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Prevalence of anxiety symptom anddepressive symptom among college students during COVID-19 pandemic: A meta-analysis

Huiwen Jiang[1], Linghui Li[1], and Hongzhong Si[2]

[1] Qingdao University School of Mathematics and Statistics.

[2] State Key Laboratory of Bio-Fibers and Eco-Textiles, Shandong Collaborative Innovation Center of Marine Biobased Fiber and Ecological Textile, Qingdao University, Qingdao, 266071, PR China

Abstract: **The global pandemic of COVID-19 has brought huge changes to people's lifestyles, postgraduates have also been affected seriously. Evidence about these significant changes indicated that graduate students were more prone to feel anxious and depressed due to the pressure of scientific research. To derive a precise assessment of the prevalence of anxiety symptom and depressive symptom among graduate students worldwide, we conducted this meta-analysis. Based on the guidance of PRISMA, literature was searched in Pubmed, Web of Science, CNKI, and Wanfang database (last search February 23, 2022). These articles after the screening were analyzed by a random-effects model to estimate the pooled prevalence of anxiety symptom and depressive symptom. Also, subgroup analysis, sensitivity analysis, and publication bias were performed in this meta-analysis.**

Keywords: postgraduates; meta-analysis; anxious; depressive; COVID-19

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*Corresponding Author: Linghui Li

1. Introduction

Novel coronavirus (SARS-COV-2) was discovered due to the unexplained viral pneumonia case in Wuhan, Hubei Province in December, 2019. On February 8, 2020, the National Health and Health Commission named it Corona Virus Disease 2019, or COVID-19 for short [25]. As the COVID-19 epidemic is spreading in the world, it not only threatens people's lives, but also brings great psychological pressure. There is a high concentration of teaching staff on campus, involving a large number of people. For the purpose of epidemic prevention and control, all schools have taken a series of measures, such as closing schools and isolating them, and teaching them remotely [8]. Graduate students are a higher-level group in the education system.On September 22, 2020, the Ministry of Education and Education, the National Development and Reform Commission and the Ministry of Finance jointly issued "the Opinions on Accelerating the Reform and Development of Postgraduate Education in the New Era", which proposed postgraduate education shoulders the important mission of cultivating high-level talents and creating innovation, is an important cornerstone of national development and social progress, and is the basic layout to cope with global talent competition [68]. Graduate students not only shoulder the mission of national scientific and technological innovation and academic innovation, but also make great contributions to the development of enterprises [19]. So we should pay more attention to the development and mental health of graduate students. Due to the influence of the COVID-19 epidemic, the anxiety and depression of graduate students, who already have great research pressure and internship pressure, are not optimistic [22]. Many countries have investigated the prevalence and influencing factors of mental health problems such as anxiety and depression of college students [13][35][53][69]. There was a meta-analysis on the prevalence of anxiety and depression among COVID-19 patients, which showed that the prevalence of this group of people was increased [4][6]. However, there is no research to investigate the prevalence of anxiety and depression among graduate students, and they are also greatly affected by the epidemic. In order to better understand the mental health status of graduate students during the COVID-19 epidemic, a meta-analysis was conducted to understand the prevalence of anxiety and depression among graduate students. Moreover, because medical postgraduates are faced with more internship pressure and research pressure than non-medical postgraduates, in order to better study the anxiety and depression of medical postgraduates and non-medical postgraduates under the influence of COVID-19 epidemic, the research objects are divided into medical postgraduates and non-medical postgraduates [27].

2. Method

We conducted this systematic review and meta-analysis in accordance with the Cochrane Handbook for Systematic Reviews of Interventions [20] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [45] framework. And We conducted this meta-analysis under the PRISMA [46] guidelines to estimate the prevalence of anxiety symptom and depressive symptom among graduate students during the COVID-19 pandemic.

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3. Literature search

On February 23, 2022, we searched four electronic databases with three related languages. Two Chinese databases are China National Knowledge Internet(CNKI) and Wanfang database, and two English databases are Web of Science and PubMed. These three terms are (coronavirus OR novel coronavirus OR COVID-19) and (graduated OR graduated students OR postgraduate) and (mental health OR depression OR anxiety). See appendix for detailed search strategy. The publication time of the search is limited from 2020 to February 2022. In addition to the database searches, we hand-searched the reference sections of previous reviews identified from the database search for relevant studies.

Inclusion and exclusion criteria

Inclusion criteria Studies satisfying the following criteria were Included in our systematic review: (1) Graduate students whose courses, internships and scientific research are affected by the COVID-19 epidemic; (2) The study contains descriptions of anxiety symptoms or depression symptoms or both. Exclusion criteria are: (1) Graduate students with mental illness; (2) There is no standard assessment tool for anxiety and depression symptoms, only self-report and self-made questionnaire; (3) The sample size is less than 50; (4) lack of sufficient data for basic analysis.

We have no restrictions on the language or country of origin of publications, nor on the age of inclusion of research subjects. We will sort out all the inquired studies and delete the duplicate data. Then, two reviewers will conduct the audit according to the audit standards respectively, and if there are differences, the third reviewer will be consulted to help judge. Figure1 shows the PRISMA flow diagram [37] of our study identification and selection process.

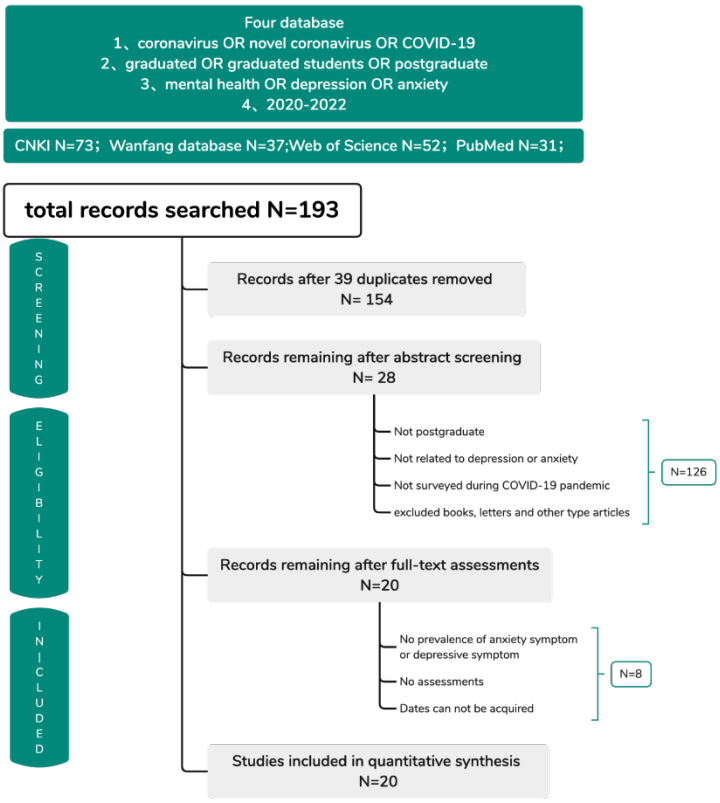

Figure 1. Flow chart of the progress of acquiring the qualified literature and studies included in the meta-analysis.

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4. Data extraction

Data extraction was completed by two reviewers independently and in duplicate. We used a standardized data extraction form developed a priori. The data extraction form included the following items: (1) author names, (2) study title, (3) publication date, (4) digital object identifier, (5) country of origin, (6)study design, (7)sample size, (8)questionnaire response rate, (9) patient demographics(i.e., gender), (10) screening tools and cutoff values used to identify psychiatric disorders, (11) outcome measures, and(12) relevant subgroup data. For a longitudinal study in our meta-analysis, we chose the prevalence surveyed during the COVID- 19 pandemic. Disagreements were resolved by recruiting a third author to review the data. For some studies lacking data, we tried to contact the corresponding authors to gain the data we need.

5. Outcomes and measures

The main outcomes in this systematic review were the prevalence of depression and anxiety, as assessed using clinical interviews or self- and clinician-rated screening questionnaires. Patients exhibiting depressive or anxious symptoms, such as hyperventilation, irritability, or fatigue, but were not assessed using interviews and questionnaires were not included in the analysis.

To comply with quarantine requirements and social distancing guidelines, a majority of patients were assessed using self-rated electronic questionnaires, including Zung Self-Rating Depression Scale (SDS) [71], Zung Self-Rating Anxiety Scale (SAS) [70], General Anxiety Disorder 7-item scale (GAD-7) [58], Patient Health Questionnaire depression module-9 (PHQ-9) [34], Depression Anxiety and Stress Scales (DASS-21) [49], and Symptom Checklist-90 (SCL-90) [7].

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6. Quality assessment

The quality of the literature included in our meta-analysis was assessed by using a modified version of the Newcastle-Ottawa Quality Assessment Scale (NOS) which is suitable for cross-sectional studies [44], and it is similar in format to the scale used in previous meta-analyses [52]. Given that we aimed to know the prevalence of anxiety symptom and depressive symptom, the studies included were all single-arm observational studies, we removed irrelevant sections of the NOS, such as comparability and assessment of the outcome. After removing the irrelevant sections of NOS, there were five dimensions needed to evaluate the quality of the included studies. Those five dimensions were as follows: 1) represent: students were selected by using random sampling; 2) sample size: population > 200 was identified as a qualified sample; 3) response: the rate of response was beyond 80%; 4) valid assessment: appropriate tools to evaluate anxiety symptom and depressive symptom; and 5) valid statistical methods: correct and clear statistic methods to describe their data. We used green to indicate that the research meets the requirement of the corresponding dimension. The total quality score ranged between 0 and5; studies scoring ≥ 3 points were regarded to have a low risk of bias, while studies with < 3 points were regarded to have a high risk of bias (Deng et al., 2021)[6].

7. Statistical analysis

We conducted all statistical analyses using R4.1.2(https://www.r-project.org/), and random-effects meta-analyses were performed using the meta5.2-0 library (https://cran.r-project.org/web/packages/meta/) [15]. To avoid variance instability when the prevalence trends toward 0% or 100% and to prevent confidence intervals (CIs) from extending beyond 0% and 100%, it is necessary to convert the prevalence rate. We compared five conversion methods, namely untransformed proportions, Log transformation, Logit transformation, Arcsine transformation and Freeman-Tukey Double arcsine transformation [1]. According to the comparison results, we transformed the extracted prevalence values using the Arcsine transformation method for prevalence pooling [1][38]. We then converted the results back to prevalence values with 95% CIs for ease of interpretation.The sensitivity analysis was performed to evaluate the robustness and reliability of the pooled prevalence. The Cochran's Q-test, with a significance level of $P < 0.10$, was used to assess the presence of heterogeneity, as recommended by the Cochrane Handbook. We further quantified heterogeneity using I2 statistics [20][21]. An I2value ≥ 75% was considered to indicate serious heterogeneity as recommended by the Cochrane Handbook.

8. Subgroup analyses

We performed subgroup analyses by different screening tools and cutoff values, country, types of research objects, the severity of depression and anxiety, and publication time. Through subgroup analysis, the differences of prevalence rates among different countries, publication time, whether the investigated subjects are medical students and postgraduates and different evaluation tools were studied.

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9. Sensitivity analyses

We performed sensitivity analyses by subtracting each study and calculating the pooled prevalence and I2 of the remaining studies, in order to identify studies that may severely affect the pooled prevalence or heterogeneity.

10. Publication bias

We examined the presence of small study effects as an indication for publication bias using funnel plots and Egger's regression tests [2][12][41][59].

11. Literature screening

Overall, 193 articles were retrieved in four electronic databases and imported into the software Endnote. After removing 39 duplications, 154 articles were screened by two researchers. By reading the titles and abstracts, 126 articles were eliminated due to these researches' population is not about postgraduate group or researches' purpose is not related to anxiety symptom and depressive symptom or researches were not surveyed during the COVID- 19 pandemic.Because some studies did not report the prevalence of anxiety symptom or depressive symptom, and some other studies did not assess the prevalence through generally accepted scales, and even relevant data were not provided in a few studies, 8 articles were eliminated and 20 articles were finally included in the meta-analysis (Figure1).

Table 1. The characteristics of 20 studies.

Study	Country	Study design	Response rate (%)	Survey time	Sample size (N)	Female (%)	Anxiety symptom	Depressive symptom
Liang Zhengyan et al. Liang et al. (2021)	China	cs	93.4	20210207	3137/2829	2465	SAS Mild: 50-59 Moderate: 60-69 Severe: > 69	SDS Mild: 53-61 Moderate: 72-71 Severe: > 72
Imran N et al. Imran et al. (2021)	Pakistan	cs	88.6	20200415-202005	10178	5776	GAD- 7 Mild: 5-9 Moderate: 10- 14 Severe: 15-21	PHQ- 9 Mild: 5-9 Moderate: 10 - 14 Severe: 15-27
Sultana R et al. Sultana et al. (2020)	Pakistan	cs	99.25	20200727-20200807	268	264	DASS-21 Mild: 8-9 Moderate: 10- 19 Severe: > 20	DASS- 21 Mild: 10-13 Moderate: 14-27 Severe: > 27
Das A et al. Das et al. (2020)	India	cs	–	20200523-20200606	188	–	–	PHQ- 9 Mild: 5-9 Moderate: 10 - 14 Severe: 15-27
Ghogare A S et al. Ghogare et al. (2021)	India	cs	–	20200415-20200424	195	140	DASS-21 Mild: 8-9 Moderate: 10- 19 Severe: > 20	DASS- 21 Mild: 10-13 Moderate: 14-27 Severe: > 27

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Carr E et al. Carr et al. (2022)	UK	cs	20	20200415-20200510	484	345	GAD-7 Mild: 5-9 Moderate: 10-14 Severe: 15-21	PHQ-9 Mild: 5-9 Mild: 5-9 Severe: 15-27
Wang Jintao et al. Jintao et al. (2021)	China	cs	–	20201228	2829	–	DASS-21 Mild: 8-9 Moderate: 10-19 Severe: >20	DASS-21 Mild: 10-13 Moderate: 14-27 Severe: >27
Li Huiyan et al. Huiyan et al. (2021b)	China	cs	93.30	20210621-20200622	1336	700	SAS Mild: 50-59 Moderate: 60-69 Severe: >69	SDS Mild: 50-59 Moderate: 60-69 Severe: >69
Kang Derong et al. Derong et al. (2021b)	China	cs	–	–	2829	–	SAS Mild: 50-59 Moderate: 60-69 Severe: >69	SDS Mild: 50-59 Moderate: 60-69 Severe: >69
Chen Huarui et al. Huarui et al. (2020)	China	cs	–	202002	795	452	GAD-7 Mild: 5-9 Moderate: 10-14 Severe: 15-21	PHQ-9 Mild: 5-9 Moderate: 10-14 Severe: 15-27
Liang Yifan et al. Yifan et al. (2020)	China	cs	97.18	–	793	420	SCL-90 Mild: 2-3 Moderate: 3-4 Severe: >=4	SCL-90 Mild: 2-3 Moderate: 3-4 Severe: >=4
Wang Hui et al. Hui, Qilan, Hong, Zhen, et al. (2020)	China	cs	95.71	202002	871	630	SCL-90 Mild: 2-3 Moderate: 3-4 Severe: >=4	SCL-90 Mild: 2-3 Moderate: 3-4 Severe: >=4
Wang JianfengJianfeng (2020)	China	cs	–	20200410-20200426	187	–	SAS Mild: 50-59 Moderate: 60-69 Severe: >69	SDS Mild: 53-61 Moderate: 72-71 Severe: >72
Li Jawen et alJawen and Lengran (2021)	China	cs	96.3	–	360	150	SCL-90>2	SCL-90>2
Wang Menyao et alMenyao et al. (2020)	China	cs	–	20200224—20200307	131	82	–	SDS Mild: 53-61 Moderate: 72-71 Severe: >72

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Zhao Wanjun et alWanjun et al. (2021)	China	97.2	202012	486	234	SAS Mild: 50-59 Moderate: 60-69 Severe: >69	–
Xu Xin et alXin et al. (2021)	China	–	–	643	373	SAS Mild: 50-59 Moderate: 60-69 Severe: >69	SDS Mild: 0.5-0.59 Moderate: 0.6-0.69 Severe: >0.69
Ma Mingsheng et alMingsheng et al. (2021)	China	–	–	303	–	GAD-7 Mild: 5-9 Moderate: 10-14 Severe: 15-21	PHQ-9 Mild: 5-9 Moderate: 10-14 Severe: 15-27
Dong Hao et alHao et al. (2020)	China	100	20200120-20200220	162	110	SAS>=50	SDS>=53
Li Xiu et alXiu et al. (2020)	China	88.36	20200207-20200211	501	–	SAS Mild: 15-25 Moderate: 26-35 Severe: >36	–

12. Study characteristics

Table 1 shows the overall characteristics of the 20 included studies with 24161 patients in our analysis.Fifteen (75%)studies were conducted in China, and the remaining five studies were, respectively, conducted in Pakistan [29][61], India [5][17] and UK [3]. All studies were cross-sectional studies.The median number of participants with valid responses rate across the included studies was 93.4% (range 20-100 %). All the college students were surveyed online from 2020 to 2022, respectively. Since the surveys investigated college students who were at a similar age, we did not extract the information about mean age and standard deviation. For the assessment of anxiety symptom, four studies used the GAD-7 [39][58], eight studies used SAS [51][70], three studies used DASS-21 [49] and three studies used SCL-90 [7] to assess anxiety symptom. For the assessment of depressive symptom, five studies used PHQ-9 [34], three studies used DASS-21, seven studies used SDS [72] and SCL-90 was used in the other three studies.

13. Quality of included studies

Figure2 shows the NOS of the included studies. The median NOS was 4 (range 2-5). Two (10%) studies had a high risk of bias (quality score < 3), and 18 (90%) studies had a low risk of bias (quality score ≥ 3). While a majority of the studies employed appropriate statistical methods, used validated screening tools, and had low nonrespondent rates, very few studies justified their choice of sample size or used random sampling.

14. The pooled prevalence of anxiety

14.1 Overall analysis

Seventeen of the total studies reported the condition of anxiety symptom among these postgraduates, the pooled prevalence of anxiety symptom of 17 studies (N = 23,655) was 27.9% (95% CI: 27.3-28.4%) using the common effect model and 24.6% (95% CI:14.7-36%) using the random effects model.Moreover, it was highly heterogeneous (I2 = 99%, p < 0.001) (Figure3).

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Study	Represent	Sample size	Response	Valid assessment	Valid Statistical methods	Overall score
Liang Zhengyan et al.	■	■	■	■	■	5
Imran N et al.		■	■	■	■	4
Sultana R et al.		■	■	■	■	4
Das A et al.						2
Ghogare A S et al.	■			■	■	3
Carr E et al.	■	■		■	■	4
Wang Jintao et al.		■		■	■	3
Li Huiyan et al.		■	■	■	■	4
Kang Derong et al.	■	■		■	■	4
Chen Huarui et al.		■		■	■	3
Liang Yifan et al.		■	■	■	■	4
Wang Hui et al.		■	■	■	■	4
Wang Jianfeng et al.				■	■	2
Li Jawen et al.	■	■	■	■	■	5
Wang Menyao et al.	■			■	■	3
Zhao Wanjun et al.		■	■	■	■	4
Xu Xin et al.		■		■	■	3
Ma Mingsheng et al.		■		■	■	3
Dong Hao et al.			■	■	■	3
Li Xiu et al.		■	■	■	■	4

Figure 2. Quality rating of included studies using the modified Newcastle-Ottawa Scale.

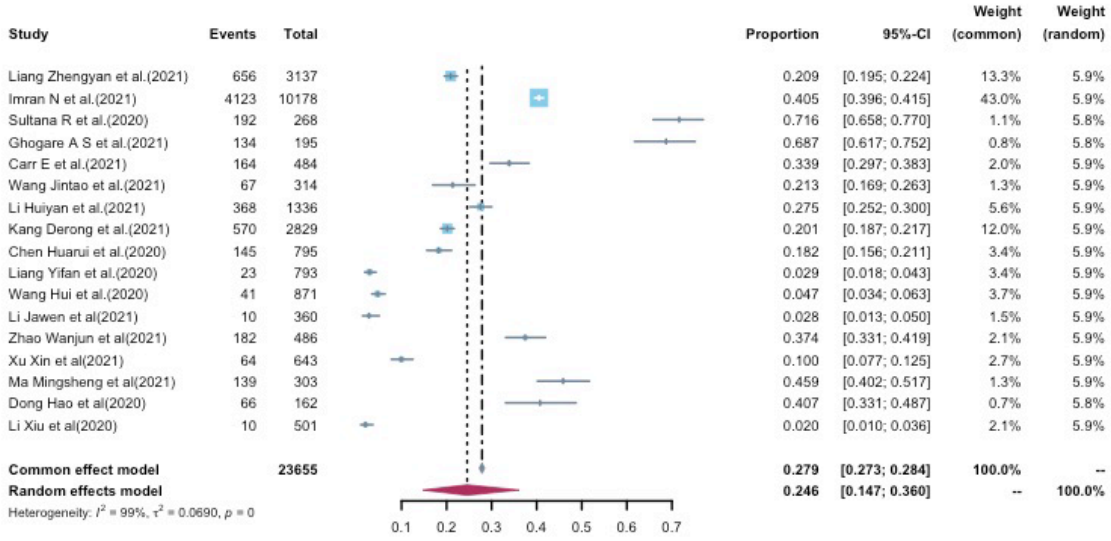

Figure 3. The pooled prevalence of anxiety symptom.

14.2Sensitivity analysis

The results of the sensitivity analysis showed that the pooled anxiety symptom did not change significantly after excluding any study, the meta-analysis was considered to be stable (Figure4). The maximum change in prevalence from omitting a study was 3%.

14.3Publication bias

Studies with a small sample size have a large number and low precision,and are distributed symmetrically at the bottom of the leaky graph;studies with a large sample size have high precision,and are distributed at the top of the leaky graph and concentrated in the middle.Using a leaky plot,you can directly observe whether the estimated effect size of the original study is related to its sample size.However,when there is publication bias,it is manifested as an asymmetric leakage map,which is skewed.The scattered distribution on both sides of and the funnel diagram is shown in Figureis symmetrical,and there is no skewness distribution.No publication bias about anxiety symptom was indicated by Egger's regression test(p=0.7487).

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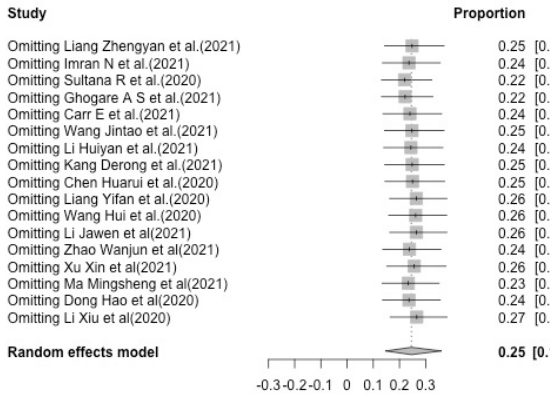

Figure 4. The sensitivity analysis of the pooled anxiety symptoms.

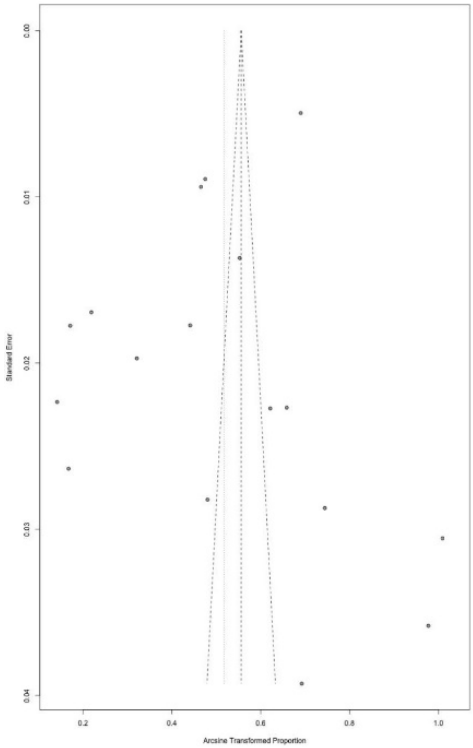

Figure 5. This is funnel diagram of the pooled anxiety symptoms

15. The pooled prevalence of depression

15.1Overall analysis

Seventeen of the total studies reported the condition of depressive symptom among these postgraduates,the pooled prevalence of anxiety symptom of 18 studies(N=23,174)was 36%(95%CI:35.3-36.6%)using the common effect model and 29.8%(95%CI:21.4-38.9%)using the random effects model.Moreover,it was highly heterogeneous(I2=99%,p<0.001)(Figure).

15.2Sensitivity analysis

The results of the sensitivity analysis showed that the pooled depressive symptom did not change significantly after excluding any study,the meta-analysis was considered to be stable(Figure).The maximum change in prevalence from omitting a study was 2%.

15.3Publication bias

No publication bias about depressive symptom was indicated by Egger's regression test(p=0.4678).And the funnel diagram is shown in Figure.

15.4Subgroup analysis

Results of the subgroup analysis of the prevalence of depression,anxiety,and sleep disturbances by assessment tool,country,object type,and publication time are summarized in Table.

15.5Assessment tool

According to the result of subgroup analysis by four assessment tools of anxiety symptom,the pooled prevalence of anxiety symptom with 7 studies used SAS was 20.6%(95%CI:10.5-33.1%)and with 3 studies used DASS-21 was 53.6%(95%CI:21.8-83.9%)using the random effects model with high heterogeneity(I2=99%,p<0.01)(see Figure.S1,online only).Based on the result of subgroup analysis by four assessment tools of depressive symptom,the pooled prevalence of depressive symptom with 3 studies used DASS-21 was 42.4%(95%CI:17.1-70.2%)using the random effects model with high heterogeneity(I2=99%,p<0.01)(see Figure.S2,online only).

15.6Country

For subgroup analysis by different countries,the lowest prevalence of anxiety symptom was observed in Chinese postgraduates among which 17%(95%CI:9.4-26.2%)were detected with anxiety symptoms,and the highest was found in Indian postgraduates among which 68.7%(95%CI:61.7-75.2%)were detected with anxiety symptoms(see Figure.S3,online only),the lowest prevalence of depressive symptom surveyed was in Chinese postgraduates among

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which 22.6%(95%CI:15.4-30.7%)were detected with depressive symptoms,and the highest was Pakistan postgraduates among which 56.4%(95%CI:36-75.7%)were detected with depressive symptoms(see Figure.S4,online only).

15.7Object type

For subgroup analysis by object type, the prevalence of anxiety symptom among non-medical graduate students (24.3%) is about the same as that of medical graduate students (24.7%) using the random effects model(see Figure. S5, online only), however, the prevalence of depressive symptom among medical graduate students(32.8%) was higher than non-medical graduate students (26.2%)(see Figure. S6, online only).

15.8Publication time

For subgroup analysis by different publication times,the pooled prevalence of anxiety symptom with 11 studies in 2020 was 27.7%(95%CI:13.6-44.4%)and with 6 studies in 2021 was 19.3%(95%CI:8.6-32.9%)(see Figure.S7,online only).Moreover,the pooled prevalence of depressive symptom with 12 studies in 2020 was 30.9%(95%CI:19.7-43.3%)and with 6 studies in 2021 was 27.7%(95%CI:15.8-41.5%)(see Figure.S8,online only).

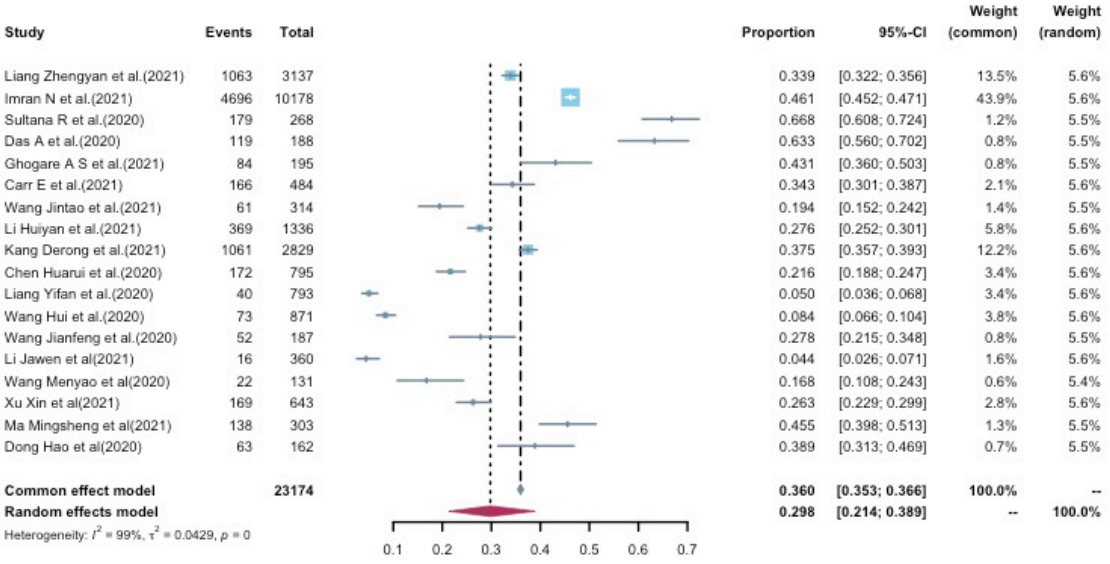

Figure 6. The pooled prevalence of depressive symptom.

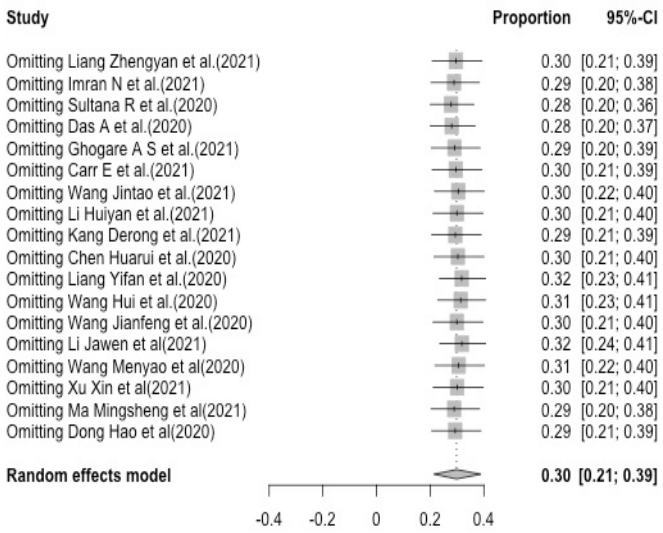

Figure 7. The sensitivity analysis of the pooled depressive symptoms.

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16. Discussion

16.1Comprehensive analysis

To our knowledge,this is the first meta-analys is to explore the prevalence of anxiety symptom and depressive symptom among postgraduates worldwide during the COVID-19 pandemic.Our results showed that the overall prevalence of anxiety and depression disturbances among COVID-19 postgraduates is 24.6%(95%CI:14.7-36%) and 29.8%(95%CI:21.4-38.9%)respectively using the random effects model.Compared with another meta-analysis paper on the influence of COVID-19 on college students'mental health [53],the poor prevention of anxiety symptom was 31%(95%CI:23-39%)and the pooled prevalence of depressive symptom was 34%(95%CI:27-41%).Dodd et al.'s research [11] shows that younger students(≤23 years old)are more affected by COVID-19 than older students(>24 years old).Our research result is consistent with the previous research results,and the ability of graduate students to withstand stress and resolve anxiety is better than that of undergraduate students.

Compared with the psychological anxiety and depression of graduate students before COVID-19 [63] ,the poor prevention of anxiety symptom was 20%and the pooled prevalence of depressive symptom was 34%.Although graduate students have better psychological endurance than undergraduates,they will also be affected by the epidemic.Graduate students,especially doctoral students,are under great pressure in scientific research,and their anxiety is rather serious.They can't experiment in a closed environment,and the research progress is slow,which aggravates students'psychological problems.Studies have shown that the decrease of face-to-face social interaction [56][57] and exercise time [16][40][50][54] could increase the risk of anxiety and depression and that the longer students stared at the screen,the higher risk of anxiety and depression [14]. During the pandemic COVID-19, the closed management of graduate students can't communicate with each other and exercise,and they can't avoid spending a lot of time watching computers while studying online.These reasons will increase the anxiety and depression of graduate students.

16.2Interpretation of subgroup analyses

We found that the assessment tools used for assessing depression and anxiety had a significant effect on the resultant prevalence values.The prevalence of anxiety symptom and depressive symptom of SCL-90(anxiety symptom prevalence:3.5%,depressive symptom prevalence:5.9%)were both the lowest.This may be related to the cutoff selected by different assessment tools.This study found that the prevalence of anxiety symptom and depressive symptom among graduate students in different countries were various from each other.The prevalence of anxiety symptom of Indian postgraduates was the highest,and the prevalence of depressive symptom of Pakistan students was the highest,while the prevalence of anxiety symptom and depressive symptom of Chinese graduate students were both the lowest.There may be two reasons for this situation.The first one is given that a majority of the included studies were rapidly conducted and disseminated during the early phases of the pandemic,the research objects were often limited to those who were easily accessible by the investigators via convenience sampling.As a result,we found that a majority of the studies were limited to Chinese postgraduates.Our subgroup results for postgraduates originating from UK,India and Pakistan were based on single studies.The second on is although China was the first outbreak site of the COVID-19 [23], the spread of the pandemic was well controlled,there were few confirmed cases around the students,that is,the risk of infection was relatively low.The prevalence of anxiety symptom was related to the condition of the pandemic,the countries with better COVID-19 control had a lower prevalence [66].

Our subgroup analyses by object type showed that the prevalence of anxiety symptom and depressive symptom of medical postgraduates were higher then non-medical postgraduates [48].The reason for the higher tendency of medical postgraduates to suffer from anxiety and depression may be that the pressure of study and practice faced by medical postgraduates is often higher than that of non-medical postgraduates,and some medical postgraduates are in the front line of anti-epidemic,which is also a great challenge to their psychological endurance.

Our subgroup analyses by publication time showed that the prevalence of anxiety symptom and depressive symptom of 2021 were lower then 2020.Another cross-country comparative study showed that the lower confidence in controlling their country's pandemic,the higher level of anxiety among students in the country [55].With the relief of epidemic situation and the deepening of graduate students'understanding of epidemic situation,the anxiety and depression of graduate students in 2021 is obviously better than that in 2020.

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16.3Study strengths and limitations

The limitations of our study must be noted in order to better interpret our findings.First,we observed significant between-study heterogeneity that was not resolved by our proposed subgroup analyses and sensitivity analyses.Second,all but two of our included studies used self-rating scales for assessing the prevalence of mental health.While this was likely due to local quarantine guidelines,self-rated scales generally have lower sensitivity and specificity compared with clinician/observer-rated scales [47] or structured clinical interviews(e.g.,the Structured Clinical Interview for DSM-5)[60].Thus,our results should be considered with this limitation in mind and future studies should incorporate clinicianrated tools or interviews,perhaps with the assistance of telemedicine technologies [10][33].Third,included studies were all cross-sectional studies,which could not prove the causation between the COVID-19 pandemic and the increased prevalence of anxiety symptom and depressive symptom among college students.Fourth,the response rates were less than 80%or no description in half included studies which may lead to selection bias.Finally,most of the research subjects are graduate students from China,and the subgroup analysis may also cause deviation.However,the above limitations would not affect our meta-analysis on the prevalence of anxiety symptom and depressive symptom.Though some studies with a low response rate,the sample size was quite large.

However,this study also has several notable strengths.First,we did not detect signs of publication bias as shown by funnel plots and Egger's regression analysis.Second,our results were not substantially affected by the omission of one included study,nor were they greatly affected by the removal of preprint articles or single-arm cohort studies.Third,Totally,our study included 24,161 graduate students.It was quite a large sample for our meta-analysis to figure out the pooled prevalence of anxiety symptom and depressive symptom among graduate students worldwide.Fourth,Since the inclusion criteria of our meta-analysis were studies that must have authoritative and acknowledged scales for estimating anxiety symptom and depressive symptom,and excluded those random self-reporting studies,the scales were all with high reliability and validity,which made our evaluation of the prevalence of anxiety symptom and depressive symptom more accurate and reliable.Finally,although the heterogeneity is relatively high,it is necessary to conduct this meta-analysis during the special period,it can reflect the approximate prevalence of anxiety symptom and depressive symptom worldwide,and describe a general impression of what kind of situation the graduate students stayed in,with so high prevalence during the pandemic,measures should be taken to help graduate students go through such hardship.

17. Conclusion

The objective of this systematic review and meta analysis was to assess the prevalence of depression and anxiety among graduate students affected by COVID-19.The results of our analysis suggest that the pooled prevalence of anxiety symptom was 27.9%,and the pooled prevalence of depressive symptom was 36%.Graduate students in India and Pakistan have significantly higher levels of anxiety and depression than China,and the degree of anxiety and depression of medical graduate students is also higher than that of non-medical graduate students.The anxiety and depression of graduate students in 2021,when the epidemic situation is moderate,is better than that of graduate students in 2020.To better understand the prevalence of anxiety symptom and depressive symptom among graduate students around the world,future studies can use a standard and reliable questionnaire to conduct surveys reasonably sampled from the world.At the same time,we should pay more attention to the anxiety and depression of the epidemic areas and medical postgraduates,and take effective measures.

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