BMC Psychology

SYSTEMATIC REVIEW

Open Access

Prevalence of depression among university students in China: a systematic review and meta-analysis

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Abstract

Background Depression among university students in China represents a critical public health challenge, with emerging evidence suggesting exacerbated risks during the COVID-19 pandemic. Despite prior regional studies, a comprehensive national analysis comparing pre-pandemic and pandemic-era prevalence, while accounting for profession-specific stressors, remains lacking. This study aims to quantify depression prevalence across Chinese universities, identify high-risk subgroups, and assess the pandemic's impact.

Methods A systematic search was conducted on PubMed, CNKI, Wang-fang Database, and Web of Science. The articles were cross-sectional studies focusing on the prevalence of depression among university students in China, with clearly defined criteria for diagnosing depression included. MetaXL 5.3 was used to pool the outcomes and perform a meta-analysis, assessing the prevalence of depression among university students and influential factors such as the impact of COVID-19.

Results Data from 32 cross-sectional studies ($n = 93,679$) on depression prevalence among students were analyzed. The prevalence estimates ranged from 12.1% to 77.1%, with a summary prevalence of 34.70% after meta-analytic pooling. Subgroup investigations based on major, sample size, geographical region, gender, and the influence of COVID-19 were conducted. Prior to the pandemic, student depression prevalence was 35.0% (95%CI, 26.9%-43.4%), which increased to 38.7% (95%CI, 33.6%-44.0%) during and after the pandemic.

Discussion This study underscores a substantial mental health burden among Chinese university students, intensified by pandemic-related disruptions. Medical students and those in high-stress regions warrant prioritized interventions. Systemic reforms in healthcare education and regionally tailored mental health policies are urgently needed. Longitudinal studies are critical to track post-pandemic recovery trajectories.

Systematic review registration CRD42024502949.

Keywords University students, Depression, Prevalence, Meta-analysis, China

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Introduction

Rationale

Depression, classified as a major depressive disorder (MDD) by the Diagnostic and Statistical Manual of Mental Disorders (DSM- 5) [1], is characterized by persistent low mood, anhedonia, and cognitive impairments lasting ≥2 weeks, alongside physiological disruptions such as sleep disturbances and fatigue [2, 3]. Unlike transient depressive emotions—normative responses to stressors that typically resolve spontaneously within days [4]—depression involves neurobiological dysregulation, including monoamine neurotransmitter imbalances and hypothalamic–pituitary–adrenal axis hyperactivity [5, 6]. The substantial personal and societal burden of this condition is reflected in its epidemiological scale: globally, depression affects 280 million individuals [7], with young adults (18–25 years) representing a particularly vulnerable demographic due to developmental transitions and psychosocial stressors [8, 9].

This vulnerability is amplified in university populations, where academic pressure, financial strain, and identity formation challenges converge to elevate mental health risks [10]. These challenges are exacerbated by the developmental transition phase of young adulthood, where immature self-regulation mechanisms and intense psychological conflicts frequently converge [10]. Consequently, university students frequently experience depression and other negative moods [10]. Studies before the COVID- 19 pandemic document severe consequences: depressive symptoms in this group correlate with diminished academic performance (e.g., grade declines and dropout risks) [11], heightened anxiety levels, physical illness, reduced physical activity, unsafe sexual behavior, increased smoking, diminished quality of life, self-harming behaviors, and an elevated risk of suicide [12–16]. Longitudinal data from China reveal a concerning trend, with depression prevalence rising from 33.6% to 35.4% between 2015 and 2018 [17], suggesting systemic failures in existing campus mental health interventions.

Moreover, individuals were found to be more susceptible to depression during the COVID- 19 pandemic compared to the pre-pandemic period [18]. As the first country to implement nationwide lockdowns, containment strategies in China—including prolonged campus closures, mandatory online learning, and strict social isolation—created a "dual crisis" of academic disruption and psychological isolation [19, 20]. Empirical evidence from the COVID- 19 pandemic revealed that individuals undergoing centralized quarantine measures showed a significantly elevated incidence of depressive disorders compared to the general population [21–23]. These findings align with global observations [24–27], though the unique context of early and stringent pandemic response in China underscores the need for localized research.

Critically, the prolonged psychological distress observed during this period necessitates immediate intervention strategies, as untreated depression in students correlates with long-term functional impairment [28], reduced workforce productivity [29], and elevated healthcare costs [30].

The critical role of mental health in shaping the psychological well-being, academic performance, and long-term societal contributions of university students necessitates a systematic assessment of depression prevalence within China's higher education population, followed by the implementation of evidence-based interventions to mitigate risks [31].

Objective

This study seeks to bridge three pivotal knowledge gaps in current research. The systematic review encompasses literature from 2014 to 2023, specifically targeting the absence of meta-analytical evidence comparing depression prevalence across pre-pandemic and pandemic eras—a critical knowledge gap given COVID- 19's global mental health repercussions. Methodologically, we extend traditional subgroup analyses (sex, region, sample size) through innovative stratification by pandemic chronology and medical education status. As the initial COVID- 19 epicenter [32], the pandemic experience in China uniquely influenced collegiate depression patterns through sustained campus lockdowns and profession-specific exposure risks [33], creating mental health determinants distinct from global counterparts. Our analytical framework thus achieves dual objectives—quantifying temporal mental health shifts while elucidating profession-specific vulnerability patterns within pandemic-altered educational ecosystems.

Materials and methods

Protocol and registration

The protocol was developed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) and registered in PROSPERO (CRD42024502949) [34, 35].

Eligibility criteria

Studies were included if they met the following criteria:

- Cross-sectional studies investing the prevalence of depression among university students in China;
- Reported a prevalence level for depression using diagnostic criteria, a research diagnostic tool, or a validated screening instrument;

- Provided the number of participants meeting predefined criteria for depression or a percentage from which the number of participants with depression could be calculated;
- Had a sample size of more than 300 participants.

Studies were excluded if they:

- Used a screening tool without specifying the cut-off threshold for detecting depression;
- Lacked accessible raw data;
- Focused on stress in emergency or special situations (e.g., earthquakes, influenza outbreaks), while those related to COVID- 19 were retained;
- Were inconsistent with the theme (e.g., reviews, reports);
- Were not written in Chinese or English.
- Scores ≤ 4 on the risk assessment.

The initial selection was independently conducted by LZZ and YZY, followed by a secondary assessment of the selected literature by ZLL. Any controversies were resolved through group discussions to reach a mutual agreement.

Information sources

The searches were conducted using the following databases: PubMed, CNKI, Web of Science, and Wang-fang Database.

Search strategy

A search of the relevant literature was conducted by both English and Chinese search terms:"prevalence"or"rate," "depression"or"depressive disorder,""university"or"university students,""China"or"Chinese,"and"cross-sectional study."No restrictions were applied regarding language, publication status, or publication time to avoid potential bias and to ensure a comprehensive review of the available literature. We screened titles and abstracts of all citations identified by our research for potential suitability and retrieved citations that appeared relevant for detailed examination. The screening process is presented in a systematic review and meta-analyses flow chart, which outlines the number of studies identified, included, and excluded at each stage of the review process.

Study selection

Two reviewers (LZZ and YZY) independently performed title and abstract screening as well as full-text reviews. Cross-sectional/Prevalence Study Quality, recommended by the Agency for Healthcare Research and Quality, was utilized in this process [36, 37]. In this study, the articles are classified as excellent (ten or more items with a 'yes' response); 'good' (seven to nine 'yes' answers); 'weak' (from five to six 'yes' responses) and 'poor' methodological quality (from one to four 'yes' answers). Literature with more than four 'yes' answers was included in the meta-analysis, as these were considered high-quality studies. Disagreements, such as differing star ratings for a single study, were re-evaluated by a third reviewer (ZLL), whose decision served as the final standard.

Data collection process

Two reviewers(CHW and ZLL) conducted abstractions independently and in duplicate using standardized forms. Discrepancies were resolved by consensus. For missing data, reviewers attempted to contact study authors when possible.

Data items

The following study data was abstracted from each study:

- Study citation and author contact details,
- Study design, duration, and setting,
- Country,
- Number of participants,
- Basic information of participants (age, sex, major),
- Prevalence (male, female).

Data synthesis and summary measures

Statistical analysis was carried out by using MetaXL 5.3. When $P \geq 0.1$ and $I^2 < 50\%$, there was no significant statistical heterogeneity, then a fixed effect model was adopted. $P < 0.1$ and $I^2 \geq 50\%$ suggested statistical heterogeneity, then the random-effects model was used for combined analysis [38, 39]. A one-by-one elimination method was adopted in sensitivity analysis. Subgroup analysis was used to explore the source of heterogeneity. In addition, publication bias was measured using funnel plots [40].

Results

Literature retrieval results

The search yielded 548 relevant articles, including 160 from CNKI, 156 from the Web of Science, 187 from the Wang-fang Database, and 46 from PubMed databases. The literature selection period ranges from the establishment of each database to February 2024, the time of retrieval. However, given that older data might lack contemporary relevance, only articles published between 2014 and 2023 were ultimately included in the analysis. Given China's termination of centralized quarantine measures in early 2023, which included discontinuation of isolation protocols for confirmed cases and close contact tracing, we excluded studies published in 2024 onward from our current analysis. This policy shift, coupled with the official reclassification of COVID- 19 as a

routine respiratory disease under"Category B management for Category B infectious diseases", fundamentally altered the pandemic's psychosocial impact profile [41]. Emerging post-decontrol studies likely capture transitional-phase effects distinct from both acute pandemic periods and endemic stabilization phases. We therefore propose these constitute a discrete subgroup requiring separate epidemiological characterization once sufficient longitudinal data (2025–2028) become available for robust trend analysis. After the removal of 108 articles on account of duplicates or other reasons, titles and abstracts were screened for potential eligibility. Review, non-related articles, and those researches that the prevalence rates could not be extracted were removed, resulting in a total of 52 eligible studies. After taking into account available data, sample size, and risk assessment, 32 articles were included in the review (Fig. 1).

Study characteristics

Table 1. presents the 32 studies included in the review, including 28 in Chinese and 4 in English. All the studies used scales to detect depression (BDI, PHQ- 9, SDS, CES-D, DASS- 21), the most popular being the SDS and the PHQ- 9. The studies represented a total of 93,679 individuals and a total of 32,445 depressed students. Sample sizes ranged from 416 to 23,863 participants.

Integrated cutoff scores for depression assessment scales:

(1) The Beck Depression Inventory-II (BDI-II) (range: 0–63) classifies severity as 0–13 (minimal), 14–19 (mild), 20–28 (moderate), and 29–63 (severe) [74];
(2) The Patient Health Questionnaire- 9 (PHQ- 9) (range: 0–27) uses thresholds of 5–9 (mild), 10–14 (moderate), 15–19 (moderately severe), and ≥20 (severe) [75];
(3) The Self-Rating Depression Scale (SDS), converted to a 25–100 index, defines depression as ≥53, with mild (53–62), moderate (63–72), and severe (≥ 73) categories [76];
(4) The Center for Epidemiological Studies Depression Scale (CES-D) (range: 0–60) identifies clinically significant symptoms at ≥16, further stratified as mild (16–20), moderate (21–25), and severe (≥ 26) [77];
(5) The Depression subscale of the DASS- 21 (scored 0–42 after doubling raw scores) categorizes severity as mild (10–13), moderate (14–20), severe (21–27), and extremely severe (≥ 28) [78].

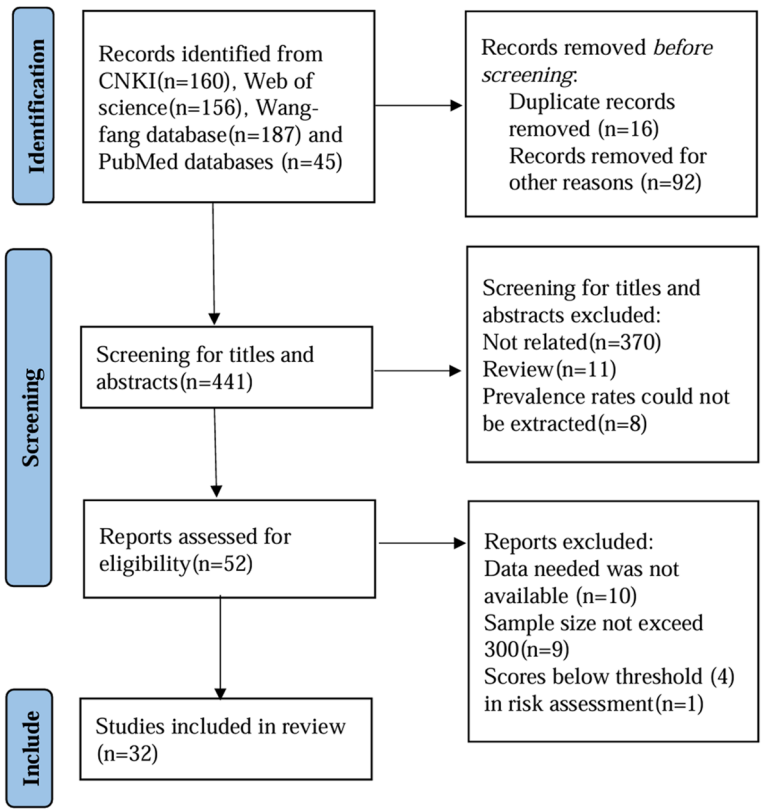

Fig. 1 Search results and study selection

Table 1 Basics of literature included the prevalence of depression among university students in China

Article	Location	Publish year	Sample size	Number of Depressed/Total students	Prevalence, %	95%CI,%	Depression Scale
Wen-Ping Ji et al. [42]	Anhui	2023	1438	568/1438	39.5	37.0, 42.0	PHQ- 9
Ling Cui et al. [43]	Shanghai	2022	416	52/416	12.5	9.5, 15.9	BDI
Qian-Min Ma et al. [44]	NR	2023	577	82/577	14.2	11.5, 17.2	SDS
Wen-Lei Zhou [45]	Shandong	2019	800	342/800	44.3	39.3, 46.2	SDS
Zhuo-Yan Zhu et al. [46]	Nationwide	2020	15,936	4894/15936	30.7	30.0, 31.4	PHQ- 9
Da-Zhu Wang et al. [47]	Anhui	2019	327	78/327	23.9	19.4, 28.6	SDS
Hong-Wei Li et al. [48]	NR	2015	600	212/600	35.3	31.6, 39.2	BDI
Jin-Yang Wang et al. [49]	Jilin	2016	482	200/482	41.5	37.1, 45.9	SDS
Lan Ma et al. [50]	Henan	2020	3609	1741/3609	48.2	46.6, 49.9	CES-D
Meng Liu et al. [51]	Gansu	2019	734	246/734	33.5	30.1, 37.0	SDS
Hai-Ling Deng et al. [52]	Guangxi	2019	934	385/934	41.2	38.1, 44.4	SDS
Hao Zhu et al. [53]	Inner Mongolia	2023	1569	341/1569	21.7	19.7, 23.8	DASS- 21
Yu-Qi Hou et al. [54]	Western Hunan	2020	1140	407/1140	35.7	32.9, 38.5	SDS
Peng Jin et al. [55]	Jiangsu	2014	1095	395/1095	36.1	33.3, 38.9	SDS
Ju-Fang Zhao et al. [56]	Inner Mongolia	2023	4724	571/4724	12.1	11.2, 13.0	CES-D
Yun-Xia Li et al. [57]	Qinghai	2018	1581	770/1581	48.7	46.2, 51.2	SDS
Feng-Mei Zhang et al. [58]	Shandong	2014	833	161/833	19.3	16.7, 22.1	SDS
Jing-Fen Sun et al. [59]	Liaoning	2021	1691	626/1691	37.0	34.7, 39.3	SDS
Jing-Jing Xi et al. [60]	Anhui	2023	7512	1227/7512	16.3	15.5, 17.2	SDS
Su-Yun Hu et al. [61]	Hubei	2021	304	109/304	35.9	30.6, 41.3	SDS
Chun-Mei Yan et al. [62]	Gansu	2022	1816	704/1816	38.8	36.5, 41.0	PHQ- 9
Xing-Jie Yang et al. [63]	Nationwide	2020	4139	1614/4139	39.0	37.5, 40.5	PHQ- 9
Chun Li et al. [64]	Jiangsu	2021	3406	1898/3406	55.7	54.1, 57.4	SDS
Xiao-Pan Shi et al. [65]	Hubei	2021	1830	694/1830	37.9	35.7, 40.2	PHQ- 9
Na-Na Cai et al. [66]	Henan	2021	1294	277/1294	21.5	19.2, 23.7	SDS
Hai-Feng Li et al. [67]	Shandong	2020	910	309/910	34.0	30.9, 37.1	CES-D
Xia Chen et al. [68]	Henan	2021	519	400/519	77.1	73.4, 80.6	DASS- 21
Xue-Xiao Xie et al. [69]	Shandong	2022	4850	1414/4850	29.2	27.9, 30.4	SDS
Ying Guo et al. [70]	Yunnan	2022	2048	1076/2048	52.5	50.4, 54.7	PHQ- 9
Shuo Cheng et al. [71]	Shandong	2020	645	143/645	22.2	19.0, 25.5	SDS
Yan-Qiu Yu et al. [72]	Nationwide	2021	23,863	9326/23863	39.1	38.5, 39.7	PHQ- 9
Ru-Yue Shao et al. [73]	Chongqing	2020	2057	1183/2057	57.5	55.4, 59.6	SDS

BDI Beck Depression Inventory, *PHQ-9* Patient Health Questionnaire, *SDS* Self-rating Depression Scale, *CES-D* The Center of Epidemiological Studies Depression Scale, *DASS-21* Depression Anxiety and Stress Scale-21, *NR* Not Reported

Assessment of quality

Table 2 presents the quality assessments for the 32 studies, according to the quality assessment tool that the Agency for Healthcare Research and Quality recommended [36, 37, 79]. All studies were cross-sectional studies. The overall quality of the articles was middle, with a median quality score of 5/11. One study (3%) scored 7/10, and the remaining studies scored 5/11 or 6/11. No papers achieved the maximum score of 11.

The criteria for evaluating a cross-sectional study consisted of 11 items answered with"yes,""no,"and"unclear" [79]:

1) Define the source of information (survey, record review).
2) List inclusion and exclusion criteria for exposed and unexposed subjects (cases and controls) or refer to previous publications.
3) Indicate the time period used for identifying patients.
4) Indicate whether or not subjects were consecutive if not population-based.
5) Indicate if evaluators of subjective components of the study were masked to other aspects of the status of the participants.

Table 2 Literature quality evaluation form

Article	Publish year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Sum
Wen-Ping Ji et al. [42]	2023	1	1	0	1	1	0	0	1	0	1	0	6
Ling Cui et al. [43]	2022	1	1	0	1	1	0	0	1	0	1	0	6
Qian-Min Ma et al. [44]	2023	1	1	0	1	1	0	0	0	0	1	0	5
Wen-Lei Zhou [45]	2019	1	1	0	1	1	0	0	0	0	1	0	5
Zhuo-Yan Zhu et al. [46]	2020	1	1	0	1	1	0	0	0	0	1	0	5
Da-Zhu Wang et al. [47]	2019	1	1	0	1	1	0	0	1	0	1	0	6
Hong-Wei Li et al. [48]	2015	1	1	0	1	1	0	0	0	0	1	0	5
Jin-Yang Wang et al. [49]	2016	1	1	0	1	1	0	0	0	0	1	0	5
Lan Ma et al. [50]	2020	1	1	0	1	1	0	0	1	0	1	0	6
Meng Liu et al. [51]	2019	1	1	0	1	1	0	0	1	0	1	0	6
Hai-Ling Deng et al. [52]	2019	1	1	0	1	1	0	0	1	0	1	0	6
Hao Zhu et al. [53]	2023	1	1	0	1	1	0	0	0	0	1	0	5
Yu-Qi Hou et al. [54]	2020	1	1	0	1	1	0	0	1	0	1	0	6
Peng Jin et al. [55]	2014	1	1	0	1	1	0	0	1	0	1	0	6
Ju-Fang Zhao et al. [56]	2023	1	1	0	1	1	0	0	1	0	0	0	5
Yun-Xia Li et al. [57]	2018	1	0	0	1	1	0	0	1	0	1	0	5
Feng-Mei Zhang et al. [58]	2014	1	1	0	1	1	0	0	0	0	1	0	5
Jing-Fen Sun et al. [59]	2021	1	0	0	1	1	0	0	1	0	1	0	5
Jing-Jing Xi et al. [60]	2023	1	1	0	1	1	0	0	0	0	1	0	5
Su-Yun Hu et al. [61]	2021	1	1	0	1	1	0	0	1	0	1	0	6
Chun-Mei Yan et al. [62]	2022	1	1	0	1	1	0	0	1	0	1	0	6
Xing-Jie Yang et al. [63]	2020	1	1	0	1	1	0	0	0	0	1	0	5
Chun Li et al. [64]	2021	1	1	0	1	1	0	0	0	0	1	0	5
Xiao-Pan Shi et al. [65]	2021	1	1	0	1	1	0	0	0	0	1	0	5
Na-Na Cai et al. [66]	2021	1	1	0	1	1	0	0	0	0	1	0	5
Hai-Feng Li et al. [67]	2020	1	1	0	1	1	0	0	1	0	1	0	6
Xia Chen et al. [68]	2021	1	1	0	1	1	0	0	0	0	1	0	5
Xue-Xiao Xie et al. [69]	2022	1	1	0	1	1	0	0	0	0	1	0	5
Ying Guo et al. [70]	2022	1	1	0	1	1	1	0	1	0	0	0	6
Shuo Cheng et al. [71]	2020	1	1	0	1	1	0	0	1	0	1	0	6
Yan-Qiu Yu et al. [72]	2021	1	1	0	1	1	0	0	1	0	1	0	6
Ru-Yue Shao et al. [73]	2020	1	1	0	1	1	0	0	1	0	0	0	5

6) Describe any assessments undertaken for quality assurance purposes (e.g., test/retest of primary outcome measurements).
7) Explain any patient exclusions from the analysis.
8) Describe how confounding was assessed and/or controlled.
9) If applicable, explain how missing data were handled in the analysis.
10) Summarize patient response rates and completeness of data collection.
11) Clarify what follow-up, if any, was expected and the percentage of patients for which incomplete data or follow-up was obtained.

Prevalence of depression

The prevalence estimates reported by the individual studies ranged from 12.1% to 77.1%. A heterogeneity test was performed on the results of 32 studies, and the results showed that $Q = 6090.1943$, $\tau^2 = 0.073$, $I^2 = 99.5\%$, and $P < 0.001$, indicating a high degree of heterogeneity. Therefore, the random effects model was selected for meta-analysis. Meta-analytic pooling of the prevalence estimates of depression reported by 32 studies yielded a summary prevalence of 34.70% (32,445/93679 individuals; 95%CI, 30.27%—39.26%). The lowest prevalence of depression was 12.1%, reported by Ling Cui et al. [43], and the highest prevalence was 77.1%, reported by Xia

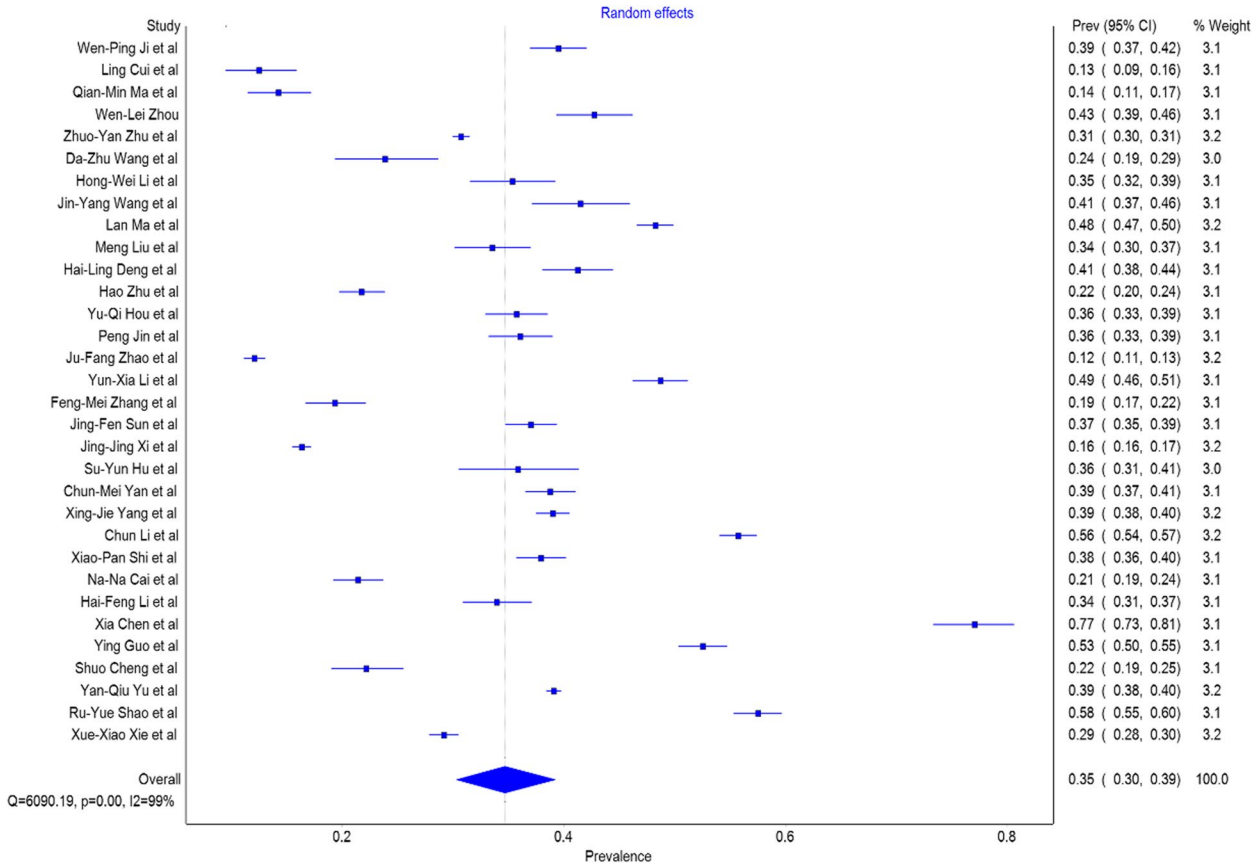

Fig. 2 Forest plot of the prevalence of depression among Chinese university students. CI: Confidence interval. I2: Evolution of heterogeneity measure. Due to formatting limitations, I^2 is displayed as I2 in this figure. Q: A measure of heterogeneity among studies in a meta-analysis

Table 3 Subgroup analysis of the prevalence of depression among Chinese university students

Subgroups		Number of references	Prevalence(95%CI),%	I^2(%)	P
Major	Medical	7	38.3(28.3, 48.5)	99.3	< 0.01
	Comprehensive	25	33.7(28.7, 38.9)	99.5	< 0.01
COVID- 19	Before COVID- 19	16	35.0(26.9, 43.4)	99.4	< 0.01
	During/After COVID- 19	13	38.7(33.6, 44.0)	99.3	< 0.01
Region	Northern	15	34.5(26.6, 42.7)	99.4	< 0.01
	Southern	9	40.1(32.3, 48.2)	98.8	< 0.01
	Central Region	3	26.0(9.9, 44.0)	99.4	< 0.01
	Nationwide	3	36.2(30.1, 42.4)	99.4	< 0.01
Sex	Male	32	34.3(29.2, 39.5)	98.4	< 0.01
	Female	32	36.0(29.9, 42.3)	99.2	< 0.01
Sample Size	< 500	4	27.6(14.2, 42.2)	97.4	< 0.01
	500 ~ 1000	9	34.9(24.0, 46.2)	98.9	< 0.01
	1000–2000	9	34.9(29.2, 40.8)	98.1	< 0.01
	> 2000	10	37.2(28.7, 45.9)	99.8	< 0.01

CI Confidence interval, *P* Probability value, I^2 Evolution of heterogeneity measure

Chen et al. [68]. The forest plot in Fig. 2 shows 95% CIs of the 32 studies assessed.

Subgroup analysis

The subgroup analyses were conducted according to major, sample size, region, sex, and impact of COVID-19. Table 3 shows the result of the subgroup analysis.

The pooled prevalence of depression was higher in medical students (38.3% with 95%CI of 28.3%– 48.5%) than in comprehensive students (33.7% with 95%CI of 28.7%– 38.9%). Subgroup analyses according to sample size confirmed a higher pooled prevalence of depression as the sample size increased. Regarding region, after the removal of 2 studies that did not mention the survey area, the prevalence of students in different regions showed obvious differences. For students of northern region, the pooled prevalence was 34.5% (95%CI, 26.6%– 42.7%) in fifteen studies; for students of southern region, depression prevalence increased to 40.1% (95%CI, 32.3%– 48.2%) in nine studies; for students in the central region had the lowest prevalence, at 26.0% (95%CI, 9.9%– 44.0%) in three studies; among the students across the country, depression prevalence was 36.2% (95%CI, 30.1%– 42.4%) in three studies.

When the same analyses were done separately directly at sex, it showed that the pooled prevalence of depression among females (36.0% with 95%CI of 29.9%– 42.3%) was higher than among males (34.3% with 95%CI of 29.2%– 39.5%).

Sixteen studies done before COVID- 19 revealed a pooled prevalence of depression in students of 35.0% (95%CI, 26.9%– 43.4%), whereas it rose to 38.7% (95%CI, 33.6%– 44.0%) in thirteen studies done during or after the epidemic.

Sensitivity analysis

The sensitivity analysis of 32 included articles was carried out using a one-by-one exclusion method. The results in Table 4. showed that the prevalence of depression in Chinese college students was stable at about 34.7%, demonstrating that the stability of this meta-analysis was relatively good.

Risk of bias in individual studies

The funnel plot was used to test whether there was publication bias among the studies.

The distribution of each study in the funnel plot in Fig. 3 shows the existence of publication bias.

Table 4. Sensitivity analysis of the prevalence of depression among Chinese university students

Omitting Article	Prevalence,%	95%CI,%	P	I^2,%
Wen-Ping Ji et al. [42]	34.5	(30.0,39.2)	< 0.01	99.5
Ling Cui et al. [43]	35.5	(31.0,40.1)	< 0.01	99.5
Qian-Min Ma et al. [44]	35.4	(31.0,40.1)	< 0.01	99.5
Wen-Lei Zhou [45]	34.4	(29.9,39.1)	< 0.01	99.5
Zhuo-Yan Zhu et al. [46]	34.8	(29.9,39.9)	< 0.01	99.5
Da-Zhu Wang et al. [47]	35.1	(30.5,39.7)	< 0.01	99.5
Hong-Wei Li et al. [48]	34.7	(30.2,39.3)	< 0.01	99.5
Jin-Yang Wang et al. [49]	34.5	(30.0,39.1)	< 0.01	99.5
Lan Ma et al. [50]	34.3	(29.8,38.9)	< 0.01	99.5
Meng Liu et al. [51]	34.7	(30.2,39.4)	< 0.01	99.5
Hai-Ling Deng et al. [52]	34.5	(30.0,39.1)	< 0.01	99.5
Hao Zhu et al. [53]	35.1	(30.6,39.8)	< 0.01	99.5
Yu-Qi Hou et al. [54]	34.7	(30.1,39.3)	< 0.01	99.5
Peng Jin et al. [55]	34.7	(30.1,39.3)	< 0.01	99.5
Ju-Fang Zhao et al. [56]	35.6	(31.5,39.8)	< 0.01	99.4
Yun-Xia Li et al. [57]	34.3	(29.8,38.9)	< 0.01	99.5
Feng-Mei Zhang et al. [58]	35.2	(30.7,39.9)	< 0.01	99.5
Jing-Fen Sun et al. [59]	34.6	(30.1,39.3)	< 0.01	99.5
Jing-Jing Xi et al. [60]	35.4	(31.2,39.7)	< 0.01	99.4
Su-Yun Hu et al. [61]	34.7	(30.2,39.3)	< 0.01	99.5
Chun-Mei Yan et al. [62]	34.6	(30.0,39.2)	< 0.01	99.5
Xing-Jie Yang et al. [63]	34.6	(30.0,39.3)	< 0.01	99.5
Chun Li et al. [64]	34.0	(29.7,38.5)	< 0.01	99.4
Xiao-Pan Shi et al. [65]	34.6	(30.1,39.3)	< 0.01	99.5
Na-Na Cai et al. [66]	35.2	(30.6,39.8)	< 0.01	99.5
Hai-Feng Li et al. [67]	34.7	(30.2,39.4)	< 0.01	99.5
Xia Chen et al. [68]	33.4	(29.1,37.8)	< 0.01	99.5
Xue-Xiao Xie et al. [69]	34.9	(30.3,39.6)	< 0.01	99.5
Ying Guo et al. [70]	34.1	(29.7,38.7)	< 0.01	99.5
Shuo Cheng et al. [71]	35.1	(30.6,39.8)	< 0.01	99.5
Yan-Qiu Yu et al. [72]	34.5	(29.6,39.7)	< 0.01	99.5
Ru-Yue Shao et al. [73]	34.0	(29.6,38.5)	< 0.01	99.5

CI Confidence interval, *P* Probability value, I^2 Evolution of heterogeneity measure

Discussion

The synthesis of data from 32 studies involving 93,679 Chinese university students reveals a pooled depression prevalence of 34.70% (95% CI: 30.27%–39.26%), highlighting a critical public health concern. This estimate not only exceeds China's general adult depression prevalence of 6.8% [10] but surpasses rates documented in prior systematic reviews of Chinese university students [31] while aligning with global reports indicating elevated rates among university students [80]. This is due to these articles only analyzed the studies before COVID- 19 while our research included the studies during and after COVID- 19.

Notably, depression prevalence among university students in our study rose from 35.0% (95%CI, 26.9%– 43.4%) (pre-pandemic) to 38.7% (95%CI, 33.6%– 44.0%) during or after COVID- 19, consistent with global trends where prolonged isolation and

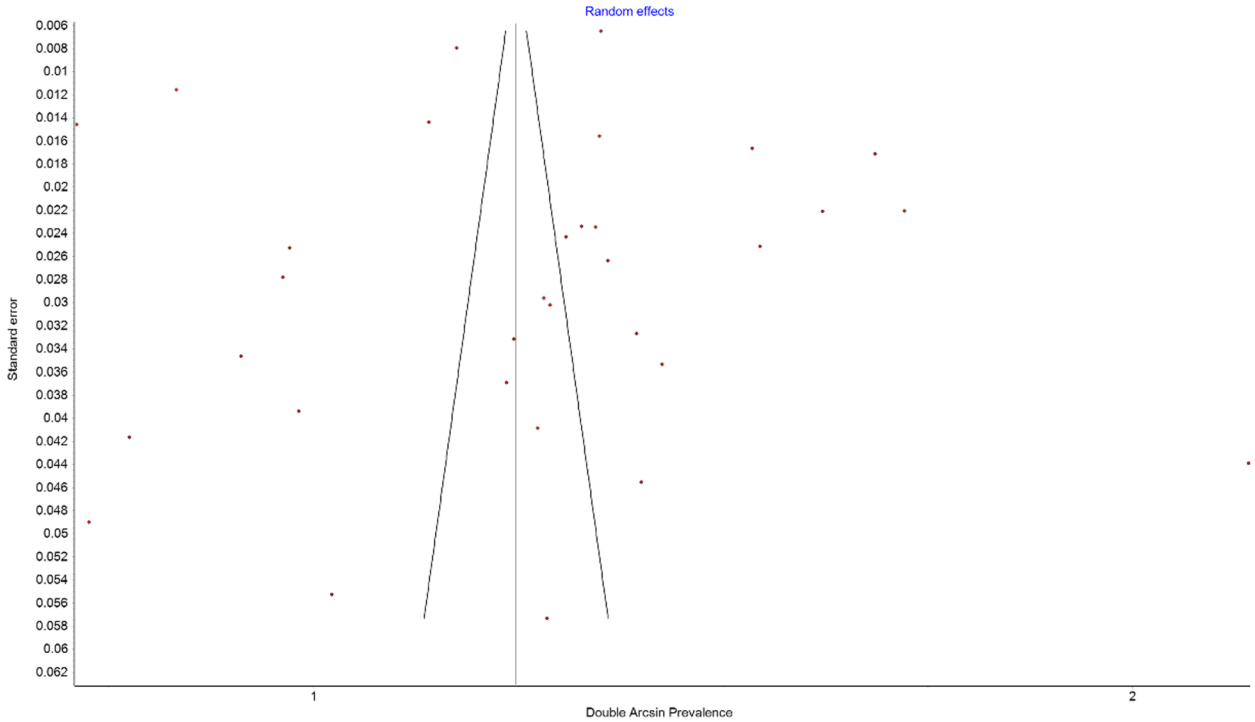

Fig. 3 Funnel plot of sensitivity of prevalence of depression among Chinese university students

academic disruptions exacerbated mental health burdens [81–85]. For instance, a cross-sectional study in the United States reported that all students surveyed were being negatively affected by the pandemic in some way, and 59% of respondents experienced high levels of psychological impact [86]. This finding corresponds with our theoretical framework in the Introduction, which posited that China's prolonged campus quarantine measures might exacerbate emotional distress among students through social isolation and academic disruption [87]. Also, pandemic-enforced isolation may exacerbate Internet Addiction Disorder (IAD) among university students, with longitudinal studies confirming its bidirectional relationship with depression through shared neurobiological mechanisms (e.g., dopamine dysregulation) and confinement-intensified coping behaviors [88–90]. Extending these findings, we suggest that the pandemic's career impacts emerge through two interrelated mechanisms: altered developmental timelines in professional preparation and economically-driven employment insecurities. Distinct from previous crises, this stressor complex uniquely intertwines labor market dynamics with pandemic-specific health apprehensions. While intentionally developed independently of existing frameworks to avoid confirmation bias, future studies should assess their congruence with established psychological theories.

Our study also reported that medical students exhibited a significantly higher pooled prevalence of depression (38.3%, 95% CI: 28.3%–48.5%) compared to non-medical peers (33.7%, 95% CI: 28.7%–38.9%), reflecting systemic challenges within China's healthcare education and profession. The demanding nature of medical education, marked by chronic exposure to academic overload and high-stakes postgraduate examinations, has been robustly linked to burnout development [91, 92]. This association is mediated through multifactorial pathways, with curriculum-driven stressors interacting synergistically with personal life disruptions and suboptimal learning environments to exacerbate psychological strain [93–95]. Further, even when medical students complete all their studies and become doctors, the tense doctor-patient relationship(DPR) in China [96] with frequent violent attacks against healthcare workers [97, 98] greatly decreases the enthusiasm of young medical students for pursuing their future careers. In the short term, the DPR in China will be hard to improve [99]. The reasons mentioned above may contribute to the substantial psychological stress in medical students. These psychological burdens become particularly concerning given critical research gaps—while multinational meta-analyses have documented medical student burnout globally [100], the psychological impacts of China's deteriorating DPR remain understudied, with domestic researchers yet

to systematically examine how these tensions influence career-related mental health outcomes among medical students.

Compounding these institution-level stressors, our analysis reveals critical demographic variations in depression risk. Geographical disparities—with significantly higher rates in southern (40.1%) versus central China (26.0%)—likely reflect entrenched regional socioeconomic divides [101]. Similarly, the gender differential (36.0% female vs. 34.3% male) aligns with transnational pandemic patterns, possibly attributable to women's constrained physical activity during lockdowns and disproportionate caregiving burdens [102]. Such a phenomenon might be even more pronounced in China, where lockdown was enforced [22, 103].

As the most commonly reported psychological problem in Chinese university students, it is suggested that more attention should be paid to those with signs and symptoms of depression, and timely screening and proper interventions are highly necessary.

Limitation

This study has several key constraints. First, reliance on self-report scales may underestimate depression prevalence due to cultural stigma around mental health disclosure [104]. Second, the cross-sectional design precludes assessment of long-term mental health trajectories, especially regarding COVID- 19's enduring effects. Third, extreme heterogeneity (I^2= 99.5%) likely stems from unmeasured confounders like regional economic disparities, which were rarely reported in original studies. Fourth, variability in diagnostic tools (e.g., PHQ- 9 vs. CES-D thresholds) complicates direct comparisons, as milder symptom scales inflate prevalence estimates [105]. Crucially, no studies used Structured Clinical Interview for the DSM [106], potentially conflating transient distress with clinical depression. Finally, publication bias assessment was limited to funnel plots without Egger's test, potentially omitting smaller studies with null findings.

Conclusion

In summary, these findings underscore the urgency of targeted interventions for high-risk subgroups, including medical students and those in high-stress regions. Reforming medical education to reduce burnout and improving legal protections for healthcare workers could mitigate systemic stressors. Universities should prioritize accessible mental health services, particularly during public health crises. By contextualizing China's depression burden within global trends, this study informs culturally adaptive strategies to address a growing crisis. Future research should be directed at comparing the depression of Chinese university students with that of university students in other countries and study whether China's compulsory quarantine caused a more serious impact on university students than the epidemic control in other countries.

Acknowledgements
Not applicable.

Authors' contributions
Zhou-Zhou Lin, Hao-Wei Cai contributed equally to the work. Conceived and designed the systematic review, Jia Li, Lian-Ping He and Ling-Ling Zhou; Literature retrieval, Zhou-Zhou Lin, Zhi-Yang Yuan and Ling-Ling Zhou; Literature selection, Zhou-Zhou Lin and Lian-Ping He; Data analysis: Zhou-Zhou Lin and Hao-Wei Cai; Wrote the paper, Zhou-Zhou Lin, Yu-Fei Huang and Jia Li.

Funding
The work was supported by National Undergraduate Training Program for Innovation and Entrepreneurship (20241180013).

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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Received: 22 January 2025 Accepted: 2 April 2025
Published online: 11 April 2025

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