Review article

Prevalence of anxiety symptoms among Chinese university students amid the COVID-19 pandemic: A systematic review and meta-analysis

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ARTICLE INFO

ABSTRACT

College students in China are particularly vulnerable to worry. In the meanwhile, the COVID-19 pandemic might worsen anxiety symptoms. However, due to the inconsistency of many studies regarding anxiety symptoms, it has proven challenging to provide accurate psychiatric health treatments to undergraduates. Therefore, in order to determine the prevalence of anxiety among Chinese university students during the COVID-19 epidemic, this study will undertake a systematic review and meta-analysis.

English databases (i.e Embase (Ovid), APA PsycInfo, Medline, Pubmed, Cochrane Library) were utilized to identify papers that provide information on the incidence of anxiety among Chinese college students during the pandemic. Two authors evaluated the qualifications of relevant studies, assessed the risk of bias (RoB), and retrieved data. RoB was evaluated using the cross-sectional study quality evaluation criteria from the American Agency for HealthCare Quality and Research (AHRQ). Three hundred seventy-three records were retrieved. Twenty-five studies were eventually included, involving 1,003,743 Chinese college students. The findings of the study identified that the pooled prevalence of anxiety symptoms was 25.0% (95% CI: 21%–29%, P < 0.001), and those among medical-related professionals were lower than those of the general population (22.1% vs. 25%, P < 0.001). In addition, the prevalence of studies with more female respondents was higher than those with fewer female respondents (26.4% vs. 8%). In the later phases of the COVID-19 pandemic compared to the early stages, anxiety prevalence is higher (29.1% vs. 17.2%). Finally, using meta-regression to explore the source of heterogeneity, this study found that the most potential source was whether the graduate students or otherwise.

This meta-analysis revealed that during the COVID-19 pandemic, a quarter of Chinese college students had anxiety symptoms. Therefore, it is necessary to provide continuous psychological assessment and treatment services for college students.

1. Introduction

When entering university, students face changes in many areas, including studies, relationships and employment situations. As university life continues, these changes may bring about mental health issues. Numerous health issues are now being studied. One of them has found that mental health among university students is already prevalent (Eisenberg et al., 2013; Rb et al., 2018) . The university stage is a critical period in a person's life, thus academics should pay close attention to the mental health of university students. It was discovered that Chinese university students experience moderate anxiety, and that this anxiety is increasing with the current socio-economic development and increased stress among university students (Li, 2021). However, the public

believes that mental health and counseling services are stigmatized, and the mental health industry in China lacks professional practitioners and has a fragmented service model, which contributes to the relatively low usage of mental health services. Undergraduate students are in the early stages of adulthood and their relationship with their parents is changing during this period. Conflict with parents might arise in college students because they are still developing their sense of uniqueness and psychological independence. As a result, this conflict can last well into late adolescence (Dan, 2009; Lu, 2020). Therefore, changes in school and family life may have an effect on the mental well-being of university students. The researchers discovered that the average prevalence of anxiety symptoms was 27.22% in a study of medical students (Mao et al., 2019).

Since December 2019, a new coronavirus-based pneumonia was prevalent in China. This virus spreads rapidly and carries the risk of death. The lack of knowledge about the virus has led to panic in the community and may raise the probability of mental health issues in the overall population (Zhou et al., 2020a). Affected by the outbreak, China's Ministry of Education has requested a postponement of the start of the second semester for the 2020 academic year, asking all university students to hold off returning to campus. In an effort to stop the outbreak from spreading, every student had to undergo home quarantine. Their way of life and learning changes. Everyone in society is significantly impacted by stress and anxiety. Recent research indicates that isolated individuals may feel extreme anxiety (Brooks et al., 2020). Relative to this, due to home isolation, college students lack communication with their surroundings; the social support perceived by college students has declined, thus further increasing the pressure on themselves (Chen et al., 2020a). The perception of social support is a safeguard for mental health. During isolation university students' perceived a reduction in social support, which can trigger anxiety symptoms (Sun S.F. et al., 2021). In addition, their grade had an impact on anxiety symptoms. Academic stress increases as a student progresses through university, and because academic stress is linked to unpleasant feelings, juniors and seniors report experiencing higher levels of anxiety (Cheng et al., 2020). Graduation dates and internships have been postponed, increasing the pressure on college students (Liu J. et al., 2020; Luo W. et al., 2021). College students are unable to finish their final assignments with the help of teachers but to complete the papers and dissertations alone at home.

Regional differences can also be a cause of anxiety. The survey found that adolescents in Wuhan appeared to be more anxious than those in other regions (Chen S. et al., 2020b). All of these conditions can lead to a range of mood disorders, including an increase in personal anxiety (Sun et al., 2007; Shu Y. C. et al., 2021).

During the quarantine period, college students used social media and cell phones to receive such information. However, during the pandemic, various false, exaggerated, and untrue information may cause college students to waste energy while focusing on them (Gong et al., 2020 ; Wu et al., 2020). Meanwhile, studies have found that anxiety levels are associated with dysfunctional information consumption when people receive information (Escolà-Gascón et al., 2020). Escolà-Gascón et al. (2021) found that the more saturated or overloaded the media with information about COVID-19, the more difficult it is for people to detect and distinguish between true and false information. When people are less able to discriminate between information in these messages, it likewise affects their level of mental health.

Additionally, conflicts between adolescents and their parents, lack of social support, and other factors can further cause personal anxiety. In summary, the COVID-19 pandemic has enhanced the anxiety symptoms of college students.

Overall, the psychological status of undergraduates were affected in different ways during the pandemic. In 2003, China experienced an outbreak of SARS, after which the public experienced an increase in psychological problems (Main et al., 2011). As COVID-19 was an unexpected public health event, we know from experience that timely psychological interventions are very meaningful. Understanding the prevalence of anxiety symptoms among Chinese university students during the COVID-19 pandemic is necessary to gain a thorough understanding of the mental health status of Chinese undergraduates and to be able to develop targeted psychological interventions based on characteristics of different groups. However, the research that has been done on the anxiety symptoms of Chinese undergratudates during the pandemic. Differences exist in their research methods, such as varied sampling methods, different measurement instruments, and inconsistent sample sizes between studies, and the results obtained vary considerably (6–80%) (Deng et al., 2021).

Due to the difference in earlier cross-sectional studies since the beginning of the epidemic, this study was conducted to characterize the anxiety symptoms of Chinese university students after the onset of the pandemic by carefully searching for relevant papers and by Meta-analysis. Therefore, the goal of this study was to calculate and evaluate the frequency of anxiety symptoms and investigate the cause of the variations in prevalence seen in earlier research. This design of future research on the anxiety symptoms of Chinese college students experience major public events may also be influenced by this, which has significant implications for additional therapies.

2. Methods

This meta-analysis is registered in the International Platform of Registered Systematic Review and Meta-analysis Protocols (Inplasy). The registration number is INPLASY2021100104.

2.1. Inclusion and exclusion criteria

The following criteria were used to determine which studies were eligible for inclusions: (a) study that reported the prevalence of anxiety symptoms; (b) studies that included Chinese college students, including those who are studying abroad; (c) studies that used standardized measurement tools to assess anxiety symptoms; (d) studies that were conducted during the COVID-19 pandemic; (e) studies that were published publicly in peer-reviewed journals. In addition, studies involving non-Chinese college students, mixed studies in which the results for a particular group of college students were not reported individually, and studies that did not make use of anxiety-related standardized test methods were all disregarded. The studies included in this study were all published articles and were peer-reviewed. Unpublished studies were not peer-reviewed, so the quality of the literature is difficult to ensure and may contain many problems, such as flaws in the study design. Therefore, we did not include articles that were not peer-reviewed.

2.2. Literature search

The databases listed below were searched: Embase (Ovid), APA PsycInfo, Medline, Pubmed, and Cochrane Library. The keywords used were: (Angst OR Nervousness OR Hypervigilance OR Anxiousness OR Social Anxiety*), (Student* or School Enrollment*), (Coronavirus Disease-19 or Coronavirus Disease 19 or 2019 nCoV Disease* or COVID19 or Coronavirus Disease, 2019 or SARS-CoV-2 Infection* or SARS CoV 2 Infection or 2019 Novel Coronavirus or Wuhan Seafood Market Pneumonia Virus or SARS CoV 2 Virus or 2019-nCoV or Wuhan Coronavirus or SARS Coronavirus 2 or Severe Acute Respiratory Syndrome Coronavirus 2). The literature search ended on April 6, 2021. Figure 1 provides the detailed search strategies.

2.3. Data extraction

Using a preset content, the following data were extracted: first author, year, survey participants, survey date, sampling method, sample size, the proportion of males in the survey participants, age of the survey participants, and tools for assessing anxiety symptoms. The "Fighting Covid-19 China in action" discussed that China's experience in fighting COVID-19 could be divided into distinct stages. Before February 20th, 2020 was classified as an early stage of the outbreak. The time following February 20th, 2020 is considered to be the latter stage because the number of new cases in China rapidly decreased after that date to single digits. During the article selection process, author 1 judged each research to determine whether it was an independent study and sent it to author 2 for review. When a controversial study arises, it is referred to a third independent researcher for judgment. Finally, the selected articles are independent studies, and the data between each study are not repeated or interfered with each other.
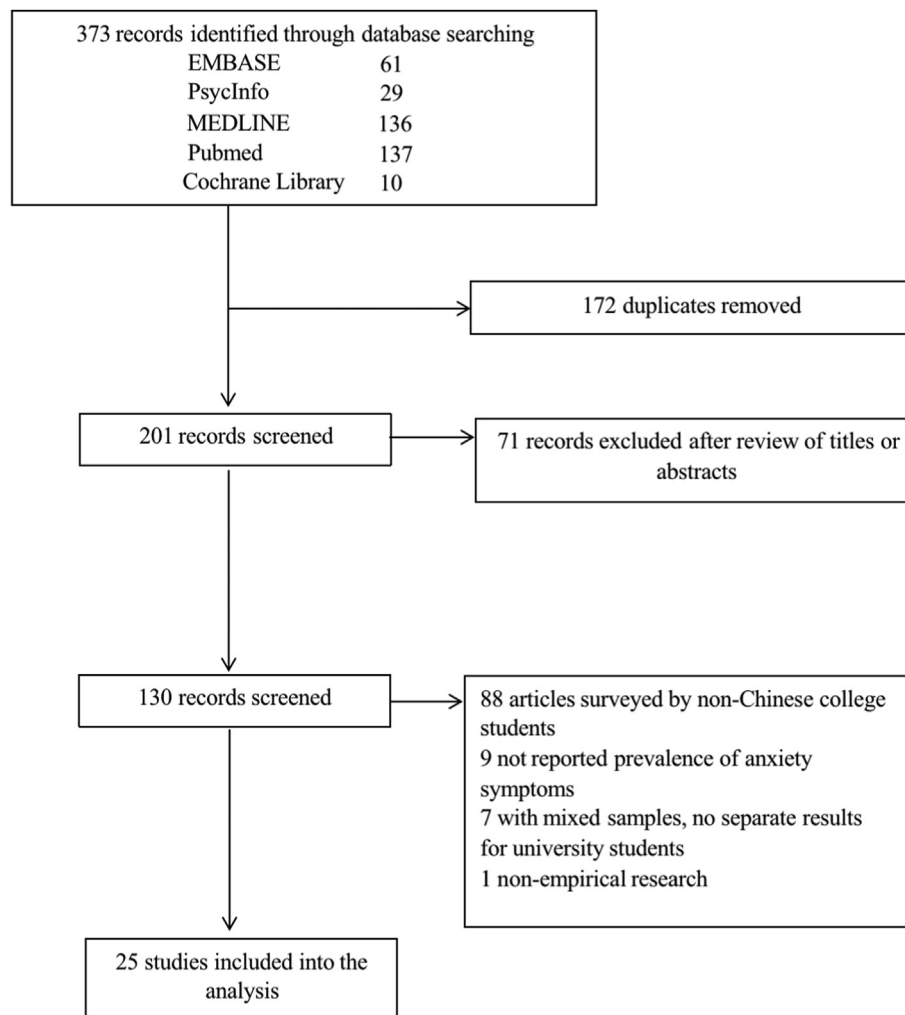
Figure 1. Flowchart of study inclusion.

2.4. Quality assessment

The American Agency for HealthCare Quality and Research's (AHRQ) Cross-sectional Research Quality Evaluation Scale was used to evaluate the quality of the included literature. The American Health Care Quality and Research Institute put it together. There are 11 questions, and three options for each: "Yes," "No," and "I don't know." Answering "Yes" would score one point, while "No" or "I don't know" would score 0. There was also a question with reversal scoring. The total score for the document quality assessment ranged from 0 to 11; the greater the score, the higher the document quality evaluation. An evaluation was rated high-quality if it received an 8 or greater. The scale is recommended by authorities and has been found to have good inter-rater reliability by researchers (Mamikutty et al., 2021).

This study's first and second authors conducted research inclusion, data extraction, and article quality evaluation and evaluation. Also, the differences that had occurred in the process to reach a consensus during the evaluation was discussed.

2.5. Data analysis

In this study, we used Excel spreadsheets to collect basic information and statistics from the literature, and Stata 14.0 (Stata Corp, College Station, TX) and Comprehensive Meta-analysis software 3.3 were used for meta-analysis and meta-regression. Meta-analysis was used to generate the aggregated estimates and their 95% confidence intervals

(95% CIs) for the entire sample and the prevalence of anxiety symptoms. I2 was used to test the heterogeneity between the studies. When I2≤50%, the high fixed-effects model was used to generate the combined estimated value; otherwise, the random-effects model was used. In addition, the subgroup analysis explored the sources of variability in estimating the prevalence of anxiety symptoms, the funnel plot and the Begg test evaluated publication bias, and the Z-test compared the prevalence of each cohort.

3. Results

3.1. Characteristics of included studies

The procedure for including a research is shown in Figure 1. Finally, the meta-analysis included 25 studies comprising 1,003,743 Chinese college students (Cao et al., 2020; Chang et al., 2020a; Deng et al. 2020; Feng et al., 2020; Fu et al., 2021; Ge et al., 2020; Han et al., 2021; Jia et al., 2021; Li et al., 2021a; Li M. et al., 2020; Liu J. et al., 2020; Ma et al., 2020; Meng et al., 2020; Nurunnabi et al., 2020; Song et al., 2020; Song et al., 2021; Sun S.F. et al., 2021; Sun Y. et al., 2020; Wang et al., 2021; Wu et al., 2021a; Xie L. et al., 2020; Yang K. H. et al., 2021; Zhang et al., 2020; Zhou et al., 2020b). The characteristics of all included literature are shown in Table 1.

Among the 25 studies, one investigated overseas Chinese students (Song et al., 2020), while 12 adopted convenience sampling to recruit the research subjects. In the selected study, the sample size ranged between

Table 1. Characteristics of included 25 studies.

Author (Publication year)	Participants and setting	Dates of the survey	Sampling method	Sample size(n)	Male students, n (%)	Age, years	Survey method	Anxiety assessment	Prevalence of anxiety (%)
Deng et al. (2020).	University students in 267 cities in China	May 8 to 11,2020	Snowball sampling	1607	1041 (64.8%)	<18: 20 (1.2%) 18–22:1573 (97.9%) >22:14 (0.9%)	Online self-administered questionnaire	Anxiety subscale of DASS-21 ≥ 7	88[5.5%]
Nurunnabi et al. (2020).	University students in Shanxi, Hubei, Beijing, Heilongjiang, and Guangdong.	May 26th to June 3rd, 2020	Random sampling	559	226 (40.4%)	18–22:281 (50.27%) 23–27:192 (34.35%) 28–32:66 (11.81%) 33+: 20 (3.58%)	Online self-administered questionnaire	self-designed questionnaire	185 (33.1%)
Song et al., (2020).	Native Chinese students who are studying at U.S. universities	NR	Snowball sampling	261	122 (46.7%)	≤19: 132 (50.6%) 20–23: 88 (33.7%) >23: 41 (15.7%)	Online self-administered questionnaire	Anxiety subscale of DASS-21 > 7	129[49.4%]
Sun Y et al., (2020)	Nursing students in Zhengzhou, China.	February 15 to March 31, 2020.	Convenience sampling	474	72 (15.2%)	<20: 59 (12.5%) 20–22:275 (58%) >22: 140 (29.5%)	Online self-administered questionnaire	SAS≥50	58 (12.4%)
Wu et al. (2021a).	Chinese college students of 16 provinces or Municipalities.	February 4 to 12, 2020	Random sampling	11787	5056 (42.9%)	Mean:20.45 SD:1.76	Online self-administered questionnaire	GAD-7 ≥5	2098 (17.8%)
Xie L et al. (2020).	College students who live outside Hubei and are not infected by COVID-19	Feb 4, 2020, to Feb 7, 2020	Random sampling	2705	608 (22.5%)	NR	Online self-administered questionnaire	GAD-7≥5	400[14.8%]
Yang K.H et al. (2021).	University students in China	April 2020 to May 2020	Convenience sampling	521	117 (22.5%)	≤22: 320 (61.4%) >22: 201 (38.6%) Mean: 22.02 ± 1.761	Online self-administered questionnaire	SAS≥50	236 (45.3%)
Han et al. (2021).	Undergraduates and postgraduates in China	February 22 to 24,2020	Convenience sampling	495	134 (33.1%)	NR	Online self-administered questionnaire	Anxiety subscale of DASS-21 ≥ 8	171 (42.2%)
Song et al. (2021).	College students in Anhui Province, China	February 17 to23. 2020.	Random cluster sampling.	1128	486 (44.0%)	18–23: 993 (88.0%) 24–27:114 (10.1%) 27: 21 (1.9%)	Online self-administered questionnaire	SAS≥50	95 (8.4%)
Jia et al. (2021).	University students in 31 provinces in China	February 2020,	Convenience sampling	740	282 (38.1%)	NR	Online self-administered questionnaire	SAS≥50	139 (18.8%)
Li et al. (2021a).	22 universities in Guangdong Province, China.	T1: Feb 3 to 10, 2020 T2: March 24-April 3, 2020	Random sampling	T1: 164101 T2: 148343	T1: 60456 (36.8%) T2: 55484 (37.4%)	NR	Online self-administered questionnaire	GAD-7≥7	T1: 7,802 (11.4%) T2: 10,125 (14.7%)
Fu et al. (2021).	University students from 21 Chinese universities	May 10 to June 10, 2020	Convenience sampling	89588	39194 (43.7%)	18-20: 28482 (31.8%) 21-25: 57012 (63.6%) 26-30: 4094 (4.6%)	Online self-administered questionnaire	GAD-7≥5	36865[41.1%]
Wang et al. (2021).	Students of a university in Xi'an, China	February 13 to 16, 2020	Stratified sampling	430	139 (32.3%)	Range:18-25	Online self-administered questionnaire	SAS≥50	60 (14.0%)
Ma et al. (2020).	College students from 108 colleges and universities in Guangdong Province, China	NR	Convenience sampling	746217	331 613 (44.4%)	<18: 27 640 (3.7%) 18–19: 252616 (33.9%) 20–21: 327639 (43.9%) 22–23: 120142 (16.1%) 24–25: 14925 (2.0%) ≥26: 3255 (0.4%)	Online self-administered questionnaire	GAD-7≥7	11.0%
Zhang et al. (2020).	College students in China	February 19 to March 20, 2020,	Convenience sampling	66	25 (37.8%)	Mean (SD): 20.70 (2.11)		Anxiety subscale of DASS21 ≥ 7	30[45.5%]

Table 1 (*continued*)

Author (Publication year)	Participants and setting	Dates of the survey	Sampling method	Sample size(*n*)	Male students, n (%)	Age, years	Survey method	Anxiety assessment	Prevalence of anxiety (%)
							Online self-administered questionnaire		
Chang et al. (2020a).	College students in Guangdong Province, China	January 31, 2019–February 3, 2020	Convenience sampling and snowball sampling>	3881	1434 (37.0%)	Mean: 20	Online self-administered questionnaire	GAD-7≥6	1032 (26.6%)
Meng et al. . (2020).	Undergraduates and postgraduates of three universities in Shanghai, China	April 15 to 30, 2020	Cluster sampling	1195	531 (44.4%)	Range: 17–39 Mean: 21.11	Online self-administered questionnaire	PANAS	557(46.6%)
Liu J et al. (2020).	Medical students of a university in Wuhan, China	February 23, 2020, to April 2, 2020	Convenience sampling	217	90 (41.5%)	Range:18–27 Mean:21.7	Online self-administered questionnaire	GAD-7≥5	48(22.1%)
Ge et al. (2020).	Undergraduates in Shandong Province, China	February 10th to 13th, 2020	Convenience cluster sampling	2009	985 (49.0%)	NR	Online self-administered questionnaire	GAD-7≥7	251 (12.5%)
Sun S. F. et al. (2021)	University students in China	March 20th and April 10th, 2020	Convenience sampling	1912	578 (30.2%)	Median: 20 Range: 18-49	Online self-administered questionnaire	GAD-7 ≥5	664 (34.7%)
Li M et al. (2020)	University students in China	March 3–15, 2020	Convenience sampling	1676	588 (35.1%)	Mean:20.17	Online self-administered questionnaire	HAI≥15	408 (24.3%)
Cao et al. (2020).	Undergraduate of a medical university in Changzhi, China	NR	Cluster sampling	7143	2168 (30.4%)	NR	Online self-administered questionnaire	GAD-7	1776 (24.9%)
Li et al. (2021b).	Undergraduate students of a university in Southwest China	February to March 2020.	Convenience sampling	7747	3947 (50.9%)	Mean: 20.72	Online self-administered questionnaire	GAD-7≥5	810 (10.5%)
Zhou et al. (2020b).	College students in China	March 8 to 15, 2020.	Random sampling	4099	1434 (35.0%)	NR	Online self-administered questionnaire	GAD-7≥5	1112 (27.1%)
Feng et al. (2020).	Students of a university in Beijing, China	February 8–28, 2020	Cluster sampling	1346	364 (27.0%)	Mean:19.69	Online self-administered questionnaire	GAD-7≥5	354 (26.3%)

Note: NR: Not Reported; SD: Standard Deviation; DASS-21: Depression, Anxiety and Stress Scale - 21 Items; SAS: Self-Rating Anxiety Scale; GAD-7: Generalized Anxiety Disorder - 7 Items; HAI: The Health Anxiety Inventory; PANAS: Positive And Negative Affect Schedule; In anxiety assessment, the number marked after the scale indicates that the scale score is greater than this number, which is the diagnosis of anxiety.

66 and 746,217; the median was 1,607. All studies obtained data through online questionnaires. The most popular instrument for assessing anxiety symptoms was the Generalized Anxiety Disorder - 7 Items scale ($k = 13$), followed by the Self-Rating Anxiety Scale ($k = 5$), the Depression, Anxiety and Stress Scale - 21 Items ($k = 4$), the Positive And Negative Affect Schedule ($k = 1$), The Health Anxiety Inventory ($k = 1$), and a self-compiled measurement questionnaire ($k = 1$).

3.2. RoB of included studies

There were six articles with scores of 6 or less, 11 articles with 7, seven articles with 8, and one with 9.

3.3. Meta-analysis of the prevalence of anxiety symptoms

Anxiety symptoms were seen in 25% (95 CI: 21%–29%) (Figure 2) of Chinese college students overall. The prevalence of studies with more female respondents was higher than those with fewer female respondents (26.4% vs. 8%). In comparison to the overall population, medical-related professions were less common (22.1% vs. 25%). In contrast, anxiety was more common in the early stages of the pandemic than it was in the latter stages (17.2% vs. 29.1%). When different anxiety symptom measurement tools were used for research, anxiety symptoms were also different. For instance, when the anxiety subscale of the Depression, Anxiety and Stress Scale - 21 Items was used for measurement, the prevalence of anxiety symptoms was greater than that of other scales like the Self-Rating Anxiety Scale or the Generalized Anxiety Disorder - 7 Items scale (Table 2).

3.4. Meta-regression

To verify the source of heterogeneity, this study further conducted a meta-regression analysis. It was discovered that, out of all the variables

examined, whether or not graduate students were participating was the most likely source of heterogeneity (Table 2).

3.5. Publication bias among included studies

Unpublished researches are not subjected to peer review, making it challenging to assess their quality; therefore, when developing inclusion and exclusion criteria, researchers exclude unpublished articles. There is a need for a valid test of publication bias. Since the funnel plot in Figure 3 is not symmetrical, testing publication bias required quantitative techniques. However, the Begger and Egger test coefficients were 0.944 and 0.063, indicating no publication bias in the included literature. A Comprehensive Meta-analysis software was used to calculate Rosenthal Failsafe-N. The results show that the Rosenthal Failsafe-N coefficient is 420710, which is much larger than 135, that is, $5k + 10$, indicating that at least 420710 researches are needed to overturn the conclusion of this study (Rothstein et al., 2005). The results of the meta-analysis are relatively stable.

4. Discussion

4.1. Main findings

Several research on the anxiety symptoms experienced by Chinese college students during the COVID-19 epidemic were included in this systematic review and meta-analysis. This study discovered that the overall prevalence of anxiety symptoms was 25% throughout the COVID-19 pandemic. Medical students experienced this pandemic with a tad less concern than other demographics. In previous anxiety studies involving the general public, the prevalence of anxiety among general community residents was 15.8% (Jin et al., 2020). Therefore, college students had more anxiety was than other ordinary community residents. In addition,
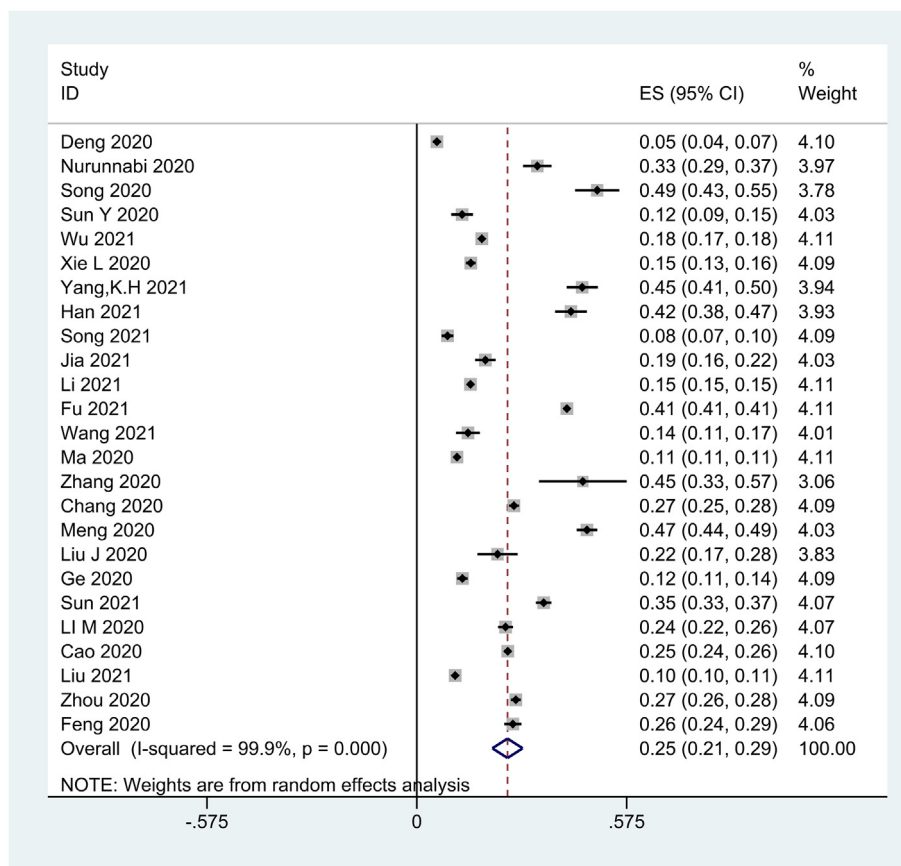

Study ID	ES (95% CI)	% Weight
Deng 2020	0.05 (0.04, 0.07)	4.10
Nurunnabi 2020	0.33 (0.29, 0.37)	3.97
Song 2020	0.49 (0.43, 0.55)	3.78
Sun Y 2020	0.12 (0.09, 0.15)	4.03
Wu 2021	0.18 (0.17, 0.18)	4.11
Xie L 2020	0.15 (0.13, 0.16)	4.09
Yang,K.H 2021	0.45 (0.41, 0.50)	3.94
Han 2021	0.42 (0.38, 0.47)	3.93
Song 2021	0.08 (0.07, 0.10)	4.09
Jia 2021	0.19 (0.16, 0.22)	4.03
Li 2021	0.15 (0.15, 0.15)	4.11
Fu 2021	0.41 (0.41, 0.41)	4.11
Wang 2021	0.14 (0.11, 0.17)	4.01
Ma 2020	0.11 (0.11, 0.11)	4.11
Zhang 2020	0.45 (0.33, 0.57)	3.06
Chang 2020	0.27 (0.25, 0.28)	4.09
Meng 2020	0.47 (0.44, 0.49)	4.03
Liu J 2020	0.22 (0.17, 0.28)	3.83
Ge 2020	0.12 (0.11, 0.14)	4.09
Sun 2021	0.35 (0.33, 0.37)	4.07
LI M 2020	0.24 (0.22, 0.26)	4.07
Cao 2020	0.25 (0.24, 0.26)	4.10
Liu 2021	0.10 (0.10, 0.11)	4.11
Zhou 2020	0.27 (0.26, 0.28)	4.09
Feng 2020	0.26 (0.24, 0.29)	4.06
Overall (I-squared = 99.9%, p = 0.000)	0.25 (0.21, 0.29)	100.00

NOTE: Weights are from random effects analysis

Figure 2. Forest plot of prevalence of anxiety among Chinese university students amid the COVID-19 pandemic.

Table 2. Results of meta-analyses of prevalence of anxiety among Chinese university students amid the COVID-19 pandemic.

	Prevalence (%)	95% CI	I^2 (%)	Z	P	Model	Begger test	Egger test	P-values for heterogeneity from meta-regression
All studies	24.8	(20.7, 29.0)	99.9	11.71	<0.001	Random model	0.944	0.063	
Sampling method									0.809
Random sampling	21.1	(17.1,25.0)	99.1	10.44	<0.001	Random model	0.221	0.098	
Convenience sampling	27.8	(16.6, 39.1)	100	4.84	<0.001	Random model	0.876	0.257	
Others	23.1	(13.4,32.7)	99.5	4.68	<0.001	Random model	0.368	0.170	
Cluster sampling	25.1	(24.2,26.0)	13.2	53.36	<0.001	Fixed model	1.000	-	
Anxiety assessment									0.672
Anxiety subscale of DASS-21	35.5	(8.4,62.5)	99.4	2.57	0.010	Random model	1.000	0.091	
SAS	19.7	(9.6,29.7)	98.5	3.84	<0.001	Random model	0.221	0.094	
GAD-7	21.8	(16.1,27.5)	100	7.50	<0.001	Random model	0.760	0.133	
Others	34.6	(20.2,49.1)	98.7	4.69	<0.001	Random model	1.000	0.634	
Sample size									0.073
> 1000	21.6	(16.5,26.8)	100	8.29	<0.001	Random model	0.685	0.120	
< 1000	31.1	(21.8, 40.3)	97.8	6.58	<0.001	Random model	0.251	0.066	
Male									0.069
> 50%	8.00	(3.1,12.9)	98.2	3.21	0.001	Random model	1.000	-	
< 50%	26.4	(21.9, 30.8)	99.9	11.61	<0.001	Random model	0.342	0.050	
NOS									0.888
> 7	25.4	(22.7,28.1)	99.8	18.28	<0.001	Random model	0.711	0.018	
≤7	24.2	(16.2,32.3)	99.9	5.89	<0.001	Random model	0.053	0.057	
Postgraduate									0.025
No	13.9	(8.5,19.4)	99.4	4.99	<0.001	Random model	1.000	0.885	
Unclear	28.4	(23.4,33.5)	99.9	11.03	<0.001	Random model	0.529	0.076	
Hubei Province									0.473
No	14.8	(13.4,16.1)	-	21.66	<0.001	Fixed model	-	-	
Unclear	25.3	(21.0,29.5)	99.9	11.61	<0.001	Random model	0.785	0.065	
Early stage of the epidemic									0.552
Yes	17.2	(12.7,21.6)	98.3	7.55	<0.001	Random model	0.806	0.874	
No	29.1	(18.1,40.0)	99.5	5.21	<0.001	Random model	0.348	0.013	
Unclear	25.0	(18.6,31.5)	100	7.60	<0.001	Random model	0.640	0.206	
Medical related majors									0.866
Yes	22.1	(16.6,27.6)	-	7.85	<0.001	Fixed model	-	-	
Unclear	24.9	(20.7,29.2)	99.9	11.53	<0.001	Random model	1.000	0.065	

Chinese college students had higher anxiety levels in the study of more female survey participants and the middle and late periods of the pandemic. Similarly, anxiety was different when using different measurement tools. For instance, when measuring with Depression, Anxiety, and Stress Scale - 21 Items, anxiety prevalence was higher (35.5%).

There are two reasons why Chinese college students experienced a relatively high number of anxiety symptoms during the COVID-19 pandemic. The first reason is that during the COVID-19 pandemic, home isolation was used as a preventative tactic. However, the mass quarantine had numerous detrimental impacts on college students' mental health, including anxiety, depression, and alcohol addiction (Ahmed et al., 2020).

In home quarantine, parents and children spend more time together, which may have increased conflicts (e.g., sleep time, eating habits, etc.) and lead to parent-child tension, thereby making college students accumulate negative emotions and increase psychological stress (Qi, 2020; Xu et al., 2022). On the other hand, because people can only receive information through media, for example, the Internet and increased anxiety can decrease people's ability to distinguish the truthfulness of news reports, making them less able to better distinguish fake news, which increases their anxiety even more. It has been shown that news media during the COVID-19 pandemic can affect anxiety symptoms (Escolà-Gascón et al., 2021), but this variable was not taken into account in this study. Future studies could consider adding this factor. To lessen anxiety about the pandemic in this regard, mental health practitioners

adviseencouraging healthy habits and minimizing exposure to unpleasant news (Banerjee, 2020).

The second reason is on the learning side. The home quarantine prevents college students from returning to school and allows them to attend classes online, but online classes do not provide the same environment as live teaching, nor do they provide opportunities for peer interaction and social support. These may contribute to the onset of anxiety symptoms (Guessoum et al., 2020; Chen et al., 2022). In addition, after Chinese college students return to campus, most college campuses continue to be closed, and college students are deprived of their original peer experiences, which has important implications for the emotional and psychological health development of adolescents (Gruber J et al., 2020).

Similar to earlier research, women were more likely than men to experience anxiety during the epidemic (Selcuk et al., 2020; Zhou et al., 2021). Even before the pandemic, women had a greater frequency of anxiety problems than men did (Kessler, 2003). During the COVID-19 epidemic, anxiety symptoms were three times more common than in males (Wang et al., 2020). According to certain researchers, women are more prone than men to consider COVID-19 as a threat to their own health as well as the health of the broader public and to perceive coronaviruses as a hazard to both (Pérez-Fuentes et al., 2020). All of this is connected to anxiety levels that are higher.

According to other research in the literature, anxiety symptoms were found less frequently in the current study among medical students than
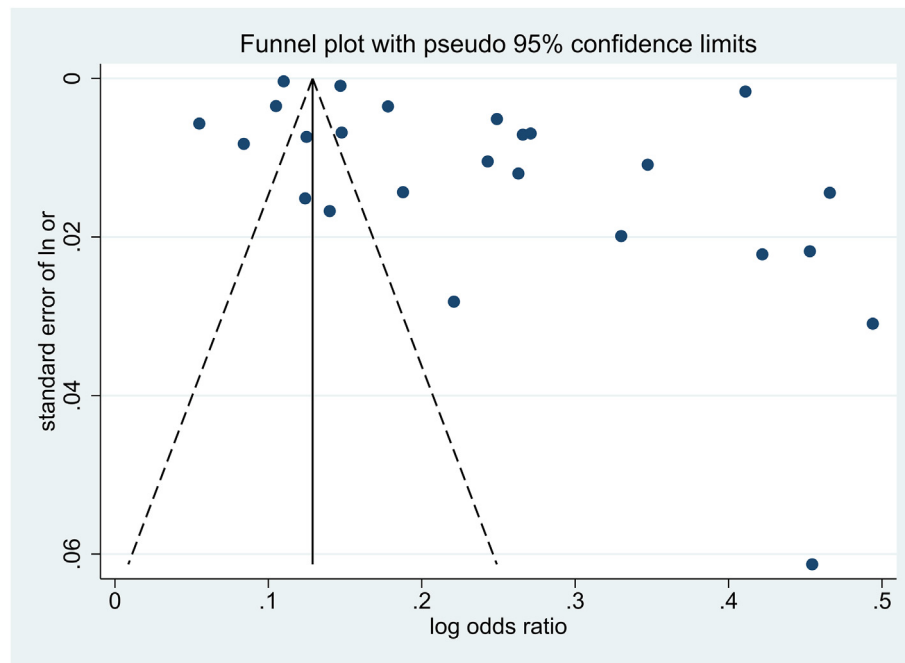
Figure 3. Funnel plot of publication bias among the 25 included studies

among non-medical students during the pandemic (Woon et al., 2021). The professional learning experience of medical students allows them to reduce unnecessary worry and panic when faced with a major pandemic, which is consistent with the idea that knowledge of pandemic prevention can increase confidence and lessen the likelihood of anxiety (Gao et al., 2020).

In the final phases of the epidemic in China, college students' anxiety levels are greater. Due to the pandemic, Chinese college students are only allowed to enroll in online courses towards the conclusion of the winter break, which interferes with their regular studies, exams, and graduation festivities.; the inability to come and go freely after returning to school due to closed administration also affects college students' anxiety levels (Wu et al., 2021b).

In exploring the source of heterogeneity through meta-regression, this study found that the most potential possible source of heterogeneity was whether the investigated group was within or outside China and whether graduate students were involved or otherwise.

4.2. Findings from the subgroup analysis

This study found that medical college students' levels of anxiety were lower than the prevalence of comprehensive anxiety symptoms among college students. Medical students are knowledgeable in both the professional and medical fields and are well-versed in disease information. They can differentiate between information and have access to additional information outlets. Therefore, they tend to be optimistic and confident about the pandemic (Chang et al., 2020b; Xiong et al., 2021).

In studies with more female respondents, anxiety symptoms were higher. Women tend to experience stronger negative emotions than men, and it is more challenging to regulate negative emotions; this gender difference is based on cranial nerves. Therefore, women are more likely to feel anxiety symptoms (Mcrae et al., 2008; Yuan et al., 2010; Zhou et al., 2019).

When using the DASS-21 Anxiety Scale for measurement, most studies used 7 points as the cutoff value. Chinese people are less likely to express their own emotional experiences (Clara et al., 2001), and the anxiety subscale of DASS-21 emphasizes more on the physiological response caused by anxiety, which is more in line with the expression

habits in the Chinese cultural context, and therefore has a higher detection rate of anxiety (Gong et al., 2010).

4.3. Limitations

First, since this study mainly included observational studies, it found that the included articles could have publication bias through the funnel chart. Second, there may still be other unexplained characteristics associated with the incidence of anxiety symptoms because the subgroup analysis maintained a high degree of variability within each study stratum.

Such heterogeneity indicates that it is necessary to apply a widely accepted anxiety state assessment and a representative sample of Chinese undergraduates during the COVID-19 pandemic to further conduct rigorously designed studies to produce reliable estimates. Third, the survey sample of overseas students was small (n = 261), and only one research participant involved overseas Chinese students, making them under-represented. Since the sample size of abroad students was insufficient to fulfill the standards of meta-analysis, more surveys of overseas students can be considered in the future, it would be necessary to investigate the anxiety of overseas students in the future. The fourth point is that as this study was selected from Chinese university students, the conclusions drawn from this study should be generalized with caution to other countries and cultures. Future research could consider participants from different countries and cultures and explore how the findings vary between countries.

4.4. Implications and conclusions

This study found that a quarter of Chinese universities live with anxiety symptoms. An individual's mental health mental health is significantly impacted by anxiety, which is a common symptom of mental health issues. Given the high prevalence of anxiety among college students, mental health services for this population are necessary, which include timely psychological counseling, corresponding evaluations, and complementary treatments. We should also focus on mental health issues among key populations. The staff who directly contact college students, including school psychological counselors and mental health counselors,

should promptly provide psychological support services to college students. After the pandemic, college students' mental health needs monitoring and screening following the epidemic.

Declarations

Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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