



Systematic Review and Meta-analysis Investigating the Prevalence of Depression, Anxiety, Loneliness and Help seeking among International Students

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Abstract

Objectives: To identify current data, research gaps, and forms of the prevalence of depression, anxiety, loneliness and help seeking among international students around the world. To present estimations outlining international students figures through systematic review and meta-analysis investigation. And to look at patterns in nations where data are available.

Design: Systematic review and meta-analysis. Data sources: Data derived from various electronic databases, including JSTOR, PubMed, Wiley Online Library, ScienceDirect, Springer, and Sage Publishing.

Eligibility requirements for chosen studies: Studies were considered eligible if they satisfied all of the requirements for inclusion, including the study population (international students enrolled in higher education), outcomes (depression, anxiety, loneliness, or help-seeking behaviour). Quantitative, qualitative, and mixed-methods studies were included, (enough information to calculate the prevalence of depression, anxiety, loneliness, or help-seeking behaviour).

Methods: The Q statistic, which measures weighted squared deviations, T^2 , the between-studies variance, T , the between-studies standard deviation, and I^2 , which measures the ratio of true heterogeneity to total observed variance, were used to quantify heterogeneity in effect sizes, i.e., variation in the true effect sizes.

Results: According to the analysis's findings using the random-effects model, the estimated prevalence of depression was 31.3%, with a 95% confidence interval (CI) of [24.4, 38.7]. The estimated prevalence of anxiety, or the summary effect size, was found to be 29.3%, with a 95% confidence interval (CI) of [22.6, 36.4]. And estimated prevalence of loneliness, or the summary effect size, was found to be 45.8%, with a 95% confidence interval (CI) of [39.0, 52.7]. In terms of estimated prevalence of help-seeking behaviour, or the summary effect size, was 15.1%, with a 95% confidence interval (CI) of [12.3, 18.0], based on analytical results from the random-effects model.

Conclusion: A sizeable section of international students in many nations experiences problematic levels of depression, anxiety, loneliness with decreased number of those seeking help. results are constrained by the lack of data and methodological diversity.

Keywords: Systematic Review; Depression; Anxiety; Loneliness and Help Seeking; International Students

Abbreviations

CI: Confidence Interval; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis; NOS: Newcastle-Ottawa Quality Assessment Scale; PHQ-9: Patient Health Questionnaire-9; DASS: Depression Anxiety Stress Scale; BDI-II: Beck Depression Inventory-II; GCS: Generalized Contentment Scale; GHQ-28: General Health Questionnaire – 28; HADS: Hospital Anxiety and Depressive Scale; CES-D: Center for Epidemiological Studies–Depression Scale; BHM-20: Behavioral Health Measure-20.

Introduction and Literature Review

International education involves personal and academic development opportunities that students treat as exciting prospects. According to Oduwaye O, et al. [1], the path of international students contains substantial obstacles that combine cultural differences with language communication problems and the experience of living in physical isolation. These stressful conditions push people toward developing mental health problems, which include depression, anxiety, and loneliness [2,3]. The global increase in international students does not match the existing knowledge about how common mental health issues are among them, as well as how these students seek help. The research investigates both the occurrence of depression and anxiety and feelings of loneliness among international students, together with their behavior toward getting assistance. By revealing these mental health problems, the study aims to aid the development of support programs that improve international student welfare.

Prevalence of Mental Health Issues

The evidence shows that international students face higher risks of developing mental health problems. The data indicates that international students suffer from depression and anxiety at rates higher than their domestic counterparts. At Southern Medical University in China, researchers discovered that depression afflicted 36% of international students, along with 52.63% who experienced [4,5]. These high mental health rates among international students result mostly from academic stress combined with cultural differences and insufficient social friendships [3]. The mental health issues of international students become worse because of the feelings of being alone, which develop from being separated from loved ones.

Loneliness and its Impact

Social bonds are essential for human wellbeing, when this is not established, feelings of loneliness begin to develop. The experience of loneliness is widespread among studying abroad students because this social condition directly triggers depression and anxiety. Based on Corney T, et al. [2],

international students usually experience social isolation symptoms after moving to a new cultural setting since they fail to connect with fellow students. Research shows that both mental health effects and performance decline accompanied by reduced quality of life result from experiencing [1,6]. It is essential to address loneliness because doing so helps reduce its negative effects on international student welfare.

Help-Seeking Behaviors

Beyond the excitement of enrolling as an international student, one needs assistance and support when living abroad embarking on a new path. A large percentage of international learners show lower rates of consulting mental health professionals compared to students who are native to the host nation. As LaMontagne AD, et al. [7] explains, several obstacles prevent international students from seeking help, such as public disgrace, inadequate knowledge of resources, and discrepancies in mental health beliefs between cultures. International student help-seeking intentions receive significant influence from their subjective norms and opinions and perceived ability to control behavior, according to research that employs the Theory of Planned Behavior. To promote help-seeking behaviors, it is vital to increase mental health knowledge and fight social prejudices.

Interventions and Support Systems

Effective support for international students' needs to address personal needs alongside structural improvements. Students' mental health results improve substantially through culturally appropriate counseling mixed with membership programs and educational mental health resources [8]. Higher education institutions are essential in creating protected environments that support international students' mental wellness [6,7]. Organizations that unite peer-based assistance with community involvement strategies demonstrate high effectiveness in reducing student feelings of loneliness and promoting proper help-seeking channels.

Therefore, future research must emphasize studying the critical issue of international student mental health. The research investigates both mental health prevalence rates and barriers that prevent help-seeking in order to build new intervention programs. International students require fast intervention regarding mental support since it affects how students perform academically as well as their overall lifestyle quality.

Report

Objective of the Project

The objective of the project was to conduct a systematic review and meta-analysis for

- a) prevalence of depression among international students
- b) prevalence of anxiety among international students
- c) prevalence of loneliness among international students
- d) prevalence of help seeking among international students

Methods

Definitions of the 4 study variables

The study involved 4 variables, depression, anxiety, loneliness, and help-seeking behavior.

- Depression is a condition characterized by a sense of despair, isolation, avoidance, and poor self-esteem [9]. Symptoms associated with depression include lack of interest and pleasure from activity, detachment from social activity, loss of appetite, sleep disturbance, and feelings of worthlessness [10].
- Anxiety is a state of mind overwhelmed by unsafe, threatening, and unpleasant impacts due to stimulants experienced by individuals [11]. Anxiety is also described as a non-adaptive hypervigilance or a concern towards an unknown outcome [12].
- Loneliness is described as the unpleasant and distressing feeling resulted from the discrepancy between a person's desired and attained levels of social relations [13]. In other words, loneliness is the subjective experience of a quantitative or qualitative deficiency in one's social relationships [14].
- Help-seeking behavior is formal help-seeking that involves any action of energetically seeking help from professional health care services who have a legitimate and recognized professional role in providing relevant advice, support, and/or treatment (e.g., professional psychological services and mental health services) [15].

Search Strategy

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement was consulted to report this systematic review [16]. A comprehensive searching strategy was carefully designed to select eligible studies, published between January 1, 2013 and October 31, 2022, from multiple electronic databases, including JSTOR, PubMed, Wiley Online Library, ScienceDirect, Springer, and Sage Publishing. The search was performed by combining the following keywords: "international students" and ("depression" or "anxiety" or "loneliness" or "help seeking" or "psychological health" or "mental health") without limitations on the publication type, but excluding languages other than English. According to Morrison A, et al. [17], there was no evidence of a systematic bias from the use of language restrictions in systematic review-based meta-analyses.

In addition, according to Jones JB, et al. [18] the average length of time from publication to the emergence of new evidence was about 6 years. Therefore, the search was limited to articles published between 2013 and 2022 to capture research on the recent prevalence of depression, anxiety, loneliness, and help-seeking behavior for international students. The references listed in each identified article were also screened and manually searched to make the results more comprehensive. Authors of conference abstracts were contacted for full text publications, if available. The work was done by the researcher solely.

Study Selection, Inclusion and Exclusion Criteria

The researcher solely assessed articles potentially relevant for eligibility. After removing duplicates, the researcher reviewed all abstracts returned from the literature search and selected articles for full-text reading based on the inclusion and exclusion criteria. The selected full-text articles were downloaded and reviewed by the researcher. Eligible studies were included if they met the inclusion criteria for the study population (international students in higher education), outcomes (depression, anxiety, loneliness, or help-seeking behavior), study methods (quantitative, qualitative, and mixed-methods studies) and statistics (sufficient data to allow calculation of prevalence of depression, anxiety, loneliness, or help-seeking behavior).

Specifically, studies were included if they had a primary focus on international students in higher education. As such, studies that focused on domestic students or studies that did not distinguish results between domestic and international students were excluded. Articles were included if they provided results addressing depression, anxiety, loneliness, or help-seeking behavior directly and were excluded if they were only referred to in the context of general psychological distress (or similar). As the primary focus of the review was on depression, anxiety, loneliness, and help-seeking behavior, not the broader well-being construct, articles addressing well-being were only included if they also included specific reference to depression, anxiety, loneliness, or help-seeking behavior.

Finally, articles were restricted to English language, peer-reviewed journal, conference proceedings or PhD dissertations, and quantitative, qualitative (with sufficient descriptive statistics), or mixed methodologies. Encyclopedia, editorials, comments/discussion, qualitative research without sufficient descriptive statistics, practice guidelines, appendices, and literature reviews, were excluded.

Data Extraction

The researcher extracted the following information from the included articles: first author, year of publication,

research method, research design, target population, sample, sampling method, host country, ages, years in the host country, total number of subjects surveyed, total number of subjects responded, total number of international students, instruments used and the scoring rules for the outcome measures (i.e., depression, anxiety, loneliness, and help-seeking behavior), and number of subjects for each event of interest (i.e., depression, anxiety, loneliness, and help-seeking behavior). In the event more information was needed (e.g., frequency counts (or percentages) were only provided for severe depression but not for moderate level of depression), the corresponding author(s) of the original paper were contacted.

Study Quality Appraisal

The quality of the studies selected for retrieval was assessed using the Newcastle-Ottawa quality assessment scale (NOS), adapted for cross sectional studies [19,20]. The adapted form of NOS for cross sectional studies (see Table 1) contains seven items, categorized into three dimensions including selection, comparability, and outcome, to evaluate risk of bias for a study. For each item a series of response options is provided. The total score of the adapted form of NOS can be obtained by summing the scores of each item. The total score ranged from 0-9, with higher scores indicating lower risk of bias. Specifically, studies were considered to have a low, medium or high risk of bias if they scored 7-9 points, 5-6 points, and 4 points or less, respectively [21].

Dimension	Scoring options
<i>Selection (maximum 5 points)</i>	
Representativeness of the cases	1 point was given if the sample was truly representative of the average in the target population (all subjects or random sampling) or somewhat representative (non-random sampling); 0 point was given otherwise.
Sample size	1 point was given if sample size was justified and satisfactory; 0 point was given otherwise.
Non-respondents	1 point was given if comparability between included and non-included subjects was established, and if the response rate was satisfactory; 0 point was given otherwise.
Ascertainment of the survey tool	2 points were given if secure record (medical charts) or validated measurement tool was used, 1 point was given if self-report was used; 0 point was given if no description of measurement tool.
<i>Comparability (maximum 1 point)</i>	
Demographic information	1 point was given if description of the sample demographics was provided; 0 point was given otherwise.
<i>Outcome (maximum 3 points)</i>	
Assessment of outcome	2 points were given if the measures of outcomes were assessed independently and blindly or from record linkage (database records); 1 point was given if the outcome was assessed by self-report; 0 point was given otherwise.
Statistical analysis	1 point was given if the statistical test used to analyze the data was clearly described and appropriate; 0 point was given otherwise.

Table 1: Newcastle-Ottawa quality assessment scale (adapted for cross sectional studies).

Statistical analysis

Data were compiled in and analyzed using Microsoft Excel 2019. As the data collected were frequency counts, proportion (i.e., prevalence), the variance of proportion, and the associated 95% confidence interval (CI) were computed to represent the effect sizes to assess the consistency of the effect across studies and to compute a summary effect [22].

Note that all computations related to effect sizes were carried out after applying the arcsine transformation for proportions and the results were converted back to the original metric [23].

Heterogeneity in effect sizes, i.e., variation in the true effect sizes, was quantified using the following statistics, the Q statistic (a measure of weighted squared deviations),

T^2 (the between-studies variance), T (the between-studies standard deviation), and I^2 (the ratio of true heterogeneity to total observed variance) [22].

The Q statistic is defined as $Q = \sum_{i=1}^k W_i (Y_i - M)^2$, where W_i is the study weight, Y_i is the study effect size (in terms of proportion), M is the summary effect, and k is the number of studies (See the computation for summary effect for the fixed-effect model for more details of how to obtain W_i and M) [24]. The value Q is weighted sum of squares, which is a measure of weighted squared deviations reflecting the total dispersion. Under the null hypothesis that all studies share a common effect size, Q follows a central chi-squared distribution with degrees of freedom equal to $k - 1$. A p -value less than 0.05 for the Q statistic would lead to a rejection of the null hypothesis and provide evidence that the true effects vary, and hence we can conclude that the studies do not share a common effect size.

The between-studies variance τ^2 is the estimation of the variance of the true effect sizes τ^2 , and is defined

as $\tau^2 = \frac{Q-df}{C}$, where $(Q-df)$ represents the dispersion in true effects on a standardized scale, which reflects the excess dispersion. Since Q is the observed weighted sum of squares and df is the expected weighted sum of squares (under the assumption that all studies share a common effect), the difference, $Q - df$, reflects the excess variation, the part that will be attributed to differences in the true effects from study

to study. The quantity C is computed as $C = \sum_{i=1}^k W_i - \frac{\sum_{i=1}^k W_i^2}{\sum_{i=1}^k W_i}$, with a purpose of putting the measure back to the original metric. This method of estimating the variance between studies is known as the method of moments or the DerSimonian and Laird method [25] T , the estimate of the actual standard deviation τ , is simply the square root of T^2 . This is $T = \sqrt{T^2}$. T can be used to describe the distribution of the effects size and how wide spread the range of the true effect sizes is (i.e., the dispersion of true effect sizes).

The I^2 statistic, proposed by Higgins JP, et al. [26], measures the proportion of the observed variance reflecting real differences in effect size. The I^2 is computed as $I^2 = \left(\frac{Q-df}{Q} \right) * 100\%$. I^2 is interpreted as the proportion of total variation in study estimates due to heterogeneity rather than sampling error, and hence can be viewed as a measure of inconsistency. Higgins JP, et al. [26] suggest that values on the order of 25%, 50%, and 75% might be considered as low, moderate, and high, respectively. Fifty percent is often used as a cutoff for heterogeneity.

To assess the heterogeneity in meta-analysis is a crucial issue because the presence of heterogeneity can affect the statistical model to be applied to the meta-analytic data [25,27-29]. There are two popular statistical models for meta-analysis, the fixed-effect model and the random-effects model [22,23]. Under the fixed-effect model, it is assumed that all studies in the analysis share the same true effect size and that all differences in observed effects are due to sampling error, and hence the summary effect is the estimate of this common effect size [22,30]. Under the random-effects model, it is assumed that the true effect size varies from study to study, and the summary effect is an estimate of the mean of the distribution of effect sizes [22,30].

Therefore, in this study, when the studies' results only differ by the sampling error (i.e., no significant heterogeneity), a fixed-effect model can be applied to obtain an estimate of the common effect size. By contrast, if the study results differ by more than the sampling error (i.e., significant heterogeneity), then a random-effects model, in order to take into account both within- and between-studies variability, is applied to obtain an estimate of the mean of the distribution of effect sizes [22,25,27-30]. In this study, the computation of the summary effects for fixed-effect model and random-effects model followed the steps discussed in Chapter 11 (pp. 63-67) for estimating the summary effect using a fixed-effect model and Chapter 12 (pp. 68-75) for estimating the summary effect using a random-effects model in Borenstein M, et al. [22].

In particular, under the fixed-effect model, the weighted mean M , i.e., the summary effect size, can be estimated as

$M = \frac{\sum_{i=1}^k W_i Y_i}{\sum_{i=1}^k W_i}$. Note that W_i is the weight assigned to each study in a fixed-effect analysis with $W_i = 1/V_{Y_i}$ where V_{Y_i} is the within-study variance for study i (i.e., V_{Y_i} is the estimated variance of the observed effect size for study i). The variance

of the summary effect size is estimated as $V_M = \frac{1}{\sum_{i=1}^k W_i}$, and the estimated standard error of the summary effect is $SE_M = \sqrt{V_M}$. Following that, the 95% lower and upper limits (LL_M vs. UL_M) for the summary effect can be estimated as $LL_M = M - Z * SE_M$ and $UL_M = M + Z * SE_M$, where Z is the upper $(1-\alpha)/2$ critical value for the standard normal distribution. For a 95% confidence interval ($\alpha = 0.05$), the critical value for the standard normal distribution 1.96. Also, Z -value to test the null hypothesis that the common true effect is zero can be computed using $Z = M / SE_M$.

Under the random-effects model, the weight assigned to each study is $W_i^* = 1/V_{Y_i}^*$, where $V_{Y_i}^*$ is defined as the sum of

the within-study variance for study i (V_{Y_i}) and the between-studies variance (T^2). The weighted mean M^* , i.e., the summary effect size, can be estimated as $M^* = \frac{\sum_{i=1}^k W_i^* Y_i}{\sum_{i=1}^k W_i^*}$, where W_i^* is the weight assigned to each study in a random-effects analysis. The variance of the summary effect size is estimated as $V_{M^*} = \frac{1}{\sum_{i=1}^k W_i^*}$, and the estimated standard error of the summary effect is $SE_{M^*} = \sqrt{V_{M^*}}$. Following that, the 95% lower and upper limits (LL_{M^*} vs UL_{M^*}) for the summary effect can be estimated as $LL_{M^*} = M^* - Z * SE_{M^*}$ and $UL_{M^*} = M^* + Z * SE_{M^*}$, where Z is the upper $(1-\alpha)/2$ critical value for the standard normal distribution. For a 95% confidence interval ($\alpha = 0.05$), the critical value for the standard normal distribution 1.96. Finally, a Z-value to test the null hypothesis that the common true effect is zero can be computed using $Z = M^* / SE_{M^*}$. Without further specification, for any tests, a p-value less than 0.05 was an

indication of statistical significance. All p-values were two sided.

Analysis Results

Study Selection

The systematic search identified 9413 references across all databases, of which 8537 were screened after duplicates were removed. Titles and abstracts were screened for the 8537 articles and 7972 did not fulfil inclusion criteria based on titles and abstract. Full-text review was conducted on 565 manuscripts and 515 were excluded at this step. 50 papers fulfilled inclusion criteria for the systematic review and meta-analysis and reported prevalence data for at least one outcome of interest ($n = 35$ for depression, $n = 29$ for anxiety, $n = 14$ for loneliness, and $n = 17$ for help-seeking behavior). The study selection process is briefly described in the PRISMA flow diagram (Figure 1).

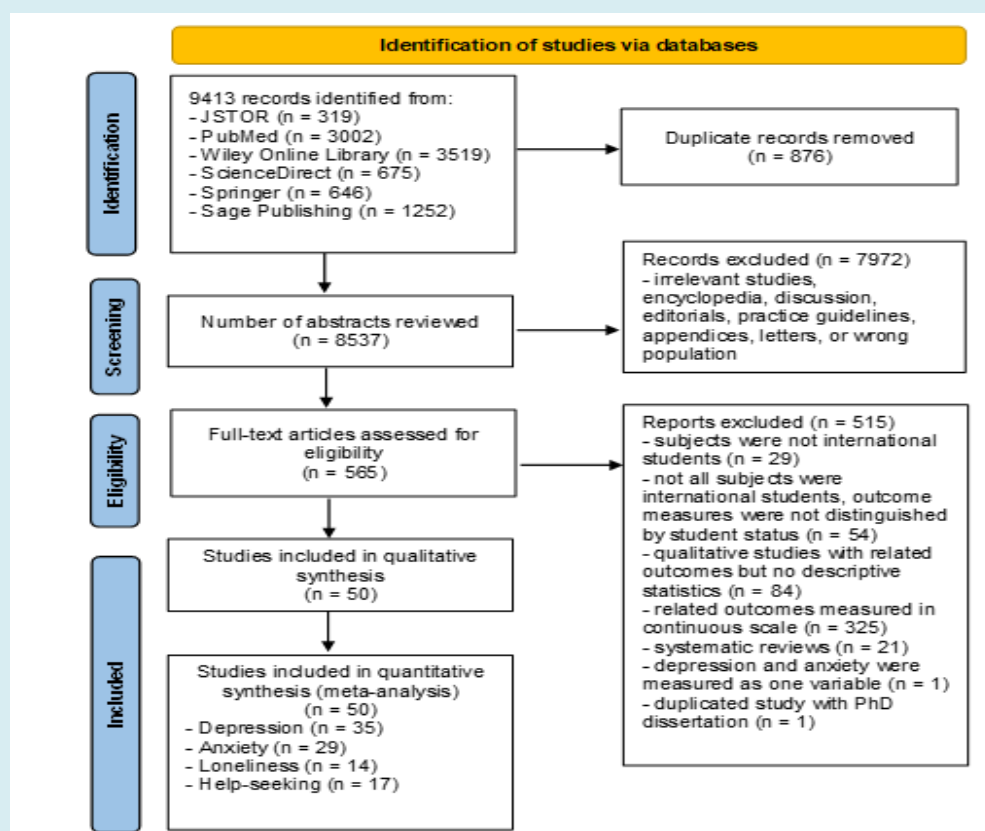


Figure 1: PRISMA flow chart.

Characteristics of the Selected Studies

Table 2 summarizes the characteristics of the 50 selected studies. Each study reported at least one outcome measure

of interest. Majority of the studies ($n = 38$) were quantitative studies, 2 were qualitative studies with descriptive statistics, and 10 were mixed-methods studies. All the quantitative and mixed-methods studies utilized cross-sectional surveys

for data collection. The mixed-methods studies also implemented interviews (n = 6), focus groups (n = 2), and open-ended questions (n = 3) to collect qualitative data. The

two qualitative studies collected data via interviews and open-ended questions.

Study	Outcomes	Research method	Research design	Target population	Sampling method	Host country	Ages	Years in host country	N surveyed	N valid responses
Alam MD, et al. [31]	depression, anxiety, loneliness	quantitative	cross-sectional survey study	international university students in China	snowball sampling	China	18-40	35.3% > 3 years	428	402
AlKrenawi A, et al. [32]	depression, anxiety	quantitative	cross-sectional survey study	female Saudi Arabian students enrolled in US colleges and universities	convenience sampling	US	17-58	1-27 years	84	84
Atherton K, et al. [33]	help seeking	mixed methods	cross-sectional survey + open-ended questions	Chinese international university students in New Zealand	convenience sampling	New Zealand	17-26+	62.4% > 1 year	838	205
Barreira P, et al. [34]	depression, anxiety, help seeking	quantitative	cross-sectional survey study	PhD students in the Economics departments of US universities	convenience sampling	US	20-35+	1-6+ years	1185	513 (238 domestic + 275 international)
Bathke A, et al. [35]	depression, anxiety, loneliness	quantitative	cross-sectional survey study	students participated in study abroad through the Learning Abroad Center of the University of Minnesota	purposeful sampling	Europe, America, Oceania, Asia, Africa/Middle East	18+	NA	7191	613
Chae D, et al. [36]	depression, anxiety, loneliness	quantitative	cross-sectional survey study	international university students in South Korea	convenience sampling	South Korea	Mean = 24.91	NA	165	165
Chen H, et al. [37]	help seeking	quantitative	cross-sectional survey study	Chinese international university students in US	convenience sampling	US	18-30	0-3+ years	113	110
Clough BA, et al. [38]	help seeking	quantitative	cross-sectional survey study	university students in Australia	convenience sampling	Australia	17-52	0-3+ years	357	357 (148 domestic + 209 international)
Clough BA, et al. [39]	help seeking	quantitative	cross-sectional survey study	international tertiary students (undergraduate + postgraduate) in Australia	convenience sampling	Australia	17-52	0-3+ years	67	45
Gülnar B, et al. [40]	depression	quantitative	cross-sectional survey study	international university students in Turkey	purposeful sampling	Turkey	mean = 21.95	mean = 3.34 years	283	283
Han X, et al. [41]	depression, anxiety	quantitative	cross-sectional survey study	Chinese international students at Yale university	convenience sampling	US	18-39	NA	364	130

Jiang X, et al. [42]	depression	quantitative	cross-sectional survey study	university students in South Korea	snowball sampling	South Korea	mean = 24.02	NA	533	533
Jones-White DR, et al. [43]	depression, anxiety	quantitative	cross-sectional survey study	doctoral students in US	random sampling	US	18-73	NA	2582	2582 (1768 domestic + 814 international students)
Kahwa KM, et al. [44]	depression, anxiety, help seeking	quantitative	cross-sectional survey study	international university students in Malaysia	purposeful sampling	Malaysia	18-35	NA	280	280
Kambouropoulos A [45]	depression, anxiety, loneliness	mixed methods	cross-sectional survey + follow-up interviews	international university students in Australia	convenience sampling	Australia	mean = 23.9	NA	90 (survey)	90
Khosravi R, et al. [46]	depression, anxiety	mixed methods	cross-sectional survey + focus group discussions	international university students in Malaysia	convenience sampling	Malaysia	18-64	NA	60 (survey)	60
Kim HR, et al. [47]	depression, anxiety	quantitative	cross-sectional survey study	international university students in South Korea	snowball sampling	South Korea	20-30+	NA	488	488
Kivelä L, et al. [48]	depression, anxiety, loneliness	quantitative	cross-sectional survey study	university students in Netherlands	purposeful sampling	Netherlands	mean = 21	NA	374	349 (180 domestic + 169 international students)
Lai AYK, et al. [49]	depression	quantitative	cross-sectional survey study	international university students in UK or USA	snowball sampling	UK or US	18-25+	NA	124	124
Larnyo E, et al. [50]	depression, anxiety	quantitative	cross-sectional survey study	international university students in China	purposeful sampling	China	18-42	0-5+ years	480	474
Lefdhahl Davis EM, et al. [51]	loneliness, help seeking	qualitative	interview + online survey with open-ended questions	Saudi women international students	purposeful sampling	US	20-35	1-3+ years	25	25
Li P, et al. [52]	help seeking	mixed methods	cross-sectional survey + open-ended questions	Asian international university students	convenience sampling	US	18-47	NA	177	177
Lian Z [53]	depression, anxiety, help seeking	mixed methods	cross-sectional survey + open-ended questions	Chinese international university students in US	purposeful sampling	US	mean = 23.75	NA	389	222
Lu L, et al. [54]	depression	quantitative	cross-sectional survey study	international students studying medicine in China	purposeful sampling	China	mean = 22.76	NA	1030	519
Mahihu C [4]	depression, anxiety	quantitative	cross-sectional survey study	international students in the health professions	purposeful sampling	China	18-44	0-5 years	114	114

Maleku A, et al. [55]	depression, anxiety, loneliness	quantitative	cross-sectional survey study	international university students in US	purposeful sampling	US	mean = 27.8	NA	835	103
Marahwa P, et al. [56]	depression, anxiety	quantitative	cross-sectional survey study	university students in China and Africa (Chinese in China, Africans in China, Africans in Africa)	purposeful sampling	China	98% < 35 years	NA	636	636
de Moissac D, et al. [57]	depression, anxiety	quantitative	cross-sectional survey study	university students in Canada	convenience sampling	Canada	mean = 24	NA	5000	932 (722 domestic + 210 international students)
Morris A, et al. [58]	loneliness	quantitative	cross-sectional survey study	international university students in Australia	purposeful sampling	Australia	18-30+	NA	all international students in the 43 higher education institutions in Sidney and Melbourne, Australia	7084
Nahidi S [59]	help seeking	mixed methods	cross-sectional survey + focus group discussions + interviews	international students from a country with difficult socio-political environment than Australia	convenience sampling	Australia	18-40	0-3 years	180 (survey)	180
Nasir MAM, et al. [60]	help seeking	quantitative	cross-sectional survey study	international university students in Malaysia	convenience sampling	Malaysia	18-28+	1-5+ years	23	23
Negrete V [61]	help seeking	quantitative	cross-sectional survey study	Asian international university students	snowball sampling	US	18-40	0-2 years	236	78
Nguyen MH, et al. [62]	depression	quantitative	cross-sectional survey study	international university students in Japan	convenience sampling	Japan	17-20+	0-3+ years	268	268 (67 domestic + 201 international)
Poyrazli S [63]	depression, anxiety, loneliness	quantitative	cross-sectional survey study	international students	convenience sampling	US	18-46	NA	168	168
Poyrazli S, et al. [64]	depression, anxiety, help seeking	quantitative	cross-sectional survey study	U.S. students studying abroad	purposeful sampling	Italy	69% under 21 years old	NA	111	111
Rosa D, et al. [65]	depression, anxiety	quantitative	cross-sectional survey study	international and domestic university students in Canada	random sampling	Canada	18-30+	NA	15000	4640 (4035 domestic + 605 international)
Sanci L, et al. [66]	depression, anxiety, loneliness, help seeking	quantitative	cross-sectional survey study	university students in Australia	convenience sampling	Australia	mean = 24	NA	56375	14880 (9398 domestic + 5482 international students)

Saravanan C, et al. [67]	depression, loneliness	mixed methods	cross-sectional survey + semi-structured interviews	international university students in Malaysia	purposeful sampling	Malaysia	19-21	NA	520	29
Schofield MJ, et al. [68]	depression	quantitative	cross-sectional survey study	university students in Australia	random sampling	Australia	18-26+	NA	5000	800 (696 domestic + 104 international)
Shadowen N, et al. [69]	depression, anxiety	quantitative	cross-sectional survey study	international university students in US	purposeful sampling	US	Mean = 24.9	46% <= 2 years	1991	490
Snoubar Y [70]	help seeking	quantitative	cross-sectional survey study	international university students from war and conflict zones	purposeful sampling	Turkey	Demographic questionnaire issued, no results reported in the article	NA	121	63
Song B, et al. [71]	depression, anxiety	quantitative	cross-sectional survey study	Chinese international university students in US	snowball sampling	US	19-23+	NA	291	261
Sustarsic M, et al. [72]	loneliness	qualitative	interviews	international graduate students in US	purposeful sampling	US	23-37	mean = 2.5 years	20	20
Teng Y, et al. [73]	loneliness	quantitative	cross-sectional survey study	Chinese international university students in Japan	snowball sampling	Japan	mean = 24.67	mean = 35.31 months	307	305
Tu D [74]	help seeking	mixed methods	cross-sectional survey + interviews	Chinese international students in community colleges in US	convenience sampling	US	18+	2 months to 84 months	39	39
Udah H, et al. [75]	depression, anxiety	mixed methods	cross-sectional survey + interviews	international university students in Australia	convenience sampling	Australia	18-45	NA	58 (survey)	58
Varughese A, et al. [76]	depression, anxiety	mixed methods	cross-sectional survey + interviews	Indian international university students in Canada	convenience sampling	Canada	75% were 18-25	NA	1000	600
Xiong Y, et al. [77]	help seeking	quantitative	cross-sectional survey study	Asian international university students in US	random sampling	US	mean = 22.15	NA	97259 (3701 Asian international students)	97259 (3701 Asian international students)
Xiong Y, et al. [78]	depression, anxiety, loneliness	quantitative	cross-sectional survey study	Asian international university students in US	random sampling	US	mean = 22.15	NA	97259 (3701 Asian international students)	97259 (3701 Asian international students)
Yuan LL, et al. [79]	depression, anxiety	quantitative	cross-sectional survey study	international medical students in China	purposeful sampling	China	16-42	NA	1030	550

Table 2: Study descriptions.

The target populations were either university students (including both domestic and international students) or international students. The sampling methods utilized in these studies included snowball sampling (n = 7), random

sampling (n = 5), purposeful sampling (n = 18), and convenience sampling (n = 20). US (n = 18), Australia (n = 8), and China (n = 6) were the top three host countries. Almost all studies (n = 49) reported ages of the participants.

Only 19 studies reported how long study participants have been in the host countries. The sample size of the studies (international students only) ranged from 20 to 5482.

Of the 50 studies, 35 reported data for prevalence of depression. Table 3 summarized the instruments and the associated scoring instructions and criteria used to determine depression for each study. Patient Health Questionnaire-9 (PHQ-9) [80] (n = 12), Depression Anxiety Stress Scale (DASS-21) [81] (n = 4), and Beck Depression Inventory-II (BDI-II) [82] (n = 3) were the most commonly utilized instruments for measuring depression. Other instruments utilized to measure depression included: Patient Health Questionnaire-2 (PHQ-2) depression screener [83,84] (n = 2), Generalized Contentment Scale (GCS) [85] (n = 1), General Health Questionnaire – 28 (GHQ-28) [86] (n = 1), Patient Health Questionnaire-4 (PHQ-4) [87] (n =

1), Hospital Anxiety and Depressive Scale (HADS) [88] (n = 1), and the 20-item Center for Epidemiological Studies–Depression Scale (CES-D) [89] (n = 1). The remaining studies (n = 9) utilized a single item to measure depression, including

- One Likert-scale item from the Behavioral Health Measure-20 (BHM-20) [90] (symptoms of depression),
- one Likert-scale question regarding social and psychological issues – depression
- yes/no questions such as a) mental health symptoms (depression) during the last month, b) any experiences of depression in the twelve months (from Retrospective Depression, Anxiety, and Major life Events scale (R-DAMLES-12) [91], c) depression diagnosis, d) depression in the past year, e) experiencing the psychological symptom/concern – depression, f) diagnosis of depression in the last 12 months, and g) felt depression during the pandemic.

Depression			
Study	Instrument	Scoring	Indication of depression
Alam MD, et al. [31]	DASS-21	The depression subscale consists of items 3, 5, 10, 13, 16, 17, and 21 with scores ranging from normal (0–9), mild (10–13), moderate (14–20), severe (21–27), to extremely severe (28+).	DASS-21 depression scale score ≥ 14
AlKrenawi A, et al. [32]	BDI-II	Beck AT, et al. [82] suggested the cut score guidelines for the total scores as follows: 0–13 (minimal), 14–19 (mild), 20–28 (moderate), and 29–63 (severe). A cut off of 20 was used as an indication of depression.	BDI-II score ≥ 20
Barreira P, et al. [34]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
Bathke A, et al. [35]	one Likert-scale item from BHM-20 (symptoms of depression)	5-point Likert scale (never/rarely/sometimes/often/almost always)	response = sometimes/often/almost always
Chae D, et al. [36]	one yes/no question (Mental health symptoms (depression) during the last month)	yes/no	response = yes

Gülnar B, et al. [40]	GCS	The GCS is a 25-item self-rating instrument, each statement on a 5-point scale ranging from “rarely or none of the time” (1) to “most or all of the time” (5). Answers	GCS score ≥ 2.61
		ranged one to five therefore 0.80 (4/5= 0.80) range was used in staging: 1.00-1.80 = very low; 1.81-2.60 = low; 2.61-3.40 = midpoint; 3.41-4.20 = high; 4.21-5.00 = very high.	
Han X, et al. [41]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
Jiang X, et al. [42]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
Jones-White DR, et al. [43]	PHQ-2	The response options included “not at all (0),” “several days (+1),” “more than half the days (+2),” and “nearly every day (+3).” Summed the two items and use a cut-point of 3 recommended by Kroenke K, et al. [80].	PHQ-2 score ≥ 3
Kahwa KM, et al. [44]	DASS-21	The depression subscale consists of items 3, 5, 10, 13, 16, 17, and 21 with scores ranging from normal (0–9), mild (10–13), moderate (14–20), severe (21–27), to extremely severe (28+).	DASS-21 depression scale score ≥ 14
Kambouropoulos A [45]	one Likert-scale question (social and psychological issues - depression)	never a problem, has been a problem, ongoing problem	depression “has been a problem” or is an “ongoing problem”
Khosravi R, et al. [46]	GHQ-28	severe depression (Items 22-28): For every item, there are 4 probable answers on hand (0-not at all, 1-no more than usual, 2-rather more than usual, 3-much more than usual).	Based on GHQ-28 subscale - severe depression (Items 22-28) (cut-off value for the subscale was not mentioned in the study)

Kim HR, et al. [47]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
Kivelä L, et al. [48]	BDI-II	Beck AT, et al. [82] suggested the cut score guidelines for the total scores as follows: 0–13 (minimal), 14–19 (mild), 20–28 (moderate), and 29–63 (severe). A cut off of 20 was used as an indication of depression.	BDI-II score ≥ 20
Lai AYK, et al. [49]	PHQ-4	Total score is determined by adding together the scores of each of the 4 items. Scores are rated as normal (0–2), mild (3–5), moderate (6–8), and severe (9–12). Total score ≥ 3 for first 2 questions suggests anxiety. Total score ≥ 3 for last 2 questions suggests depression. Löwe B, et al [87] recommends a cut-off score of 6 for the total score.	PHQ-4 score ≥ 6
Larnyo E, et al. [50]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
Lian Z [53]	one one yes/no question of R-DA-MLES-12 (any experiences of depression in the twelve months)	yes/no	response = yes
Lu L, et al. [54]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10

Mahihu C [4]	HADS	The questionnaire contains 14 questions, with seven items related to depression and another seven related to anxiety. Each item has a score ranging from 0 - 3. Thus, depending on the level of depression and anxiety, the scores can vary from 0 - 21. The cut-off score for each subscale is a score greater or equal to 8.	HADS score ≥ 8
Maleku A, et al. [55]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
Marahwa P, et al. [56]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
de Moissac D, et al. [57]	one yes/no question (depression in the past year)	yes/no	response = yes
Nguyen MH, et al. [62]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
Poyrazli S [63]	one yes/no question (experiencing the psychological symptom/ concern - depression)	yes/no	response = yes
Poyrazli S, et al. [64]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10

Rosa D, et al. [65]	one yes/no question (diagnosis of depression in the last 12 months)	yes/no	response = yes
Sanci L, et al. [66]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10
Saravanan C, et al. [67]	BDI-II	Beck AT, et al. [82] suggested the cut score guidelines for the total scores as follows: 0–13 (minimal), 14–19 (mild), 20–28 (moderate), and 29–63 (severe). A cut off of 20 was used as an indication of depression.	BDI-II score ≥ 20
Schofield MJ, et al. [68]	DASS-21	The depression subscale consists of items 3, 5, 10, 13, 16, 17, and 21 with scores ranging from normal (0–9), mild (10–13), moderate (14–20), severe (21–27), to extremely severe (28+).	DASS-21 depression scale score ≥ 14
Shadowen N, et al. [69]	CES-D	Items were rated on a 4-point scale, and total CES-D scores could range from 0 to 60, with higher scores indicating more depressive symptoms. A score of 16 and above is the typical cut-off score for screening positively for clinically significant depressive symptoms [89].	CES-D score ≥ 16
Song B, et al. [71]	DASS-21	The depression subscale consists of items 3, 5, 10, 13, 16, 17, and 21 with scores ranging from normal (0–9), mild (10–13), moderate (14–20), severe (21–27), to extremely severe (28+).	DASS-21 depression scale score ≥ 14
Udah H, et al. [75]	one yes/no question (felt depression during the pandemic)	yes/no	response = yes
Varughese A, et al. [76]	PHQ-2	Each of the four questions (two for PHQ and two for GAD) is scaled from 0 (not at all) to 3 (nearly every day). For each scale, the responses to the two questions are summed to yield a score that ranges from 0 to 6. If the combined score on the two PHQ-2 questions is 3 or greater, major depressive disorder is likely.	PHQ-2 score ≥ 3

Xiong Y, et al. [78]	one yes/no question (depression diagnosis)	yes/no	response = yes
Yuan LL, et al. [79]	PHQ-9	The total scores can range from 0 to 27, with scores indicating minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) depression levels, respectively. A PHQ-9 score of 10 or higher is regarded as a cut-off point, with a sensitivity of 88% for major depression.	PHQ-9 score ≥ 10

Table 3: Measurement of depression for the 35 studies selected.

Of the 50 studies, 29 reported data for prevalence of anxiety. Table 4 summarized the instruments and the associated scoring instructions and criteria used to determine anxiety for each study. General Anxiety Disorder-7 (GAD-7) [92] (n = 9), DASS-21 (n = 3), and Beck anxiety inventory (BAI) [93] (n = 3) were the most commonly utilized instruments for measuring depression. Other instruments utilized to measure depression included: Generalized Anxiety Disorder-2 (GAD-2) scale [94] (n = 2), GHQ-28 (n = 1), PHQ-4 (n = 1), and HADS (n = 1). The remaining studies (n = 9) utilized a single item to measure anxiety, including

- one Likert-scale item from BHM-20 (symptoms of anxiety),
- one Likert-scale question regarding social and psychological issues – anxiety, and
- yes/no questions such as a) any experiences of anxiety in the past twelve months (from R-DA-MLES-12), b) anxiety diagnosis, c) anxiety in the past year, d) diagnosis of anxiety in the last 12 months, e) experienced anxiety during the pandemic, g) experiencing the psychological symptom/concern – anxiety, and h) mental health symptoms (anxiety) during the last month.

Anxiety			
study	Instrument	Scoring	Indication of anxiety
Alam MD, et al. [31]	DASS-21	The anxiety subscale consists of items 2, 4, 7, 9, 15, 19, and 20, with scores ranging from normal (0–7), mild (8–9), moderate (10–14), severe (15–19), to extremely severe (20+).	DASS-21 anxiety scale ≥ 10
AlKrenawi A, et al. [32]	BAI	Beck AT [93] suggested the cut score guidelines for the total scores as follows: 0–7 (minimal), 8–15 (mild), 16–25 (moderate), and 26–63 (severe). The suggested cutoff score in the manual for clinically significant anxiety is 16.	BAI score ≥ 16
Barreira P, et al. [34]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) levels [92].	GAD-7 ≥ 10
Bathke A, et al. [35]	one Likert-scale item from BHM-20 (symptoms of anxiety)	5-point Likert scale (never/rarely/sometimes/often/almost always)	response = sometimes/often/almost always

Chae D, et al. [36]	one yes/no question (Mental health symptoms (anxiety) during the last month)	yes/no	response = yes
Han X, et al. [41]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) levels.	GAD-7 ≥ 10
Jones-White DR, et al. [43]	GAD-2	Response options included “not at all (0),” “several days (+1),” “more than half the days (+2),” and “nearly every day (+3).” A cut-point of 3 was an indication of clinically significant GAD symptoms.	GAD-2 ≥ 3
Kahwa KM, et al. [44]	DASS-21	The anxiety subscale consists of items 2, 4, 7, 9, 15, 19, and 20, with scores ranging from normal (0–7), mild (8–9), moderate (10–14), severe (15–19), to extremely severe (20+).	DASS-21 anxiety scale ≥ 10
Kambouropoulos A [45]	one Likert-scale question (social and psychological issues - anxiety)	never a problem, has been a problem, ongoing problem	anxiety “has been a problem” or is an “ongoing problem”
Khosravi R, et al. [46]	GHQ-28	anxiety (Items 8-14): For every item, there are 4 probable answers on hand (0-not at all, 1-no more than usual, 2-rather more than usual, 3-much more than usual).	Based on GHQ-28 subscale - anxiety (Items 8-14) (cut-off value for the subscale was not mentioned in the study)
Kim HR, et al. [47]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) levels.	GAD-7 ≥ 10
Kivelä L, et al. [48]	BAI	Beck AT [93] suggested the cut score guidelines for the total scores as follows: 0–7 (minimal), 8–15 (mild), 16–25 (moderate), and 26–63 (severe). The suggested cutoff score in the manual for clinically significant anxiety is 16.	BAI score ≥ 16
Lai AYK, et al. [49]	PHQ-4	Total score is determined by adding together the scores of each of the 4 items. Scores are rated as normal (0-2), mild (3-5), moderate (6-8), and severe (9-12). Total score ≥ 3 for first 2 questions suggests anxiety. Total score ≥ 3 for last 2 questions suggests depression. Löwe et al (2010) [87] recommends a cut-off score of 6 for the total score.	PHQ-4 ≥ 6
Larnyo E, et al. [50]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) levels.	GAD-7 ≥ 10

Lian Z [53]	one yes/no question of R-DAMLES-12 (any experiences of anxiety in the past twelve months)	yes/no	response = yes
Mahihu C [4]	HADS	The questionnaire contains 14 questions, with seven items related to depression and another seven related to anxiety. Each item has a score ranging from 0 - 3. Thus, depending on the level of depression and anxiety, the scores can vary from 0 - 21. The cut-off score for each subscale is a score greater or equal to 8.	HADS $\geq$ 8
Maleku A, et al. [55]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0-4), mild (5-9), moderate (10-14) or severe ($\geq$ 15) levels.	GAD-7 $\geq$ 10
Marahwa P, et al. [56]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0-4), mild (5-9), moderate (10-14) or severe ($\geq$ 15) levels.	GAD-7 $\geq$ 10
de Moissac D, et al. [57]	one yes/no question (anxiety in the past year)	yes/no	response = yes
Poyrazli S [63]	one yes/no question (experiencing the psychological symptom/concern - anxiety)	yes/no	response = yes
Poyrazli S, et al. [64]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0-4), mild (5-9), moderate (10-14) or severe ($\geq$ 15) levels.	GAD-7 $\geq$ 10
Rosa D, et al. [65]	one yes/no question (Diagnosis of anxiety in the last 12 months)	yes/no	response = yes
Sanci L, et al. [66]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0-4), mild (5-9), moderate (10-14) or severe ($\geq$ 15) levels.	GAD-7 $\geq$ 10
Shadowen N, et al. [69]	BAI	Beck AT [93] suggested the cut score guidelines for the total scores as follows: 0-7 (minimal), 8-15 (mild), 16-25 (moderate), and 26-63 (severe). The suggested cutoff score in the manual for clinically significant anxiety is 16.	BAI score $\geq$ 16

Song B, et al. [71]	DASS-21	The anxiety subscale consists of items 2, 4, 7, 9, 15, 19, and 20, with scores ranging from normal (0–7), mild (8–9), moderate (10–14), severe (15–19), to extremely severe (20+).	DASS-21 anxiety scale ≥ 10
Udah H, et al. [75]	one yes/ no question (experienced anxiety during the pandemic)	yes/no	response = yes
Varughese A, et al. [76]	GAD-2	Each of the 2 questions is scaled from 0 (not at all) to 3 (nearly every day). The responses to the two questions are summed to yield a score that ranges from 0 to 6. If the combined score on the two GAD-2 is 3 or greater, generalized anxiety disorder is likely.	GAD-2 ≥ 3
Xiong Y, et al. [78]	one yes/no question (anxiety diagnosis)	yes/no	response = yes
Yuan LL, et al. [79]	GAD-7	Based on a clinical cut-off score of 10, the GAD-7 scale distributes anxiety levels across minimal or none (0–4), mild (5–9), moderate (10–14) or severe (≥ 15) levels.	GAD-7 ≥ 10

Table 4: Measurement of anxiety for the 29 studies selected.

Of the 50 studies, 14 reported data for prevalence of loneliness. Table 5 summarized the instruments and the associated scoring instructions and criteria used to determine loneliness for each study. Three instruments, such as the 3-item University of California, Los Angeles, Loneliness Scale (UCLA-LS) [95] ($n = 1$), the 8-item UCLA loneliness scale (ULS-8) [96] ($n = 1$), and De Jong-Gierveld Loneliness Scale (DJGLS) [97] ($n = 1$) were utilized by three studies ($n = 3$) to measure loneliness. Four studies ($n = 4$) had used Likert-scale items, such as a) symptoms of loneliness (from BHM-20), b) I feel lonely in Australia, c) factors (loneliness) contributing for the depression and homesickness among

students who did not recover from their depression and homesickness, and d) how frequently do you have such feeling since Covid-19. Another 4 studies ($n = 4$) had used yes/no questions such as a) social and psychological issues – loneliness, b) experiencing the psychological symptom/concern – loneliness, c) experienced any of the following while at university, and d) loneliness experienced, to measure loneliness. For the two qualitative studies [51,72], number of participants endorsed the idea of loneliness was used to determine the prevalence of loneliness for the study participants.

Loneliness			
Study	Instrument	Scoring	Indication of loneliness
Alam MD, et al. [31]	3-item UCLA-LS	Answers were scored on a 3-point scale ranging from 1 (Hardly ever) to 3 (Often) and summed to create a continuous total score ranging from 3 to 9. The score then collapsed into one of two categories: a score of 3–5 reflects a negative screening for loneliness, and a score of 6–9 reflects a positive screening for loneliness.	UCLA-LS ≥ 6

Bathke A, et al. [35]	one Likert item from BHM-20 (symptoms of loneliness)	5-point Likert scale (never/rarely/sometimes/often/almost always)	response = sometimes/often/almost always
Chae D, et al. [36]	one yes/no question (feeling loneliness during the last month)	yes/no	response = yes
Kambouropoulos A [45]	One Likert-scale question (social and psychological issues - loneliness)	never a problem, has been a problem, ongoing problem	loneliness "has been a problem" or is an "ongoing problem"
Kivelä L, et al. [48]	DJGLS	DJGLS consists of 11 items assessing subjective loneliness rated on a 5-point scale. Total scores range from 0 to 11, with scores 0–2 reflecting no loneliness, 3–8 moderate loneliness, and 9–11 severe loneliness.	DJGLS ≥ 3
Lefdhahl Davis EM, et al. [51]	NA	NA	number of participants endorsed the idea (experienced loneliness)
Maleku A, et al. [55]	8-item UCLA loneliness scale (ULS-8)	Each item has a 4-level frequency score, with answer choices of 1 (never), 2 (rarely), 3 (sometimes), and 4 (always). The total score ranges from 8 to 32 points, with higher scores suggesting a higher degree of loneliness.	moderate/severe loneliness (cut-off value not mentioned in the article)
Morris A, et al. [58]	one Likert-scale question (I feel lonely in Australia)	5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree)	response = agree / strongly agree
Poyrazli S [63]	one yes/no question (experiencing the psychological symptom/concern - loneliness)	yes/no	response = yes
Sanci L, et al. [66]	one yes/no question (Experienced any of the following while at university)	yes/no	response =
Saravanan C, et al. [67]	one Likert-scale question (factors (loneliness) contributing for the depression and homesickness among students who did not recover from their depression and homesickness)	no problem, mild, moderate, severe	response = moderate / severe
Sustarsic M, et al. [72]	NA	NA	number of participants endorsed the idea of loneliness

& Takemoto, 2022 [71]	one Likert-scale question (how frequently do you have such feeling since Covid-19)	1 = never, 2 = rarely, 3 = sometimes, and 4 = always	response = always
Xiong Y, et al. [78]	one yes/no question (loneliness experienced)	yes/no	response = yes

Note. NA = not available.

Table 5: Measurement of loneliness for the 14 studies selected.

Of the 50 studies, 17 reported data for prevalence of help-seeking behavior. Table 6 summarized the instruments and the associated scoring instructions and criteria used to determine help-seeking behavior for each study. All studies utilized one single item to measure help-seeking behavior. One study (n = 1) asked one question regarding methods of coping. The remaining studies (n = 16) asked a yes/no question to assess help-seeking behavior. The yes/no questions were a) accessing the university's student counselling service, b) receiving treatment for depression, anxiety, or any mental health issue, c) previous experience

in counseling, d) previous use of mental health services, e) previous use of mental health services, f) had sought help for their psychological distress from the available university services, g) had attended mental health or counseling services, h) received counseling services, i) has previous experience with psychological counselling, j) used counseling services for social adjustment, k) seen a mental health professional, l) previously attended mental health counseling, m) accessed counselling and psychological services, n) personally received counseling in the past, and o) sought mental health services.

Help-Seeking			
Study	Instrument	Scoring	Indication of help-seeking behavior
Atherton K, et al. [33]	one yes/no question (accessing the university's student counselling service)	yes/no	response = yes
Barreira P, et al. [34]	one yes/no question (receiving treatment for depression, anxiety, or any mental health issue)	yes/no	response = yes
Chen H, et al. [37]	one yes/no question (previous experience in counseling)	yes/no	response = yes
Clough BA, et al. [38]	one yes/no question (previous use of mental health services)	yes/no	response = yes
Clough BA, et al. [39]	one yes/no question (previous use of mental health services)	yes/no	response = yes
Kahwa KM, et al. [44]	one yes/no question (had sought help for their psychological distress from the available university services)	yes/no	response = yes
Li P, et al. [52]	one yes/no question (had attended mental health or counseling services?)	yes/no	response = yes
Lian Z [53]	one yes/no question of R-DA-MLES-12 (received counseling services)	yes/no	response = yes

Nahidi S [59]	one yes/no question (has previous experience with psychological counselling)	yes/no	response = yes
Nasir MAM, et al. [60]	one yes/no question (used counseling services for social adjustment)	yes/no	response = yes
Negrete V [61]	one yes/no question (seen a mental health professional?)	yes/no	response = yes
Poyrazli S, et al. [64]	one yes/no question (previously attended mental health counseling)	yes/no	response = yes
Sanci L, et al. [66]	one yes/no question (accessed counselling and psychological services)	yes/no	response = yes
Snoubat Y [70]	one question (methods of coping)	family support, prayers to God, friends' support, psychologist/ social worker support	response = psychologist/ social worker support
Tu D [74]	one yes/no question (personally received counseling in the past)	yes/no	response = yes
Xiong Y, et al. [77]	one yes/no question (sought mental health services)	yes/no	response = yes

Table 6: Measurement of help-seeking behavior for the 17 studies selected.

Risk of Bias

The adapted form of NOS for cross sectional studies was used to determine the risk of bias and the quality of the studies included (Table 7). With regard to the sample selection, all studies had samples that were representative of the target population and had had satisfactory sample sizes. However, none of the studies reported the comparability of the respondents and the non-respondents, which may imply there was a self-selection bias. While over half of the studies (n = 27) utilized validated measurement tools for outcome measures, the remaining studies (n = 23) studies

used subjective measures (e.g., self-reporting, unverified intentions or behaviors), which can lead to information bias. Care should be taken while interpreting such information, as there may be a tendency for study participants to provide what they believe to be socially acceptable answers [98]. Almost all studies had provided description of the sample demographics. All studies had clearly described the statistical test used to analyze the data. Overall, the total scores of the adapted form of NOS ranged from 5 to 7, indicating low to medium risk of bias for the selected studies, which ensured the reliability of the studies reviewed.

Study	Selection				Comparability	Outcome		
	Representativeness of the cases	Sample size	Non-respondents	Ascertainment of the survey tool	Demographic information	Assessment of outcome	Statistical analysis	Total
Alam MD, et al. [31]	1	1	0	2	1		1	7
AlKrenawi A, et al. [32]	1	1	0	2	1	1	1	7
Atherton K, et al. [33]	1	1	0	1	1	1	1	6

Barreira P, et al. [34]	1	1	0	2	1	1	1	7
Bathke A, et al. [35]	1	1	0	2	1	1	1	7
Chae D, et al. [36]	1	1	0	1	1	1	1	6
Chen H, et al. [37]	1	1	0	1	1	1	1	6
Clough BA, et al. [38]	1	1	0	1	1	1	1	6
Clough BA, et al. [39]	1	1	0	1	1	1	1	6
Gülner B, et al. [40]	1	1	0	2	1	1	1	7
Han X, et al. [41]	1	1	0	2	1	1	1	7
Jiang X, et al. [42]	1	1	0	2	1	1	1	7
Jones-White DR, et al. [43]	1	1	0	2	1	1	1	7
Kahwa KM, et al. [44]	1	1	0	2	1	1	1	7
Kambouropoulos A [45]	1	1	0	1	1	1	1	6
Khosravi R, et al. [46]	1	1	0	2	1	1	1	7
Kim HR, et al. [47]	1	1	0	2	1	1	1	7
Kivelä L, et al. [48]	1	1	0	2	1	1	1	7
Lai AYK, et al. [49]	1	1	0	2	1	1	1	7
Larnyo E, et al. [50]	1	1	0	2	1	1	1	7
Lefdahl Davis EM, et al. [51]	1	1	0	1	1	1	1	6
Li P, et al. [52]	1	1	0	1	1	1	1	6
Lian Z [53]	1	1	0	2	1	1	1	7
Lu L, et al. [54]	1	1	0	2	1	1	1	7
Mahihu C [4]	1	1	0	2	1	1	1	7
Maleku A, et al. [55]	1	1	0	2	1	1	1	7
Marahwa P, et al. [56]	1	1	0	2	1	1	1	7
de Moissac D, et al. [57]	1	1	0	1	1	1	1	6

Morris A, et al. [58]	1	1	0	1	1	1	1	6
Nahidi S [59]	1	1	0	1	1	1	1	6
Nasir MAM, et al. [60]	1	1	0	1	1	1	1	6
Negrete V [61]	1	1	0	1	1	1	1	6
Nguyen MH, et al. [62]	1	1	0	2	1	1	1	7
Poyrazli S [63]	1	1	0	1	1	1	1	6
Poyrazli S, et al. [64]	1	1	0	1	1	1	1	6
Rosa D, et al. [65]	1	1	0	1	1	1	1	6
Sanci L, et al. [66]	1	1	0	2	1	1	1	7
Saravanan C, et al. [67]	1	1	0	2	1	1	1	7
Schofield MJ, et al. [68]	1	1	0	2	1	1	1	7
Shadowen N, et al. [69]	1	1	0	2	1	1	1	7
Snoubar Y [70]	1	1	0	1	0	1	1	5
Song B, et al. [71]	1	1	0	2	1	1	1	7
Sustarsic M, et al. [72]	1	1	0	1	1	0	1	5
Teng Y, et al. [73]	1	1	0	1	1	1	1	6
Tu D [74]	1	1	0	1	1	1	1	6
Udah H, et al. [75]	1	1	0	1	1	1	1	6
Varughese A, et al. [76]	1	1	0	2	1	1	1	7
Xiong Y, et al. [77]	1	1	0	1	1	1	1	6
Xiong Y, et al. [78]	1	1	0	1	1	1	1	6
Yuan LL, et al. [79]	1	1	0	2	1	1	1	7

Table 7: Newcastle-Ottawa quality assessment scale, adapted for cross sectional studies.

Prevalence of Depression

Figure 2 shows the forest plot of prevalence of depression. The number of international students for the 35 studies ranged from 29 to 4624. The event counts (i.e., number of subjects exhibiting symptoms of depression)

for the 35 studies ranged from 3 to 1221. The prevalence of depression (computed as “(event counts / number of international students)*100%”) ranged from 4.3 to 94.8. Figure 2 also summarizes the results of the meta-analysis using the fixed effect model and the random-effects model, and the study weights under each model.

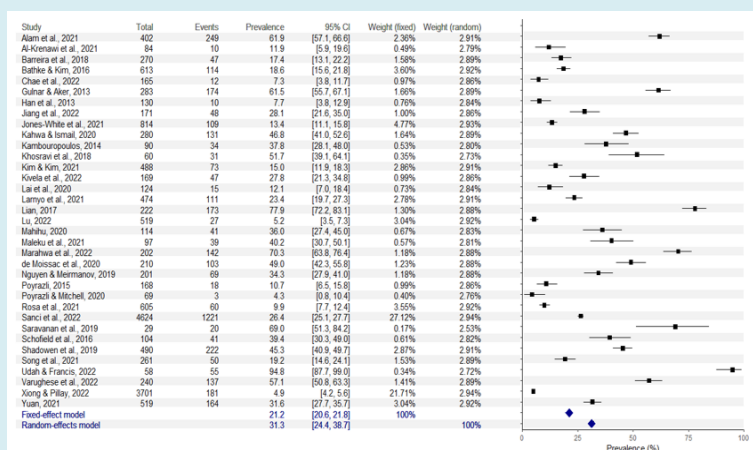


Figure 2: Forest plot for prevalence of depression.

Note. Total = total number of international students; event = number of subjects exhibiting symptoms of depression; prevalence = prevalence of depression (computed as “(event counts / number of international students)*100%”); CI = confidence interval; weight (fixed) = study weight under fixed effect model; weight (random) = study weight under random effect model.

Heterogeneity in effect sizes, i.e., variation in the true effect sizes, among the 35 studies, was quantified using the following statistics, the Q statistic, T^2 , T , and the I^2 statistics. The Q statistic was equal to 3177.2522, with $df = 34$ and $p < 0.001$, indicating that the studies did not share a common effect size and not all variation was due to sampling errors within studies. The between-studies variance T^2 was 0.0532, the between-studies standard deviation T was 0.2305. The I^2 statistic was 0.9893, indicating 98.93% of total variation across studies was due to heterogeneity rather than chance. Based on these measures of heterogeneity, as there was

evidence of heterogeneity among the studies, the random-effects model was used to obtain the summary effect (i.e., the estimated prevalence of depression) for the 35 studies. Based on the analysis results of the random-effects model, the summary effect size, i.e., the estimated prevalence of depression, was 31.3%, with a 95% CI = [24.4, 38.7].

Prevalence of Anxiety

Figure 3 shows the forest plot of prevalence of anxiety. The number of international students for the 29 studies ranged from 58 to 4260. The event counts (i.e., number of subjects exhibiting symptoms of anxiety) for the 29 studies ranged from 6 to 599. The prevalence of anxiety (computed as “(event counts / number of international students)*100%”) ranged from 5.5 to 74.3. Figure 4 also summarizes the results of the meta-analysis using the fixed effect model and the random-effects model, and the study weights under each model.

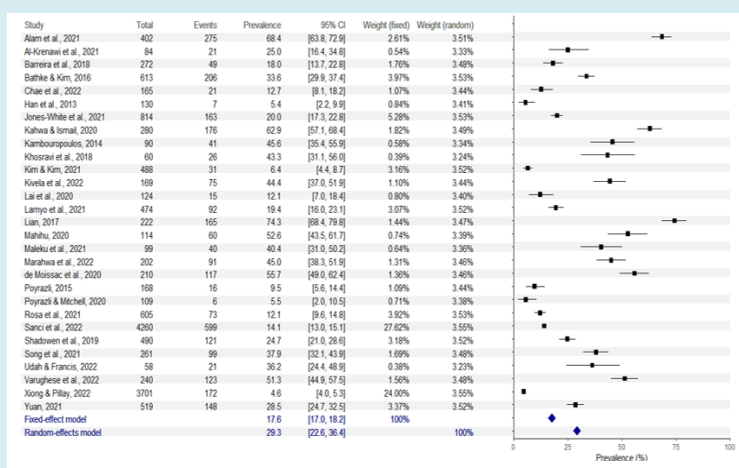


Figure 3: Forest plot for prevalence of anxiety.

Note. Total = total number of international students; event = number of subjects exhibiting symptoms of anxiety; prevalence = prevalence of anxiety (computed as “(event counts / number of international students)*100%”); CI = confidence interval; weight (fixed) = study weight under fixed effect model; weight (random) = study weight under fixed effect model.

Heterogeneity in effect sizes, i.e., variation in the true effect sizes, among the 29 studies, was quantified using the following statistics, the Q statistic, T^2 , T , and the I^2 statistics. The Q statistic was equal to 2671.0811, with $df = 28$ and $p < 0.001$, indicating that the studies did not share a common effect size and not all variation was due to sampling errors within studies. The between-studies variance T^2 was 0.0428, the between-studies standard deviation T was 0.2070. The I^2 statistic was 0.9895, indicating 98.95% of total variation across studies was due to heterogeneity rather than chance. Based on these measures of heterogeneity, as there was

evidence of heterogeneity among the studies, the random-effects model was used to obtain the summary effect (i.e., the estimated prevalence of anxiety) for the 29 studies. Based on the analysis results of the random-effects model, the summary effect size, i.e., the estimated prevalence of anxiety, was 29.3%, with a 95% CI = [22.6, 36.4].

Prevalence of Loneliness

Figure 4 shows the forest plot of prevalence of loneliness. The number of international students for the 14 studies ranged from 20 to 7077. The event counts (i.e., number of subjects exhibiting loneliness) for the 14 studies ranged from 3 to 2477. The prevalence of loneliness (computed as “(event counts / number of international students)*100%”) ranged from 12.0 to 77.5. Figure 5 also summarizes the results of the meta-analysis using the fixed effect model and the random-effects model, and the study weights under each model.

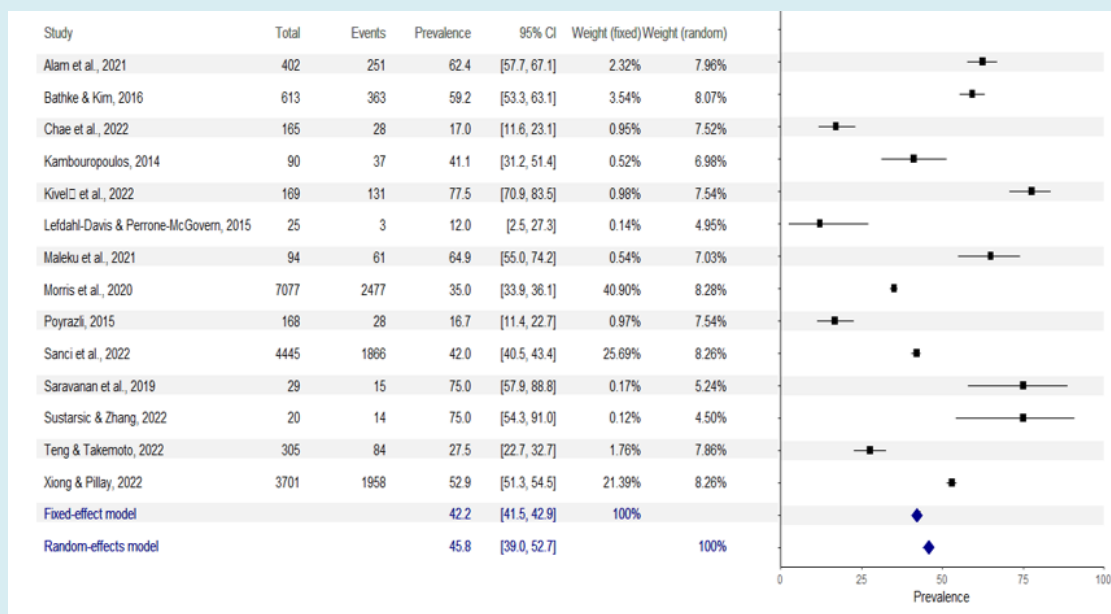


Figure 4: Forest plot for prevalence of loneliness.

Note. Total = total number of international students; event = number of subjects exhibiting loneliness; prevalence = prevalence of loneliness (computed as “(event counts / number of international students)*100%”); CI = confidence interval; weight (fixed) = study weight under fixed effect model; weight (random) = study weight under fixed effect model.

Heterogeneity in effect sizes, i.e., variation in the true effect sizes, among the 14 studies, was quantified using the following statistics, the Q statistic, T^2 , T , and the I^2 statistics. The Q statistic was equal to 748.9388, with $df = 13$ and $p <$

0.001, indicating that the studies did not share a common effect size. The between-studies variance T^2 was 0.0148, the between-studies standard deviation T was 0.1216. The I^2 statistic was 0.9826, indicating 98.26% of total variation across studies was due to heterogeneity rather than chance. Based on these measures of heterogeneity, as there was evidence of heterogeneity among the studies, the random-effects model was used to obtain the summary effect (i.e., the estimated prevalence of loneliness) for the 14 studies. Based on the analysis results of the random-effects model, the summary effect size, i.e., the estimated prevalence of loneliness, was 45.8%, with a 95% CI = [39.0, 52.7].

Prevalence of Help-Seeking Behavior

Figure 5 shows the forest plot of prevalence of help-seeking behavior. The number of international students for the 17 studies ranged from 23 to 4426. The event counts (i.e., number of subjects exhibiting help-seeking behavior) for the 17 studies ranged from 2 to 504. The prevalence of help-

seeking behavior (computed as “(event counts / number of international students)*100%”) ranged from 3.2 to 37.2. Figure 5 also summarizes the results of the meta-analysis using the fixed effect model and the random-effects model, and the study weights under each model.

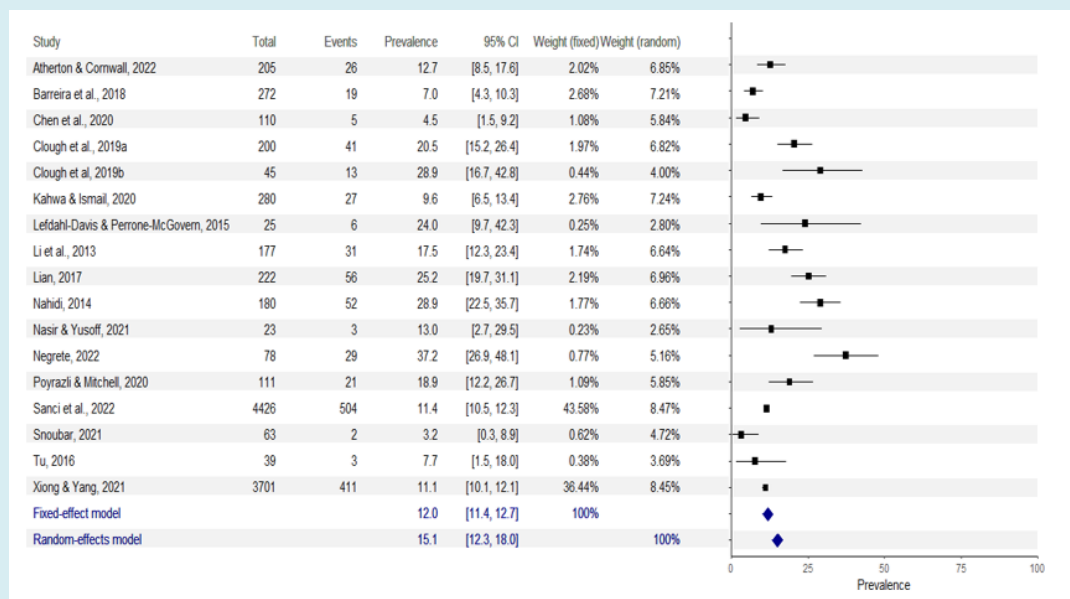


Figure 5: Forest plot for prevalence of help-seeking behavior.

Note. Total = total number of international students; event = number of subjects exhibiting help-seeking behavior; prevalence = prevalence of help-seeking behavior (computed as “(event counts / number of international students)*100%”); CI = confidence interval; weight (fixed) = study weight under fixed effect model; weight (random) = study weight under fixed effect model.

Heterogeneity in effect sizes, i.e., variation in the true effect sizes, among the 17 studies, was quantified using the following statistics, the Q statistic, T^2 , T , and the I^2 statistics. The Q statistic was equal to 149.0017, with $df = 16$ and $p < 0.001$, indicating that the studies did not share a common effect size. The between-studies variance T^2 was 0.0049, the between-studies standard deviation T was 0.0697. The I^2 statistic was 0.8926, indicating 89.26% of total variation across studies was due to heterogeneity rather than chance. Based on these measures of heterogeneity, as there was evidence of heterogeneity among the studies, the random-effects model was used to obtain the summary effect (i.e., the estimated prevalence of help-seeking behavior) for the 17 studies. Based on the analysis results of the random-effects model, the summary effect size, i.e., the estimated prevalence of help-seeking behavior, was 15.1%, with a 95% CI = [12.3, 18.0].

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