Mental Health Problems and Educational Guidance of Medical Students After the Outbreak of COVID-19: A Meta-analysis

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Abstract. The outbreak of COVID-19 has had a significant influence on medical students, which resulted in various psychological health problems. To provide the basis for mental health education, we conducted this meta-analysis to accurately assess the global prevalence of mental health problems among medical students during the COVID-19 pandemic. Based on the guidance of PRISMA, 3219 articles were searched in CNKI, CQVIP, PubMed, Web of Science, and EBSCO. 10 articles were finally included in the statistical analysis after filtering by the article selection criteria. All data analysis were performed by Stata software, and a random effect model was used to combine correlation coefficient. A sensitivity analysis, publication bias, meta-regression, and subgroup analysis were also conducted in our analysis. In conclusion, the pooled prevalence of anxiety, stress, and depression symptoms among these medical students was 31% (95%CI: 20%–41%), 27% (95%CI: 1%–53%) and 36% (95%CI: 15%–58%), respectively. The results of our analysis suggested that the prevalence of depression symptom in medical students increased during the COVID-19 pandemic and was higher than that in students with different majors. And it is necessary and urgent to screen the depression symptom of medical students and take appropriate intervention measures.

Keywords: The COVID-19 pandemic · Medical student · Anxiety · Depression · Stress · Meta-analysis

1 Introduction

IN December 2019, the coronavirus disease 2019 (COVID-19) was first discovered in Wuhan, China. It has become a worldwide pandemic which caused 437, 333, 859 confirmed cases and 5,960,972 confirmed deaths in the world until February 26, 2022, and a total of 10, 585, 766, 316 vaccine doses have been administered [1]. So far, there have been over 70 novel Coronavirus variants worldwide, the daily rate of infection has also reached a new peak. As we know, every sudden public health event is a severe challenge to the physical and mental health of people. Facing the spread of the epidemic, people are prone to obvious stress responses, which impacts their work, study and life [2]. College students are in an essential phase of rapid physical and mental development

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and changes, complex and changeable emotional reactions, gradual formation of self-awareness and social role transformation [3]. Affected by the epidemic, the colleges and universities worldwide were closed, and students were isolated and studied online at home. These changes have had a significant impact on the physical and mental health of students [4, 5].

Before the COVID-19 outbreak, medical students have shown to have higher rates of mental health problems than other students [6, 7], because they need to face the long-term heavy academic pressure, high-intensive internships, complicated interpersonal relationship, and uncertainty about their future careers [8], and most of the stress comes from the academic burden. During the COVID-19 pandemic, medical students who staying at home or backing to school are prone to psychological problems due to pressure from study, clinical train and employment. So, it is of great significance to evaluate their psychological state and formulate effective intervention measures.

Many studies have reported the prevalence of mental health such as anxiety, depression and suicide among medical students during the COVID-19 epidemic. Other studies have also conducted a meta-analysis of the pooled prevalence of anxiety and depression symptoms among medical students during the pandemic [9]. However, no meta-analysis investigated the pooled prevalence of stress symptom among medical students. To better understand the psychological health of medical students during the COVID-19 pandemic, we conducted a systematic review and meta-analysis of studies to understand the prevalence of anxiety, stress, and depression symptoms in medical students.

2 Methods

The meta-analysis was carried out according to the PRISMA guidelines [10] to estimate the prevalence of anxiety, stress, and depression symptoms among medical students in the post-pandemic era.

2.1 Search Strategy

Two researchers searched for all relevant cross-sectional studies after June, 2020, via CNKI, CQVIP, PubMed, Web of Science and EBSCO. The search strategy was on the basis of three key terms, which was (Coronavirus OR novel coronavirus OR COVID-19) and (medical students OR medical-related students) and (depression OR anxiety OR stress). The detailed search strategy would be shown in the supplement. No language restriction was made. Additional potential studies also be detected from Baidu, Google, and references of selected articles. This search was updated on January 1, 2020. Any differences were resolved through discussion with a third researcher.

2.2 Selection Criteria

Duplications were excluded firstly. With filtering the titles, abstracts and full article of the literature, studies were included if: 1) it is a cross-sectional study after June 1, 2020; 2) they were focused on the medical or medical-related students; 3) the study contained the prevalence of anxiety, stress, or depression symptoms; 4) the full-text was available;

studies were excluded if: 1) the medical students had mental illness already; 2) the anxiety, stress, or depression symptoms were assessed with a homemade questionnaire, but were not a standard assessment tool; 3) the article lack of sufficient data for primary analysis; 4) it was not focusing on medical students; 5)it was review articles.

2.3 Data Extraction and Quality Assessment

The data was extracted by three researchers. First, the data was extracted independently by two researchers using a pre-designed data extraction form.

The form used to extract the useful data including the following information: 1) the first author of the study; 2) the country of the study; 3) sampling methods; 4) response rate; 5) survey time; 6) sample size; 7) the percentage of females; 8) the assessment tools; 9) relevant subgroup data; 10) the prevalence of anxiety, stress, and depression symptoms.

Articles included were evaluated by two independent reviewers. The assessment tool used to appraise the quality of each study was from The Agency for Healthcare Research and Quality for Cross-Sectional/Prevalence Study [11]. Quality was assessed by 11 criteria, each with a score of 0 or 1. If the result of the study on the question is positive, then one score is awarded for each criterion. The tool assesses the studies for their source of information, inclusion and exclusion criteria, study timeframe, continuity of sample, appropriateness of sample selection, quality assurance assessments, sample exclusion reasons, confounding factor assessment, missing data handle, response rates and completeness of data collection, and presence of follow-ups.

Any differences were resolved through discussion with a third researcher.

2.4 Statistical Analysis

Statistical analyses were performed with STATA statistical software (version 16).

The I^2 test was used to test the percentage of variation across the included studies, which is due to heterogeneity rather than chance. The higher the ratio, the higher the level of heterogeneity [12, 13]. For meta-analysis, a fixed effects model ($I^2 < 50\%$, $P < 0.1$) was used when the heterogeneity was relatively low between studies. In contract, a random effects model ($I^2 \geq 50\%$, $P < 0.1$) was used when the heterogeneity was substantial. If heterogeneity was still high after using the random effects model, the causes for the heterogeneity were studied. $P < 0.05$ was used to determine statistical significance [8].

In this review, the overall prevalence of each study and the standard error (SE) of the overall prevalence was calculated. The pooled prevalence of all included studies was obtained by the inverse variance method, including the weighted averages using the SE mentioned above. The corresponding P-values and 95% confidence intervals (95% CI) were also reported. Meanwhile, a sensitivity analysis was performed by excluding each study individually and rerunning the meta-analysis to test the stability of the pooled prevalence of stress, anxiety, and depression symptoms. Publication bias was detected through a funnel plot and Egger's tests [14] ($P < 0.05$ indicate publication bias). Finally, the meta-regression and subgroup analyses were conducted to explore the sources of

heterogeneity in meta-analysis. The differences in research methods, demographic characteristics, or geographical location could led to high heterogeneity of the included studies.

3 Results

3.1 Results of the Search

Figure 1 is a flow chart which shows the literature retrieval strategy and the research selection process. Overall, 3219 articles were searched in five databases, and no studies were obtained from other sources. A total of 3219 articles were imported into the software Endnote. After removing 370 duplications, two researchers screened the rest 2,849 articles. By filtering the abstract and title, 2769 articles were eliminated for the following reasons:1)it was not meeting inclusion criteria; 2) it was a survey study; 3) the abstracts were unavailable. Through reading the full text, eighty articles were further screened. However, the full text of some studies was not available, the survey time of some studies did not meet our requirement, and some other studies did not have validated assessment tools. Ten articles (Xu 2021 [15], Guo 2021 [16], Adhikari 2021 [17], Chalise 2021 [18], Marcen-Roman 2021 [19], Mekhemar 2021 [20], Mishra 2021 [21], Natalia 2021 [22], Physiology 2020 [23], Soltan 2021 [24]) were finally included in the meta-analysis.

3.2 Characteristics of the Studies Included

Table 1 summarizes the characteristics of the ten included studies. All included studies were cross-sectional studies, with the exception of a longitudinal study that examined the mental health of medical students before and after the COVID-19 outbreak [23], and only the second survey which managed the mental health during the COVID-19 pandemic was included for analysis. The ten studies were from eight countries. The male-female ratio was not reported in two studies [16, 22]. All studies were carried out using an online survey, respectively. For the ten identified studies, five studies used the DASS-21 [20–24] to assess anxiety, stress, and depression symptom of medical students simultaneously. In the other five studies, two research teams used PHQ-ADS [18] and GADS [19] to investigate the prevalence of depression and anxiety symptoms respectively, within which one study used PSS-10-C [19] to assess stress symptom. One study in China used SSCS [15] to investigate stress symptom and SAS [15] to anxiety symptom. The rest two studies used GAD-7 [16] to assess anxiety symptom and PHQ-9 [17] to assess depression symptom, respectively. To be specific, these scales are tools for assessing symptoms of anxiety, stress, and depression, not clinical diagnosis.

3.3 Quality Assessment

We assessed the quality of the included studies in our meta-analysis by using an assessment tool from The Agency for Healthcare Research and Quality for Cross-Sectional/Prevalence Study [11] which has eleven questions. The quality scores of the studies ranged from 5 to 8 out of 11, with an average score of 6.7. The most common limitations were: 1) do not explain how missing data were handled in the analysis; 2) some

Table 1. Characteristics of included studies in the meta-analysis

Author (Year)	Country	Survey time	Simple size	Degree	Male: Female	Grade	Response rate	Study design	Stress Assessment	Prevalence of Stress (%)	Depression Assessment	Prevalence of Depression (%)	Anxiety Assessment	**Prevalence of Anxiety (%)**	**Quality Score**
Xu (2021)	China	September to November 2020	3000	medical	783:2111	1–5	95.50%	Convenient sampling	SSCS	72.20%	--	--	SAS	16.00%	7
Guo (2021)	United States of America	August 2020	929	medical	UNclear	1–4	91.70%	Cluster sampling	--	--	--	--	GAD-7	31.10%	5
Adhikari (2021)	Nepal	August 2020	223	medical	135:88	1–5	UNclear	Convenient sampling	--	--	PHQ-9	23.32%	--	--	7
Chalise (2021)	Nepal	December 2020 to January 2021	315	medical	109:206	1–4	100.00%	Convenient sampling	--	--	PHQ-ADS	18.41%	PHQ-ADS	12.38%	6
Marcén-Román (2021)	Spain	Jan-21	252	nursing, physiotherapy, occupational therapy	46:206	UNclear	UNclear	UNclear	PSS-10-C	13.10%	GADS	80.95%	GADS	71.43%	7
Mekhemar (2021)	Germany	July 2020 to January 2021	211	Dental Students	55:156	UNclear	100.00%	UNclear	DASS-21	15.64%	DASS-21	18.96%	DASS-21	14.22%	7
Mishra (2021)	India	September to October 2020	728	medical, nursing, dental	165:423	UNclear	80.77%	UNclear	DASS-21	3.57%	DASS-21	12.76%	DASS-21	17.52%	7

(*continued*)

Table 1. (*continued*)

Author (Year)	Country	Survey time	Simple size	Degree	Male: Female	Grade	Response rate	Study design	Stress Assessment	Prevalence of Stress (%)	Depression Assessment	Prevalence of Depression (%)	Anxiety Assessment	**Prevalence of Anxiety (%)**	**Quality Score**
Natalia (2021)	Indonesia	Jul-20	1027	medical	UNclear	UNclear	UNclear	UNclear	DASS-21	20.50%	DASS-21	UNclear	DASS-21	UNclear	7
Saraswathi 2020	India	Jun-20	269	medical	78: 139	1–5.5	80.67%	UNclear	DASS-21	11.52%	DASS-21	23.96%	DASS-21	26.73%	8
Soltan (2021)	Egypt	May to June 2020	282	medical	101:181	1–6	100.00%	UNclear	DASS-21	52.84%	DASS-21	75.18%	DASS-21	56.38%	6

SSCS: College Student Stress Scale; SAS: Self-rating Anxiety Scale; GAD-7: Seven-item General Anxiety Disorder Scale; PHQ-9: The Patient Health Questionnaire; PHQ-ADS: The Patient Health Questionnaire-Anxiety and Depression Scale; GADS: The Goldberg Abbreviated Anxiety and Depression Scale; PSS-10-C: The modified PSS-10 version related to COVID-19; DASS-21: Twenty one-item Depression Anxiety Stress Scale.

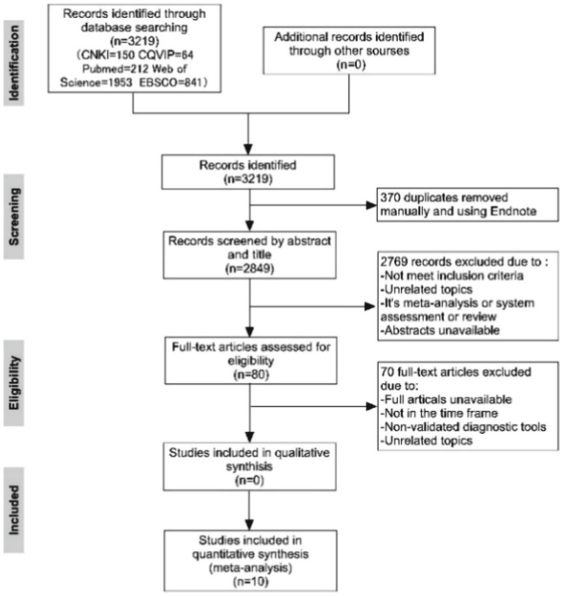

Fig. 1. The research selection process

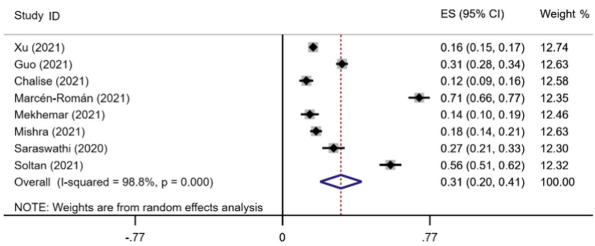

Fig. 2. The pooled prevalence of anxiety symptom

studies do not summarize patient response rates and completeness of data collection; 3) all the studies do not have follow-up;

3.4 Meta-analysis of the Prevalence of Anxiety, Stress, and Depression Symptoms

The anxiety symptom was reported in nine of the included studies, and the pooled prevalence of anxiety symptom was 31% (95% CI: 20%-41%) with high heterogeneity ($I^2 = 98.8\%$, $p < 0.001$) (Fig. 2). The pooled prevalence of stress symptom among these medical students was 27% (95% CI: 1%-53%), with significant heterogeneity between seven of the included studies ($I^2 = 99.9\%$, $p < 0.001$) (Fig. 3). Eight of the included studies surveyed the depression symptom, and the pooled prevalence of depression symptom was 36% (95% CI: 15%-58%) with high heterogeneity ($I^2 = 99.4\%$, $p < 0.001$) (Fig. 4).

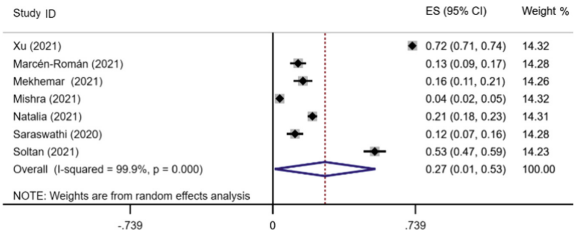

Fig. 3. The pooled prevalence of stress symptom

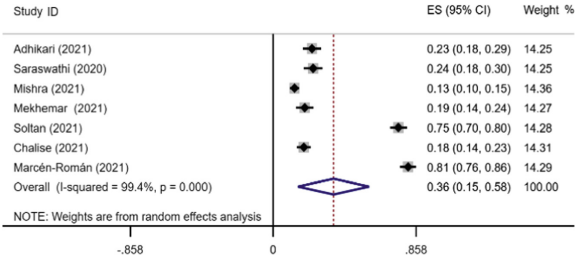

Fig. 4. The pooled prevalence of depression symptom

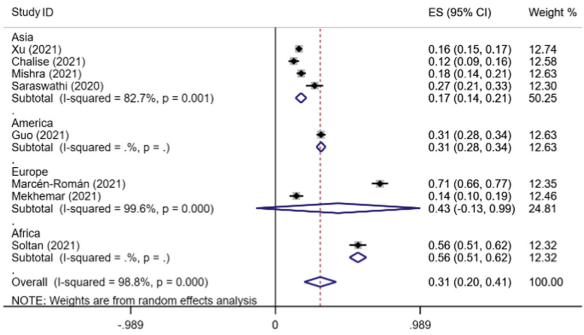

Fig. 5. Subgroup analysis based on the region for estimating anxiety symptom

3.5 Subgroup Analysis

In the subgroup analysis by regions, Asian students had the lowest prevalence of anxiety symptom (17%), while African students had the highest prevalence of anxiety symptom (56%) (Fig. 5). The lowest prevalence of stress symptom was in European students, among which 14% were detected, and the highest was also African students with a rate of 53% (Fig. 6). The lowest prevalence of depression symptom was 19% which was observed in Asian students, and the highest was also in African students with 75% were discovered (Fig. 7). Therefore, the mental health status of African medical students deserves great attention and positive measures should be taken.

Based on the subgroup analysis of the assessment tool, the pooled prevalence of anxiety, stress, and depression symptoms with five studies used DASS-21 was 29% (I^2

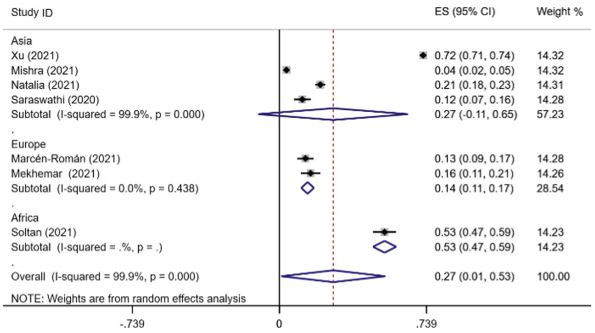

Fig. 6. Subgroup analysis based on the region for estimating stress symptom

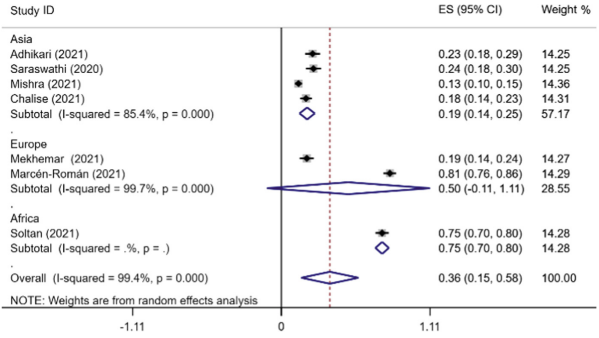

Fig. 7. Subgroup analysis based on the region for estimating depression symptom

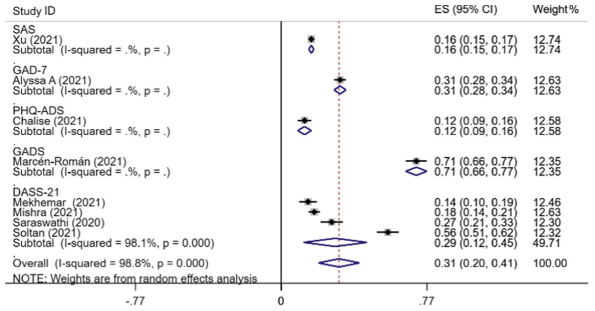

Fig. 8. Subgroup analysis based on assessment tools for estimating anxiety symptom

$= 98.1\%$, $p < 0.001$) (Fig. 8), 21% ($I^2 = 98.9\%$, $p < 0.001$) (Fig. 9) and 33% ($I^2 = 99.4\%$, $p < 0.001$) (Fig. 10), respectively. So different assessment tools might not the main source of high heterogeneity.

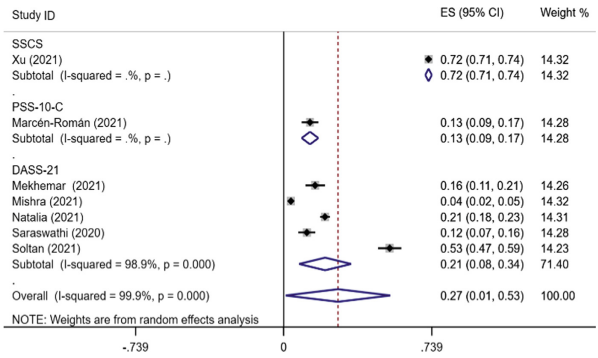

Fig. 9. Subgroup analysis based on assessment tools for estimating stress symptom

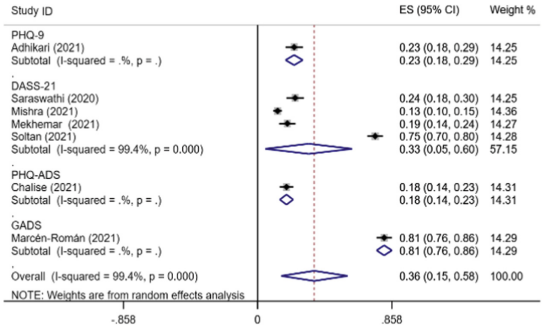

Fig. 10. Subgroup analysis based on assessment tools for estimating depression symptom

3.6 Sensitivity Analysis

Removing each study from the analysis and rerunning the meta-analysis did not substantially change the pooled prevalence of anxiety, stress, and depression symptoms. All of the options had a very high heterogeneity, and the result of the I^2 test was higher than 80%. This suggests that no single study had an inappropriate impact on the pooled prevalence. The meta-analysis was considered to be stable.

3.7 Publication Bias

Visual inspection of the funnel plot (Fig. 11) suggested no presence of publication bias in the estimated prevalence, which was confirmed by non-significant Egger's test results. The p values of Egger's regression test of anxiety, stress, and depression symptoms were 0.814, 0.095 and 0.279 respectively.

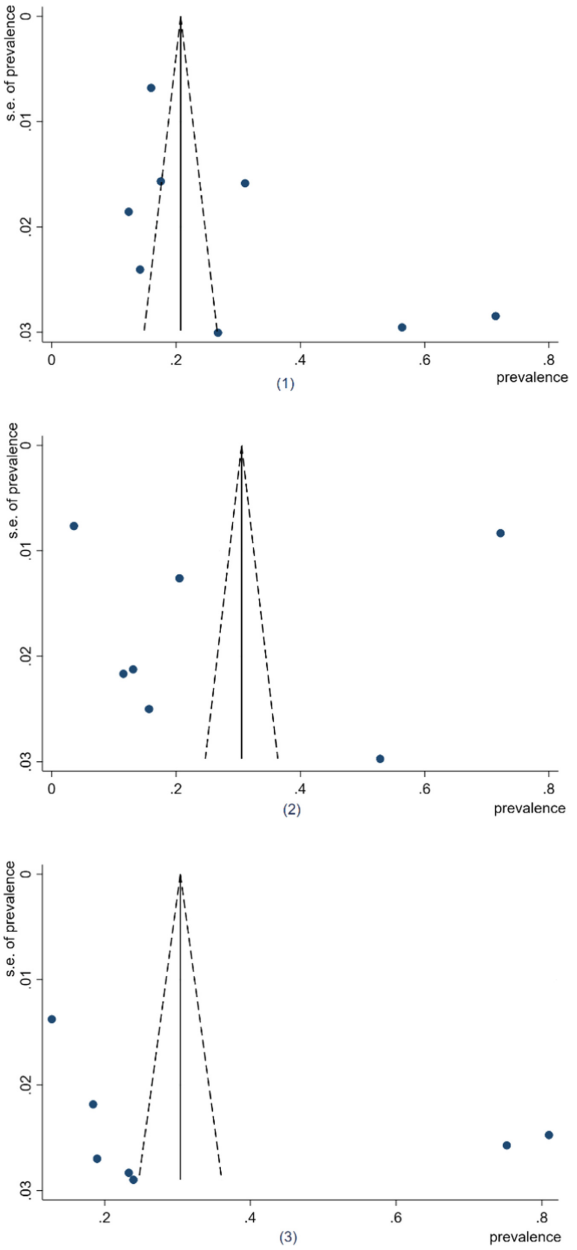

Fig. 11. (1) Funnel plot assessing the prevalence of anxiety among medical students. s.e = standard error (2) Funnel plot assessing the prevalence of stress among medical students. s.e = standard error (3) Funnel plot assessing the prevalence of depression among medical students. s.e = standard error

4 Discussion

4.1 Main Findings

This study presents a meta-analysis to explore the global prevalence of anxiety, stress, and depression symptoms among medical students during the COVID-19 pandemic. Our results found that the pooled prevalence of anxiety, stress, and depression symptoms is 31% (95%CI: 20%–41%), 27% (95% CI: 1%–53%), and 36% (95% CI: 15%–58%), respectively. Students from different regions underwent different levels of mental health problems. Except for the prevalence of stress symptom, the lowest prevalence of anxiety and depression symptoms were observed in the Asian medical students. The highest prevalence of anxiety, stress, and depression symptoms were detected in African medical students. And we could also find that the source of heterogeneity between studies possibly was not from the assessment tools.

4.2 Comparison with Previous Epidemiological Data

From the previous studies, medical students from different countries had a different level of anxiety, but all show higher level of anxiety compared to their peer group [25]. Before the COVID-19 outbreak, the global prevalence rate of anxiety among medical students was 33.8% (95% CI: 29.2–38.7%) [26]. However, the pooled prevalence of anxiety symptom during the COVID-19 outbreak was 31% (95% CI: 20%–41%) in our study. Lasheras's study [9] also reported that an estimated prevalence of anxiety symptom was 28% (95% CI: 22–34%) in medical students during the COVID-19 epidemic. Therefore, the global prevalence of anxiety symptom after the COVID-19 outbreak was slightly lower than that before. And for the college students, the rate of anxiety during the COVID-19 epidemic was 31% (95% CI: 23–39%) [27] which was the same as the result that we have identified here. Hence, the prevalence of anxiety symptom among medical students might not be significantly different from that of other students.

Meanwhile, our study is the first to systematically analysis the stress level in medical students during the pandemic. Before the COVID-19 outbreak, the pooled prevalence of stress was 40.9% from medical students in Brazil [28]. The stress level of the clinical-year students in a Saudi medical school from 2011–2012 is 64.9% [29]. It was relatively higher than our result with the pooled prevalence of 27% (95% CI: 1%-53%) during the COVID-19 pandemic. And in college students, another result in China also showed a higher prevalence of stress. Students with moderate to severe pressure (PSS-10 $\geq$ 14) accounted for 67.50% under COVID-19 [30].

Based on a previous study, the global prevalence of depression symptom among medical students was 28.0% (95%CI, 24.2%-32.1%) before the year 2019 [30]. Our results suggested that the rate of depression (36%, with 95% CI: 15%-58%) in the medical students could be slightly higher during the COVID-19 outbreak. And the pooled prevalence of depression symptom was 34% among general college students during the epidemic time in another meta-analysis [26]. Therefore, the prevalence of depression symptoms was slightly higher among medical students than that among non-medical students during the pandemic time.

4.3 Reasons for High Heterogeneity

4.3.1 Time

Growing evidence supports a strong link between the COVID-19 pandemic and mental health [15–24]. We could see the data from the WHO, which was updated on March 1, 2022, the situation of the pandemic varied by region and countries [1]. The survey time in our included studies was between June 2020 to January 2021. Within that time, the smoothed new cases per 1M population rapidly grew in the United States of America and Spain. Meanwhile, Spain medical students hold a high level of anxiety (71.38%) and depression (80.95%), the United States of America medical students also had a high prevalence of anxiety (31.1%). And we all know that China quickly brought the epidemic under control after the outbreak [31]. One study said that once the pandemic is well controlled, people can go back to their normal lives, which could also help to reduce the risk of mental health [19]. This kind of situation may help Chinese medical students staying a lower level of anxiety symptom (16%). It's also worth noting that college students in China returned to school gradually after June, 2020. One study also reveals that anxiety, impetuous mood, interest decline and other problems are relatively apparent in the college students who returning school during the COVID-19 outbreak [32]. Many college students feel pressure for the closed school management during the epidemic period [33]. It also might lead to higher pressure in Chinese college students. So, one of the reasons for high heterogeneity might be the different levels of the epidemic outbreak at one time, and the mental health of medical students varies at various stages of epidemic development.

4.3.2 Culture Background and Education System

It's interesting that a result of a previous meta-analysis about the global prevalence of anxiety in medical students before the COVID-19 outbreak also has a high heterogeneity with a rate of 33.8% (95% CI:29.2–38.7%) [26]. According to one study [34], cultural differences affect the threshold and tendency of people to report distress or depression symptoms, and western countries tend to have more biased responses when reporting depression symptoms due to social expectations and favorable self-presentation. The results from Fan, C [35] also showed a significant ethnic difference among different cultures in attitudes towards mental illness and awareness of mental health services. Hence, the cultural background might be one of the reasons for high heterogeneity.

As we all know, one of the most prominent compulsory education problems in China today is too much homework on students and too high parental expectations, which result in heavy academic burden on students [36]. The overburdened education model may lead to higher levels of stress in Chinese medical students, and the same problem also exists in other Asian countries [37]. In contrast, the Western countries do not impose the same obligation to excel academically as Asian countries do [38]. Therefore, educational background has a certain influence on the mental health of medical students.

Medical school leaders must consider the unique socio-cultural and educational system background when developing strategies to solve the mental health of medical students.

4.4 Association Between Mental Health and COVID-19 Relevant Factors

It was found that the severity of anxiety and depression in medical students was negatively correlated with emotional stability and positively correlated with stress susceptibility [39]. In our study, we discussed anxiety, stress, depression together.

As we know, medical students in school need to face the long-term heavy academic burden, high-intensity internships, complicated interpersonal relationships, and uncertainty regarding their future careers [8], and these might be one of the factors of high pressure before the COVID-19 outbreak. It found that anxiety negatively correlated with the academic satisfaction of medical students [40]. The cultivation mechanism makes medical students vulnerable to have the symptom of depression and anxiety [41]. It was possible that staying at home and learning online might had eased the burden of educational programs, and helped the students to adjust their mental state. Thus, the stress and anxiety symptoms among medical students reflected a reduction during the pandemic time. Meanwhile, mental resilience is a protective factor of anxiety and depression symptoms in medical students [14]. In the post-epidemic period, the epidemic is under control as a whole in China, and continuously fighting against the virus has become the new normal [31]. Psychological resilience can help medical students effectively cope with the continuous stress and relieve anxiety symptoms. This also could contribute in turn to a reduction in their stress and anxiety during COVID-19 pandemic.

However, medical students, like other students, were not avoid spending significant amounts of time using computers while studying online during the COVID-19 pandemic. A high prevalence of smartphone addiction has also been observed at that time, with impaired daily behavior and mental health of medical students [42]. Studies have also shown that staying at home and decreasing face-to-face communication and physical exercise could increase the risk of anxiety and depression [43]. Many medical students also worried about delaying in scientific research, clinical practice and job hunting when staying at home. And others felt that they had a lower efficiency of study at home due to irregular life [44]. All of this might result in a relatively higher level of depression symptom among medical students during the COVID-19 outbreak. The above negative factors will hurt the mental health of medical students if not eliminated.

In comparison with their peers, medical students could find more practical ways to get official sources of information. They also had a more profound understanding of the prognosis and transmission of COVID-19, a broader knowledge of the disease because of medical background [45]. So, they were less likely to be misled by sensational misinforming news reported in unofficial channels. And having a greater awareness of the disease might help the medical students to prevent themselves from the epidemic and increase their sense of security. Another study also indicated that medical students showed greater compliance in avoiding contact with symptomatic person, as well as a reduce in social visits, attendance of crowded places and use of public facilities [46]. Compared with non-medical students, these could help medical students to have less mental pressure on the epidemic, and maintain a relatively comparable degree of anxiety symptom.

5 Strengths and Limitations

Because this meta-analysis was carried out using data from the COVID-19 pandemic, it has several notable limitations. Firstly, all of our included studies were a cross-sectional or longitudinal study in design, so this study could not have a dynamic analysis of mental health problems among medical students; Secondly, the heterogeneity of the included studies and subgroup analysis was relatively high in our meta-analysis. We just analyzed the reasons from epidemic severity, different cultural and education background; there were many factors such as gender, sample size and profession that were not synthesized in this present meta-analysis. Thirdly, the lack of data in our subgroup analysis led to the unbalanced distribution of covariates, and the high heterogeneity within the subgroup reduced the effectiveness of our subgroup analysis.

However, this study also has several strengths. Firstly, in the previous meta-analyses, the prevalence of anxiety and depression symptom were the most commonly research direction of mental health among medical students during the COVID-19 pandemic, and our study was the first to explore the prevalence of stress symptom together. Secondly, our results were not substantially affected by our sensitivity analyses, the meta-analysis was considered to be stable. Thirdly, the assessment tools used to measure mental health problems in the included studies were standard scales with good reliability and validity and were widely used. Lastly, the heterogeneity was very high, but it was essential to conduct this meta-analysis focusing on the medical students. It reflected the pooled prevalence of mental health problems worldwide which could rise the attention of the university, and they could take actions to help medical students go through such hardship.

6 Conclusions

In summary, the results of our meta-analysis showed that the pooled prevalence of anxiety, stress, and depression symptoms was 31%, 27% and 36%, respectively. Medical students have a relatively higher prevalence of depression, but a lower prevalence of stress than students with different majors during the COVID-19 outbreak. In comparison with the time before the COVID-19 epidemic, the overall level of anxiety and stress symptoms decreased, and the prevalence of depression symptom appeared to increase among medical students. These findings emphasize the necessity and urgency to provide timely screening and proper intervention in depression problem among medical students.

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