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Gabriel Xing Da TAN
Singapore Management University, gabrieltan.2021@socsc.smu.edu.sg

Xun Ci SOH
Singapore Management University, xunci.soh.2021@socsc.smu.edu.sg

Andree HARTANTO
Singapore Management University, andreeh@smu.edu.sg

Adalia Yin Hui GOH
Singapore Management University, adalia.goh.2020@socsc.smu.edu.sg

Nadyanna M. MAJEED

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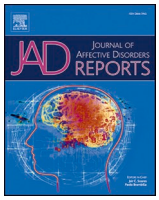

Review Article

Prevalence of anxiety in college and university students: An umbrella review

Gabriel X.D. Tan [a], Xun Ci Soh [a], Andree Hartanto [a,*], Adalia Y.H. Goh [a], Nadyanna M. Majeed [b]

[a] School of Social Sciences, Singapore Management University, Singapore
[b] Faculty of Arts and Social Sciences, National University of Singapore, Singapore

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ABSTRACT

The pervasiveness of anxiety has been increasing progressively over the years, becoming one of the most critical concerns among colleges and universities. With implications extending towards poorer academic performance and overall student mental health, there is an urgent need to address this growing concern. As such, we conducted an umbrella review of systematic reviews and meta-analyses to summarize data in the literature on the overall prevalence of anxiety among college and university students. Moreover, this umbrella review also considered the impact of the COVID-19 pandemic and assessed potential moderators through distinct subgroup analyses. A systematic search was carried out across various sources, including five databases, five journals, Google Scholar, and ProQuest Dissertations & Theses Global, which yielded 25 reviews that met inclusion criteria. Sample sizes ranged from 1,122 to 1,264,132 (*Mdn* = 22,171) that covered all regions including Africa, Arab States, Asia-Pacific, Europe, Middle East, North America, and South America. Findings from these 25 reviews were subsequently synthesized narratively. The overall prevalence of anxiety among college and university students had a median of 32.00 % and ranged from 7.40 to 55.00%. Subgroup analyses revealed that being female, living in Asia versus Europe, and being an undergraduate were associated with higher levels of anxiety. In addition, an increase in anxiety was observed pertaining to the impacts of the Covid-19 pandemic. Our findings highlight the susceptibility of college and university students to anxiety and emphasizes the need for more comprehensive strategies, implementations, and interventions to combat this rising trend.

1. Introduction

Entering college or university is one of the most important milestones in a student's life. Marked by increasing responsibilities that represent the beginning of one's transition into adulthood, university life typically revolves around striking a balance between elements such as academic performance, extracurricular activities, personal and romantic relationships, finances, and, sometimes, part-time work as well (Creed et al., 2015; Dyson and Renk, 2006; Schmidt and Lockwood, 2017). These central elements to college and university life begets the need for adaptation and achieving an optimal work-life balance in order to cope with daily stresses that arise from mounting pressures and expectations (Dyson and Renk, 2006). However, this phase of student life is often characterized by prevalent mental health-related problems such as anxiety, depression, sleep disorders, and eating disorders, among others (Cuttilan et al., 2016; Gaultney, 2010; Tavolacci et al., 2015; Wang and Liu, 2022).

Anxiety, in particular, is especially prevalent among college and university students. In accordance with the American Psychological Association (n.d.), anxiety is characterized by persistent intrusive thoughts and concerns that result in perpetual worry and tension. In a similar fashion, anxiety has also been described as having a disproportionate amount of worry and fear relative to everyday situations, which leads to adverse thoughts and predictions about future events (Perrotta, 2019). These repeated patterns of heightened worry and fear further introduces consequences such as poorer health outcomes (Jonas et al., 1997; Roest et al., 2010; Woodward and Fergusson, 2001), sleep disturbances (Dunn et al., 2022; Mellman, 2006; Ramsawh et al., 2009; Shala et al., 2021), and impaired cognitive performance (Derakshan and Eysenck, 2009; Hartanto and Yang, 2022; Majeed et al., 2023). The 2018 National College Health Assessment survey conducted by the American College Health Association (2018), which surveyed over 88,000 college students in America, found that more than half of the students (63.40 %) experienced overwhelming anxiety at some point in their last twelve

* Corresponding author at: Singapore Management University, School of Social Sciences, 90 Stamford Road, Level 4, 178903, Singapore.
E-mail address: andreeh@smu.edu.sg (A. Hartanto).

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months. In the more recent Spring 2022 National College Health Assessment (American College Health Association, 2022), more than one in three students (34.60 %) reported being diagnosed with an anxiety disorder (e.g., generalized anxiety disorder, social anxiety disorder, panic disorder, and specific phobia), while 35.10 % of students reported anxiety as an impeding factor to academic performance. In tandem, a meta-analysis conducted by Chang et al. (2021) found that the prevalence of anxiety among college and university students residing in European, American, and Asia-Pacific regions was 31.00 % (95 % CI: 23.00–39.00 %). However, another systematic review and meta-analysis involving European students conducted by Oliveira Carvalho et al. (2022) suggests that this anxiety prevalence may be even higher, residing at 55.00 % (95 % CI: 45.00–64.00 %) instead. For college and university students receiving mental health-related services, anxiety is deemed the most common and pressing concern assessed by mental health professionals, with an increasing number of students being affected over the years (Center for Collegiate Mental Health, 2020, 2022).

The COVID-19 pandemic, which surfaced in December 2019, has also played a major role in the exacerbation of mental health-related disorders and negative emotions experienced by college and university students. At the time of writing, there have been over 640 million confirmed cases of COVID-19 and over 6.6 million COVID-19-related deaths worldwide (World Health Organization, n.d.). The pandemic has been described as one that is highly stress-inducing as a result of quarantine, illness, uncertainty, and death of a loved one due to COVID-19 (Kumar and Nayar, 2021; Usher et al., 2020). Consequently, the pandemic has also given rise to evident psychological impacts such as panic, anxiety, fear and stress (Brooks et al., 2020; Husky et al., 2020; Pedrosa et al., 2020). A student mental health survey carried out by Active Minds (2020) in the United States found that out of 2000 college students, 88.80% cited stress and anxiety as one of the main impacts the COVID-19 pandemic has had on their lives. Similarly, the increasing levels of anxiety as a result of the COVID-19 pandemic was found to be especially true for college and university students (Alemany-Arrebola et al., 2020; Wang et al., 2020).

There have been several systematic reviews and meta-analyses reporting the prevalence of anxiety experienced by college and university students. However, these systematic reviews and meta-analyses have been largely limited in terms of scope, comprising mainly of restrictions such as geographical region, discipline of study (e.g., medicine versus non-medicine etc.), and type of degree (e.g., undergraduates versus postgraduates etc.). Even in the absence of such restrictions, hardly any reviews covered regions wide enough to yield an overall anxiety prevalence while simultaneously assessing the impact of the COVID-19 pandemic on this prevalence. Hence, this umbrella review was conducted with the aim of bridging this gap by estimating the overall prevalence of anxiety among college and university students, without any restrictions in terms of geographical region, discipline of study, and type of degree. Additionally, this umbrella review also considers the impact of the COVID-19 pandemic while also identifying potential moderators (e.g., gender) associated with the anxiety experienced by college and university students. As such, our review intends to provide further insights into the overall prevalence of anxiety, and its associated moderators, among college and university students that enables the development of more effective interventions.

2. Method

2.1. Transparency and openness

This umbrella review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009). Only the design of this current umbrella review was pre-registered; the synthesis plan was not. The pre-registration (dated 6 October 2022) for this umbrella review can be found on the Open Science Framework (OSF) at https://osf.io/5upj8/. For this umbrella review, the software Zotero version 6.0.23 (Zotero, n.d.) was used to convert nbib files from PubMed into ris files, while the software Mendeley version 2.82.0 (Mendeley, n.d.) was used to consolidate and deduplicate records obtained after the retrieval process.

2.2. Search strategy

The search strategy was generated by the first author and agreed upon by all authors. Systematic searches were performed on various sources for systematic reviews and meta-analyses available up to 6 October 2022. Sources included five databases (*EBSCOhost ERIC; EBSCOhost PsycINFO; PubMed; Web of Science; Scopus*) and five journals (*BMC Psychiatry; The American Journal of Psychiatry; Journal of Affective Disorders; Journal of Abnormal Psychology; Depression and Anxiety; Journal of Anxiety Disorders*); these journals were chosen as they were associated with anxiety and its associated disorders. Two other sources (*ProQuest Dissertations & Theses Global; Google Scholar*) were also searched for additional published and unpublished literature.

Keywords for the search were developed by the first author for each of the different databases and sources to capture the full and comprehensive results for each source.[1] For example, for databases *EBSCOhost ERIC* and *EBSCOhost PsycINFO*, the following keywords were used: *(prevalen* OR incidence OR rate* OR epidemiolog* OR occurrence OR pervasiveness) AND (anxiet* OR phobi* OR "panic disorder*") AND ("college student*" OR "university student*" OR "undergraduate*" OR "medical student*" OR "dental student*" OR "nursing student*" OR "postgraduate*" OR "doctorate student*" OR "phd student*" OR "phd candidate*" OR "ph.d candidate*" OR "ph.d student*" OR "master's student*" OR "masters student*" OR "graduate student*") AND ("meta-analy*" OR "meta analy" OR "quantitative synthesis" OR review)*. No date restrictions were applied to the searches. The search strategy used for each source can be found in Table 1.

2.3. Selection criteria

The first author, second author, and fourth author independently screened for the eligibility of the reviews obtained from the various databases and sources. Firstly, titles and abstracts were evaluated based on a preliminary set of criteria by the first author and fourth author (agreement rate = 92 %), which looked at whether records (1) were published in English, (2) mentioned anxiety, (3) mentioned prevalence, and (4) were either systematic reviews or meta-analyses. Subsequently, the remaining records were assessed based on their full text by the first author and second author (agreement rate = 95 %). All disagreements were resolved through discussion between the two authors and upon consensus, irrelevant and duplicate records were removed. The selection criteria that guided the inclusion and exclusion of systematic reviews and meta-analyses for the full-text screening were as follows:

1 Records were included if they were published in English.
2 Records were included if they were systematic reviews or meta-analyses.
3 Reviews were included if they focused on the prevalence of any self-reported and/or clinically diagnosed anxiety disorders consisting of:
   a Generalized anxiety disorder
   b Social anxiety disorder
   c Separation anxiety disorder

[1] Different sources had different search strategies as not every source could capture the same wildcards. For example, for the database Scopus, "meta% analy*" was used as one of the keywords. However, for the database EBSCOhost ERIC, "meta-analy*" was used instead of "meta%analy*" as EBSCOhost ERIC was not able to register the use of the "%" wildcard.

Table 1
Detailed search strategy for identification of records.

Source	Search strategy
EBSCOhost ERIC EBSCOhost PsycINFO	(prevalen* OR incidence OR rate* OR epidemiolog* OR occurrence OR pervasiveness) AND (anxiet* OR phobi* OR "panic disorder*") AND ("college student*" OR "university student*" OR "undergraduate*" OR "medical student*" OR "dental student*" OR "nursing student*" OR "postgraduate*" OR "doctorate student*" OR "phd student*" OR "phd candidate*" OR "ph.d candidate*" OR "ph. d student*" OR "master's student*" OR "masters student*" OR "graduate student*") AND ("meta-analy*" OR "meta analy" OR "quantitative synthesis" OR review)
PubMed Web of Science Scopus ProQuest Dissertations and Theses Global	(prevalen* OR incidence OR rate* OR epidemiolog* OR occurrence OR pervasiveness) AND (anxiet* OR phobi* OR "panic disorder*") AND ("college student*" OR "university student*" OR "undergraduate*" OR "medical student*" OR "dental student*" OR "nursing student*" OR "postgraduate*" OR "doctorate student*" OR "phd student*" OR "phd candidate*" OR "ph.d candidate*" OR "ph. d student*" OR "master's student*" OR "masters student*" OR "graduate student*") AND ("meta% analy*" OR "meta analy*" OR "quantitative synthesis" OR review)
Relevant Journals Google Scholar	(prevalence AND (anxiety OR phobia OR "panic disorder") AND ("university student" OR "college student") AND review)

d Panic disorder
e Phobias
f Selective Mutism

For the anxiety disorders listed above, the authors had to ensure that the prevalence was measured and assessed using validated assessment tools. These included but are not limited to the Beck Anxiety Inventory (BAI; de Paula et al., 2020), Depression Anxiety Stress Scale (DASS; Deng et al., 2021), General Anxiety Disorder Scale (GAD; Quek et al., 2019), Hospital Anxiety and Depression Scale (HADS; Jia et al., 2022), and Self-Rating Anxiety Scale (SAS; Wang & Liu, 2022).

For reviews that included empirical studies that measured the prevalence of anxiety using non-validated assessment tools, the quality of these reviews was subjected to further evaluation by the authors. Reviews were then included only if their qualities and assessment tools used were deemed to be suitable or valid in assessing the prevalence of anxiety. The validity of the assessment tools used were considered in reference to available literature and justifications used by the studies themselves. In the event that the validity of the assessment tools could not be assessed due to the lack of available information, the authors assessed the impact of those empirical studies on the overall estimated prevalence of anxiety for the systematic reviews and meta-analyses that included them. Subsequent eligibility assessment considered the face validity of the reviews, where both sample size and number of studies were taken into account. To minimize the impact of potentially invalid findings on the overall anxiety prevalence, any review that included empirical studies with non-validated assessment tools should not have such studies exceed 10 % of that review's total sample size or number of studies.

4 Reviews were included if their constituent samples comprised only college students and/or university students. This was limited to:
   a Undergraduates
   b Postgraduates (including but not limited to Master's students and PhD students at any stage of candidature)
5 Reviews were included if they estimated the prevalence of anxiety in percentages (%). For systematic reviews that did not state an overall prevalence of anxiety, they were included if conclusions regarding the prevalence of anxiety were drawn or could be drawn from the reviews.
6 Reviews were included if they did not contain any significant methodological bias, which was determined through quality assessment (see section below for details). Based on consensus between the authors, it was decided that only reviews with at least five "yes" responses, based on the Joanna Briggs Institute (JBI) critical appraisal instrument for Systematic Reviews and Research Syntheses (JBI, 2017), were included.
7 No exclusions were applied due to locational or otherwise geospatial restrictions. That is, included reviews could assess the prevalence of anxiety globally, in a specific country, or in a specific region. In addition, reviews were included regardless of peer review status. That is, both peer-reviewed and non-peer-reviewed reviews were included.

2.3.1. Quality assessment

The quality of each review was independently assessed by the first author and second author using the Joanna Briggs Institute (JBI) critical appraisal instrument for Systematic Reviews and Research Syntheses (JBI, 2017). The records were evaluated according to an 11-item checklist, where each item was rated according to four categories (*yes, no, unclear*, and *not applicable*) based on how closely the items adhered to each criterion. The criteria guiding methodological evaluation of each record were (1) clarity of review question, (2) use of appropriate inclusion criteria, (3) use of appropriate search strategies, (4) adequacy of sources and resources to search for studies, (5) use of appropriate criteria for appraisal of studies, (6) independent critical appraisal of studies, (7) employment of methods to minimize errors in data extraction, (8) use of appropriate data synthesis methods, (9) assessment of the likelihood of publication bias, (10) have recommendations for policy and/or practice backed by data reported, and (11) use of appropriate specific directives for new research. Each review was then given a score based on how many "yes" responses were accorded (i.e., the number of "yes" ratings out of 11). An overall agreement rate of 98 % (Range = 92–100 %; see Table 2) was achieved, and any remaining discrepancies or disagreements were resolved through discussion between the reviewers, with the involvement of a third reviewer for further discussion when necessary.

2.4. Data extraction

The first and second author extracted information from the reviews, which were: author(s), year of publication, title of publication, countries and regions covered by the review, participant demographics, total

Table 2
Agreement rates between coders for quality assessment.

Criterion	Agreement rate (%)
Is the review question clearly and explicitly stated?	100
Were the inclusion criteria appropriate for the review question?	96
Was the search strategy appropriate?	92
Were the sources and resources used to search for studies adequate?	100
Were the criteria for appraising studies appropriate?	100
Was critical appraisal conducted by two or more reviewers independently?	100
Were there methods to minimize errors in data extraction?	100
Were the methods used to combine studies appropriate?	100
Was the likelihood of publication bias assessed?	100
Were recommendations for policy and/or practice supported by the reported data?	92
Were the specific directives for new research appropriate?	100
Overall	98

number of studies, total unique sample size, anxiety prevalence and how it was estimated, whether reviews covered self-reported or clinically diagnosed anxiety, if the review performed subgroup analyses, and assessment tools used. Regional classification of the different countries followed the listing by Wikimedia, Meta-Wiki ("List of countries by regional classification", 2022). Table 3

2.5. Analytic plan

2.5.1. Data synthesis

The included reviews, and their subsequent applicable findings, were synthesized narratively by investigating the obtained overall prevalence of anxiety for each review. We then looked into the different subgroup analyses conducted to explore, narratively as well, the various effects different subgroups have on the anxiety experienced by college and university students.

2.5.2. Subgroup analysis

Subgroup analysis was performed on the most common subgroups investigated by all the included reviews, as well as those that were examined by at least two reviews. Moreover, subgroups were only examined when useful and meaningful conclusions regarding their influence on anxiety could be drawn; the influence of a subgroup had to stem from its direct impact on anxiety (e.g., gender) rather than indirectly from differences in study methodologies (e.g., sample size). We then explored and speculated on potential reasons to explain the impact that belonging to a particular subgroup has on anxiety prevalence.

3. Results

3.1. Search outcome and eligibility

As illustrated in the PRISMA diagram (see Fig. 1), a total of 1718 records were obtained from the initial search. Of these, 481 duplicates were later identified and removed while 1160 records were further eliminated after screening their titles and abstracts. Afterwards, another 52 records were eliminated after reading their full texts as 3 records were not published in English, 10 records were not systematic reviews or meta-analyses, 33 records did not focus on college or university students alone, 4 records lacked an overall prevalence of anxiety, and 2 records were duplicates. Eventually, a total of 25 records—none of which included unpublished literature—were assessed for their quality in order to be included in the final review.

Based on the JBI critical appraisal instrument for Systematic Reviews and Research Syntheses, methodological quality scores for each review ranged from 6 to 10 ($Mdn = 9$), with a mean score of 8.48 ($SD = 1.36$). As all 25 reviews had at least five "yes" responses, none of them had any significant methodological bias and thus met the criteria for the final inclusion (as shown in Table 4).

Table 3
Agreement rates between coders for data extraction.

Information extracted	Agreement rate (%)
Regions covered	100
How was anxiety defined?	100
Sample demographics (type of student, etc.)	100
Year(s) searched for studies	100
Total number of studies	100
Total sample size	92
Clinically diagnosed or self-reported anxiety	100
Anxiety prevalence	100
How the overall prevalence was estimated	100
Assessment tools used	88
Number of studies for subgroup analysis (if any)	92
Subgroup analysis in detail (if any)	96
Limitations	100
Overall	98

3.2. Review characteristics

The characteristics of the 25 included reviews in this umbrella review are shown in Table 5. Reviews were published between the years ranging from 2016 to 2022 (inclusive), and sample sizes ranged from 1122 to 1264,132 ($Mdn = 22,171$) that covered all regions including Africa, Arab States, Asia-Pacific, Europe, Middle East, North America, and South America. Of the 25 included reviews, 8 reviews focused specifically on medical students, 1 review specifically on nursing students, 1 review specifically on dental students, 1 review specifically on graduate and Ph.D students, and the remaining 14 on college and university students in general.

3.3. Prevalence of anxiety

Based on the 25 included reviews, the overall prevalence of anxiety in college and university students had a median of 32.00 % and ranged from 7.40 to 55.00% (as shown in Fig. 2). This prevalence range depended on the various subgroup analyses that were further explored later in this umbrella review, of which several findings were noteworthy.

3.4. Subgroup analysis

Subgroup analysis of the 25 included reviews eventually probed into six different categories: Gender, Region, Assessment Tool, Discipline of Study, Educational Level, and Time Period.

3.4.1. Gender

Across the seven reviews with subgroup analysis based on gender (Batra et al., 2021; Chang et al., 2021; Deng et al., 2021; Jia et al., 2022; Li et al., 2021; Liyanage et al., 2022; Quek et al., 2019), there was a general trend of females having higher anxiety prevalence as compared to males, with the exception of Chang et al. (2021). However, this trend was not statistically significant. The prevalence of anxiety had a median of 28.40 % (Range = 22.90–39.00 %) for males and 34.60 % (Range = 30.00–44.00 %) for females, as shown in Table 6.

3.4.2. Region

For subgroup analysis based on region, reported by a total of eight reviews (Batra et al., 2021; Demenech et al., 2021; Jia et al., 2022; Li et al., 2022; Liyanage et al., 2022; Quek et al., 2019; Santabarbara et al., 2021; Zhu et al., 2021), results were mixed except when comparing the regions of Asia and Europe.

Based on Jia et al. (2022), Li et al. (2022), and Santabarbara et al. (2021), anxiety prevalence for Asia (Mdn = 37.00 %, Range = 33.00–37.00 %) exceeded that of Europe (Mdn = 23.20 %; Range = 21.00–35.90 %), with the exception of findings from Liyanage et al. (2022), where Asia (33.00 %, 95 % CI = [25.00 %, 43.00 %]) had a significantly lower prevalence than Europe (51.00 %, 95 % CI = [44.00 %, 59.00 %]).

For the remaining regions, as different reviews had conflicting prevalence when drawing from comparisons, the results were mixed. Furthermore, each review defined the regions based on their own classification, which engendered difficulties in making accurate comparisons across the regions that are defined differently by each review. Consequently, no conclusions or trends could be further derived. The prevalence for the varying regions by each review can be found in Table 7.

3.4.3. Assessment tool

Anxiety prevalence based on nine reviews (Batra et al., 2021; Chang et al., 2021; Demenech et al., 2021; Jia et al., 2022; Lasheras et al., 2020; Li et al., 2022; Olivera Carvalho et al., 2022; Santabarbara et al., 2021; Wang & Liu, 2022) for the different assessment tools uncovered DASS-21 as measuring a higher anxiety prevalence when compared with

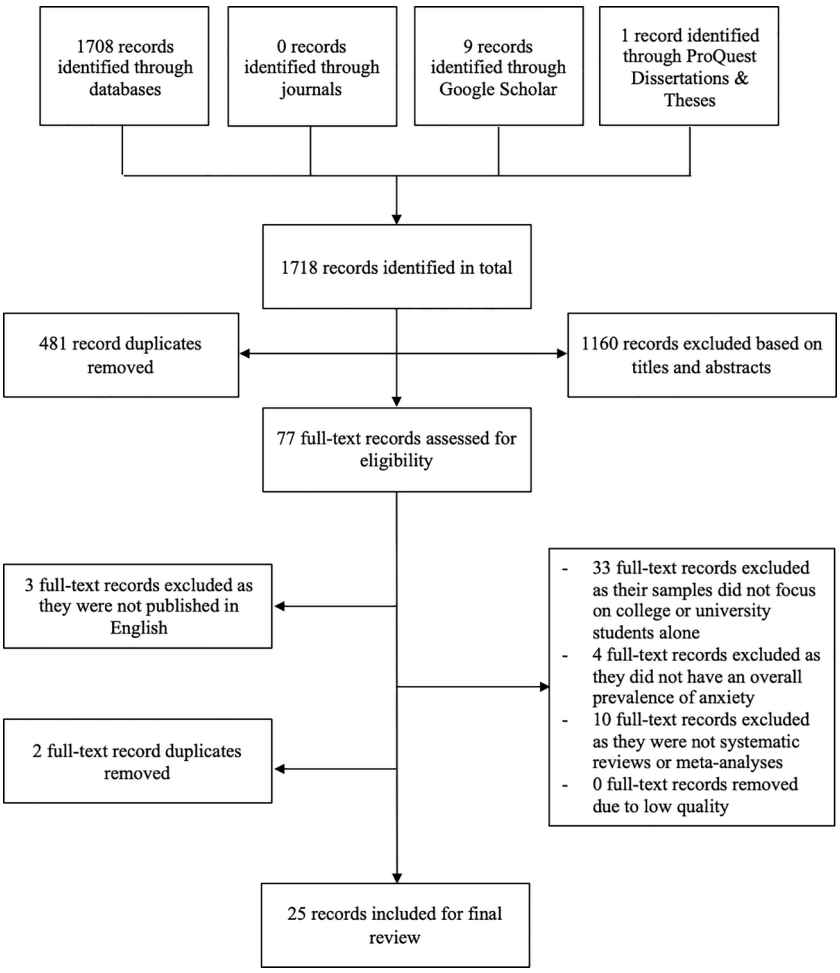

Fig. 1. PRISMA diagram detailing all steps involved in the retrieval process with reasons for exclusion.

SAS, and HADS having a higher anxiety prevalence when compared to GAD-7.

From findings by Chang et al. (2021), Jia et al. (2022), and Li et al. (2022), the prevalence of anxiety obtained from DASS-21 (*Mdn* = 33.00 %, Range = 24.90–47.70 %) was greater than that of SAS (*Mdn* = 19.00 %, Range = 16.10–23.30 %). However, only the findings in Li et al. (2022) were statistically significant. An exception was found by Santabarbara et al. (2021) with the prevalence for DASS-21 (36.00 %, 95 % CI = [20.00 %, 53.00 %]) being lower than SAS (57.00 %, 95 % CI = [52.00 %, 62.00 %]), although not statistically significant as well. Next, Jia et al. (2022) and Li et al. (2022) found the prevalence of anxiety measured using HADS (*Mdn* = 50.45 %, Range = 42.40–58.50 %) to be higher than that of GAD-7 (*Mdn* = 33.50 %), with statistically significant findings by only Jia et al. (2022).

The prevalence obtained by the other assessment tools used yielded mixed results. For example, when comparing the anxiety prevalence measured using GAD-7 and DASS-21, Chang et al. (2021) and Jia et al. (2022) found the prevalence for GAD-7 (*Mdn* = 33.75 %, Range = 33.50–34.00 %) to be higher than the prevalence for DASS-21 (*Mdn* = 28.95 %, Range = 24.90–33.00 %). In contrast, the anxiety prevalence for GAD-7 (*Mdn* = 31.00 %, Range = 21.80–33.50 %) was lower than the prevalence for DASS-21 (*Mdn* = 36.00 %, Range = 35.50–47.70 %) in the reviews by Li et al. (2022), Santabarbara et al. (2021), and Wang & Liu (2022). Thus, no further conclusions or trends could be drawn. Additionally, each review included different empirical studies that utilized different assessment tools with different cut-off values, which created difficulties in comparing scales that were used in one review with another review that did not use the same scales. The prevalence for each assessment tool used for each review can be found in Table 8, and a forest plot based on the assessment tool used for each review can be found in Fig. 3.

3.4.4. Discipline of study

Subgroup analysis based on the discipline of study comprised differing and mixed results across five reviews (Demenech et al., 2021; Li et al., 2022, 2021; Wang & Liu, 2022; Zhu et al., 2021). The reviews by Li et al. (2022) and Li et al. (2021) found that students in medicine-related disciplines (*Mdn* = 32.05 %, Range = 17.00–47.10 %) experienced higher levels of anxiety compared to other disciplines (*Mdn* = 26.40 %, Range = 16.00–36.80 %). However, this did not hold true for the remaining reviews by Demenech et al. (2021), Wang & Liu (2022), and Zhu et al. (2021) which reported that other disciplines had higher levels of anxiety instead, as shown in Table 9. It should be noted that across all five reviews, none of the findings were statistically significant.

3.4.5. Educational level

Subgroup analysis based on educational level bore a general trend revealing that undergraduates experienced higher levels of anxiety as compared to graduate students. Based on a total of three reviews (Deng et al., 2021; Li et al., 2021; Zhu et al., 2021), the anxiety prevalence for undergraduates (*Mdn* = 24.00 %, Range = 23.00–28.30 %) was greater than that of graduate students (*Mdn* = 17.00 %, Range = 14.00–28.10 %), although only slightly higher in Zhu et al. (2021), as shown in Table 10. It should be noted that none of the findings were statistically significant across all 3 reviews.

Table 4
Methodological Quality Assessment of the Included Reviews According to the JBI Critical Appraisal of Systematic Reviews and Research Syntheses.

Author, Year	Clear review question?	Appropriate inclusion criteria?	Appropriate search strategy?	Adequate use of sources?	Appropriate appraisal criteria?	Appraisal by two or more reviewers?	Methods to minimize error in data?	Appropriate method to combine studies?[a]	Assessed publication bias?	Appropriate recommendations?	Appropriate new research directives?	Overall score	Overall appraisal
Batra et al. (2021)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	Include
Chang et al. (2021)	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	9	Include
Cuttilan et al. (2016)	Y	Y	Y	N	Y	Y	Y	NA	N	Y	Y	8	Include
Demenech et al. (2021)	Y	Y	Y	N	?	?	Y	Y	Y	Y	Y	8	Include
Deng et al. (2021)	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	9	Include
de Paula et al. (2020)	Y	Y	Y	N	Y	Y	N	Y	N	Y	N	6	Include
Dessauvagie et al. (2022)	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	7	Include
Ebrahim et al. (2022)	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	9	Include
Esan et al. (2019)	Y	Y	Y	Y	?	?	N	NA	N	Y	Y	6	Include
Jia et al. (2022)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	Include
Lasheras et al. (2020)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11	Include
Li et al. (2022)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	Include
Li et al. (2021)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	Include
Liyanage et al. (2022)	Y	Y	Y	N	Y	Y	?	Y	Y	Y	Y	9	Include
Mao et al. (2019)	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	8	Include
Mulyadi et al. (2021)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	Include

(*continued on next page*)

Table 4 (*continued*)

Oliveira Carvalho et al. (2022)	Y	Y	Y	Y	?	?	Y	Y	Y	Y	N	8	Include
Pacheco et al. (2017)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	Include
Quek et al. (2019)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	Include
Santabarbara et al. (2021)	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	10	Include
Satinsky et al. (2021)	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	9	Include
Wang & Liu (2022)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	10	Include
Wang et al. (2021)	Y	Y	Y	N	?	?	N	Y	Y	Y	Y	7	Include
Zeng et al. (2019)	Y	?	Y	Y	Y	N	Y	Y	Y	Y	Y	9	Include
Zhu et al. (2021)	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	9	Include

Note. Possible responses for each question: yes/no/unclear/not applicable; Possible responses for overall appraisal: include/exclude/seek further information; Y = Yes; N = No; ? = Unclear; NA = Not applicable.

[a]Reviews were marked with "NA" if we did not manage to get a response from the authors for the relevant information despite at least two attempts for clarification.

3.4.6. Time period

Derived from two reviews (Li et al., 2022, 2021), a general trend was observed where anxiety prevalence was higher both as Covid-19 hit, and as it ravaged on. The prevalence for anxiety was highest at 40.70 % (95 % CI = [39.50 %, 42.00 %]) after Covid-19 and lowest before 1 March 2020 at 19.00 % (95 % CI = [13.00 %, 25.00 %]), as shown in Table 11. Anxiety prevalence was greater after Covid-19 (40.70 %, 95 % CI = [39.50 %, 42.00 %]) than it was before (38.90 %, 95 % CI = [33.00 %, 43.80 %]), although not statisticallysignificant, as explored by Li et al. (2022). As Covid-19 progressed, Li et al. (2021) found that the anxiety prevalence before 1 March 2020 (19.00 %, 95 % CI = [13.00 %, 25.00 %]), during the earlier stages of Covid-19, was significantly lower than after 1 March 2020 (37.00 %, 95 % CI = [26.00 %, 48.00 %]), during the later stages of Covid-19.

There are important caveats concerning these findings, which revolve around inconsistencies with how each review characterizes time periods with reference to the Covid-19 pandemic. For the review by Li et al. (2022), it was not stated how "Before Covid-19″ and "After Covid-19″ were defined.[2] Additionally, as different regions were impacted by the pandemic at varying times, setting a cut-off date, such as 1 March 2020 in the review by Li et al. (2021), might not be an accurate representation of the stages of the pandemic in other regions.

4. Discussion

College and university students are faced with mounting responsibilities that consist of family responsibilities, managing their time and finances, building relationships, and living up to both personal and societal expectations (Bean and Metzner, 1985; Creed et al., 2015; Dyson and Renk, 2006; Gerdes and Mallinckrodt, 1994). The need to adapt and balance between these responsibilities leave college students vulnerable to mental health-related issues such as anxiety (Gaultney, 2010; Tavolacci et al., 2015), which is further associated with poorer health outcomes (Jonas et al., 1997; Roest et al., 2010; Woodward and Fergusson, 2001), impaired cognitive performance (Derakshan and Eysenck, 2009; Hartanto and Yang, 2022; Majeed et al., 2023), and sleep disturbances (Dunn et al., 2022; Mellman, 2006; Ramsawh et al., 2009; Shala et al., 2021). Consequently, anxiety has become one of the most critical and pressing concerns amongst colleges and universities (Center for Collegiate Mental Health, 2020, 2022). However, despite its importance, it is still unclear how prevalent anxiety is globally among college and university students. Current literature surrounding the prevalence of anxiety amongst college and university students is largely restricted by region; no study thus far has covered regions wide enough to yield an overall anxiety prevalence for college and university students globally. In addition to region, the current literature is also limited by discipline of study and type of degree as well. As such, the current study conducted is the first comprehensive umbrella review that uncovered the overall prevalence of anxiety among college and university students without any restrictions in terms of region, discipline of study, and type of degree. Additionally, this umbrella review also examines various potential moderators through distinctive subgroup analyses while shedding light on the persistent impact the Covid-19 pandemic has had on the lives of college and university students. After taking into account all of the aforementioned limitations and factors, we found that the anxiety prevalence among college and university students had a median

[2] At least two attempts were made to contact the authors for clarification, but we did not manage to get a response.

Table 5
Characteristics of the 25 included reviews.

Author, Publication year	Type of review	Country, Region	Number of studies	Sample size	Participants	Anxiety prevalence[a], 95% CI	Assessment tools
Batra et al. (2021)	MA	9 countries (Asia-Pacific, Europe, Middle East, North America)	20	84,097	College students	39.40% [28.60%, 51.30%]	BAI, DASS, GAD, SAS, STAI, Other
Chang et al. (2021)	MA	7 countries (Asia-Pacific, Europe, North America)	13	144,010	College students	31.00% [23.00%, 39.00%]	DASS, GAD, SAS, STAI
Cuttilan et al. (2016)	SR	5 countries (Asia-Pacific, Middle East)	6	2210	Medical students	7.04%	AKUADS, BAI, HADS, ISSH, SCL-90
Demenech et al. (2021)	SR/MA	Brazil	18	9745	College students	37.75% [25.32%, 50.17%]	BAI, DASS, GAD, HADS, MINI, SPIN, STAI, Other
Deng et al. (2021)	SR/MA	26 countries (Africa, Asia-Pacific, Europe, Middle East, North America)	69	1094,240	College students	32.00% [26.00%, 38.00%]	DASS, EAS, GAD, HAM, PQEEPH, SAS, STAI, Other
de Paula et al. (2020)	SR	17 countries (Africa, Arab States, Asia-Pacific, Europe, Middle East, North America, South America)	22	22,171	College students	24.50%	BAI, DASS, DSM, GHQ, HADS, SAS, SCL-90
Dessauvagie et al. (2022)	SR	Malaysia and Thailand	10	5351	College students	42.40%	DASS, GAD, HADS, STAI
Ebrahim et al. (2022)	SR/MA	9 countries (Asia-Pacific, Europe, Middle East, North America, South America)	9	22,357	College students	29.13% [20.90%, 39.00%]	GAD
Esan et al. (2019)	SR	Nigeria	4	1122	Medical students	28.80%	DASS, HADS
Jia et al. (2022)	SR/MA	14 countries (Asia-Pacific, Europe, Middle East, North America, South America)	37	34,285	Medical students	33.70% [26.80%, 41.10%]	BAI, DASS, GAD, HADS, SAS, STAI
Lasheras et al. (2020)	SR/MA	5 countries (Asia-Pacific, Middle East, South America)	8	11,710	Medical students	28.00% [22.00%, 34.00%]	BAI, DASS, GAD, STAI
Li et al. (2022)	SR/MA	19 countries (Africa, Asia-Pacific, Europe, North America)	46	136,402	College students	39.00% [34.60%, 43.40%]	BAI, DASS, EDA-SF, GAD, HADS, PHQ-4, SAS
Li et al. (2021)	SR/MA	10 countries (Asia-Pacific, Europe, Middle East, North America)	20	73,912	College students	36.00% [26.00%, 46.00%]	DASS, GAD, SAS
Liyanage et al. (2022)	SR/MA	10 countries (Asia-Pacific, Europe, Middle East, North America)	36	1090,901	College students	41.00% [34.00%, 49.00%]	DASS, GAD, HAI, HAM, PHQ-4, SAS, STAI
Mao et al. (2019)	SR	China	11	18,263	Medical students	27.22%	BAI, HAM-A, SAS, SCL-90
Mulyadi et al. (2021)	SR/MA	6 countries (Asia-Pacific, Europe, Middle East, North America)	10	9554	Nursing students	32.00% [24.00%, 42.00%]	DASS, GAD, SAS, STAI, Other
Oliveira Carvalho et al. (2022)	SR/MA	8 countries (Europe)	10	14,920	College students	55.00% [45.00–64.00%]	DASS, GAD, HADS, SAS
Pacheco et al. (2017)	SR/MA	Brazil	6	2784	Medical students	32.90% [22.00%, 44.90%]	BAI, STAI
Quek et al. (2019)	MA	29 countries (Africa, Asia-Pacific, Europe, Middle East, North America, South America)	69	40,438	Medical students	33.80% [29.20%, 38.70%]	BAI, BSI, DASS, EST-Q, GAD, HADS, SAS, SQ-48, STAI
Santabarbara et al. (2021)	MA	10 countries (Arab States, Asia-Pacific, Europe, Middle East, North America, South America)	15	6141	Dental students	35.00% [26.00%, 45.00%]	DASS, GAD, SAS
Satinsky et al. (2021)	SR/MA	6 countries (Asia-Pacific, Middle East, North America, South America)	9	15,626	Graduate and Ph. D. students	17.00% [12.00%, 23.00%]	BSI, DASS, DSM, GAD, GHQ, MASQ, SCID-5, STAI
Wang & Liu (2022)	SR/MA	China	25	1003,743	College students	25.00% [21.00%, 29.00%]	DASS, GAD, HAI, SAS, Other
Wang et al. (2021)	SR/MA	8 countries (Asia-Pacific, Europe, Middle East, North America)	20	79,329	College students	29.00% [23.00%, 35.00%]	DASS, GAD, SAS, STAI
Zeng et al. (2019)	MA	China	3	14,202	Medical students	21.00% [3.00%, 39.00%]	BAI, SCL-90, SAS
Zhu et al. (2021)	MA	38 countries (Africa, Arab States, Asia-Pacific, Europe, Middle East, North America, South America)	144	1264,132	College students	28.20% [24.60%, 32.10%]	BAI, DASS, GAD, GHQ, HADS, HAM-A, PHQ-4, SAS, STAI

Note. The assessment tools mentioned encapsulates any variation of that particular assessment tool. For example, GAD refers to any version of GAD such as GAD-2 and GAD-7; MA: Meta-analysis; SR: Systematic review; SR/MA: Systematic review and meta-analysis; CI: Confidence Interval; BAI: Beck Anxiety Inventory; DASS:

Depression Anxiety Stress Scale; GAD: Generalized Anxiety Disorder Scale; SAS: Zung Self-Rating Anxiety Scale; STAI: State-Trait Anxiety Inventory; HADS: Hospital Anxiety and Depression Scale; AKUADS: Aga Khan University Anxiety and Depression Scale; ISSH: Influence of Studying on Students' Health; SCL-90: Symptoms Checklist-90; MINI: Mini International Neuropsychiatric Interview; SPIN: Social Phobia Inventory; EAS: Existence of Anxiety Scale; HAM-A: Hamilton Anxiety Rating Scale; PQEEPH: Psychological Questionnaires for Emergent Events of Public Health; HAI: Health Anxiety Inventory; PHQ-4: Patient Health Questionnaire-4; DSM: Diagnostic and Statistical Manual of Mental Disorders; GHQ: General Health Questionnaire; BSI: Brief Symptom Inventory; EST-Q: Emotional State-Questionnaire; SQ-48: Symptom Questionnaire-48; MASQ: Mood and Anxiety Symptom Questionnaire; SCID-5: Structured Clinical Interview for DSM-5 Axis I Disorders; EDA-SF: Emotional Distress Anxiety-Short Form.

[a] All anxiety prevalence reported by each review consisted only of self-reports.

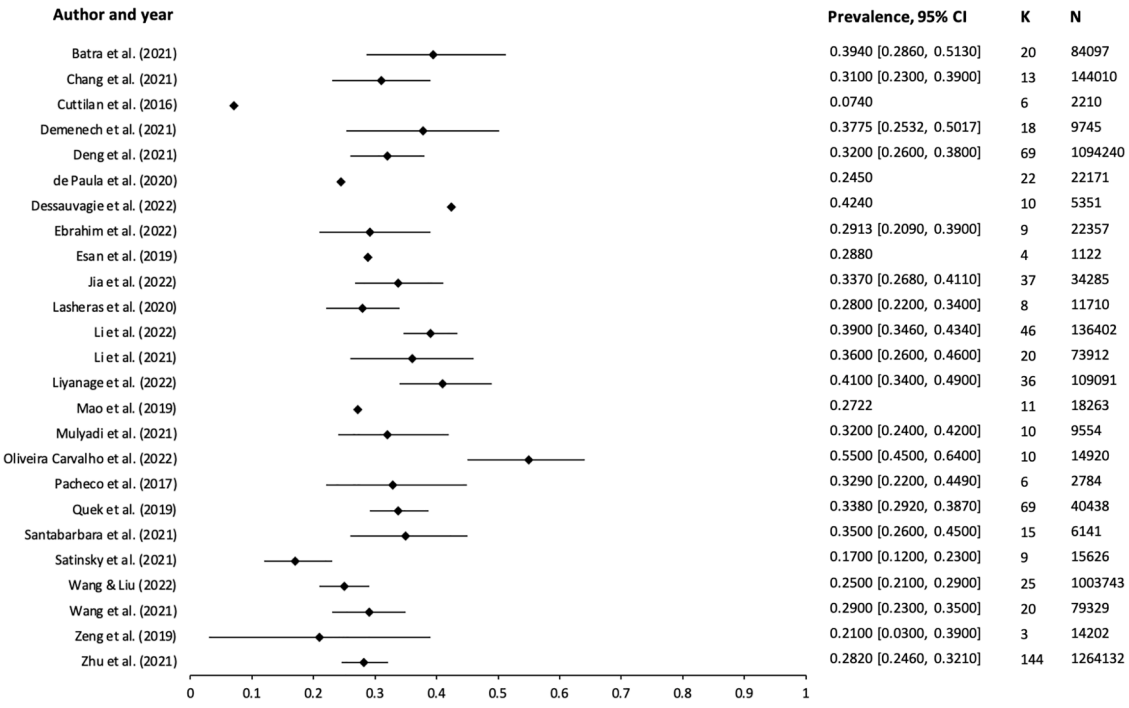

Fig. 2. Forest plot for the prevalence of anxiety based on each individual review.
Note. K = number of studies; N = total sample size. The diamonds represent the point prevalence estimates for each review, while the lines indicate their 95 % CI.

Table 6
Subgroup analysis based on gender for prevalence of anxiety.

Author, Year	No. of studies	Sample size[a]	Male Anxiety prevalence, 95 % CI	Female Anxiety prevalence, 95 % CI
Batra et al. (2021)	5	9825	22.90 % [36.30 %, 52.50 %]	34.60 % [20.50 %, 52.00 %]
Chang et al. (2021)	13	144,010	36.00 % [15.00 %, 57.00 %]	30.00 % [24.00 %, 37.00 %]
Deng et al. (2021)	22	124,526	37.00 % [21.00 %, 53.00 %]	44.00 % [34.00 %, 55.00 %]
Jia et al. (2022)	Male: 14 Female: 15	–	28.40 % [19.20 %, 40.00 %]	33.80 % [23.60 %, 45.90 %]
Li et al. (2021)	Male: 7 Female: 8	–	27.00 % [12.00 %, 42.00 %]	33.00 % [22.00 %, 43.00 %]
Liyanage et al. (2022)	17	117,109	39.00 % [29.00 %, 50.00 %]	43.00 % [29.00 %, 58.00 %]
Quek et al. (2019)	Male: 23 Female: 22	Male: 9186 Female: 10,386	27.60 % [19.30 %, 37.80 %]	38.00 % [27.60 %, 49.50 %]

[a] Reviews were marked with "–" if we did not manage to get a response from the authors for the relevant information despite at least two attempts for clarification.

of 32.00 % and ranged from 7.40 to 55.00 %.

Subgroup analyses revealed several notable findings that warrant further exploration. Firstly, there is a trend where female students were more likely to experience anxiety as compared to male students (Batra et al., 2021; Deng et al., 2021; Jia et al., 2022; Li et al., 2021; Liyanage et al., 2022; Quek et al., 2019). The median prevalence of anxiety was 28.40 % (Range = 22.90–39.00 %) for male students and 34.60 % (Range = 30.00–44.00 %) for female students. As one of the most consistent factors associated with anxiety (Demenech et al., 2021), this gender disparity was accredited to influences stemming from genetic and psychosocial differences (Bandelow and Michaelis, 2015), such as hormonal factors (Pigott, 1999), inherent behavioral responses (Chaplin et al., 2008), and cognitive thought control strategies (Bahrami and Yousefi, 2011). Additionally, lack of confidence issues, employment of thought suppression, and negative problem orientation were also more prevalent in females than males (Robichaud et al., 2003), which possibly contributes to the higher anxiety prevalence observed for female students. However, it is also imperative to consider the possibility that this gender difference in anxiety susceptibility may also emerge from being underreported by males (Smith et al., 2018). Among men in general, existing literature has identified several barriers to help-seeking, such as the fear of mental disorders, fear of being seen as weak, fear of humiliation and shame, and blatant denial (Galdas et al., 2005; Good et al., 1989; Lynch et al., 2018; Mansfield et al., 2003; Rasmussen et al., 2018). Furthermore, these barriers are particularly salient for men who subscribe to typical masculine beliefs (Galdas et al., 2005; Mansfield et al., 2003).

Secondly, among the reviews that we included, students living in

Table 7
Subgroup analysis based on region for prevalence of anxiety.

Author, Year	Subgroups	No. of studies	Sample Size[a]	Anxiety prevalence, 95 % CI
Batra et al. (2021)	Asia	13	79,676	30.40 % [20.00 %, 43.40 %]
	Others (Europe, North America, South America)	7	4421	57.50 % [38.60 %, 74.40 %]
	Africa	1	–	11.00 % [9.80 %, 12.30 %]
Jia et al. (2022)	Asia	27	–	33.20 % [24.40 %, 42.60 %]
	Europe	2	–	23.20 % [21.00 %, 25.50 %]
	North America	4	–	38.20 % [27.30 %, 49.70 %]
	South America	3	–	49.00 % [36.60 %, 61.50 %]
	Africa	2	1752	30.00 % [11.60 %, 48.50 %]
Li et al. (2022)	Asia	26	117,475	37.00 % [30.90 %, 43.10 %]
	Australasia	1	611	17.50 % [14.50 %, 20.50 %]
	Europe	5	5046	35.90 % [26.00 %, 45.80 %]
	North America	12	7246	48.30 % [37.40 %, 59.20 %]
Liyanage et al. (2022)	Asia	21	978,340	33.00 % [25.00 %, 43.00 %]
	Europe	9	103,717	51.00 % [44.00 %, 59.00 %]
	USA	5	7509	56.00 % [44.00 %, 67.00 %]
Quek et al. (2019)	Asia	18	19,520	35.20 % [26.30 %, 45.30 %]
	Middle East	21	7695	42.40 % [33.30 %, 52.10 %]
	Others (Africa, Europe, North America, Oceania, South America)	30	13,223	27.50 % [21.50 %, 34.50 %]
Santabarbara et al. (2021)	Asia	7	2771	37.00 % [24.00 %, 51.00 %]
	North and South America	4	1802	39.00 % [24.00 %, 55.00 %]
	Europe	4	1568	21.00 % [18.00 %, 24.00 %]
Zhu et al. (2021)	East Asia	36	–	13.10 % [10.10 %, 16.80 %]
	Europe	30	–	31.40 % [25.00 %, 38.60 %]
	North America	14	–	33.80 % [24.30 %, 44.80 %]

[a] Reviews were marked with "–" if we did not manage to get a response from the authors for the relevant information despite at least two attempts for clarification.

Table 8
Subgroup analysis based on assessment tool for prevalence of anxiety.

Author, Year	Subgroups	No. of studies	Sample size	Anxiety prevalence[a], 95 % CI
Batra et al. (2021)	GAD-7	8	27,898	33.00 % [18.10 %, 52.30 %]
	Others	12	56,199	43.90 % [28.90 %, 60.10 %]
Chang et al. (2021)	GAD-7	9	29,289	34.00 % [24.00 %, 44.00 %]
	SAS	2	45,430	19.00 % [−3.00 %, 41.00 %]
	DASS-21	1	217	33.00 % [27.00 %, 39.00 %]
	STAIY-2	1	69,054	27.00 % [27.00 %, 28.00 %]
Demenech et al. (2021)	BAI	6	1651	40.32 % [22.40 %, 58.24 %]
	Others	12	8094	36.53 % [15.13 %, 57.93 %]
Jia et al. (2022)	GAD-7	20	24,432	33.50 % [24.10 %, 43.60 %]
	SAS	4	1444	16.10 % [2.00 %, 39.90 %]
	DASS-21	3	1954	24.90 % [19.60 %, 30.60 %]
	DASS-42	2	670	61.50 % [40.40 %, 80.60 %]
	STAI-A	1	1165	22.70 % [20.30 %, 25.20 %]
	BAI	3	3572	26.40 % [16.20 %, 38.10 %]
	HADS	4	1335	58.50 % [52.20 %, 64.60 %]
Lasheras et al. (2020)	GAD-7	5	9051	26.00 % [19.00 %, 33.00 %]
	Others	3	2659	31.00 % [20.00 %, 43.00 %]
Li et al. (2022)b	GAD-7	11	98,278	33.50 % [26.30 %, 40.70 %]
	SAS	10	19,832	23.30 % [18.20 %, 28.40 %]
	DASS-21	12	5963	47.70 % [34.40 %, 61.10 %]
	HADS	3	2461	42.40 % [23.10 %, 61.70 %]
	Others	7	7273	49.00 % [35.00 %, 63.00 %]
Oliveira Carvalho et al. (2022)	GAD	6	11,511	57.00 % [44.00 %, 69.00 %]
	Other	4	3409	51.00 % [29.00 %, 73.00 %]
Santabarbara et al. (2021)	GAD-7	7	2608	31.00 % [20.00 %, 43.00 %]
	SAS	1	403	57.00 % [52.00 %, 62.00 %]
	DASS-21	6	2871	36.00 % [20.00 %, 53.00 %]
Wang & Liu (2022)	GAD-7	13	1191,095	21.80 % [16.10 %, 27.50 %]
	SAS	5	3293	19.70 % [9.60 %, 29.70 %]
	DASS-21	4	1979	35.50 % [8.40 %, 62.50 %]
	Others	3	3430	34.60 % [20.20 %, 49.10 %]

Note. GAD: Generalized Anxiety Disorder Scale; GAD-7: Generalized Anxiety Disorder Scale 7-item; SAS: Zung Self-Rating Anxiety Scale; DASS-21: Depression Anxiety Stress Scale 21-item; STAIY-2: State-Trait Anxiety Inventory Form Y-2; BAI: Beck Anxiety Inventory; DASS-42: Depression Anxiety Stress Scale 42-item; STAI-A: State-Trait Anxiety Inventory; HADS: Hospital Anxiety and Depression Scale.

[a] Each review included empirical studies that utilized different cut-off scores for the different assessment tools, which prevents direct comparisons of the same assessment tool used in different reviews.

[b] There was a likely error concerning the prevalence estimate and confidence interval for the BAI assessment tool. Although we attempted to contact the authors at least twice for clarification, we did not get a response and therefore decided to remove the BAI scale from this subgroup analysis.

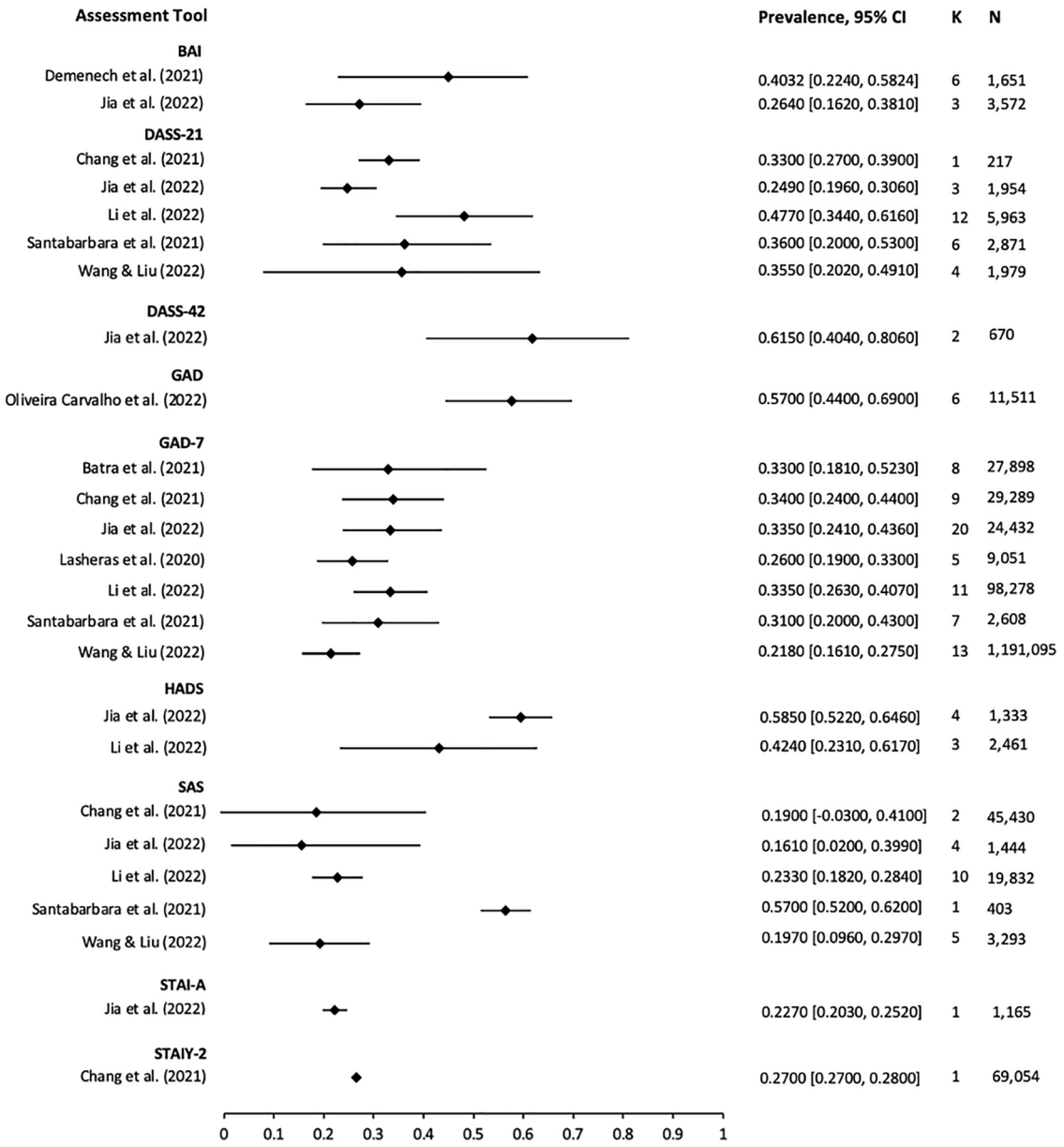

Fig. 3. Forest plot for subgroup analysis based on assessment tool.
Note. K = number of studies. The diamonds represent the point prevalence estimates for each assessment tool, while the lines indicate their 95 % CI.

Asia were found to have a higher anxiety prevalence as compared to students living in Europe (Jia et al., 2022; Li et al., 2022; Santabarbara et al., 2021), which hints at the possible role played by cultural factors in explaining the varying anxiety prevalence between the two regions (Lee et al., 2006; Marques et al., 2011). The median prevalence of anxiety was 37.00 % (Range = 33.00–37.00 %) for Asia and 23.20 % (Range = 21.00–35.90 %) for Europe. Asians were found to be less forgiving towards underachievement as compared to Europeans, which leaves them more vulnerable to anxiety and self-doubt as a result of their persistent need for high levels of academic performance (Stankov, 2010). In addition, existing studies also suggest that this difference could be the result of having either an independent or interdependent self-construal, with lower levels of independent self-construal corresponding to greater social anxiety (Krieg and Xu, 2015; Norasakkunkit and Kalick, 2002). These studies found that those of Asian heritage scored lower on independent self-construal and higher on interdependent self-construal as compared to their European heritage counterparts, which explains the higher levels of social anxiety experienced by those of Asian heritage.

Thirdly, we also found a trend that undergraduates have a higher prevalence of anxiety as opposed to postgraduates (Deng et al., 2021; Li et al., 2021; Zhu et al., 2021). The median prevalence of anxiety was 24.00 % (Range = 23.00–28.30 %) for undergraduates and 17.00 % (Range = 14.00–28.10 %) for postgraduates. This trend is consistent with the current literature, where a study by Wyatt & Oswalt (2013) found that undergraduates consistently reported experiencing more anxiety, feeling hopeless or overwhelmed, and engaging in self-harm or suicidal ideation. This contrast can be tied to the differing capacities between undergraduates and postgraduates in regulating and managing their emotions (Deng et al., 2021). Graduates, having been typically exposed to more stressful academic situations, may have developed better mechanisms and skills to cope with adversity. However, it is also highly possible that undergraduates experiencing anxiety might be impeded in their chances to even pursue postgraduate studies, thereby creating an inaccurate image that postgraduates experience lower anxiety than undergraduates.

Finally, there was a general pattern of higher anxiety prevalence

Table 9
Subgroup analysis based on discipline of study for anxiety prevalence.

Author, Year	Subgroups	No. of studies	Sample size[a]	Anxiety prevalence, 95 % CI
Demenech et al. (2021)	Medicine	10	4967	35.27 % [16.40 %, 54.14 %]
	General	4	3955	32.62 % [4.87 %, 60.37 %]
	Others (Healthcare, Nursing, Odontology, Social Communication)	4	823	49.28 % [36.58 %, 61.98 %]
Li et al. (2022)	Medicine	10	–	47.10 % [35.10 %, 59.10 %]
	Others (Unclear)	36	–	36.80 % [31.80 %, 41.80 %]
Li et al. (2021)	Medicine	5	–	17.00 % [15.00 %, 19.00 %]
	Others (Unclear)	3	–	16.00 % [12.00 %, 20.00 %]
Wang & Liu (2022)	Medicine	2	7360	22.10 % [16.60 %, 27.60 %]
	Others (Unclear)	23	996,383	24.90 % [20.70 %, 29.20 %]
Zhu et al. (2021)	Healthcare	47	–	28.20 % [22.00 %, 35.30 %]
	Others (Unclear)	93	–	29.90 % [25.30 %, 34.90 %]

[a] Reviews were marked with "–" if we did not manage to get a response from the authors for the relevant information despite at least two attempts for clarification.

Table 10
Subgroup analysis based on educational level for anxiety prevalence.

Author, Year	Subgroups	No. of studies	Sample size[a]	Anxiety prevalence, 95 % CI
Deng et al. (2021)	College	1	108	6.00 % [2.00 %, 11.00 %]
	Undergraduate	30	184,759	24.00 % [17.00 %, 30.00 %]
	Graduate	4	5238	14.00 % [4.00 %, 29.00 %]
Li et al. (2021)	Undergraduate	10	–	23.00 % [16.00 %, 30.00 %]
	Graduate	5	–	17.00 % [9.00 %, 25.00 %]
Zhu et al. (2021)	Undergraduate	92	1220,951	28.30 % [23.80 %, 33.30 %]
	Graduate	39	43,181	28.10 % [21.30 %, 36.00 %]

[a] Reviews were marked with "–" if we did not manage to get a response from the authors for the relevant information despite at least two attempts for clarification.

observed among students both after the events of the Covid-19 pandemic and as it progressed on. The median prevalence of anxiety ranged was 38.90 % (Range = 33.00–43.80 %) before Covid-19 and 40.70 % (Range = 39.50–42.00 %) after Covid-19, and 19.00 % (Range = 13.00–25.00 %) before 1 March 2020, during the earlier stages of Covid-19, and 37.00 % (Range = 26.00–48.00 %) after 1 March 2020, during the later stages of Covid-19. This increase can be attributed to long-term isolation, mounting psychological pressure as a result of this isolation, constant exposure to negative news, and a workload that is not

Table 11
Subgroup analysis based on time period for anxiety prevalence.

Author, Year	Subgroups	No. of studies	Sample size[a]	Anxiety prevalence, 95 % CI
Li et al. (2022)	Before Covid-19	41	–	38.90 % [33.00 %, 43.80 %]
	After Covid-19	5	–	40.70 % [39.50 %, 42.00 %]
Li et al. (2021)	By Mar. 1st 2020	9	–	19.00 % [13.00 %, 25.00 %]
	After Mar 1st 2020	8	–	37.00 % [26.00 %, 48.00 %]

[a] Reviews were marked with "–" if we did not manage to get a response from the authors for the relevant information despite at least two attempts for clarification.

accompanied by adequate in-person support from teachers and instructors (Ganesan et al., 2021; Li et al., 2022, 2021; Loades et al., 2020; Strasser et al., 2022). In tandem with the general population as a whole, these findings highlight the numerous adverse effects the Covid-19 pandemic has on one's psychological health. Overarchingly, being female, living in Asia versus Europe, and being an undergraduate is associated with higher levels of anxiety. Moreover, we can also expect an increase in anxiety pertaining to the impacts of the Covid-19 pandemic. It is important to note that these subgroup findings should be interpreted with caution as they were not statistically significant—-with the exception of subgroup analysis by time period.

This umbrella review has several important implications. With nearly one in three college and university students having been found to be experiencing anxiety (American College Health Association, 2022), it confers the need for a more holistic approach towards the mental healthcare of students. Furthermore, when compared to the 2017 report by the World Health Organization (2017), which estimated that anxiety is prevalent among 3.60 % of the general population, our findings (*Mdn* = 32.00 %) reveal a stark difference—further affirming the importance of addressing college and university students with more careful regard. Concerning gender, it is imperative to consider both the possible outcomes of (1) females having higher anxiety as compared to males, and (2) being underreported by males. Interventions should consider providing more support for female students while simultaneously de-stigmatizing and encouraging male students to reach out and seek help when needed (Chatmon, 2020; Debate et al., 2018; Rafal et al., 2018). This umbrella review also revealed high heterogeneity with regard to prevalence rates, which can be alluded to methodological differences in both the reviews, and their included primary studies. Most notably, different primary studies utilized different assessment tools and subsequent cut-off values, which could have yielded varied anxiety prevalences. Future research can consider using a standardized validated assessment tool, with standardized cut-off values, to conduct surveys among college and university students globally to obtain a more accurate prevalence of anxiety. Regarding time period in the post-pandemic era, which incurs a greater inclination to poor psychological health, there is undoubtedly a need to expand the amount of support provided to students compared to before (Bäuerle et al., 2020; Torjesen, 2020; Tsamakis et al., 2021), especially for undergraduates (Kecojevic et al., 2020; Lee et al., 2021; Liu et al., 2022).

The rising prevalence of anxiety suggest the importance of research in examining potential protective factors that may aid in buffering the negative ramifications that follow. While more research is necessary, several studies have hinted at the beneficial role of optimism (Dolcos et al., 2016; Majeed et al., 2021; Yu et al., 2015), resilience (Brown, 2019; Davydov et al., 2010; Yildirim et al., 2022), gratitude (Cregg and Cheavens, 2021; Hartanto et al., 2022; Petrocchi and Couyoumdjian, 2016), leisure (Folse et al., 1985; Hartanto et al., 2021; Weng and Chiang, 2014), mindfulness (Bamber and Morpeth, 2019; Gallego et al., 2014; Yildirim et al., 2022), physical activity (Anderson and

Shivakumar, 2013; McDowell et al., 2019; Shirotriya et al., 2022), social support (Munir and Jackson, 1997; Yasin and Dzulkifli, 2010; Yildirim et al., 2023) and emotional regulation (Cisler et al., 2010; Hartanto et al., 2022; Nesayan et al., 2017) in dealing with anxiety and its accompanying consequences. More importantly, research has shown that educational institutions and its staff, such as school counselors and psychologists, also play an important role in managing these consequences by ensuring that psychological help and interventions are available for students in need (Dekruyf et al., 2013; Splett et al., 2013; Stephan et al., 2007).

This umbrella review has limitations that should be acknowledged. Firstly, as the reviews included in this paper focused on anxiety in general, it indicates gaps in the existing literature pertaining to the prevalence of specific forms of anxiety disorders such as generalized anxiety disorder, phobia, panic disorder, social anxiety disorder, separation anxiety disorder, and selective mutism. Secondly, as this umbrella review focused on the prevalence of anxiety, subgroup analyses could only be examined for reviews that indicated the anxiety prevalence for a specific subgroup. This meant that information about risk factors from reviews that conducted risk factor analyses could not be utilized in this umbrella review. As such, future research can consider looking specifically into risk factors associated with anxiety among college and university students. Lastly, the prevalence of anxiety reported by all 25 included reviews were based on self-reports as opposed to a clinical diagnosis by a licensed professional, which could represent a less accurate picture of the actual prevalence of anxiety.

In conclusion, this current umbrella review shows that college and university students have a relatively high prevalence of anxiety as compared to general population estimates by the World Health Organization (2017). Female students, undergraduates, and living in Asia versus Europe were associated with greater anxiety based on subgroup analysis, calling for more extensive and careful consideration when dealing with populations from these subgroups. In addition, periods after the Covid-19 pandemic, and its later stages, have also seen more prevalent anxiety among college and university students in general. Our findings support the need for more comprehensive strategies, implementations, and interventions to combat this rising trend. Although potential protective factors—such as but not limited to the role played by optimism, resilience, and emotional regulation—have been brought up above, the role of educational institutions and its staff, such as school counselors and psychologists, are primary in ensuring that psychological help and treatments are made accessible and available to the students who require them.

Author statement

All authors have read and agreed to the published version of the manuscript.

CRediT authorship contribution statement

Gabriel X.D. Tan: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Xun Ci Soh:** Writing – review & editing, Validation. **Andree Hartanto:** Writing – review & editing, Funding acquisition, Supervision, Methodology, Investigation, Conceptualization. **Adalia Y.H. Goh:** Writing – review & editing, Validation. **Nadyanna M. Majeed:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Formal analysis.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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