplementary Material S2.

Study Selection

All references were organized in EndNote (EndNote X9® Basic, Thomson Reuters, New York, USA), and duplicate studies were removed. Study selection occurred in two phases. In the first phase, two reviewers (LUN, PABA) independently screened the titles and abstracts of all retrieved studies. Studies that did not meet the inclusion criteria were discarded. In the second phase, the same reviewers (LUN, PABA) applied the same selection criteria to screen the full text of the studies. Any disagreement in either phase was resolved through discussion and consensus between reviewers. When consensus could not be reached, a third reviewer (GFS) participated in the final decision. The first-phase screening was conducted using the Rayyan QCRI software[16], and the second phase was conducted using a spreadsheet in Microsoft® Office Excel.

Data Collection Process

Two reviewers (LUN, PABA) independently performed data collection. All information was cross-checked after individual extraction. Disagreements between the two reviewers were discussed and resolved. A third reviewer (GFS) made the final decision in cases without agreement.

Data Items

The following information was extracted from the studies: author, year of publication, country, study design, academic level, sample size and percentage of

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female students, age, outcomes, instruments, prevalence, and risk factors associated with mental health outcomes and related conditions.

Methodological Quality Assessment

The studies included in the review were evaluated using the Joanna Briggs Institute-Critical Appraisal: Checklist for Analytical Cross-Sectional Studies[17]. This instrument consists of eight criteria that evaluate key aspects of study design and conduct, including: (1) clear definition of the sample inclusion criteria; (2) detailed description of the participants and the study context; (3) validity and reliability of the measures used to assess exposure and outcome; (4) use of objective and standardized criteria for condition measurement; (5) identification of confounding factors; (6) use of strategies to address confounding factors; (7) valid and reliable measurement of outcomes; and (8) appropriateness of the statistical analyses used. Each criterion of the instrument is rated as “yes”, “no”, “unclear”, or “not applicable”, allowing reviewers to assess items related to the methodological quality of the individual studies included. Two reviewers (PABA, WO) independently conducted this assessment. The results were compared, and any disagreements were resolved with the involvement of a third reviewer (GFS).

Summary Measures and Results

The primary goal corresponded to the risk factors associated with mental health outcomes and related conditions, categorized into academic, biological, financial (academic/institutional funding), lifestyle, comorbidities, psychological, and social domains. The risk factors were grouped according to the nature and conceptual similarity, using some of the categories adopted by Mofatteh[18]. The secondary goal was to estimate the prevalence of these mental health outcomes and related conditions.

Results

Study Selection

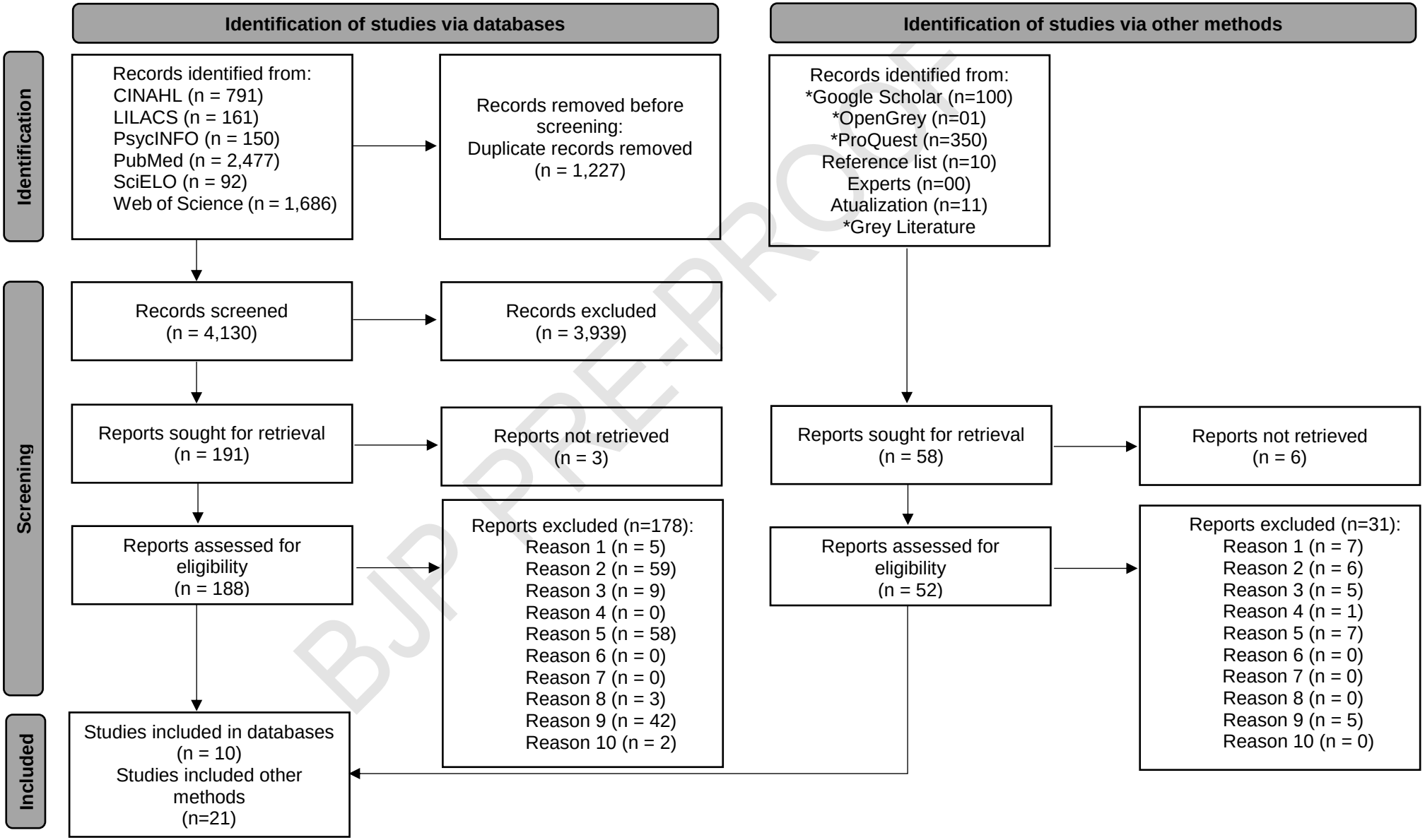
A total of 5,357 studies were retrieved from the six electronic databases searched. After removing duplicates, 4,130 studies were screened. Additionally, 472 studies were identified through grey literature and updated searches. In the first selection phase (titles and abstracts screening), 188 studies from the electronic

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databases and 52 studies from grey literature and the updated searches were selected for full-text reading. In phase 2 (full-text screening), 10 studies from the electronic databases were included, four studies from grey literature, 10 additional studies were identified from the references of the included studies, seven studies were incorporated from the updated searches, and 209 studies were excluded based on the eligibility criteria (Supplementary Material S3). The two experts contacted did not provide additional studies. In total, 31 studies were included for the qualitative analysis. Figure 1 presents a flowchart describing the entire study selection process.

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Figure 1 – Flow Diagram of Literature Search and Selection Criteria (Adapted from PRISMA[15]).



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Study Characteristics

Thirty-one studies[3,7–9,19–45] were included, all with cross-sectional designs and conducted in various countries. The United States[3,7,19–22,25–27,31,34,35,37–40,44,45] accounted for the largest number of studies, followed by China[9,32], Finland[23,42] and India[30,33], as well as Australia[8], South Korea[29], Brazil[36], Canada[41], and three studies involving students from multiple countries[24,28,43].

Sample sizes ranged from 53[29] to 21,072[32], totaling 35,669 assessed students. Regarding academic level, four studies evaluated only master's students[19,30,31,33], 13 studies evaluated doctoral students[3,8,9,23–25,28,37–39,42,43,45] and 14 studies included both academic levels[7,20–22,26,27,29,32,34–36,40,41,44].

All articles reported at least one factor associated with mental health outcomes and related conditions, and prevalence was reported in 13 studies[7,9,19,25,26,30,32–34,37,38,41,44]. Some studies assessed multiple outcomes[3,8,9,19–22,25,26,31–34,37–40,42–44], while others focused on specific outcomes such as perceived stress[7,29,30,36,45], burnout[23,24,27,28], and depressive symptoms[35,41]. Considering all included outcomes, the most frequently assessed condition among graduate students was perceived stress[3,7,8,19,20,22,25,29–31,33,36,37,39,40,43,45,46], followed by depressive symptoms[3,8,9,21,22,25,26,33–35,37,38,41,43,44], anxiety symptoms[8,9,21,22,25,26,33,34,37,38,42,44], burnout[3,20,23,24,27,28,31,38], suicide-related outcomes[25,26,32] and problems with eating behavior[26,38]. Various instruments were used to assess these conditions, most notably the Perceived Stress Scale (PSS), used in six studies[8,19,20,22,30,36]; the Patient Health Questionnaire (PHQ), used in six studies[3,9,26,34,35,38] to assess depressive symptoms; the Depression, Anxiety and Stress Scale (DASS), used in five studies[8,21,25,33,37] to assess depressive symptoms, anxiety symptoms, and perceived stress; and the Maslach Burnout Inventory (MBI), used in four studies[20,24,28,31] to assess burnout. Data extracted from the original studies are presented in Table 1.

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Table 1 – Summary of descriptive characteristics of included studies (n=31).

Author, Year; Country	Academic degree	Sample size n (n female; percentage)	Age years (Mean ± Standard Deviation), Range	Outcomes (Instruments)	Prevalence estimates (%)
Addonizio[19]., 2011, USA	Master students	372 (333; 89.5%)	(29.3±8.9) 21.0 to 62.0	Stress (PSS-10)	NR
Allen et al[20]., 2021, USA	Master and Ph.D. students	2,683 (1,690; 63.0%)	(28.0±5.8)	Stress (PSS-10) Burnout (MBI)	NR
Barry et al[8]., 2018, Australia	Ph.D. students	81 (66; 81.5%)	(38.1±1.3)	Depression, Anxiety, Stress (DASS-42) Stress (PSS-10)	NR
Boyle & McKinzie[21]., 2018, USA	Master and Ph.D. students	1,149 (788; 69.0%)	18.0 to 35.0	Depression and Anxiety (DASS-21)	NR
Clark et al[22]., 2012, USA	Master and Ph.D. students	400 (276; 69.0%)	(26.3±4.9)	Depression and Anxiety (Brief Symptom Inventory) Stress (PSS-14)	NR
Corner et al[23]., 2017, Finland	Ph.D. students	248 (147; 59.0%)	30.0 to 34.0	Burnout (Doctoral Experience Survey)	NR
Devine & Hunter[24]., 2017, Eight Countries ¶	Ph.D. students	183 (150; 82.0%)	(32.5±6.3)	Burnout (MBI)	NR
Ellison et al[25]., 2020, USA	Ph.D. students	59 (48; 81.3%)	(25.4) 18.0 to 36.0	Depression, Anxiety, Stress (DASS-21) Suicidal Ideation	Anxiety symptoms (25.4%)

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				(49-item survey)	Depressive symptoms (13.5%) Perceived stress (18.6%) Suicidal Ideation (6.7%)
Garcia-Williams et al[26]., 2014, USA	Graduate students ‡	301 (232; 77.1%)	(27.9±5.9) 18.0 to 63.0	Depression (PHQ-9) Anxiety, Eating behavior problems, Suicidal behavior (Mental Health Questionnaire)	Anxiety symptoms (52.0%) ⫫ Depressive symptoms (34.4%) ⫫ Suicidal Behavior (9.9%) ⫫ Eating Behavior (29.9%) ⫫
Harris[27]., 2019, USA	Master and Ph.D. students	92 (65; 70.7%)	(28.8±8.2)	Burnout (ProQOL-5)	NR
Hish et al[3]., 2019, USA	Ph.D. students	69 (42; 60.9%)	(26.5±2.3) 22.0 to 33.0	Burnout (SBI) Stress (GSI-R) Depression (PHQ-9)	NR
Hunter & Devine[28]., 2016, Eight Countries ¶	Ph.D. students	186 (150; 80.6%)	(32.8±6.8)	Burnout (MBI)	NR
Hyun et al[7]., 2007, USA	Master and Ph.D. students	551 (195; 35.3%)	(28.9±5.4) <20.0 to >40.0	Stress (Questionnaire)	Perceived stress † (45.0%)
Jeong & Koh[29], 2021, South Korea	Master and Ph.D. students	231 (231; 100.0%)	(32.8±5.5)	Stress (Seven-item instrument)	NR

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Juneja et al[30]., 2021, India	Master students	250 (162; 64.8%)	NR	Stress (PSS-10)	Perceived stress ¢ (88.0%)
Koeske & Koeske[31]., 1991, USA	Master students	136 (112; 82.0%)	(32.0)	Burnout (MBI) Stress (Different scales)	NR
Li & Huang[32]., 2009, China	Master and Ph.D. students	21,072 (7,503; 35.6%)	(25.1) 20.0 to 47.0	Suicidal Ideation (UPI)	Suicidal Ideation (1.8%)
Liu et al[9]., 2019, China	Ph.D. students	(325 (196; 60.3%)	(31.1±5.3) 23.0 to 47.0	Anxiety (GAD-7) Depression (PHQ-9)	Anxiety symptoms (20.0%) ╬ Depressive symptoms (23.7%)
Madhan et al[33]., 2012, India	Master students	330 (148; 44.9%)	(26.0±1.8) 24.0 to 34.0	Depression, Anxiety, Stress (DASS 21)	Anxiety symptoms (38.8%) Depressive symptoms (29.7%) Perceived stress (84.2%)
Malik et al[34]., 2023, USA	Master and Ph.D. students	341 (233; 68.3%)	(31.8±10.0)	Anxiety (GAD-7) Depression (PHQ-9)	Anxiety symptoms (75.0%) Depressive symptoms (89.1%)
Martinez et al[35]., 2024, USA	Graduate students ‡	631 (399; 63.2%)	(28.2±5.0)	Depression (PHQ-8)	NR
Meira et al[36]., 2021, Brazil	Master and Ph.D. students	707 (516; 73.0%)	(30.4±7.4) 21.0 to 65.0	Stress (PSS-14)	NR

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Miller & Orsillo[37]., 2020, USA	Ph.D. students	436 (319; 73.8%)	(30.5±8.6) 20.0 to 70.0	Depression, Anxiety, Stress (DASS 21)	Anxiety symptoms (49.5%) Depressive symptom (39.2%) Perceived stress (38.0%)
Nagy et al[38]., 2019, USA	Ph.D. students	69 (42; 60.9%)	(26.5±2.3) 22.0 to 33.0	Burnout (SBI) Depression (PHQ-9) Mood Disorders (SCID-5-RV)	Anxiety symptoms (18.8%) Depressive symptoms (10.1%) Feeding and Eating disorders (5.8%)
Nelson et al[39]., 2001, USA	Ph.D. students	53 (26; 49.0%)	(32.0) 22.0 to 49.0	Stress (Stress Questionnaire)	NR
Ogunsanya et al[40]., 2018, USA	Master and Ph.D. students	89 (47; 52.8%)	(28.7±3.5)	Stress (GSI-R, ASSIS)	NR
Peluso et al[41]., 2011, Canada	Master and Ph.D. students	292 (255; 87.0%)	21.0 to 57.0	Depression (CES-D)	Depressive symptoms (33.0%)
Phyhalto et al[42]., 2012, Finland	Ph.D. students	669 (496; 74.1%)	(42.6)	Anxiety (IGSO) Stress (Single-item stress symptoms)	NR
Sverdlik & Hall[43]., 2020, Internationally ?	Ph.D. students	3,004 (2,384; 79.6%)	(30.3±6.2) 21.0 to 69.0	Depression (CES-D) Stress (Strain scale; 10-item)	NR
Ternand[44]., 2014, USA	Master and Ph.D. students	120 (99; 83.0%)	(29.0±7.6)	Anxiety, Depression (BSI-18)	Anxiety symptoms (27.0%) Depressive symptoms (22.0%)

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Touche[45]., 2017, USA	Ph.D. students	540 (356; 66.0%)	(29.6±6.4) 22.0 to 65.0	Stress (GSSC; K6 scale)	NR

ASSIS=Acculturative Stress Scale for International Students; BSI-18=Brief Symptom Inventory; CES-D= Center for Epidemiological Studies Depression Scale; DASS 42 (long version)=Depression Anxiety Stress Scales; DASS 21 (short version)=Depression Anxiety Stress Scales; GAD-7=Generalized Anxiety Disorder; GSI-R=Graduate Stress Inventory-Revised Scale; GSSC=Graduate Student Stress and Coping Survey; IGSO: Inventory of General Study Orientations; MBI=Maslach Burnout Inventory; NR=Not Reported; PHQ-8=Patient Health Questionnaire-8; PHQ-9=Patient Health Questionnaire-9; ProQOL-5: Professional Quality of Life Scale-Version Five; PSS-14=Perceived Stress Scale-14; PSS-10=Perceived Stress Scale-10; SBI=School Burnout Inventory; SCID-5-RV=Structured Clinical Interview for DSM-5 (Research Version); UPI=University Personality Inventory; USA=United States of America; ¶Eight Countries= Australia, New Zealand, Canada, France, Norway, United Kingdom, United States of America, South Africa; ‡Graduate students: not specified by the authors the academic degree (Master or Ph.D. students); ╬Depression (Total Categories – calculated by authors): moderate (22.9%), moderately severe (9.2%), severe (2.3%); ╬Anxiety (item): Feeling intensely anxious or having anxiety attacks (52.0%); ╬Suicidal behavior: Lifetime suicide attempt (9.9%); ╬Eating behavior (mean items – calculated by author): Feeling that you can`t control what or how much you eat (40.7%), Feeling overly concerned about staying thin or losing weight (46.4%), Making yourself vomit after eating (2.7%); †Stress (mean – calculated by authors): international students (44.1%) and domestic students (46.0%); ₡Stress (Total categories – calculated by authors): moderate (69.2%), high (18.8%);⁉Internationally: 54 countries (USA (57.8%), Europe (12.2%), Canada (10.9%), United Kingdom (10.5%), Australia (3.8%), Asia/Middle East (4.8%)).

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Methodological Quality Assessment

When the included cross-sectional studies were assessed for methodological quality using the Joanna Briggs Institute Critical Appraisal Checklist for Analytical Cross-Sectional Studies[17], the items related to the validity and reliability of exposure and outcome measures, the use of objective and standardized assessment criteria, and the adequacy of statistical analyses received the highest ratings, with all studies classified as “yes” for these criteria.

Twenty studies did not clearly describe sample inclusion and exclusion criteria[7,19,22,23,24,25,26,28,29,30,31,32,33,36,39,40,41,42,44,45]. A detailed description of participants and study context was unclear in two studies[24,28]. Similarly, the identification of confounding factors was not clearly described in one study[42], and the valid and reliable measurement of outcomes was unclear in five studies[7,33,39,44,45]. In addition, strategies to address confounding factors received “no” ratings in four studies[8,25,42,44]. Further details on the methodological quality assessment are provided in Supplementary Material S4.

Results of Individual Studies

Various risk factors associated with mental health outcomes and related conditions among graduate students were identified across the studies (n = 127; 100.0%), where *n* and percentage represent the total number of identified risk factors. The most frequently reported risk factors were related to the academic domain (n = 47; 37.0%), including relationships with supervisors, faculty, and peers; satisfaction with and frequency of supervisory meeting, workload, and academic productivity; program environment; overload of responsibilities; and issues related to the research project and its stage of development (e.g., delays or exceeding the timeline).

The second most frequently reported risk factors were within the psychological domain (n = 25; 19.7%), including negative emotions, lack of motivation, lack of autonomy and confidence, thoughts about leaving the program, feelings of loneliness, as well as negative coping strategies, and daily hassles.

At the social domain (n = 17; 13.4%), factors identified included difficulties related to income, racial microaggressions and violence, and lack of emotional support from family and friends.

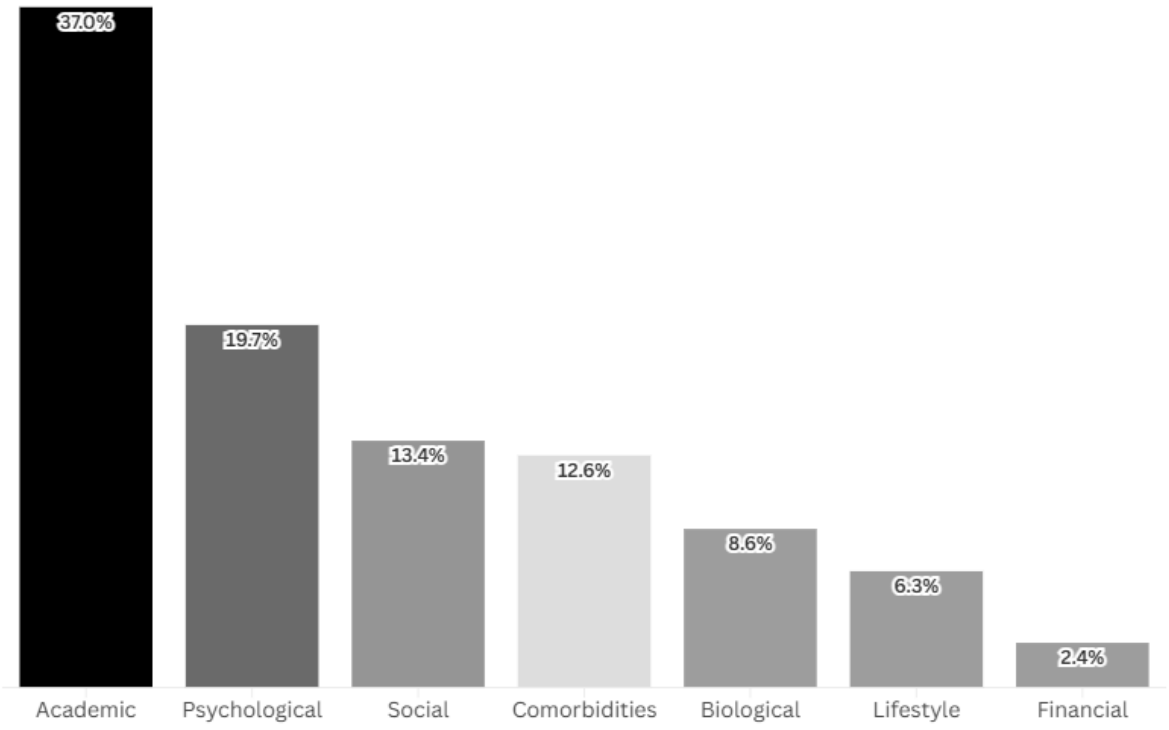
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Within the comorbidities domain (n = 16; 12.6%), anxiety and depressive symptoms were identified as important factors associated with suicide-related outcomes. In the biological domain (n = 11; 8.6%), female sex was the most frequently reported factor across the included studies.

In the lifestyle domain (n = 8; 6.3%), aspects such as substance use (licit and illicit), nonprescription medication use, sleep, and physical exercise engagement influenced students' emotional states. Finally, in the financial domain (n = 3; 2.4%), grouped according to academic/institutional funding, lack of access to scholarships, competition, and lack of funding were mentioned.

Figure 2 presents the percentages of associated risk factors according to the above-mentioned domains. Additional details on the individual studies and their respective associated risk factors are available in Supplementary Material S5.

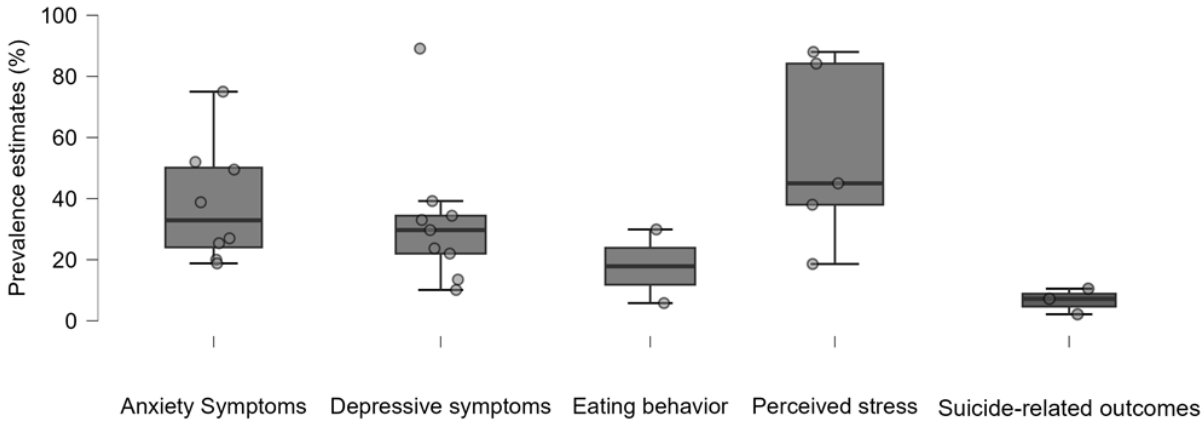
Figure 2 – Percentages of associated risk factors related to mental health outcomes and related conditions among graduate students, categorized by domains (Visualization by Flourish, Canva, London, United Kingdom).



Legend: Percentage values correspond to the total number of risk factors identified in each domain category.

A total of five studies reported the prevalence of perceived stress[7,25,30,33,37] among 1,626 students, with prevalence estimates ranging from 18.6% to 88.0%. Concerning anxiety symptoms[9,25,26,33,34,37,38,44], eight studies assessed a total of 1,981 students, with prevalence estimates from 18.8% to 75.0%. Nine studies reported depressive symptoms[9,25,26,33,34,37,38,41,44], with prevalence estimates ranging from 10.1% to 89.1% among 2,273 students. Suicide-related outcomes were addressed in three studies[25,26,32], with prevalence estimates from 1.8% to 9.9% among 21,432 students. Finally, two studies investigated problems with eating behavior[26,38], with prevalence estimates of 5.8% to 29.9% among 370 students. Additional details on prevalence are presented in Table 1 and Figure 3.

Figure 3 – Prevalence estimates of mental health outcomes and related conditions among graduate students of included studies.



Legend: Percentage values of prevalence estimates observed in the included studies that evaluated anxiety symptoms (n = 8), depressive symptons (n = 9), eating behavior problems (n = 2), perceived stress (n = 5), and suicide-related outcomes (n = 3).

Discussion

The results of this systematic review identified multiple risk factors associated with mental health outcomes and related conditions. A highly heterogeneous set of risk factors was observed and organized into seven broad conceptual domains. The academic (37.0%) and psychological (19.7%) domains were the most frequently reported, followed by the social (13.4%), comorbidities (12.6%), biological (8.6%),

lifestyle (8.3%) and financial (2.4%) domains. Individual psychological processes, characteristics of the academic environment, biological and socioeconomic factors, as well as experiences of discrimination and violence, interact with one another and with health behaviors and clinical outcomes, highlighting the multifactorial nature of these risk factors.

Graduate-level education is highly challenging for many reasons, making students more susceptible to negative changes in mental health and often requiring resilience, psychological support, guidance from advisors and faculty, as well as a more supportive academic environment[8,9,19,33].

At the psychological domain, factors such as lack of motivation and the intention to leave the program negatively affect students' creativity and academic performance[6]. Conversely, a strong sense of accomplishment and belonging, self-efficacy, and satisfaction with the program contribute to improvements in mental health[6,9,19].

In this regard, the relationship with the advisor, as well as the quality and frequency of supervision, is positively correlated with researcher self-efficacy and negatively correlated with mental health problems such as depression and anxiety[9,24]. In the study by Peluso, Carleton and Asmundson[41], the authors found that a good relationship with the academic advisor was associated with the protection of students' mental health. Similarly, the more frequent and higher the quality of supervision, the better students´ well-being[23,24].

Another important point is that perceived stress was higher among students who were behind schedule compared to those who were meeting deadlines[8]. More frequent contact with advisors may help identify students' main stressors and develop strategies to address them[8]. However, considering the increasing number of graduate students[4,36], psychological support models do not need to rely exclusively on the advisor and may also involve support from the academic community[8,47].

Indeed, the lack of support from the academic community also negatively affects mental health[8]. Evidence indicates that a sense of isolation is associated with loneliness and increased perceived stress[23,42]. In this context, support from family and friends, as well as the importance of students building a social network within the university, becomes essential for a successful academic qualification and for positive effects on mental health[23,33].

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Students' economic difficulties are also cited as a factor associated with mental health outcomes and related conditions such as depressive symptoms and perceived stress, as they create greater pressure to secure employment and, consequently, greater overload within the university[6]. Thus, financial concerns and debt represent sources of stress in graduate education, highlighting the importance of adequate funding through scholarships, for example[4,41].

Furthermore, within the social domain, racial microaggressions are also associated with emotional distress. Evidence suggests that Black graduate students report more experiences of daily and lifetime discrimination[48], which are associated with higher levels of depressive symptoms, anxiety symptoms, and perceived stress[37]. Therefore, Universities should develop strategies to support these students by fostering a more inclusive environment and promoting retention throughout the program[37,48]. Further studies conducted in different countries are needed to better understand this association and determine whether it varies according to participants' country of origin or the country in which they attend university.

According to the World Health Organization's global and regional estimates of the prevalence of mental disorders, depression is more common among females (5.1%) than among males (3.6%). Similarly, anxiety disorders are more common in females than in males (4.6% compared to 2.6% globally)[2].

Studies included in the present review indicate that sex is associated with mental health problems[19,33,36]. Female students exhibited higher levels of depressive symptoms than their male peers, being two and a half times more likely to present moderate to severe depression symptoms[33]. Moreover, females face various challenges in graduate education, such as lack of institutional support, motherhood and family responsibilities, as well as issues related to physical and/or sexual abuse and other forms of violence. When not identified and properly addressed, such experiences may make them more vulnerable to the development of mental health problems[19,46]. This evidence highlights the need to develop targeted strategies for promotion, prevention, and support, as well as a more attentive approach by the university community toward specific populations (e.g., females and Black students), thereby contributing to the reduction of inequalities and the promotion of a more inclusive and healthier academic environment[3,19,33,37].

Furthermore, a positive correlation was observed between the number of stressors and psychological distress levels, suggesting that greater exposure to

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stressors may increase susceptibility to depression and anxiety symptoms[19]. Consequently, mental health problems may be associated with or contribute to the development of other negative mental health outcomes, as well as harmful coping behaviors, such as substance abuse, whether alcohol or drugs[41].

The association described above is also observed in severe outcomes, such as suicide-related outcomes. Graduate students with suicidal behaviors exhibit more feelings of depression and anxiety, more negative emotions, eating problems, and substance use compared with their peers without suicidal behaviors[26].

Indeed, a better understanding of the causes of mental health outcomes and related conditions, as well as their associations and impacts, may support the development of effective strategies tailored to graduate students' needs, contributing to improvements in health, quality education, and academic outcomes[8,9,28]. In this context, several strategies and interventions may benefit graduate students´ mental health[9], including expanded monitoring of mental health data[4] and the implementation and dissemination, through university communication channels, of services focused on mental health promotion and prevention[7].

Although awareness of available services is essential for their use[7], the proportion of students with depression or anxiety who did not access mental health services ranged from 37% to 84%[49]. Therefore, identifying students in need of support as early as the enrollment is important to detect preexisting emotional distress, conduct campaigns through different communication channels (e.g., university websites, media, and flyers), and offer counseling and psychological support services within the university environment[7,50]. These services offer a safe space for students to discuss mental health concerns with professionals and peers with similar experiences, providing mutual support[34].

In addition to the formal psychological support services mentioned above, stress-management programs[51] and lifestyle-focused interventions are also beneficial for mental health. This is because sleep duration, regular physical activity, and time dedicated to leisure are associated with positive changes in quality of life and reduced perceived stress among graduate students[36]. Other strategies, such as yoga, meditation, and relaxation techniques, have also been used in university settings, although intervention studies in the context of graduate education are still lacking[8].

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The findings of this systematic review reinforce the notion that mental health-related outcomes show high prevalence among graduate students. These results are consistent with a recent systematic review and meta-analysis[13], which also identified a high prevalence estimates of depression (ranging from 10.0% to 47.0% vs. 10.1% to 39.2% in the present study), anxiety (4.0% to 49.0% vs. 18.8% to 52.0% in the present study), and suicide-related outcomes (2.0% to 12.0% vs. 1.8% to 9.9% in the present study), concluding that these symptoms are alarmingly prevalent among graduate students. It is highly that methodological differences across the included studies, as well as the eligibility criteria adopted in this review, explain the variation observed in the prevalence estimates of the mental health problems assessed.

The findings presented here build upon previous systematic reviews by providing an integrative framework that organizes risk factors for mental health outcomes and related conditions among graduate students (master's and doctoral students) into seven interrelated domains. This approach may help identify targeted intervention points across multiple levels, ranging from structural and institutional strategies to individual promotion and clinical care. In addition, this review provides updated evidence and expands upon previous reviews by including studies indexed in Latin American databases, thereby incorporating research published in Portuguese and Spanish and improving the representativeness of the available literature.

This study should be interpreted considering its strengths and limitations. We followed best practices recommended for systematic reviews. It followed PRISMA and was registered with PROSPERO. Articles were evaluated by two independent reviewers, with a third reviewer resolving conflicts, and the methodological quality of the included studies was assessed. The search strategy was developed by health professionals trained in bibliographic searching. Study searches included electronic databases, grey literature, expert consultation, and manual searches of the reference lists of included articles to reduce the risk of publication bias and identify as much relevant evidence as possible.

A challenging aspect was the large number of risk factors associated with mental health-related outcomes, as well as the methodological differences used by studies to measure the severity of psychiatric symptoms. Although all authors stated a common purpose in evaluating outcomes in a population of graduate students, substantial heterogeneity was observed across the published content. Also, the

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assessment of study quality showed that although some items were not clearly described, only the item related to strategies for addressing confounding factors received a lower rating. Future studies should consider these aspects to improve methodological quality and strengthen internal validity. Regarding the inclusion of a meta-analysis of prevalence results, its conduction was not feasible due to heterogeneities among the included studies, both in terms of the subgroups analyzed (doctoral, master's, or both) and the different instruments used to measure the outcomes.

We must accelerate the translation of evidence-based interventions into real-world settings to improve mental health among graduate students. Although crisis interventions and counseling remain essential, greater emphasis on prevention is necessary to achieve sustained improvements in mental health outcomes within this population.

Conclusion

The findings of this systematic review identify a range of risk factors associated with mental health outcomes and related conditions, indicating that graduate students' mental health is influenced by multiple, interrelated factors. These findings, together with the high prevalence of health outcomes and related conditions observed in this study, underscore the need for university policies that implement comprehensive and diverse support strategies aimed at promoting mental well-being and quality of life. In addition to promotion and prevention strategies, it is essential to ensure access to appropriate clinical support for students who are already experiencing severe mental health conditions, such as suicide-related outcomes. Such strategies should address the multiple factors that characterize this sensitive development phase, considering both individual characteristics and the specific experiences of historically marginalized groups. Thereby contributing to the creation of a more inclusive, health-supportive academic environment and to improved research outcomes.

Additionally, no longitudinal studies assessing mental health-related outcomes in graduate students were identified, highlighting a clear need for future research using this design. There is also a paucity of studies examining the impact of lifestyle factors such as diet, physical activity and sleep on mental health in this population. Future research should further consider analyzing master's and doctoral students

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separately, given the differences in academic demands and levels of preparation between these groups.

Other information

Protocol and registration

The study protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO), under registration number CRD42020203855, which can be accessed by the link https://www.crd.york.ac.uk/prospero. No modifications were made to the information provided in the protocol.

Support

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Competing interest

All authors declare no potential conflict of interest related to this article.

Other materials

Supplementary data related to this article are available in Supplementary Material S1, S2, S3, S4 and S5.

Author Contributions: CRediT TaxonomyPablo Antonio Bertasso de AraújoCRediT contribution not specifiedLauriana Urquiza NogueiraFormal analysis-Equal, Investigation-Equal, Methodology-Supporting, Writing - original draft-Supporting, Writing - review & editing-SupportingWelliton OraczFormal analysis-Equal, Writing - original draft-Supporting, Writing - review & editing-SupportingAntônio de Sá-JuniorConceptualization-Supporting, Validation-Supporting, Writing - review & editing-SupportingGuilherme SperettaConceptualization-Lead, Data curation-Lead, Formal analysis-Supporting,

BJP PRE-PROOF

Investigation-Supporting, Methodology-Supporting, Project administration-Lead, Supervision-Lead, Writing - review & editing-Lead

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Supplementary Material S1 – PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	3,4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	4,5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	5, S2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	5,6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	6, 7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	7, 8
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Not applicable
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Not applicable
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Not applicable
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Not applicable
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Not applicable

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Section and Topic	Item #	Checklist item	Location where item is reported
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Not applicable
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Not applicable
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	8, Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	S3
Study characteristics	17	Cite each included study and present its characteristics.	8, 9, Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	9, 10, Figure 2, S4
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	10, 11, 12, Figure 3, S5
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Not applicable
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Not applicable
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Not applicable
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Not applicable
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	12-17
	23b	Discuss any limitations of the evidence included in the review.	17, 18
	23c	Discuss any limitations of the review processes used.	18
	23d	Discuss implications of the results for practice, policy, and future research.	18,19
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	19
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	19
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	19
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	19

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Section and Topic	Item #	Checklist item	Location where item is reported
Competing interests	26	Declare any competing interests of review authors.	19
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Supplementary Material

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Supplementary Material S2 – Database search strategies

Database	Search: May 31th 2020 and update November 11th 2022 and March 7th 2024 and February 26th 2025.
CINAHL	((student OR students OR "school enrollment" OR "school enrollments" OR "student health")) AND (("mental health" OR "mental hygiene" OR "mental disorder" OR "mental disorders" OR "psychiatric diseases" OR "psychiatric disease" OR "psychiatric illness" OR "psychiatric illnesses" OR "psychiatric disorders" OR "psychiatric disorder" OR "psychiatric diagnosis" OR "behavior disorders" OR "severe mental disorder" OR "severe mental disorders")) AND (("psychological distress" OR "physiological stresses" OR "physiological stress" OR "metabolic stress" OR "metabolic stresses" OR "metabolic stress response" OR "metabolic stress responses" OR "abiotic stress" OR "abiotic stresses" OR "physiological stress response" OR "physiological stress responses" OR "physiological stress reaction" OR "physiological stress reactions" OR "physiological stress reactivity" OR "abiotic stress response" OR "abiotic stress responses" OR "abiotic stress reaction" OR "abiotic stress reactions" OR "biological stress" OR "biological stresses" OR "life stress" OR "life stresses" OR "psychologic stress" OR "psychological stressor" OR "psychological stressors" OR "mental suffering" OR suffering OR sufferings))
LILACS	tw:((tw:((student OR students OR "school enrollment" OR "school enrollments" OR "student health " OR estudiante OR estudiantes OR alumno OR alumnos OR "salud del estudiante" OR "salud de los estudiantes" OR "salud de los alumnos" OR estudantes OR estudante OR aluno OR alunos OR "saude do estudante" OR "saude dos estudantes" OR "saude dos alunos"))) AND (tw:(("mental health" OR "mental hygiene" OR "mental disorder" OR "mental disorders" OR "psychiatric diseases" OR "psychiatric disease" OR "psychiatric illness" OR "psychiatric illnesses" OR "psychiatric disorders" OR "psychiatric disorder" OR "psychiatric diagnosis" OR "behavior disorders" OR "severe mental disorder" OR "severe mental disorders" OR "salud mental" OR "saude mental" OR "higiene mental" OR "area de saude mental"))) AND (tw:(("psychological distress" OR "physiological stresses" OR "physiological stress" OR "metabolic stress" OR "metabolic stresses" OR "metabolic stress response" OR "metabolic stress responses" OR "abiotic stress" OR "abiotic stresses" OR "physiological stress response" OR "physiological stress responses" OR "physiological stress reaction" OR "physiological stress reactions" OR "physiological stress reactivity" OR "abiotic stress response" OR "abiotic stress responses" OR "abiotic stress reaction" OR "abiotic stress reactions" OR "biological stress" OR "biological stresses" OR "life stress" OR "life stresses" OR "psychologic stress" OR "psychological stressor" OR "psychological stressors" OR "mental suffering" OR suffering OR sufferings OR "estresse psicologico" OR "agente de estresse psicologico" OR "estresse relacionado a aspectos da vida" OR "estresse da vida" OR "fatores de estresse psicologico" OR "padecimento mental" OR "padecimento psiquico" OR "sofrimento mental" OR "sofrimento moral" OR "sofrimento psiquico" OR sofrimentos OR "tensao vital" OR "tensao da vida" OR "estresse fisiologico" OR "estresse abiotico" OR "estresse abioticos" OR "estresse metabolico" OR "reacao ao estresse abiotico" OR "reacoes ao estresse abiotico" OR "resposta ao estresse abiotico" OR "respostas ao estresse abiotico" OR "angustia psicologica" OR "aflicao psicologica" OR "angustia emocional" OR "esgotamento emocional" OR "estresse emocional" OR "estresse por angustia" OR "sofrimento emocional" OR "sofrimento psicologico" OR "estres psicologico" OR "estresor psicologico" OR "estresores psicologicos" OR "estres vital" OR "factor estresante psicologico" OR "factores estresantes psicologicos" OR "padecimiento mental" OR "padecimiento psiquico" OR

	"sufrimiento mental" OR "sufrimiento moral" OR "sufrimiento psiquico" OR sufrimientos OR tribulaciones OR "distres psicologico" OR "estres emocional")))) AND (db:("LILACS"))
PsycINFO	(Any Field: student OR Any Field: students OR Any Field: "school enrollment" OR Any Field: "school enrollments" OR Any Field: "student health") AND (Any Field: "mental health" OR Any Field: "mental hygiene" OR Any Field: "mental disorder" OR Any Field: "mental disorders" OR Any Field: "psychiatric diseases" OR Any Field: "psychiatric disease" OR Any Field: "psychiatric illness" OR Any Field: "psychiatric illnesses" OR Any Field: "psychiatric disorders" OR Any Field: "psychiatric disorder" OR Any Field: "psychiatric diagnosis" OR Any Field: "behavior disorders" OR Any Field: "severe mental disorder" OR Any Field: "severe mental disorders") AND (Any Field: "psychological distress" OR Any Field: "physiological stresses" OR Any Field: "physiological stress" OR Any Field: "metabolic stress" OR Any Field: "metabolic stresses" OR Any Field: "metabolic stress response" OR Any Field: "metabolic stress responses" OR Any Field: "abiotic stress" OR Any Field: "abiotic stresses" OR Any Field: "physiological stress response" OR Any Field: "physiological stress responses" OR Any Field: "physiological stress reaction" OR Any Field: "physiological stress reactions" OR Any Field: "physiological stress reactivity" OR Any Field: "abiotic stress response" OR Any Field: "abiotic stress responses" OR Any Field: "abiotic stress reaction" OR Any Field: "abiotic stress reactions" OR Any Field: "biological stress" OR Any Field: "biological stresses" OR Any Field: "life stress" OR Any Field: "life stresses" OR Any Field: "psychologic stress" OR Any Field: "psychological stressor" OR Any Field: "psychological stressors" OR Any Field: "mental suffering" OR Any Field: suffering OR Any Field: sufferings)
PubMed	(student OR students OR "school enrollment" OR "school enrollments" OR "student health") AND ("mental health" OR "mental hygiene" OR "mental disorder" OR "mental disorders" OR "psychiatric diseases" OR "psychiatric disease" OR "psychiatric illness" OR "psychiatric illnesses" OR "psychiatric disorders" OR "psychiatric disorder" OR "psychiatric diagnosis" OR "behavior disorders" OR "severe mental disorder" OR "severe mental disorders") AND ("psychological distress" OR "physiological stresses" OR "physiological stress" OR "metabolic stress" OR "metabolic stresses" OR "metabolic stress response" OR "metabolic stress responses" OR "abiotic stress" OR "abiotic stresses" OR "physiological stress response" OR "physiological stress responses" OR "physiological stress reaction" OR "physiological stress reactions" OR "physiological stress reactivity" OR "abiotic stress response" OR "abiotic stress responses" OR "abiotic stress reaction" OR "abiotic stress reactions" OR "biological stress" OR "biological stresses" OR "life stress" OR "life stresses" OR "psychologic stress" OR "psychological stressor" OR "psychological stressors" OR "mental suffering" OR suffering OR sufferings)
SciELO	((student OR students OR "school enrollment" OR "school enrollments" OR "student health " OR estudiante OR estudiantes OR alumno OR alumnos OR "salud del estudiante" OR "salud de los estudiantes" OR "salud de los alumnos" OR estudantes OR estudante OR aluno OR alunos OR "saude do estudante" OR "saude dos estudantes" OR "saude dos alunos")) AND (("mental health" OR "mental hygiene" OR "mental disorder" OR "mental disorders" OR "psychiatric diseases" OR "psychiatric disease" OR "psychiatric illness" OR "psychiatric illnesses" OR "psychiatric disorders" OR "psychiatric disorder" OR "psychiatric diagnosis" OR "behavior disorders" OR

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	"severe mental disorder" OR "severe mental disorders" OR "salud mental" OR "saude mental" OR "higiene mental" OR "area de saude mental")) AND (("psychological distress" OR "physiological stresses" OR "physiological stress" OR "metabolic stress" OR "metabolic stresses" OR "metabolic stress response" OR "metabolic stress responses" OR "abiotic stress" OR "abiotic stresses" OR "physiological stress response" OR "physiological stress responses" OR "physiological stress reaction" OR "physiological stress reactions" OR "physiological stress reactivity" OR "abiotic stress response" OR "abiotic stress responses" OR "abiotic stress reaction" OR "abiotic stress reactions" OR "biological stress" OR "biological stresses" OR "life stress" OR "life stresses" OR "psychologic stress" OR "psychological stressor" OR "psychological stressors" OR "mental suffering" OR suffering OR sufferings OR "estresse psicologico" OR "agente de estresse psicologico" OR "estresse relacionado a aspectos da vida" OR "estresse da vida" OR "fatores de estresse psicologico" OR "padecimento mental" OR "padecimento psiquico" OR "sofrimento mental" OR "sofrimento moral" OR "sofrimento psiquico" OR sofrimentos OR "tensao vital" OR "tensao da vida" OR "estresse fisiologico" OR "estresse abiotico" OR "estresse abioticos" OR "estresse metabolico" OR "reacao ao estresse abiotico" OR "reacoes ao estresse abiotico" OR "resposta ao estresse abiotico" OR "respostas ao estresse abiotico" OR "angustia psicologica" OR "aflicao psicologica" OR "angustia emocional" OR "esgotamento emocional" OR "estresse emocional" OR "estresse por angustia" OR "sofrimento emocional" OR "sofrimento psicologico" OR "estres psicologico" OR "estresor psicologico" OR "estresores psicologicos" OR "estres vital" OR "factor estresante psicologico" OR "factores estresantes psicologicos" OR "padecimiento mental" OR "padecimiento psiquico" OR "sufrimiento mental" OR "sufrimiento moral" OR "sufrimiento psiquico" OR sufrimientos OR tribulaciones OR "distres psicologico" OR "estres emocional"))
Web of Science	TOPIC: ((student OR students OR "school enrollment" OR "school enrollments" OR "student health")) AND TOPIC: (("mental health" OR "mental hygiene" OR "mental disorder" OR "mental disorders" OR "psychiatric diseases" OR "psychiatric disease" OR "psychiatric illness" OR "psychiatric illnesses" OR "psychiatric disorders" OR "psychiatric disorder" OR "psychiatric diagnosis" OR "behavior disorders" OR "severe mental disorder" OR "severe mental disorders")) AND TOPIC: (("psychological distress" OR "physiological stresses" OR "physiological stress" OR "metabolic stress" OR "metabolic stresses" OR "metabolic stress response" OR "metabolic stress responses" OR "abiotic stress" OR "abiotic stresses" OR "physiological stress response" OR "physiological stress responses" OR "physiological stress reaction" OR "physiological stress reactions" OR "physiological stress reactivity" OR "abiotic stress response" OR "abiotic stress responses" OR "abiotic stress reaction" OR "abiotic stress reactions" OR "biological stress" OR "biological stresses" OR "life stress" OR "life stresses" OR "psychologic stress" OR "psychological stressor" OR "psychological stressors" OR "mental suffering" OR suffering OR sufferings))
Google Scholar	(students) AND ("mental health" OR "mental disorders") AND ("physiological stress" OR "psychological stress")
OpenGrey	(student OR students OR "school enrollment" OR "school enrollments" OR "student health") AND ("mental health" OR "mental hygiene" OR "mental disorder" OR "mental disorders" OR "psychiatric diseases" OR "psychiatric disease" OR "psychiatric illness" OR "psychiatric illnesses" OR "psychiatric disorders" OR "psychiatric disorder" OR "psychiatric diagnosis" OR "behavior disorders" OR "severe mental disorder" OR "severe mental disorders") AND ("psychological distress" OR "physiological stresses" OR "physiological stress" OR "metabolic stress" OR "metabolic stresses" OR

BJP PRE-PROOF

	"metabolic stress response" OR "metabolic stress responses" OR "abiotic stress" OR "abiotic stresses" OR "physiological stress response" OR "physiological stress responses" OR "physiological stress reaction" OR "physiological stress reactions" OR "physiological stress reactivity" OR "abiotic stress response" OR "abiotic stress responses" OR "abiotic stress reaction" OR "abiotic stress reactions" OR "biological stress" OR "biological stresses" OR "life stress" OR "life stresses" OR "psychologic stress" OR "psychological stressor" OR "psychological stressors" OR "mental suffering" OR suffering OR sufferings)
ProQuest	noft((student OR students OR "school enrollment" OR "school enrollments" OR "student health")) AND noft(("mental health" OR "mental hygiene" OR "mental disorder" OR "mental disorders" OR "psychiatric diseases" OR "psychiatric disease" OR "psychiatric illness" OR "psychiatric illnesses" OR "psychiatric disorders" OR "psychiatric disorder" OR "psychiatric diagnosis" OR "behavior disorders" OR "severe mental disorder" OR "severe mental disorders")) AND noft(("psychological distress" OR "physiological stresses" OR "physiological stress" OR "metabolic stress" OR "metabolic stresses" OR "metabolic stress response" OR "metabolic stress responses" OR "abiotic stress" OR "abiotic stresses" OR "physiological stress response" OR "physiological stress responses" OR "physiological stress reaction" OR "physiological stress reactions" OR "physiological stress reactivity" OR "abiotic stress response" OR "abiotic stress responses" OR "abiotic stress reaction" OR "abiotic stress reactions" OR "biological stress" OR "biological stresses" OR "life stress" OR "life stresses" OR "psychologic stress" OR "psychological stressor" OR "psychological stressors" OR "mental suffering" OR suffering OR sufferings))

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Supplementary Material S3 – Excluded articles and reasons for exclusion (n=209)

Author, Year	Reasons for exclusion
Abu-Kaf et al, 2015[1]	9
Agardh et al, 2012[2]	2
Al-Gamal et al, 2016[3]	2
Ali et al, 2019[4]	2
Alterio et al, 2002[5]	5
Asante et al, 2015[6]	2
Bahhawi et al, 2018[7]	9
Balhara et al, 2019[8]	2
Bastiani et al, 2019[9]	2
Benefield et al, 2019[10]	1
Bernhardsdottir et al, 2013[11]	3
Bhullar et al, 2014[12]	2
Bibeau et al, 2007[13]	2
Bickerdike et al, 2019[14]	5
Biró et al, 2019[15]	2
Bonnet, 2016[16]	1
Bovier et al, 2004[17]	5
Brailovskaia et al, 2018[18]	9
Brailovskaia et al, 2020[19]	2
Burris et al, 2009[20]	9
Buzdar et al, 2015[21]	2
Byrd et al, 2012[22]	5
Chai et al, 2015[23]	2
Cheon, 2012[24]	2
Choi, 2003[25]	10
Choueiry et al, 2016[26]	2
Chu et al, 2015[27]	9
Ciarrochi et al, 2002[28]	2

BJP PRE-PROOF

Ciocca et al, 2018[29]	9
Cohen et al, 2019[30]	1
Cullinan et al, 2020[31]	3
Cvetkovski et al, 2012[32]	5
Deasy et al, 2014[33]	2
Deasy et al, 2015[34]	2
Deasy et al, 2016[35]	2
Deb et al, 2016[36]	9
Desouky et al, 2019[37]	2
Dewa et al, 2020[38]	3
Drabowicz, 2017[39]	1
Drum et al, 2017[40]	5
Dzhambov et al, 2019[41]	2
Eisenbeck et al, 2019[42]	2
Ertoren, 1996[43]	2
Ervasti et al, 2019[44]	5
Eskin et al, 2016[45]	2
Fang et al, 2018[46]	9
Farrer et al, 2016[47]	5
Feldman et al, 2008[48]	2
Fischer et al, 2016[49]	9
Fond et al, 2019[50]	5
Frick et al, 2011[51]	3
Furnham et al, 1983[52]	9
Gaddis et al, 2018[53]	5
Gan et al, 2012[54]	9
Garant et al, 1995[55]	2
Garcia Costa et al, 2018[56]	3
Gardner et al, 2014[57]	5
Gnan et al, 2019[58]	5

BJP PRE-PROOF

Gonçalves et al, 2016[59]	2
Grasdalsmoen et al, 2020[60]	5
Gumz et al, 2014[61]	3
Gunduz et al, 2019[62]	5
Haile et al, 2017[63]	2
Haile et al, 2017[64]	2
Hamaideh, 2012[65]	5
Hamaideh, 2018[66]	2
Hashemi et al, 2020[67]	5
Hayley et al, 2017[68]	5
Hawksley et al, 2019[69]	5
Heilmann et al, 2015[70]	2
Hernandez et al, 2005[71]	2
Hilger-Kolb et al, 2018[72]	2
Hodge et al, 2019[73]	5
Horta et al, 2012[74]	5
Hosseinpour et al, 2016[75]	5
Hunley, 2010[76]	9
Itani et al, 2018[77]	9
Johnson et al, 2006[78]	4
Jou et al, 1996[79]	5
Jou et al, 1997[80]	5
Jou et al, 2002[81]	5
Kalak et al, 2015[82]	5
Kardatzke et al, 2010[83]	1
Karim et al, 2024[84]	5
Katsumata, 2015[85]	10
Khara et al, 2019[86]	2
Khawaja et al, 2007[87]	5
Khawaja et al, 2008[88]	5

BJP PRE-PROOF

Kim et al, 2016[89]	5
Kim et al, 2017[90]	3
Knapstad et al, 2019[91]	5
Kono et al, 2015[92]	9
Koschel et al, 2017[93]	5
Kotera et al, 2020[94]	2
Kroencke et al, 2019[95]	2
Kurtovic et al, 2018[96]	2
Lace et al, 2017[97]	2
Lanier et al, 2001[98]	5
Larcombe et al, 2015[99]	3
Larcombe et al, 2016[100]	5
Lay et al, 1998[101]	5
Lee et al, 2004[102]	5
Lee et al, 2005[103]	9
Lee et al, 2019[104]	9
Lee Gi et al, 2013[105]	9
Lee Jo et al, 2013[106]	9
Lemma et al, 2012[107]	2
Levecque et al., 2017[108]	1
Li et al, 2019[109]	5
Lightstone et al, 2005[110]	5
Lin et al, 2020[111]	5
Liu et al, 2020[112]	9
Lovell et al, 2015[113]	5
MacDonald et al, 2019[114]	2
Malinauskiene et al, 2018[115]	9
Marshall et al, 2008[116]	2
Martinez et al, 2020[117]	9
Martin-Storey et al, 2016[118]	2

BJP PRE-PROOF

McFarland et al, 2013[119]	2
McIntyre et al, 2018[120]	2
McLafferty et al, 2019[121]	2
Mehlhausen et al, 2019[122]	9
Messman et al, 2019[123]	5
Mohammadian et al, 2018[124]	9
Mohr et al, 2014[125]	9
Mokhtari et al, 2013[126]	2
Monfared & Naderi, 2015[127]	1
Montagni et al, 2020[128]	9
Morpeth et al, 2018[129]	5
Morral et al, 2020[130]	2
Mulder et al, 2015[131]	5
Munson, 1984[132]	3
Nahidi et al, 2018[133]	5
Nath et al, 2012[134]	2
Newins et al, 2020[135]	9
Ng et al, 2017[136]	9
Oginni et al, 2018[137]	5
Okasaka et al, 2008[138]	9
Oksanen et al, 2017[139]	2
Oliva et al, 2018[140]	2
O´Neil-Lowy, 1983[141]	5
Ong et al, 2009[142]	5
Oppong et al, 2015[143]	9
Orzech et al, 2011[144]	2
Osse et al, 2011[145]	9
Othieno et al, 2015[146]	2
Paolucci et al, 2018[147]	9
Piumatti et al, 2019[148]	5

BJP PRE-PROOF

Poey et al, 2004[149]	3
Poorolajal et al, 2019[150]	5
Ra et al, 2017[151]	5
Randall et al, 1998[152]	9
Reavley et al, 2012[153]	5
Renner et al, 2015[154]	5
Romito et al, 2007[155]	9
Ruckert, 2015[156]	3
Rudd, 1987[157]	2
Sahoo et al, 2010[158]	2
Said et al, 2013[159]	9
Sam et al, 1991[160]	9
Samaha et al, 2016[161]	9
Sasaki et al, 2005[162]	2
Satici et al, 2013[163]	2
Sato et al, 2019[164]	9
Sawatzky et al, 2012[165]	5
Schofield et al, 2016[166]	5
Schonfeld et al, 2019[167]	9
Sellers et al, 2003[168]	2
Selvaraj et al, 2018[169]	5
Sesar et al, 2010[170]	2
Shafique et al, 2017[171]	5
Siegmann et al, 2018[172]	9
Simic-Vukomanovic et al, 2016[173]	9
Sivertsen et al, 2019[174]	3
Sokratous et al, 2014[175]	2
Stallman, 2010[176]	5
Stefan et al, 2018[177]	9
Taka et al, 2016[178]	8

BJP PRE-PROOF

Tavolacci et al, 2013[179]	9
Thomson et al, 2006[180]	5
Tung et al, 2018[181]	1
Tyssen et al, 2000[182]	8
Tyssen et al, 2001[183]	8
Valikhani et al, 2018[184]	5
Van Agteren et al, 2019[185]	5
Velten et al, 2018[186]	9
Veron et al, 2020[187]	3
Villalobos-Galvis, 2009[188]	9
Visnjic et al, 2018[189]	9
Yan, 2008[190]	3
Ye et al, 2024[191]	5
Walker et al, 2001[192]	1
Wan et al, 2020[193]	9
Wang, 2009[194]	2
Wang et al, 2016[195]	9
Watson et al, 2008[196]	2
Wei et al, 2012[197]	5
Whatnall et al, 2019[198]	5
Whatnall et al, 2019[199]	5
Whitlock et al, 2006[200]	5
Whitlock et al, 2015[201]	2
Winefield, 1993[202]	5
Wilkinson et al., 2014[203]	1
Wong, 2010[204]	2
Wu et al, 2020[205]	2
Wyatt & Oswalt., 2013[206]	1
Zagdanska et al, 2016[207]	2
Zeppegno et al, 2014[208]	2

BJP PRE-PROOF

Zhou et al., 2018[209]	1

1) Studies with other types mental disorders (n=12);

2) Studies only with undergraduate students (n=65);

3) Studies that do not report factors associated with mental disorders (n=14);

4) Secondary studies (n=1);

5) Studies that did not bring separate data from undergraduate and postgraduate students (n=65);

6) Studies only qualitative (n=0);

7) Studies not found full text (n=0);

8) Studies only with other types of population (n=3);

9) Studies that did not make clear level of academic degree (n=47);

10) Studies that could not be translated (n=2).

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Supplementary Material S4 – Methodological Quality Assessment using The Joanna Briggs Institute Critical Appraisal Tools – Checklist for Analytical Cross Sectional Studies.

Checklist for Analytical Cross Sectional Studies (n=31)

Question Cross-Sectional Studies	Addonizio, 2011	Allen et al., 2021	Barry et al, 2018	Boyle & McKinzie., 2018	Clark et al., 2012	Corner et al, 2017	Devine & Hunter, 2017	Ellison et al., 2020	Garcia-Williams et al, 2014	Harris, 2019	Hish et al, 2019	Hunter & Devine, 2016
1. Were the criteria for inclusion in the sample clearly defined?	U	Y	Y	Y	U	U	U	U	U	Y	Y	U
2. Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	U
3. Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4. Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5. Were confounding factors identified?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
6. Were strategies to deal with confounding factors stated?	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
7. Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
8. Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
%Yes/Risk	87.5	100.0	87.5	100.0	87.5	87.5	75.0	75.0	87.5	100.0	100.0	75.0
Overall	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Y= Yes; N=No; U=Unclear

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(Continuing)

Question Cross Sectional Studies	Hyun et al, 2007	Jeong et al., 2021	Juneja et al., 2021	Koeske & Koeske, 1991	Li & Huang, 2009	Liu et al, 2019	Madhan et al, 2012	Malik et al, 2023	Martinez et al., 2024	Meira et al., 2021	Miller & Orsillo, 2020	Nagy et al, 2019
1. Were the criteria for inclusion in the sample clearly defined?	U	U	U	U	U	Y	U	Y	Y	U	Y	Y
2. Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3. Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4. Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5. Were confounding factors identified?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
6. Were strategies to deal with confounding factors stated?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
7. Were the outcomes measured in a valid and reliable way?	U	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y
8. Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
%Yes/Risk	75.0	87.5	87.5	87.5	87.5	100.0	75.0	100.0	100.0	87.5	100.0	100.0
Overall	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Y= Yes; N=No; U=Unclear

BJP PRE-PROOF

(Continuing)

Question Cross Sectional Studies	Nelson et al, 2001	Ogunsanya et al, 2018	Peluso et al, 2011	Phyalto et al, 2012	Sverdlik & Hall., 2020	Ternand, 2014	Touche, 2017
1. Were the criteria for inclusion in the sample clearly defined?	U	U	U	U	Y	U	U
2. Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	Y
3. Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y
4. Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y
5. Were confounding factors identified?	Y	Y	Y	U	Y	Y	Y
6. Were strategies to deal with confounding factors stated?	Y	Y	Y	N	Y	N	Y
7. Were the outcomes measured in a valid and reliable way?	U	Y	Y	Y	Y	U	U
8. Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y
%Yes/Risk	75.0	87.5	87.5	62.5	100.0	62.5	75.0
Overall	Low	Low	Low	Mod	Low	Mod	Low

Y= Yes; N=No; U=Unclear

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Supplementary Material S5 – Risk factors associated with mental health outcomes and related conditions among graduate students according to individual studies, categorized by domains (n=31).

Author, Year; Country	Outcome(s)	Academic domain	Biological domain	Financial domain (Academic/institutional funding)	Lifestyle domain	Comorbidities domain	Psychological domain	Social domain
Addonizio et al., 2011, USA	Stress+	NR	Sex (Female)	NR	NR	NR	Confidence in graduate (Less confidence)	Levels of income (Less Income)
Allen et al., 2021, USA	Burnout Stress+	NR	NR	NR	**Burnout, Stress+** Sleep	**Stress+** Burnout **Burnout** Stress+	NR	NR
Barry et al, 2018, Australia	Stress+	Progress doctoral course (Behind or exceeding schedule)	NR	NR	NR	NR	NR	NR
Boyle & McKinzie et al., 2018, USA	Anxiety* Depression#	NR	NR	NR	NR	NR	NR	Interpersonal violence (hostile environment, sexual contact, rape, coercion, stalking)
Clark et al., 2012, USA	Anxiety* Depression# Stress+	NR	NR	NR	NR	NR	Sense autonomy	Racial microaggressions
Corner et al., 2017, Finland	Burnout	Frequency and satisfaction with supervision, Equality in the research community	NR	NR	NR	NR	NR	NR

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Devine & Hunter, 2017, Eight Countries	Burnout	Supportive supervision	NR	NR	NR	NR	Facade of compliance	NR
Ellison et al., 2020, USA	Anxiety* Depression# Stress+	NR	NR	NR	**Anxiety*** **Depression#** **Stress+** Hours of sleep **Depression#** Lower frequency of aerobic and strengthening exercises	NR	NR	NR
Garcia-Williams et al., 2014, USA	Anxiety* Depression# Eating Behavior, Suicidal Behavior	NR	**Depression#** Age (males), Sex (Female) **Eating Behavior** Sex (Female)	NR	**Suicidal Behavior** Eating issues, Substance use (Drinking Alcohol, Using Drugs, Taking medication without medical supervision)	**Suicidal Behavior** Anxiety*, Depression#	**Suicidal Behavior** Negative emotions	NR
Harris et al., 2020, USA	Burnout	NR	NR	NR	NR	NR	Psychological Inflexibility, Less Self-Compassion	NR
Hish et al., 2019, USA	Stress+ Burnout Depression#	**Burnout, Depression#** Advisor relationship	NR	NR	NR	**Stress+** Burnout, Depressive# **Burnout** Depressive#	**Stress+, Burnout, Depression#** Mastery sense (self-concept)	**Depression#** Less Social support

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Hunter & Devine, 2016, Eight Countries	Burnout	Supportive relationship (departmental and advisor level), Advisor experience, Frequency meeting (Advisor)	NR	NR	NR	NR	Intentions leave academia	NR
Hyun et al., 2007, USA	Stress+	Advisor Relationship	NR	NR	NR	NR	NR	NR
Jeong & Koh, 2021, South Korea	Stress+	Doctoral course	Age (more)	NR	NR	NR	Less sense of coherence, Health status	Marital status (Married), Less Social support
Juneja et al., 2021, India	Stress+	Environment course	Sex (Female)	NR	NR	NR	Health status	NR
Koeske & Koeske, 1991, USA	Burnout, Stress+	NR	NR	NR	NR	**Burnout** Stress+	**Burnout, Stress+** Intention to leave academia, Physical and psychological symptoms	NR
Li & Huang, 2009, China	Suicidal Ideation	NR	NR	NR	NR	Depression	Attitude towards suicide	NR
Liu et al., 2019, China	Anxiety* Depression#	**Anxiety*, Depression#** Mentor relationship and frequency meeting, Difficulty	**Depression#** Age (more)	NR	NR	**Anxiety*** Depression	**Anxiety*, Depression#** Self-efficacy research	**Anxiety*, Depression#** Difficulty in balance Work-family-doctoral program

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		in article publication, Doctoral course (More year)						
Madhan et al., 2012, India	Anxiety* Depression# Stress	**Anxiety*, Depression#, Stress** Doctoral course (Year III)	**Anxiety*** Age > 27years **Depression#** Sex (Female)	NR	NR	NR	NR	**Anxiety*, Depression#, Stress** Marital status (Single)
Malik et al., 2023, USA	Anxiety* Depression#	**Anxiety*, Depression#** Time spent searching COVID-19 information	**Anxiety*** Identifying lesbian/gay/ bisexual	NR	NR	NR	**Anxiety*, Depression#** Felling lonely	NR
Martinez et al., 2024, USA	Depression#	Delayed graduation, Isolation faculty	NR	NR	NR	NR	NR	Post-graduate employment, Not access healthcare (Personal and Family), Cared family, Spend more time running errands, Did not pay full utilities
Meira et al., 2021, Brazil	Stress+	NR	Sex (Female)	NR	Less Quality of life, Medication intake	NR	NR	NR
Miller & Orsillo, 2020, USA	Anxiety*, Depression#, Stress+	NR	NR	NR	NR	NR	Non-Acceptance of Internal Experiences	Racist Experiences, Microaggressions
Nagy et al., 2019, USA	Burnout, Depression#	**Depression#** Scholarly productivity, Graduate Climate,	NR	NR	NR	**Burnout** Life time clinical diagnosis, Current Clinical diagnosis, Functional	**Burnout, Depression#** Thoughts about dropping out academy	**Burnout, Depression#** Employment opportunities

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		Research training environment **Burnout** Graduate Climate, Research training environment				Impairment, Depression Severity		
Nelson et al., 2001, USA	Stress+	Scholastic course work, dissertation work, internship expectations, and application process, practicum placement, time management and availability, clinical work	NR	NR	NR	NR	Daily hassles	Financial situation
Ogunsanya et al., 2018, USA	Stress+	NR	NR	NR	NR	Acculturative Stress	Negative Coping	NR
Peluso et al., 2011, Canada	Depression#	Relationship academic advice, Weekly hours worked	NR	NR	NR	NR	NR	NR
Phyhalto et al., 2013, Finland	Anxiety*, Stress+	NR	NR	NR	NR	NR	**Anxiety*, Stress** Intention to leave academia	NR
Sverdlik &Hall., 2020, Internationally	Depression#, Stress+	**Depression#,Stress** Program satisfaction **Stress**	NR	NR	NR	**Depression#** Stress+	**Depression#,Stress** Less Motivation and self-efficacy	NR

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		Examination and dissertation phases						
Ternand, 2014, USA	Anxiety*, Depression#	NR	NR	NR	NR	NR	**Anxiety*, Depression#** Experiential avoidance	NR
Touche, 2017, USA	Stress+	**Problem** Mentorship / Advising program, Student-initiated Mentorship / Advising, Faculty Support, Mentor / Adviser Satisfaction, Mentor / Adviser Relationship, Interaction with Students and Faculty, Time Constraints, Role Overload, Role Conflict, Isolation	NR	Funding Competition, Stipend, Funding Confidence	NR	NR	NR	NR

Anxiety* = Anxiety symptoms; Depression# = depressive symptoms; Stress+ = Perceived Stress; NR=Not Reported

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