

The Psychological Well-Being of University Students amidst COVID-19 Pandemic

Scoping review, systematic review and meta-analysis

*Ahmed H. Ebrahim,^{1,2} Ali Dhahi,¹ Mohamed A. Husain,³ Haitham Jahrami^{1,4}

ABSTRACT: This review aimed to summarise the current evidence relating to university students' psychological well-being amidst the COVID-19 pandemic. A scoping review, using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews guidelines, was first conducted to determine if the evidence can be systematically reviewed and meta-analysed. The search was performed via Google Scholar, MEDLINE/PubMed, Science Direct, Scopus and Web of Science. A total of 90 original articles were selected for the scoping review. Meta-analysis of a total of 46,284 cases revealed an overall pooled prevalence rate of 29.1% (95% confidence interval [CI]: 20.9–39.0; K = 9, N = 22357) for anxiety symptoms and 23.2% (95% CI: 15.7–32.9; K = 12, N = 23927) for depression symptoms. This data revealed that COVID-19 had a significant impact on university students' psychological well-being.

Keywords: Adolescents; Depression; Mental Health; Pandemic; Anxiety; SARS-COV-2.

THE 2019 NOVEL CORONAVIRUS DISEASE (COVID-19), a newly emerged strain in the coronavirus family, induced a 'public health emergency of international concern' as declared by the World Health Organization (WHO).¹ The threats associated with the pandemic outbreak of this virus have been multiple and varied. The challenge extends from monitoring the transmissibility and fatality of the disease to the enormous socioeconomic and psychological ramifications harming people's quality of life and standard of living.^{2–5} According to the WHO figures for 2020, over 79 million cases were confirmed worldwide and nearly 1.7 million deaths were reported globally due to the pandemic.⁶ Many countries have adopted strict measures encompassing wide-scale lockdowns, school closures, isolation, quarantine, travel restrictions and social distancing to combat the outbreak.³ Since the beginning of the COVID-19 pandemic at the end of 2019, nations have been suffering from the consequences of the deadly virus and its evolving waves. Nevertheless, sustained efforts from individuals, communities and governments are still required to control and suppress the disease and overcome its devastating impacts.

COVID-19 has raised the risk of encountering a parallel epidemic of psychological disturbances such as stress, panic, fear, anxiety and depression.^{4,7–11} Social isolation and constrained connectedness and intimate relationships among community members are emotionally destructive. They necessitate coping behavioural changes such as adopting online socialising, maintaining physical distancing and mitigating outdoor activities intended

for sport, shopping, leisure or anything else.¹² The spread of COVID-19 disease has tightened social interactions, freedom of movement and routine life functioning. Its spill-over effects extend to physiological and physical health; the psychological burdens and imbalance may negatively affect many people's metabolic, cardiovascular and immune health through direct and indirect mechanisms.^{13–16} Sleep disturbance, nutritional deficiencies and reduced physical activity are also common problems that may associate with the uncertainty of the current pandemic.^{17–21}

Recent studies targeted global populations showed that the COVID-19 pandemic has been linked with elevated psychological distress rates and early warning signs of mental illnesses.^{21–25} Common psychological consequences of the pandemic included depressive symptoms, anxiety, stress and post-traumatic stress disorder (PTSD) symptoms. However, the vulnerability to and severity of these psychological problems varied among population segments based on many individual and textual factors—including, but not limited to, the nature of restrictions on daily living, risk of exposure to the virus, gender, COVID-19 information-seeking behaviour, education level, income level and age.^{24,26} Although older adults are more vulnerable to the COVID-19 infection-fatality risks, a study in the USA in the early stage of the outbreak has found that the prevalence of psychological distresses was more prevalent in young individuals.²⁷ Such findings indicate the importance of shedding further light on investigating the mental health impacts of the COVID-19 pandemic on young adults.

¹Ministry of Health, Manama, Bahrain; ²College of Graduate Studies and Research, Ahlia University, Manama, Bahrain; ³College of Health and Sport Science (CHSS), University of Bahrain, Sakheer, Bahrain; ⁴College of Medicine and Medical Sciences, Arabian Gulf University, Manama, Bahrain

*Corresponding Author's e-mail: ahh50@hotmail.com

University students represent one of the essential community-building blocks deserving to have adequate attention be paid to during this pandemic. According to the United Nations, more than one billion students were not physically in school after educational institutions' closure across many countries.²⁸ Besides the uncertainty of COVID-19 on the general student population, the situation could be more challenging for university students regarding their life engagement, contentment, dreams attainment, career outlook and even their typical academic progression.^{29,30} Moreover, there is emerging evidence on how college students encounter extraordinary changes in the learning process and examination mechanisms and its impact on their well-being.^{31,32} According to recent evidence, the mental health problems experienced by students in Israel and Russia during the pandemic have increased their vulnerability to substance misuse.³³ Furthermore, the higher scores of the fear of COVID-19 amongst students were associated with a higher level of sustaining maladaptive health-related behaviours such as smoking and drinking alcohol.³⁴

From another aspect, a study in New York, USA, indicated that the high rates of financial instability and resource (food and housing) insecurity due to the pandemic had exacerbated college students' psychological distress such as anxiety and depression.³⁵ Consequently, during such a multidimensional crisis, studying university students' psychological well-being has become a priority in the academic research field. However, there is ambiguity about the extent and type of studies conducted to discuss and investigate university students' psychological well-being during the COVID-19 pandemic, especially with the lack of studies based on systematic mapping or review. Hence, this work contributes to addressing such a research gap by identifying, classifying and describing the broad bodies of evidence of university students' mental health amid the pandemic. The present research aimed to provide knowledge for future researchers to help them steer a rationale for scholarly attention on areas not yet investigated relating to university students' psychological well-being during pandemics or other potential crises.

This research was guided by the following research questions: 1) Where and what type of original research was carried out to study the impact of COVID-19 on the psychological well-being of university students?; 2) What aspects/domains of students' psychological health were investigated?; 3) What are the characteristics of the selected student populations investigated by these studies?; 4) What do the key findings of these studies imply?; and 5) What are the overall pooled estimates of major psychological

distress?

Methods

PROTOCOL DEVELOPMENT

Initially, a scoping review was conducted considering the methodological guidelines and consultation given by Munn *et al.* and Arksey and O'Malley.^{36,37} To standardise the scoping review process, Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines were adopted.³⁸ A scoping review is a methodical approach to map evidence sources and describe their characteristics in a field of interest. It also tends to address broader topics with the potential of being undertaken as a stand-alone project in its own right without necessarily describing research findings in any detail.³⁶ Scoping reviews serve as a valuable tool for synthesising evidence and assessing the scope of literature on a topic.³⁷ Also, they gain increasing recognition as pertinent precursors to systematic reviews and meta-analyses.³⁹

The searched and identified key literature was systematically mapped and analysed through six fundamental stages: 1) formulating the study questions; 2) configuring and proving a specific set of keywords and selecting electronic databases; 3) identifying original research investigating the psychological well-being of university/college students amidst the COVID-19 outbreak; 4) reviewing the identified publications according to the endorsed procedure of data abstraction and charting; 5) aggregating, summarising and reporting findings; and 6) articles that met high similarity were further synthesised and meta-analysed quantitatively.

ELIGIBILITY CRITERIA

All COVID-19 related articles that were carried out to empirically study university students' psychological well-being were considered for eligibility. To be specific, only those studies that had original research merits—i.e. were primary sources whether based on quantitative, qualitative or mixed-method designs—included/targeted specific sample of university/college students and explicitly proposed a relationship between the psychological well-being construct and the COVID-19 pandemic were eligible for inclusion. The psychological well-being concept is multidimensional due to the various philosophical and psychological theories underpinning its conceptualisation. Thus, it is essential to mention how this concept has been

understood and dealt with in this review. In the first level, the researchers referred to and embraced the psychological well-being dimensions described by Huppert and Ryff.^{40,41} Secondly, the researchers' expertise in psychological well-being has intervened to determine the convergence or divergence of any identified dimension that may relate to the concept of psychological well-being.

Both published (peer-reviewed) and accepted articles in the press and made available online were included. Non-peer reviewed studies were also considered for providing a quantitative snapshot of the current research trend but were not included in this study's reported results. Published studies that reported university students' psychological well-being through inferences from a general population were excluded. The inclusion of these studies required a complex search mechanism and could complicate the screening and the charting process intended for the scoping review approach. Such studies were usually deficient regarding the information relating to the participating university students' context and characteristics. Non-English language studies were also excluded.

DATA SOURCES, SEARCH AND SELECTION STRATEGY

In September 2020, an inclusive electronic search was carried out since inception in Google Scholar (Google LLC, Mountain View, California, USA), PubMed/MEDLINE (US National Library of Medicine, Bethesda, Maryland, USA), Science Direct (Elsevier, Amsterdam, the Netherlands), Scopus (Elsevier) and Web of Science (Clarivate Analytics, Philadelphia, Pennsylvania, USA). The process was done without language or type of article restrictions and made more specific by the principal investigator and another autonomous reviewer individually. 'Grey' literature was excluded. A consistent search mechanism was adopted to identify studies that addressed the literature relevant to university students' psychological well-being during the COVID-19 pandemic. Search terms were used in combinations and configured as four sets as following: 'COVID19 Students Psychological', 'COVID19 Students Mental', 'COVID19 Students Cognitive' and 'COVID19 Students Emotional'. No time filter was applied in the search processes. A sample search strategy in PubMed for one set was as follows: 'COVID19[tiab] AND Students[tiab] AND Psychological[tiab]'; this strategy was replicated for the other three remaining sets as well. The final search results were exported into a Microsoft Excel

spreadsheet 2019 (Microsoft, Redmond, Washington, USA) to be refined and remove duplicates.

CHARTING, SCREENING AND REVIEWING PROCESS

The principal investigator had initially scrutinised the titles and abstracts of the yielded studies, which another reviewer cross-checked according to the eligibility rules. The justification for excluding any publication was documented. For eligible studies, a complete review and appraisal of the evidence were jointly performed by two reviewers who also independently charted the data and discussed the results. Disagreements were settled by mutual revision and, in case of non-resolution, a third assigned reviewer provided resolution. Microsoft Excel spreadsheet 2019 (Microsoft) was used for abstracting and charting data with the following variables classification: peer-review status, study methodology (quantitative, qualitative, or mixed-methods), study design (cross-sectional or longitudinal), the country in which the study was conducted, student population type (locals, international students, etc.), number of included universities, university type (public or private), students' discipline, year of study, programme level, age group, sample size, number of male and female students, the scope of the investigation, studied variables, measurement tools used, method(s) of data collection and key findings.

SYSTEMATIC REVIEW AND META-ANALYSIS

The scoping review activity revealed that two screening instruments were predominant in the studies; these were the Patient Health Questionnaire-9 (PHQ-9) to screen for depression and Generalised Anxiety Disorder-7 (GAD-7) to screen for anxiety. Data for these studies were autonomously extracted by two investigators and verified by a third. Methodical extraction and tabulation were executed for the following information: authors and citation, country, percentage of male and female students, sample size and event rate for each screening instrument. Data were synthesised for the meta-analysis using the random-effects model according to DerSimonian-Laird method. The authors reported the results of the overall prevalence rate and corresponding 95% confidence intervals (CI). *P* values of <0.05 were regarded as statistically significant for heterogeneity. The authors performed a detailed analysis of the heterogeneity using I^2 , Cochran (Q) statistic test, H test, tau (τ) and tau2 (τ^2). A jackknife sensitivity

analysis was applied by iteratively eliminating one study at a time to ratify that the results were not influenced by any single research.⁴² The jackknife method as a cross-validation technique has the merit of lessening the bias of an estimator with fast computation and consistent variance estimation. It has been widely cited for its practical applications when compared to other alternatives such as the bootstrap method. However, jackknife analysis is associated with crude approximations for the confidence intervals and inconsistency of the N-1 model (leave-1-out), which may yield inconsistent results across the parameters.⁴³ To further assess the impact of outliers, analysis was repeated after deleting all of the outliers to determine if the results will change. Funnel plots were used as a visual tool for scrutinising study bias in meta-analysis.⁴⁴ Furthermore, Egger's linear regression of the effect estimates on their standard errors weighted by their inverse variance was used to determine possible publication bias in a meta-analysis via funnel plot asymmetry.⁴⁵ P-curve analysis was performed to correct meta-analytic estimates due to overwhelming evidence of publication bias and the presence of outliers.⁴⁶

The risk of bias was assessed in this review using the Quality Assessment of Diagnostic Accuracy Studies version 2.0 (QUADAS-2).⁴⁷ The QUADAS-2 is an evidence-based instrument for assessing the efficiency of diagnostic accuracy tests. It consists of 14 questionnaire items posed as questions, each of which should be answered with a 'yes', 'no' or 'unclear' to determine if the analysis is biased. Two authors, acting independently, made judgments about evidence quality ('low risk', 'some concerns' or 'high risk'). The questionnaire consists of four key domains: patient selection, index test, reference standard and flow and timing. Each is weighed in terms of bias risk, with the first three being weighed in terms of applicability issues. Signalling questions are used to help with bias risk assessments. Results of the risk of bias are presented visually using publication-quality risk-of-bias assessment. Summary simple unweighted bar plot and a detailed risk of bias 'traffic light' plot was used in this review.^{48,49}

All data analyses were performed using the R programming language for statistical computing version 4.0.3 (The R Foundation, Vienna, Austria).

Results

LITERATURE SEARCH

The preliminary search in the selected electronic

databases generated 304 citations, 122 of which were duplicates and removed. The additional search yielded 93 citations, 21 of which were duplicates and removed as well. Based on the initial screening of the remaining 254 studies, 75 citations were excluded as they were not original research (e.g. review articles, letters to the editor, commentaries). Hence, 179 studies were critically appraised. It was found that 89 articles did not meet the eligibility criteria; most of these studies were either conducted on the general population or did not study the psychological well-being factor for the university students' segment. Ultimately, the remaining 90 articles were included for the scoping review [Table 1].

The selection of sources of evidence is demonstrated through the PRISMA flow chart [Figure 1].

SOURCES OF EVIDENCE CHARACTERISTICS

Among the included 90 studies, 80 (89%) were peer-reviewed published papers, while only 10 (11%) papers were accepted articles in the press and made available online. Of the selected studies, 89% relied mainly on quantitative methods, while the remaining were either qualitative research (4%) or mixed-methods research (7%) [Table 2]. A total of 84 studies were based on a cross-sectional design and only six studies adopted a longitudinal research design. Remarkably, the method of online self-administered questionnaires was a dominant data collection strategy (87% of selected studies). Regarding the number of studies carried out in different regions and countries, China had the highest research work relating to university students' psychological well-being, with 30 studies identified and majorly taken place during the first quarter of the year 2020; China is followed by the Middle East and North Africa (MENA) region (n = 22), Europe (n = 16), Indian subcontinent (n = 9), Southeast Asia (n = 4), Northern America (n = 4), Latin America (n = 3), Australia (n = 1) and East Africa (n = 1).

INVESTIGATION SCOPE OF IDENTIFIED STUDIES

A total of 57 studies (63%) principally focused on investigating the prevalence of psychological distress and pertinent risk factors. The remaining studies investigated predictors, consequences and psychosocial correlates of university students' psychological well-being. The most frequently investigated domains in the selected studies (n = 33; 37%) were depressive symptoms majorly assessed by the PHQ-9 instrument and anxiety symptoms majorly assessed by the GAD-7 instrument. It is worth noting that a few studies had

focused on the following areas of investigation: sleep quality ($n = 9$; 10%), e-learning experiences ($n = 8$; 9%) and mindfulness practices ($n = 6$; 7%).

CHARACTERISTICS OF SAMPLED UNIVERSITY STUDENTS

Approximately two-thirds of the studies were conducted on specific universities/colleges [Table 2]. In contrast, the remaining one-third of studies were based on surveying the general university student populations in selected provinces or nationwide. The vast majority of studies targeted the local university students (93%), but international students had a much lesser research focus. There was a high degree of divergence between the studies' sample size in quantitative investigations, ranging between 25 and 304,167. Thirty-five studies specifically targeted undergraduates, while 41 studies involved both undergraduates and postgraduates and only two studies paid exclusive attention to postgraduates. Moreover, 49 (54%) studies had involved students from different academic programmes. Based on classifying students' academic disciplines, medical students came first with the highest share of 12 studies.

UTILISED MEASURES AND MAJOR FINDINGS

The PHQ-9 scale was the most psychometric measure used in the selected studies to assess the depressive symptoms of sampled students ($n = 18$; 20%), followed by the GAD-7 scale ($n = 15$; 17%) to assess anxiety symptoms. GAD-7 is a valid and sensitive self-reported measure to screen and assess an individual's generalised anxiety disorder severity.⁵⁰ PHQ-9 is a reliable instrument for the screening of the presence and severity of depressive symptoms.⁵¹ These two tools' psychometric properties, ease of administration and conciseness make them some of the most frequent and preferred options for psychological state assessment and analysis. In addition to the PHQ-9 and GAD-7, other outcome measures used to assess depression and anxiety symptoms included Depression, Anxiety and Stress Scale - 21 Items ($n = 8$; 9%), Abbreviated Beck Anxiety Inventory ($n = 5$; 5%), The Kessler-10 ($n = 4$; 4%), Self-rating Anxiety Scale ($n = 3$; 3%) and PHQ-4 ($n = 2$; 2%). However, the majority of remaining studies were based on measures for assessing the dimensions of resilience ($n = 4$; 4%) using the Connor-Davidson Resilience Scale and mindfulness ($n = 5$; 5%) using the Cognitive and Affective Mindfulness Scale-Revised, Mindful Attention Awareness Scale and Five Facets Mindfulness Questionnaire Short Form.

In a large segment of the selected studies, the investigation scope was not limited to one facet of

psychological distress and a combination of factors was assessed. Anxiety and depression problems were placed at the centre of attention and studied regarding their interrelation with other disorders such as PTSD, emotional disturbances and sleep distortions. Low students' self-perceived mental health, negative emotions and worsening depressive and anxiety symptoms were associated with poor sleep quality.⁵²⁻⁵⁴ In another study, students' sleep duration of fewer than six hours per night during the pandemic was a significant predictor for depression and PTSD.⁵⁵ During lockdowns, the emotional and mood quality of a high percentage of university students were found in a state of disturbance and mixed feelings of frustration, boredom and disappointment.⁵⁶ Furthermore, it was found that students reporting probable depression or PTSD were at a higher risk of experiencing more severe alexithymia.⁵⁷ However, variations in terms of prevalence level between different psychological disorders were observed among studies. Through a nation-wide survey amongst Chinese university students during the early stages of the pandemic, clinically-relevant PTSD was amongst the most prevalent psychological distresses (30.8%), followed by anxiety (15.5%) and depressive symptoms (23.3%).⁵⁸ However, during the same period and in the same country, another study involved a sample from selected universities found that PTSD and depression prevalence rates were 2.7% and 9.0%, respectively.⁵⁵ Further studies are needed to understand the reasons behind such variations.

The GAD-7-based studies indicated the prevalence of anxiety symptoms among students and, similarly, PHQ-9 based studies indicated the prevalence of depressive symptoms.^{55,57-74} Nevertheless, differences in the style of reporting and investigated correlates were observed besides the variances in the reported results, which could relate to socio-cultural factors, sample nature, the timing of the study, imposed social distancing, lockdown and isolation periods, contraction of infection status and the extent of pandemic severity in the country/district of study.

A meta-analysis of GAD-7 revealed that nine studies, including a total of 22,357 participants, contributed to the analysis. The overall pooled prevalence rate of anxiety symptoms was 29.13% (95% CI: 20.90-39.00), $\tau^2 = 0.4434$ (95% CI: 0.3047-3.3701); $\tau = 0.6659$ (95% CI: 0.5520-1.8358); $I^2 = 99.3\%$ (95% CI: 99.1-99.4); $H = 12.05$ (95% CI: 10.79-13.45); and Q (d.f. = 8) = 1161, ($P < 0.0001$) [Figure 2].

The funnel plot indicated no publication bias; furthermore, Eggers' regression confirmed the absence of publication bias ($\beta = 7.119$, 95% CI: 6.68--20.92, $t = -1.011$; $P = 0.35$). Sensitivity analysis revealed that if

Table 1: Selected studies for the scoping review (N = 90)^{9,31,33,34,52-72,91-161}

Author & year of publication	Country	Age in years	Sample	Percentage of males	Research tools
1. Pham and Shi ⁹⁴ (2020)	USA	19–33	20	40.0	NR – a qualitative data collection
2. Satpathy and Ali ⁹⁵ (2020)	India	NR	80	NR	DASS-21
3. Akdeniz, <i>et al.</i> ⁹⁶ (2020)	Turkey	18–33	3,040	22.5	Abbreviated Beck Anxiety Inventory questionnaire
4. Savitsky, <i>et al.</i> ⁵⁹ (2020)	Israel	<26	244	22.5	GAD-7, items from COPE and resilience/self-esteem assessment
5. Lechner, <i>et al.</i> ⁶⁰ (2020)	USA	Mean = 24.94	1,958	20.0	Timeline Follow-Back Interview to document alcohol use during 2 weeks prior to and post campus closure. The PHQ-9, GAD-7, MSPSS
6. Vahedian-Azimi, <i>et al.</i> ⁹⁷ (2020)	Iran	27.37 ± 3.92 (20–38)	207	69.1	Mental health status was measured using the DASS-21
7. Sallam, <i>et al.</i> ⁶¹ (2020)	Jordan	Mean = 22 (median = 21, IQR: 20–22)	1,540	25.6	GAD-7
8. Lyons, <i>et al.</i> ⁹⁸ (2020)	Australia	Mean = 24 (median = 23, IQR: 20–46)	297	NR	The Kessler-10 measured psychological distress.
9. Yehudai, <i>et al.</i> ³³ (2020)	Israel and Russia	Mean = 24.4 ± 5.5	291 social work students from Israel (N = 170) and Russia (N = 121).	46.0	Seven-item FCV-19S156 + open-ended questions
10. Zolotov, <i>et al.</i> ⁹⁹ (2020)	Israel	Median = 25.0 (IQR: 18–56)	370	77.0	Seven-item FCV-19S156
11. Li, <i>et al.</i> ⁵² (2020)	China	The majority (84.4%) = 19–22	304,167	0.401	The Impact of Event Scale 6
12. Meo, <i>et al.</i> ¹⁰⁰ (2020)	KSA	Female Mean = 21.2 and Male Mean = 22.56	530	44.5	An online survey developed by the researchers
13. Bakkar ¹⁰¹ (2020)	Egypt	NR	384	31.0	An online survey developed by the researcher
14. Rzymyski and Nowicki ¹⁰² (2020)	Poland	Mean = 23.8 ± 3.8	85	42.3	An online survey developed by the researchers
15. Haider and Al-Salman ¹⁰³ (2020)	Jordan	The majority (89.9%) = 18–24	775	20.5	An online survey developed by the researchers
16. Silva, <i>et al.</i> ³¹ (2020)	Brazil	Mean = 22.4 ± 4.8 (range = 17–46)	230	NR	WHOQOL-bref
17. El Morr, <i>et al.</i> ⁷⁰ (2020)	Canada	Mean = 22.55 (range = 18–55)	159	78.6	PHQ-9, BAI, PSS and FFMQ-SF.
18. Yu, <i>et al.</i> ¹⁰⁴ (2020)	China	Mean = 20.69 ± 1.65 (range = 17–25)	932	15.4	Chinese versions of 21-item DASS-21157, Cognitive and Affective Mindfulness Scale-Revised (CAMS-CR)158 and Meaning in Life Questionnaire (MLQ)159
19. Khattar, <i>et al.</i> ⁵⁶ (2020)	India	NR	516	NR	A general questionnaire developed by the researchers
20. Huang, <i>et al.</i> ⁹ (2020)	China	Mean = 19.00 ± 0.84	430	NR	Emotional responses. Referring to the PANAS; Coping strategies. The tool for measuring the coping strategies during the outbreak of COVID-19 was revised based on the Brief COPE160
21. Zhang, <i>et al.</i> ¹⁰⁵ (2020)	China	NR	159	NR	Modified questions from the SRQ and the PSQI161 and considered the current COVID-19 epidemic (i.e. emotional state, somatic responses, sleep quality and behavior).

NR = not reported; GAD-7 = generalized anxiety disorder scale; COPE = coping behaviour questionnaire; PHQ-9 = patient health questionnaire-9; MSPSS = multidimensional perceived support scale; DASS-21 = depression, anxiety and stress scale; IQR = interquartile range; FCV-19S = fear of COVID-19 scale; WHOQOL-bref = World Health Organization quality of life-bref; BAI = Beck anxiety inventory; PSS = perceived stress scale; FFMQ-SF = five facets mindfulness questionnaire short form; CAMS-CR = cognitive and affective mindfulness scale-revised; MLQ = meaning of life questionnaire; PANAS = positive and negative emotion scale; SRQ = stress response questionnaire; PSQI = Pittsburgh sleep quality index scale; OCS = obsession with COVID-19 scale; KMO = Kaiser-Meyer-Olkin; IGDSF = Internet Gaming Disorder Short Form 9; IPAQ-SF = international physical activity questionnaire-short form; BPAQ = Buss Perry aggressive questionnaire; PCL = PTSD check list; ASD = acute stress disorder scale; TAS-20 = 20-item Toronto alexithymia scale; STAI = State-Trait Anxiety Inventory; CES-D = Center for Epidemiologic Studies Depression Scale; SRA = self-reported Altruism scale; TTM = transtheoretical model; PTGI = post-traumatic growth inventory; ACE = adverse childhood experiences; CD-RISC = Connor-Davidson resilience scale; PWB = psychological well-being; ISI = 7-item insomnia severity index; BIS-11 = Barratt impulsiveness scale-11; BSI-18 = brief symptom inventory.

Table 1 (cont'd): Selected studies for the scoping review (N = 90)^{9,31,33,34,52–72,91–161}

Author & year of publication	Country	Age in years	Sample	Percentage of males	Research tools
22. Ashraf, <i>et al.</i> ¹⁰⁶ (2020)	Pakistan	Range = 18–56	240	44.6	OCS (Urdu version)
23. Nguyen, <i>et al.</i> ³⁴ (2020)	Vietnam	NR	5,423	NR	FCoV-19S
24. Pastor, <i>et al.</i> ¹⁰⁷ (2020)	Philippines	20	998	NR	Open-ended question using online forms
25. Chen, <i>et al.</i> ¹⁰⁸ (2020)	China	NR	992	NR	A questionnaire developed by the researchers to assess seven dimensions of mental health: mental status, knowledge of stress management, behavioural patterns, risk perception, academic stress, family relationships as well as peer relationships
26. Rahali, <i>et al.</i> ¹⁰⁹ (2020)	Morocco	NR	NR	NR	KMO Index and Bartlett's test
27. Marelli, <i>et al.</i> ⁵³ (2020)	Italy	Range = 19–67	400	NR	PSQI and BAI (Italian version)
28. Sartorao Filho, <i>et al.</i> ¹¹⁰ (2020)	Brazil	Range = 19–30	347	25.6	GAD-7 for anxiety and PHQ-9 for depression questionnaires
29. Balhara, <i>et al.</i> ⁶² (2020)	India	Average = 19.6 ± 1.9 (median = 19; IQR = 18–20.7)	128	40.0	PHQ 9 and GAD 7 for depression and anxiety, IGDSF scale for the severity of disordered gaming; ten point visual analog scales for concern about the academics in the form of end semester examination and stress experienced due to COVID 19
30. Waseem, <i>et al.</i> ¹¹¹ (2020)	Pakistan	Range = 18–23	450	22.9	Impact of Event scale revised version
31. Lin, <i>et al.</i> ¹¹² (2020)	China	Range = 18–29	2,086	NR	Health Belief Model
32. Zhi, <i>et al.</i> ¹¹³ (2020)	China	Range = 18–23 and ≥24	420	10.2	General information questionnaire and the PSS (Chinese Version)
33. Anan, <i>et al.</i> ⁹¹ (2020)	China	Range = 18–30	252	40.5	PHQ-9, GAD-7 and PHQ-15
34. Al-Tammemi, <i>et al.</i> ¹¹⁴ (2020)	Jordan	Range = 18–38	381	47.7	10-item Kessler Psychological Distress Scale
35. Mechili, <i>et al.</i> ⁷¹ (2020)	Albania	≥18	863	11.3	PHQ-9 to measure depression levels and monitor severity
36. Khodabakhshikoolaei ¹¹⁵ (2020)	Iran	NR	15	NR	Van Manen Phenomenology approach
37. Huckins, <i>et al.</i> ¹¹⁶ (2020)	USA	Range = 18–22	217	NR	PHQ-4
38. Wang, <i>et al.</i> ⁹³ (2020)	China	Range = 20–40	285	NR	PHQ-9, GAD-7 scale and Sleep duration
39. Zhang, <i>et al.</i> ⁵⁴ (2020)	China	Average = 20	66	37.9	IPAQ-S, PSQI, DASS-21 and BPAQ
40. Suryadevara, <i>et al.</i> ¹¹⁷ (2020)	India	Range = 18–24	500	34.8	DASS-21
41. Chang, <i>et al.</i> ⁶³ (2020)	China	Range = 19–22	3,881	36.9	GAD-7 and PHQ-9
42. Naser, <i>et al.</i> ⁶⁴ (2020)	Jordan	The majority (90.6%) range = 18–29	1,165	46.2	PHQ-9 and GAD-7
43. Xin, <i>et al.</i> ¹¹⁸ (2020)	China	19.9 ± 1.6	24,378	32.2	Structural equation modelling

NR = not reported; GAD-7 = generalized anxiety disorder scale; COPE = coping behaviour questionnaire; PHQ-9 = patient health questionnaire-9; MSPSS = multidimensional perceived support scale; DASS-21 = depression, anxiety and stress scale; IQR = interquartile range; FCV-19S = fear of COVID-19 scale; WHOQOL-bref = World Health Organization quality of life-bref; BAI = Beck anxiety inventory; PSS = perceived stress scale; FFMQ-SF = five facets mindfulness questionnaire short form; CAMS-CR = cognitive and affective mindfulness scale-revised; MLQ = meaning of life questionnaire; PANAS = positive and negative emotion scale; SRQ = stress response questionnaire; PSQI = Pittsburgh sleep quality index scale; OCS = obsession with COVID-19 scale; KMO = Kaiser-Meyer-Olkin; IGDSF = Internet Gaming Disorder Short Form 9; IPAQ-SF = international physical activity questionnaire-short form; BPAQ = Buss Perry aggressive questionnaire; PCL = PTSD check list; ASD = acute stress disorder scale; TAS-20 = 20-item Toronto alexithymia scale; STAI = State-Trait Anxiety Inventory; CES-D = Center for Epidemiologic Studies Depression Scale; SRA = self-reported Altruism scale; TTM = transtheoretical model; PTGI = post-traumatic growth inventory; ACE = adverse childhood experiences; CD-RISC = Connor-Davidson resilience scale; PWB = psychological well-being; ISI = 7-item insomnia severity index; BIS-11 = Barratt impulsiveness scale-11; BSI-18 = brief symptom inventory.

Table 1 (cont'd): Selected studies for the scoping review (N = 90)^{9,31,33,34,52-72,91-161}

Author & year of publication	Country	Age in years	Sample	Percentage of males	Research tools
44. Liu, <i>et al.</i> ⁶⁵ (2020)	China	Range = 18–27	217	41.5	PHQ-9 and GAD-7
45. Tang, <i>et al.</i> ⁵⁵ (2020).	China	Range = 18–27	2,485	38.6	The 17 item PCL (civilian version) , PHQ-9, Sleep duration, Duration of home-quarantine and Exposure
46. Wang, <i>et al.</i> ¹¹⁹ (2020)	China	Range = 16–50	44,447	45.5	Zung's Self-rating Anxiety Scale and the Center for Epidemiologic Studies Depression Scale
47. Li, <i>et al.</i> ¹²⁰ (2021)	China	NR	1,442	NR	Kessler 6-item Psychological Distress Scale, acute stress reaction and the Impact of Event Scale-Revised
48. Odrizola-González, <i>et al.</i> ¹²¹ (2020)	Spain	NR	2,530	33.9	DASS-21 and the Impact of Event Scale
49. Hernández-Sánchez, <i>et al.</i> ¹²² (2020)	Latin America	Range = 18–69	934	NR	Self-report questionnaires, Entrepreneurial Orientation Questionnaire (COE in Spanish), Psychological need satisfaction and optimism scale of the questionnaire
50. Salman, <i>et al.</i> ¹²³ (2020)	Pakistan	Mean = 21.7 ± 3.5	1,134	NR	GAD-7, PHQ-9, sources of distress (14-items) and the coping strategies (Brief-COPE)
51. Tadesse, <i>et al.</i> ¹²⁴ (2020)	Ethiopia	Range = 16–20	408	52.4	DASS-21, 20-items for knowledge, eight items for attitude, and 12-items for the practice of preventive measures
52. Irawan, <i>et al.</i> ¹²⁵ (2020)	Indonesia	NR	30	50.0	Phenomenology method (Unstructured interview and documentation)
53. Dangi and George ¹²⁶ (2020)	India	Range = 16–35	1,562	NR	12 items Likert scale to assess psychological perception on terms of anxiety
54. Islam, <i>et al.</i> ¹²⁷ (2020)	Bangladesh	Range = 18–29	3,122	59.5	DASS-21 scale assessed depression, anxiety\ and stress
55. Ojewale ¹²⁸ (2020)	Nigeria	Mean = 21 ± 2.9	386	39.9	The Hospital Anxiety and Depression scale
56. Liu, <i>et al.</i> ¹²⁹ (2020)	China	Mean = ≤22	509	34.6	Self-Rating Anxiety Scale and Center for Epidemiological Studies Depression Scale
57. Arënlju and Bërxulli ¹³⁰ (2020)	Kosovo	Range = 17–37	158	21.5	Kessler 10 Distress scale
58. Pagnini, <i>et al.</i> ¹³¹ (2021)	Italy	Range = 18–34	436	30.5	NR – a qualitative data collection
59. Ye, <i>et al.</i> ¹³² (2020)	China	Mean = 22	7,800	38.5	ASD, nine-item scale adapted from the checklist of SARS-related stressors, 10-item Connor-Davidson Resilience Scale, an eight-item scale adapted from the MSPSS and eight-item scale adapted from the revised version of the Ways of Coping
60. Olmos-Gómez ¹³³ (2020)	Spain	Mean = 22	441	NR	A quantitative questionnaire developed by the researchers to assess learning environments and psychological factors
61. Xiao, <i>et al.</i> ⁶⁶ (2020).	China	Range = 17–25	933	70.1	Self-administrated, 84-item questionnaire, GAD-7 and PHQ-9
62. Liu, <i>et al.</i> ¹³⁴ (2020)	China	NR	198	34.3	Somatic Self-rating Scale includes 20 items (scored from 1–4) that cover somatic, anxiety, depression and mixed anxiety-depression symptoms.
63. Husky, <i>et al.</i> ¹³⁵ (2020)	France	Range = 18–19	219	32.9	A quantitative questionnaire developed by the researchers to assess stress and anxiety
64. Elmer, <i>et al.</i> ¹³⁶ (2020)	Switzerland	NR	212	NR	Somatic Self-rating Scale
65. Yang, <i>et al.</i> ¹³⁷ (2020)	China	NR	384	46.3	Scale of the 2019-nCoV coronavirus victimisation experience, scale of the positive thinking, scale of the resilience and scale of the mental health

NR = not reported; GAD-7 = generalized anxiety disorder scale; COPE = coping behaviour questionnaire; PHQ-9 = patient health questionnaire-9; MSPSS = multidimensional perceived support scale; DASS-21 = depression, anxiety and stress scale; IQR = interquartile range; FCV-19S = fear of COVID-19 scale; WHOQOL-bref = World Health Organization quality of life-bref; BAI = Beck anxiety inventory; PSS = perceived stress scale; FFMQ-SF = five facets mindfulness questionnaire short form; CAMS-CR = cognitive and affective mindfulness scale-revised; MLQ = meaning of life questionnaire; PANAS = positive and negative emotion scale; SRQ = stress response questionnaire; PSQI = Pittsburgh sleep quality index scale; OCS = obsession with COVID-19 scale; KMO = Kaiser-Meyer-Olkin; IGDSF = Internet Gaming Disorder Short Form 9; IPAQ-SF = international physical activity questionnaire-short form; BPAQ = Buss Perry aggressive questionnaire; PCL = PTSD check list; ASD = acute stress disorder scale; TAS-20 = 20-item Toronto alexithymia scale; STAI = State-Trait Anxiety Inventory; CES-D = Center for Epidemiologic Studies Depression Scale; SRA = self-reported Altruism scale; TTM = transtheoretical model; PTGI = post-traumatic growth inventory; ACE = adverse childhood experiences; CD-RISC = Connor-Davidson resilience scale; PWB = psychological well-being; ISI = 7-item insomnia severity index; BIS-11 = Barratt impulsiveness scale-11; BSI-18 = brief symptom inventory.

Table 1 (cont'd): Selected studies for the scoping review (N = 90)^{9,31,33,34,52–72,91–161}

Author & year of publication	Country	Age in years	Sample	Percentage of males	Research tools
66. Khan, <i>et al.</i> ¹³⁸ (2020)	Bangladesh	Range = 20–24	505	NR	DASS-21, Home-quarantine activities and extra-physical stressors perceived as psychological discomfort, Self-reported physical symptoms and Impact of Event Scale
67. Aqeel, <i>et al.</i> ¹³⁹ (2021)	Pakistan	Range = 16–25	500	NR	Beck Depression Scale, BAI, Revised Illness Perception Questionnaire and The Warwick-Edinburgh Mental Well-being Scale
68. Cao, <i>et al.</i> ⁶⁷ (2020)	China	NR	7,143	30.3	GAD-7
69. Torun and Torun ¹⁴⁰ (2020)	Turkey	Mean = 22.10 ± 2.69	275	39.3	Impact of Events Scale-Revise and PSS
70. Li, <i>et al.</i> ¹⁴¹ (2020)	China	Mean = 19.6	555	NR	PANAS and PHQ-4
71. Söğüt, <i>et al.</i> ¹⁴² (2020)	Turkey	Range = 19–22	972	NR	Survey Form and BAI
72. Tang, <i>et al.</i> ⁵⁷ (2020)	China	Range = 16–27	2,501	NR	TAS-20, PCL (Civilian Version) and PHQ-9
73. Aker and Midik ¹⁴³ (2020)	Turkey	NR	2,051	NR	40 open- and close-ended questions developed by the researchers
74. Ma and Miller ⁹² (2020)	China	Range = 18–53	182	NR	STAI and Perceived Social Support Scale
75. Patsali, <i>et al.</i> ¹⁴⁴ (2020)	Greece	NR	NR	431	CES-D as the measure for depression and an algorithm were used to identify cases of major depression
76. Feng, <i>et al.</i> ¹⁴⁵ (2020)	China	Mean = 19.76 ± 2.23	1,346	27.0	SRA scale
77. Kapasia, <i>et al.</i> ¹⁴⁶ (2020)	India	Median = 21 (63.4% were ≤21; 36.6% were ≥22)	232	50.0	A quantitative questionnaire developed by the researchers to evaluate the learning status, mode of learning, opinion on educational decisions, and problems due to the lockdown.
78. Islam, <i>et al.</i> ⁶⁸ (2020)	Bangladesh	Group 1 = 17–20 Group 2 = 21–24 Group 3 = >24	476	67.2	PHQ-9 and GAD-7
79. Ataş and Yildirim ¹⁴⁷ (2020)	Turkey	NR	355	46.4	General questionnaire
80. Rajab, <i>et al.</i> ¹⁴⁸ (2020)	KSA	The majority (60.1%) born between 1997–2012	208	45.2	General questionnaire
81. Zhao, <i>et al.</i> ⁷² (2020)	Korea, Japan and China	Korea (mean age = 23.14 ± 0.15) China (mean age = 23.63 ± 0.18) Japan (mean age = 23.08 ± 4.78)	821	Korea = 41.5 China = 29.5 Japan = 40.0	PHQ-9
82. Romero-Blanco, <i>et al.</i> ¹⁴⁹ (2020)	Spain	Mean = 20.5 ± 4.56	213	19.2	IPAQ-SF, EuroQol 5D, PREDIMED questionnaire, and TTM
83. Sundarasan, <i>et al.</i> ¹⁵⁰ (2020)	Malaysia	The majority (85%) range = 19–25	983	33.6	Zung's self-rating anxiety scale
84. Chi, <i>et al.</i> ⁵⁸ (2020)	China	Mean = 20.6 ± 1.9	2,038	37.0	Zung's self-rating anxiety Scale, PHQ-9, PCL, PTGI, Sociodemographic Correlates, ACE Questionnaire, the adult attachment scale (AAS), CD-RISC, and the subjective socioeconomic status scale
85. Vanaken, <i>et al.</i> ¹⁵¹ (2020)	Belgium	T1: Mean = 19.44 ± 1.40; Range = 17–28 T2: Mean = 19.51 ± 1.31; Range = 18–27	T1: 380 T2: 246	T1: 11.8 T2: 10.1	The impact of event scale with modifications for COVID-19; DASS-21; PWB, the social support list, and the stress-reactive rumination scale

NR = not reported; GAD-7 = generalized anxiety disorder scale; COPE = coping behaviour questionnaire; PHQ-9 = patient health questionnaire-9; MSPSS = multidimensional perceived support scale; DASS-21 = depression, anxiety and stress scale; IQR = interquartile range; FCV-19S = fear of COVID-19 scale; WHOQOL-bref = World Health Organization quality of life-bref; BAI = Beck anxiety inventory; PSS = perceived stress scale; FFMQ-SF = five facets mindfulness questionnaire short form; CAMS-CR = cognitive and affective mindfulness scale-revised; MLQ = meaning of life questionnaire; PANAS = positive and negative emotion scale; SRQ = stress response questionnaire; PSQI = Pittsburgh sleep quality index scale; OCS = obsession with COVID-19 scale; KMO = Kaiser-Meyer-Olkin; IGDSF = Internet Gaming Disorder Short Form 9; IPAQ-SF = international physical activity questionnaire-short form; BPAQ = Buss Perry aggressive questionnaire; PCL = PTSD check list; ASD = acute stress disorder scale; TAS-20 = 20-item Toronto alexithymia scale; STAI = State-Trait Anxiety Inventory; CES-D = Center for Epidemiologic Studies Depression Scale; SRA = self-reported Altruism scale; TTM = transtheoretical model; PTGI = post-traumatic growth inventory; ACE = adverse childhood experiences; CD-RISC = Connor-Davidson resilience scale; PWB = psychological well-being; ISI = 7-item insomnia severity index; BIS-11 = Barratt impulsiveness scale-11; BSI-18 = brief symptom inventory.

Table 1 (cont'd.): Selected studies for the scoping review (N = 90)^{9,31,33,34,52-72,91-161}

Author & year of publication	Country	Age in years	Sample	Percentage of males	Research tools
86. Amerio, <i>et al.</i> ⁶⁹ (2020)	Northern Italy	Mean = 22.02 ± 2.88	8,177	50.1	PHQ-9, GAD-7, ISI, The BIS-11, and the short form 12-Item health survey
87. Baiano, <i>et al.</i> ¹⁵² (2020)	Italy	T0: Mean = 23.84 ± 2.4 T1: Mean = 23.84 ± 2.5	T0: 31 T1: 25	T0: 54.8 T1: 60.0	Worry was assessed by the Penn State worry questionnaire, anxiety was assessed by the anxiety sensitivity index, and trait mindfulness was assessed by the mindful attention awareness scale
88. Ramos-Morcillo, <i>et al.</i> ¹⁵³ (2020)	Spain	Range = 18–50	32	25.0	NR – online semi-structured interviews
89. Wang and Zhao ¹⁵⁴ (2020)	China	Range = 18–24	3,611	40.2	Self-rating anxiety scale
90. Kecojovic, <i>et al.</i> ¹⁵⁵ (2020)	USA	Mean = 20.4 ± 2.9 (Median = 19; Range = 18–37)	162	28.4	Descriptive questions and to assess levels of depression, anxiety and somatic distress, the authors used BSI-18

NR = not reported; GAD-7 = generalized anxiety disorder scale; COPE = coping behaviour questionnaire; PHQ-9 = patient health questionnaire-9; MSPSS = multidimensional perceived support scale; DASS-21 = depression, anxiety and stress scale; IQR = interquartile range; FCV-19S = fear of COVID-19 scale; WHOQOL-bref = World Health Organization quality of life-bref; BAI = Beck anxiety inventory; PSS = perceived stress scale; FFMQ-SF = five facets mindfulness questionnaire short form; CAMS-CR = cognitive and affective mindfulness scale-revised; MLQ = meaning of life questionnaire; PANAS = positive and negative emotion scale; SRQ = stress response questionnaire; PSQI = Pittsburgh sleep quality index scale; OCS = obsession with COVID-19 scale; KMO = Kaiser-Meyer-Olkin; IGDSF = Internet Gaming Disorder Short Form 9; IPAQ-SF = international physical activity questionnaire-short form; BPAQ = Buss Perry aggressive questionnaire; PCL = PTSD check list; ASD = acute stress disorder scale; TAS-20 = 20-item Toronto alexithymia scale; STAI = State-Trait Anxiety Inventory; CES-D = Center for Epidemiologic Studies Depression Scale; SRA = self-reported Altruism scale; TTM = transtheoretical model; PTGI = post-traumatic growth inventory; ACE = adverse childhood experiences; CD-RISC = Connor-Davidson resilience scale; PWB = psychological well-being; ISI = 7-item insomnia severity index; BIS-11 = Barratt impulsiveness scale-11; BSI-18 = brief symptom inventory.

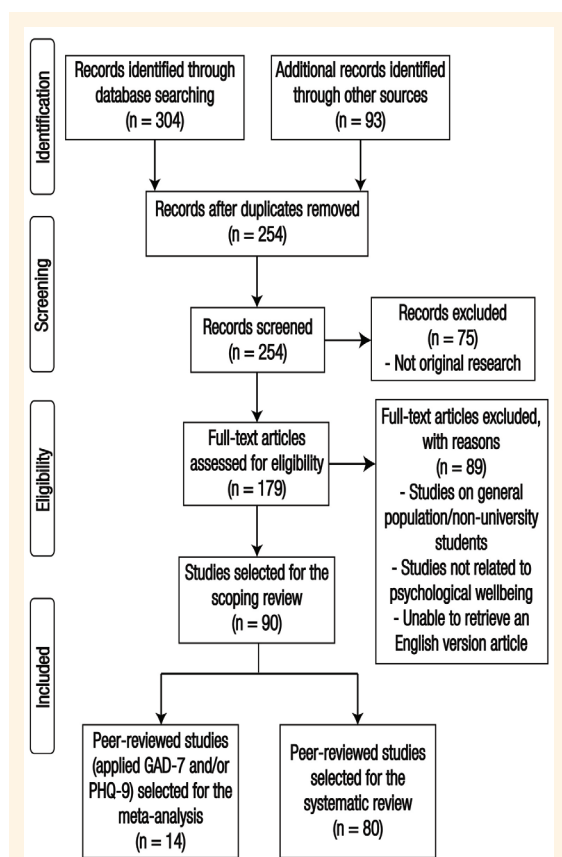


Figure 1: PRISMA diagram to show the literature identified.³⁸

one study was removed at a time, pooled results would have remained within ± 2%, suggesting that no studies are indicated for removal. P-curve analysis revealed that the null of no effect tests for right-skewness (P Full <0.0001, P Half <0.0001) to further suggest retaining

all of the studies in the final analyses. After deleting all 'outlier' studies, the forest plot showed that the overall pooled prevalence of anxiety is 24% (95% CI: 22–26%, $I^2 = 78%$, $\tau = 0.0106$, $P < 0.01$). After removing three outlier studies, the overall pooled results for anxiety symptoms did not change by >5%, and 95% CI remained overlapping,^{59,68,69} thus, the discussion was based on all of the analysis of studies, especially that random-effects modelling was used.

Meta-analysis of PHQ-9 revealed that 12 studies including a total of 23,927 participants contributed to the analysis. The overall pooled prevalence rate of depressive symptoms was 23.2% (95% CI: 15.7–32.9), $\tau^2 = 0.7297$ (95% CI: 0.4704–3.1395), $\tau = 0.8542$ (95% CI: 0.6858–1.7719), $I^2 = 99.5%$ (95% CI: 99.4–99.5), $H = 13.59$ (95% CI: 12.46–14.81) and Q (d.f.=11) = 2030 ($P < 0.0001$) [Figure 2]. The funnel plot indicated no publication bias; furthermore, Eggers' regression confirmed the absence of publication bias ($\beta = 8.629$, 95% CI: -9.21–26.47, $t = 0.948$; $P = 0.037$). Sensitivity analysis revealed that if one study was removed at a time, pooled results would have remained within ± 2%, suggesting that no studies are indicated for removal; refer to sensitivity analysis plot. P-curve analysis revealed that the null of no effect tests for right-skewness: P Full <0.0001, P Half <0.0001 to further suggest retaining all of the studies in the final analyses. The observed P-curve includes 12 statistically significant ($P < 0.05$) results, of which 12 had a P value of <0.025; there were no non-significant results entered. The forest plot of 'outlier' studies showed that an overall pooled prevalence of depression symptoms was 22% (95% CI: 19–25%, $I^2 = 78%$, $\tau^2 = 0.0106$; $P < 0.01$). After

Table 2: Characteristics of the research and sampled university students in selected studies (N = 90)

	Domain	n (%)
Research characteristics	Peer-reviewed	
	Yes	80 (89)
	No (pre-print)	10 (11)
	Research methods (Sample size range)	
	Quantitative (25–304,167)	80 (89)
	Qualitative (15–32)	4 (4)
	Mixed-methods (80–3,611)	6 (7)
	Research design	
	Cross-sectional	84 (93)
	Longitudinal	6 (7)
	Method of data collection	
	Online self-administered structured questionnaires	78 (87)
	Online semi-structured interviews	2 (2)
	Online in-depth interviews	1 (1)
Online questionnaires of close- and open-ended questions	7 (8)	
Structured-questionnaire administered by interviews	1 (1)	
Phenomenology method (unstructured interview and documentation)	1 (1)	
Sampled university students characteristics	Sample source	
	From selected/targeted universities	61 (55)
	General population/nationwide	29 (35)
	Category of sampled students	
	Local students	84 (93)
	International students	3 (3)
	Mixed (local and international)	3 (3)
	Academic level	
	Undergraduate	35 (39)
	Postgraduate	2 (2)
	Undergraduate and postgraduate	41 (46)
	Not identified	12 (13)
	Academic disciplines	
	Across different disciplines	49 (54)
	Medicine	12 (13)
	Not identified	8 (9)
	Health sciences	7 (8)
Nursing	4 (4)	
Psychology	3 (3)	
Dentistry	2 (2)	
Management/business studies	2 (2)	
Other	3 (3)	

removing seven outlier studies, the overall pooled results for depression symptoms did not change by >1%, and 95% CI remained overlapping;^{55,57,62,64,68,69,72} thus, the discussion was based on all of the analysis of studies, especially that random-effects modelling was used.

RISK OF BIAS ASSESSMENT

Overall, the quality assessment among most of the included studies (approximately 85%) had a low risk of

bias, while approximately 7% had some concerns and approximately 8% had a high risk of bias. Approximately 45% of the concerns were in the case (subject) selection dimension due to the use of convenient sampling. Only one of the studies included had an overall high risk of bias owing to limited sampling paradigm and weak data collection standard, condition recognition and evaluation [Figure 3].⁵⁷

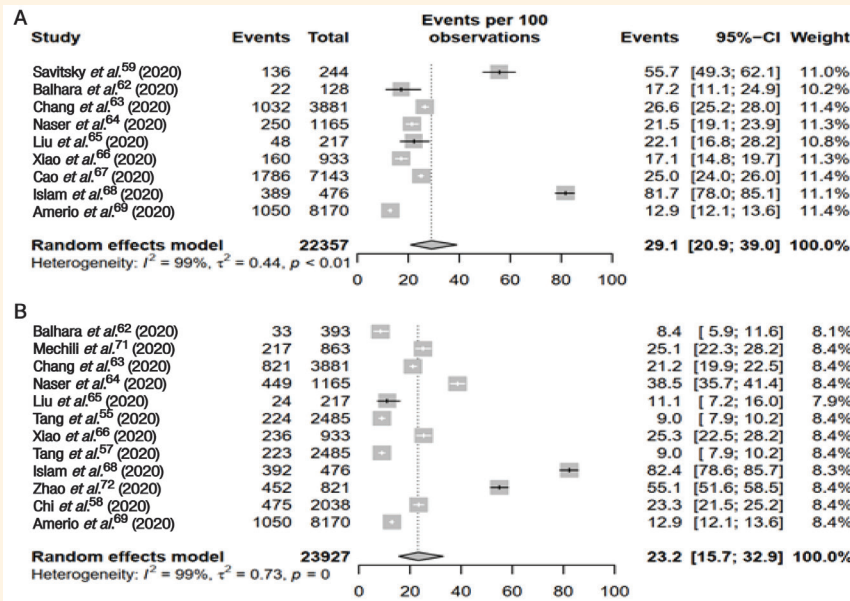


Figure 2: The prevalence rate of anxiety and depression symptoms using random effect DerSimonian and Laird meta-analyses.

Note: 1) Observations: observed odds ratio (95% confidence interval). 2) The GAD-7 scale score ranges from 0–21 and the anxiety levels are categorised as ‘non-minimal’ = <5; ‘mild’ = 5–9; ‘moderate’ = 10–14 and ‘severe’ ≥15.⁷³ The total PHQ-9 score ranges from 0–27, with scores ≥10 indicating possible depression.⁷⁴ 3) Non peer-reviewed articles were not included in this summary of results. Studies intended to validate measures without reporting prevalence data were also excluded.

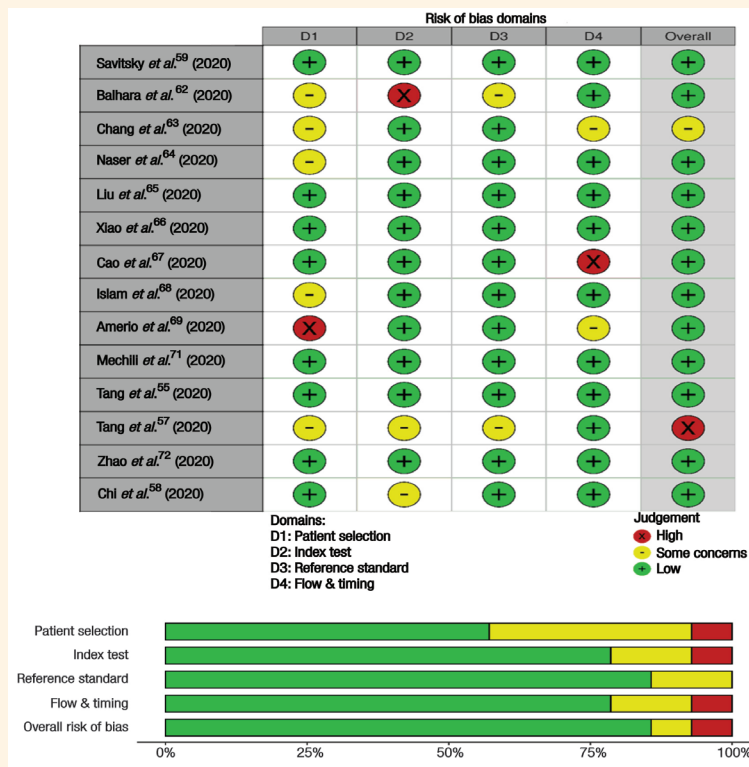


Figure 3: Detailed risk of bias traffic light plot using QUADAS-2 and summary plot.

Discussion

Since the first identification of a novel corona virus-infected case in late 2019, the COVID-19 pandemic has worsened and involved recurrent waves of infections globally in around 219 countries and territories.⁷⁵

Furthermore, the pandemic’s significant and overwhelming health and economic consequences are still exacerbating in many nations worldwide and have led to long-lasting transformational changes in life.⁷⁶ Given the importance of mental health during such a

crisis, particularly on vulnerable community segments such as university students, this study was conducted to describe the current knowledge on COVID-19 impact on university adults' psychological well-being. Its key result indicates that the overall pooled prevalence rate of anxiety symptoms was 29.1% according to GAD-7. In addition, the overall pooled prevalence rate of depressive symptoms was 23.2% according to PHQ-9. The large heterogeneity measured by $I^2 > 99\%$ is a common issue in epidemiological systematic reviews and meta-analyses.^{20,21} Other than clinical differences, methodological issues such as difficulties with randomisation, early termination of studies, use of absolute rather than relative risk assessments and publication bias might all contribute to heterogeneity.

Anxiety and depression are often comorbid disorders where anxiety could potentially devolve into depression.^{77,78} Possible explanations associated with the prevalence of variations between anxiety and depression symptoms amongst university students could be the significant predictors of uncertainty and uncontrollability.⁷⁹ The pandemic has been a severe threat to many students' academic progress and aspirations.⁸⁰ Therefore, the prevailing situation of future uncertainty, together with stressful events of illnesses, confinement and economic obstacles, has played a vital role in aggravating anxiety symptoms.^{81,82} Simultaneously with the increasing coping capacity, social support and remodelled education strategies, depression symptoms may have less potential to proliferate.^{83,84} In this context, it is worth noting that a meta-analysis study that reviewed community-based studies on depression during the COVID-19 reported a pooled prevalence of depression of 25% among the general population, compared to the current study findings at 20.45% among university students.⁸⁵ Such figures underscore the importance of differentiating the severity of the COVID-19 crisis on the different community segments' psychological health. Furthermore, epidemiological investigation intended for the second year of the pandemic should shed light on the extent and nature of students' vulnerability that may differ across academic disciplines, socioeconomic and cultural contexts.

As the first COVID-19 outbreak began in China, it is noticeable that a third of the selected studies on university students' psychological well-being were carried out in China. In addition, the prevalence of psychological symptoms amidst Chinese populations could be a determinant factor for such relatively high research activity, particularly considering the different stages of the COVID-19 outbreak in that country.⁸⁶ In a cross-sectional study that enrolled 5,676 individuals nationwide in China, the respondents reported high

incidences of depression (53.8%) using PHQ-9, anxiety (46.7%) using GAD-7 and insomnia (29.7%) using Insomnia Severity Index.⁸⁷ Hence, steering a particular focus onto university students has valid inquiry roots in China. On the contrary, the number of conducted original research concerning the students' psychological well-being is generally limited considering the extensive spread of the pandemic over the world and the presence of thousands of universities worldwide.

The low percentage of found qualitative research (4%) and mixed-methods research (7%) in this review sample indicates the deficiency of in-depth and explorative knowledge within the context of students' psychological well-being. It is worth noting that the importance of qualitative elements in the psychological field should not be undermined whether for psychopathology investigations or psychotherapy purposes.^{88,89} Furthermore, the use of longitudinal designs was limited to 7%. However, following a year since the emergence of the COVID-19 disease, there is greater feasibility to consider the adoption of longitudinal studies. Such designs could act as powerful aids in differentiating psychological symptoms, shifting across the different stages and waves of the COVID-19 pandemic.^{86,90}

Despite the higher risk surrounding international students and their susceptibility to serious psychological burdens compared to other populations, they had a much lesser research focus than the local university students (93%). Such significant disparity urges the research community to pay attention to this particular segment's socio-psychological needs. Reviewed research indicated significant incidence rates of psychological distresses amongst international students during the pandemic in association with different risk factors such as gender, exposure to pandemic-related information, double-bind situation, sleep quality and graduation uncertainty.⁹¹⁻⁹³

Amid the COVID-19 pandemic, university students' level of depression and anxiety was a prevailing research area with significant attention exhibited by interested researchers to assess the associations between specific covariates and these two psychological disorders. Major covariates included protection behaviour, disease awareness, beliefs and thoughts, regional differences, graduate student status, economic status, living environment and access to telecommunication technology.^{66,67,69,72} However, there is a shortage of studies investigating many important variables that impact university students' psychological well-being. These could include the information-seeking behaviour, exposure to media, online learning strategies, social connectedness behaviours and remodelled education approaches adopted by universities during the pandemic. From a geographical

point of view, there is a clear need to encourage research assessing university students' psychological well-being in the different countries affected by the pandemic, with more focus required in the African and Middle Eastern countries suffering severe economic and health burdens.

Conclusion

One of the significant identified research gaps is that there has been a shortage in research addressing the impact of the COVID-19 pandemic on university students' psychological well-being through an in-depth and holistic inquiry approach, which reflects the need for qualitative research. The meta-analysis findings indicate that anxiety symptoms are more prevalent than depression symptoms in the first year of the pandemic. Hence, following-up and controlling the situation demands academic decision-makers and interested researchers to deploy sustainable metrics beyond cross-sectional methods and consider action research models. Future research should focus on identifying and studying the risk factors of mental distress among university students, particularly in linkage with online education and changing learning trends. Students' contextual and individual factors also represent a vital area for current psychology to be scientifically investigated between high and low-income countries.

Furthermore, research investigating students' mental health and subjective well-being on a longitudinal basis should be placed at the forefront of universities' management priorities. Imperatively, universities' efforts at different academic disciplines to foster a psychological well-being-friendly environment for their students must be studied and reported through research; hence, positive experiences and learned lessons could be inspired to optimise mental health and counselling programmes. Universities should also ensure that their counselling centres have accessible services and structured mitigation strategies for protecting and enhancing students' psychological well-being. These services could include providing online resources and conducting active virtual group discussion sessions, which should be largely focused on positive coping, mindfulness practices, physical activity, adaptive lifestyle and health behaviour, healthy diet, good sleep hygiene and safe alternatives of social connectedness.

AUTHORS' CONTRIBUTION

AE and HJ contributed to the conception and design

of the work. AE, AD and MH were involved in search strategy, search methodology, article reviews, data curation and extraction and assessment of quality studies. HJ performed all formal data analyses. All authors were involved in drafting the manuscript and approved the final version.

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