Prevalence of depression among medical students during the COVID-19 pandemic. A systematic review and meta-analysis

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ABSTRACT

Background: Medical students frequently have depressive symptoms. Thus, the psychological impact of COVID-19 on them should be high. Aim: To conduct a systematic review and meta-analysis on the prevalence of depression in medical students during the COVID-19 pandemic. Material and Methods: MEDLINE via PubMed, Embase and Web of Science were searched for studies reporting the prevalence of depression in medical students, published from December 1, 2019 to December 27, 2020. Results: Eleven studies were included, most of them from Asia. The estimated overall prevalence of depression in medical students was 31% (95% CI: 23%-40%), with lower prevalence rates reported in studies from Asia in general, and China in particular. Conclusions: Our findings indicate that the proportion of medical students with depression during the pandemic was high, and comparable with that reported in other university students.
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Key words: COVID-19; Depression; Meta-Analysis; Students, Medical.

Frecuencia de depresión en estudiantes de medicina durante la pandemia COVID-19

Antecedentes: Los estudiantes de medicina muestran altos niveles de síntomas depresivos. Por lo tanto, se espera que el impacto psicológico de COVID-19 en ellos sea alto. Objetivo: Realizar una revisión sistemática y metanálisis de la prevalencia de depresión en estudiantes de medicina durante la pandemia de COVID-19. Material y Métodos: Se realizaron búsquedas en MEDLINE a través de PubMed, Embase y Web of Science para obtener estudios que informaran sobre la prevalencia de la depresión en estudiantes de medicina, publicados del 1 de diciembre de 2019 al 27 de diciembre de 2020. Resultados: Se incluyeron 11 estudios, la mayoría de Asia. La prevalencia general estimada de depresión en estudiantes de medicina fue del 31% (IC del 95%: 23% - 40%), con tasas de prevalencia más bajas informadas en estudios de Asia en general y China en particular. Conclusiones: Nuestros hallazgos indican que la proporción de estudiantes de medicina con depresión durante la pandemia es considerablemente alta y comparable con la informada en otros estudiantes universitarios.
Palabras clave: COVID-19; Depresión; Estudiantes de Medicina; Metaanálisis.

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The COVID-19 disease, was first identified in Wuhan, China, in December 2019[1] and it was officially declared a pandemic by the World Health Organization (WHO) in March 2020[2].

Lockdown and social distancing measures to stop the spread of the disease and the feeling of vulnerability of being infected have had a negative impact on psychological well-being[3,4]. A very recent meta-analysis conducted by the authors reported a prevalence of depression in the general population during the pandemic seven times higher than that reported before the pandemic[5].

The literature has consistently shown that university students tend to be at higher risk of mental health problems[6]. Therefore, the psychological impact of the current pandemic situation on this community is expected to be high. Some studies indicate increased rates of depression among university students during the pandemic, associated with fear of infection, isolation measures, social distancing and restrictions[7,8], academic workload, financial difficulties and difficulties in interpersonal relationships[9].

Within university students, medical students, have reported high rates of depression, suicidal ideation[10,11] and anxiety[12] prior to the pandemic due to long study hours, emotional burden, high workload and considerable financial pressure[13]. During the COVID-19 pandemic, medical students have been reported to show depressive symptoms related to social withdrawal, long hours in front of computer screens and an unhealthy lifestyle. In addition, high pandemic awareness[14] and worry seem to be associated with negative thoughts and behaviours, which in turn might be related to an increased likelihood of mental disorders[15].The present study is aimed to conduct a systematic review and meta-analysis of studies reporting on the prevalence of depression among medical students during the COVID-19 pandemic, as well as to investigate any differences between men and women, countries, and different age groups.

Materials and Methods

This study was conducted in accordance with the PRISMA guidelines for reporting systematic reviews and meta-analysis[16] (Supplementary Table 1).

Search strategy

Two researchers (JBN and MPM) searched for all cross-sectional studies reporting the prevalence of depression published from December 1, 2019 through December 27, 2020, using various databases (MEDLINE via PubMed, Embase and Web of Science). The search strategy is detailed in Supplementary Table 2.

No language restriction was made. References from selected articles were inspected to detect additional potential studies. Then we performed a manual search of the "grey literature" (e.g., medRxiv or Google Scholar) to detect other potentially eligible investigations. Any disagreement was resolved by consensus among a third and fourth reviewers (JS and BO).

Selection criteria

Studies were included if: (1) reported cross-sectional data on the prevalence of depression, or sufficient information to compute this, conducted during the COVID-19 outbreak; (2) focused on medical students; (3) included a validated instrument to assess or diagnose depression; (4) the full text was available.

We excluded studies focusing only on community-based samples of general population or specific samples that were not medical students (e.g., medical professionals, patients), as well as review articles.

A pre-designed data extraction form was used to extract the following information: country, sample size, prevalent rates of depression, proportion of women, average age, instruments used to assess depression, response rate and sampling methods.

Methodological quality assessment

Articles selected for retrieval were assessed by two independent reviewers (JBN and JS) for methodological validity before they were included in the review using the Joanna Briggs Institute (JBI) standardized critical appraisal instrument for prevalence studies[17]. Quality was evaluated according to nine criteria, each yielding a score of zero or one. One score was obtained for each criterion if the study was affirmative in the next questions: 1: Was the sample frame appropriate

Table 1. Description of studies included in meta-analysis

Author (Publication year)	Country	Mean age (SD)	% Females (n)	Sample size (n)	Response rate (%)	Sampling method	Depression assessment	Diagnostic Criteria	Prevalence	Quality assessment %	Quality assessment n
Bolatov et al. (2020)	Kazakhstan	20.31 (NR)	75.69% (604)	798	NR	Convenience sampling	PHQ-9	≥ 10	27.57%	220	7
Elhadi et al. (2020)	Libya	23.30 (2.61)	78.97% (1919)	2430	69.4%	NR	PHQ-9	≥ 10	42.84%	1041	8
Essangri et al. (2020)	Morocco	22 (3)	73.95% (406)	549	NR	Convenience sampling	PHQ-9	≥ 10	45.72%	251	7
Liu et al. (2020)	China	21.7 (1.7)	58.52% (127)	217	NR	Convenience sampling	PHQ-9	≥ 10	11.06%	24	6
Nakhostin-Ansari et al. (2020)	Iran	23.73 (1.62)	52.32% (169)	323	64.6%	Random sampling	BDI-II	≥ 14	27.55%	89	9
Nihmath-Nisha et al. (2020)	India	NR	49.58% (178)	359	NR	Convenience sampling	CES-D	> 10	44.57%	160	7
Nishimura et al. (2020)	Japan	22.0 (3.3)	34.04% (161)	473	66.0%	Convenience sampling	PHQ-9	≥ 10	15.86%	75	8
Saraswathi et al. (2020)	India	20 (1.6)	64.05% (139)	217	90.8%	Convenience sampling	DASS-21	≥ 10	35.48%	77	6
Sartorão-Filho et al. (2020)	Brazil	NR	73.82% (251)	340	98.0%	Convenience sampling	PHQ-9	≥ 10	64.41%	219	8
Vala et al. (2020)	India	NR	56.00% (140)	250	NR	NR	DASS-21	≥ 10	15.60%	39	5
Xiao et al. (2020)	China	NR	NR	620	NR	Convenience sampling	PHQ-9	≥ 10	24.84%	154	7

Note. * Quality score based on the Joanna Briggs Institute (JBI) standardized critical appraisal instrument for prevalence studies (Moola et al., 2017). BDI-II= Beck Depression Inventory; CES-D=Centre for Epidemiology Studies for Depression; DASS-21 = Depression, Anxiety and Stress scales; NR = not reported; PHQ-9 = Patient Health Questionnaire.

to address the target population?; 2: Were study participants recruited in an appropriate way?; 3: Was the sample size adequate?; 4: Were the study subjects and setting described in detail?; 5: Was data analysis conducted with sufficient coverage of the identified sample?; 6: Were valid methods used for the identification of the condition?; 7: Was the condition measured in a standard, reliable way for all participants?; 8: Was there appropriate statistical analysis?; 9: Was the response rate adequate, and if not, was the low response rate managed appropriately?

Any disagreements that arose between the reviewers were resolved through discussions, or by further discussion with a third reviewer (PGG).

Data extraction and statistical analysis

A generic inverse variance method with a random effect model was used[18]. The Hedges Q statistic was reported to check heterogeneity across studies, with statistical significance set at p < 0.10. The I^2 statistic and 95% confidence interval was also used to quantify heterogeneity[19]. Values between 25%-50% are considered as low, 50%-75% as moderate, and 75% or more as high[20]. Heterogeneity of effects between studies occurs when differences in results for the same exposure-disease association cannot be fully explained by sampling variation. Sources of heterogeneity can include differences in study design or in demographic characteristics. We performed meta-regression and subgroup analyses[21] to explore the sources of heterogeneity expected in meta-analyses of observational studies[22]. We conducted a sensitivity analysis to determine the influence of each individual study on the overall result by omitting studies one by one. Publication bias was determined through visual inspection of a funnel plot and also Egger's test[23] (p values < 0.05 indicate publication bias) since funnel plots were found to be an inaccurate method for assessing publication bias in meta-analyses of proportion studies[24].

Statistical analyses were conducted by JS and run with STATA statistical software (version 10.0; College Station, TX, USA) and R[25].

Results

Figure 1 shows the flowchart of the search strategy and study selection process. A total of 486 records were initially identified from Medline via PubMed, Embase and Web of Science, from which 208 duplicates were removed and 157 were excluded after a first screening of the titles and abstracts. Two extra records were then added after a manual search in a preprints database (MedRxiv). After reading the remaining 123 articles in full, we finally included 11 in our meta-analysis [14,15,26–34]all educational institutions in the Republic of Kazakhstan have switched to online learning (OL. Exclusion reasons are detailed in Figure 1.

Most of the studies were carried out in Asia (n = 8), but we also found studies from Africa (n = 2) and South America (n = 1). The sample size ranged from 217 to 2430 participants, and the mean age ranged from 20 to 23.7 years in the 7 studies that reported it. All studies included both men and women, with women predominating in all but two studies that reported this data. All studies were conducted using online questionnaires and, of those reporting the sampling methodology, all except one used non-random methods. The response rate was only reported by 5 studies and ranged from 64.6% to 98%. All studies measured depression using standardized scales, most commonly the Patient Health Questionnaire (PHQ, n = 7 studies) and the Depression, Anxiety, and Stress Scale (DASS, n = 2 studies), with one study using the Beck Depression Inventory (BDI) and another one using the Centre for Epidemiology Studies for Depression (CES-D) scale.

The risk of bias scores ranged from 5 to 9 out of a possible total of 9, with a mean score of 7.1 (SD = 1.1) (Table 1, Supplementary Table 3). The most common limitations were: (a) recruitment of participants not appropriate (10 studies), (b) response rate not reported, or large number of non-responders (6 studies), and (c) sample size too small to ensure good precision of the final estimate (3 studies).

The estimated overall prevalence of depression was 31% in medical students (95% CI: 23%-40%), with significant heterogeneity between studies (Q test: p < 0.001; I^2 = 98.0%) (Figure 2).

The meta-regression models showed that prevalence of depression was independent of the percentage of women (p = 0.844), mean age at baseline (p = 0.419), response rate (p = 0.866), methodological quality (p = 0.240), or sampling methods (p = 0.466). However, significantly
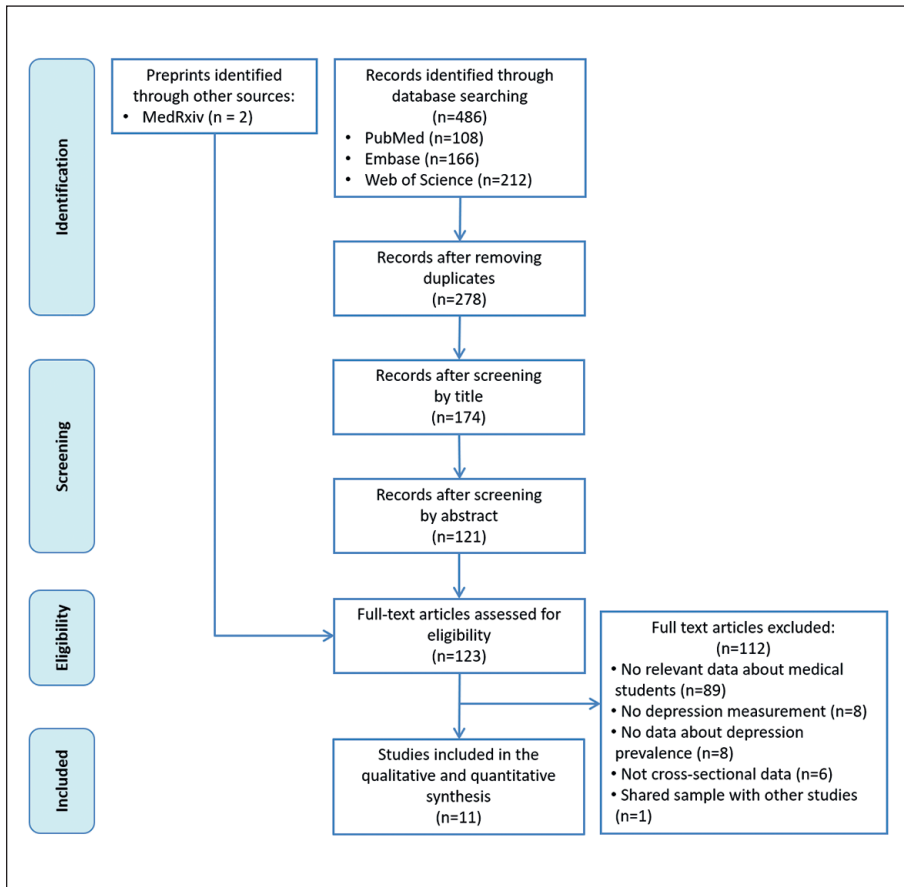
Figure 1. Flowchart of the study selection.
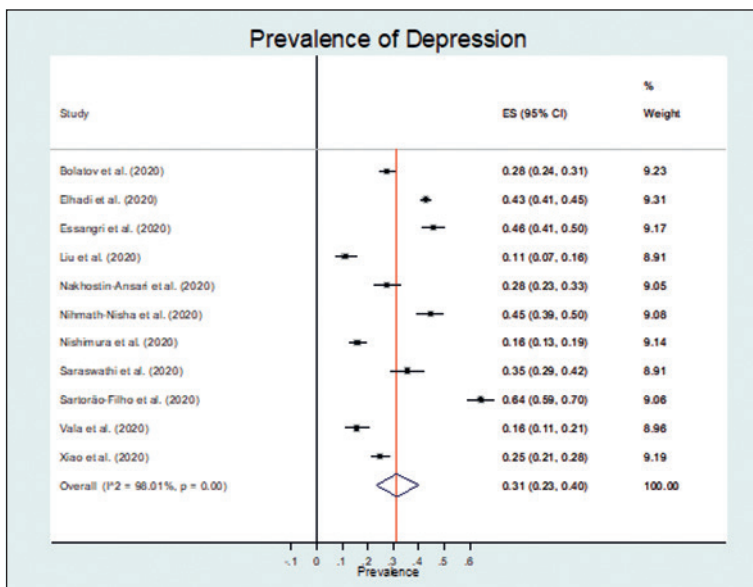
Figure 2. Forest plot for the prevalence of depression among medical students.
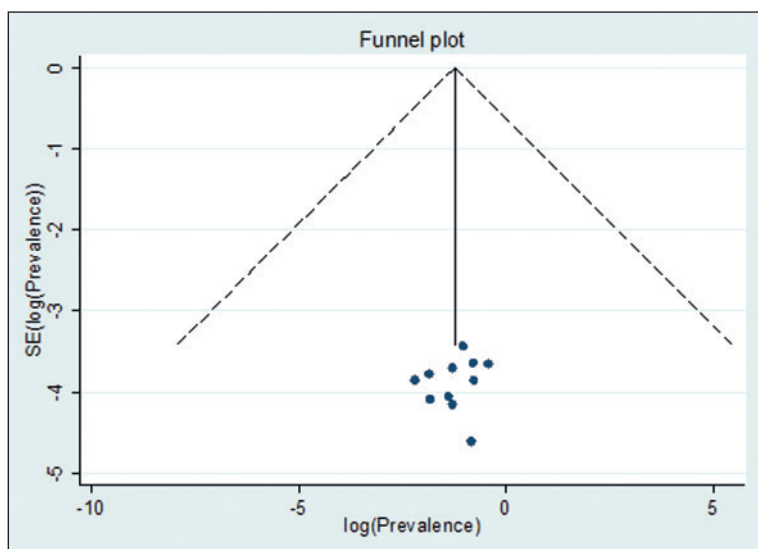
Figure 3. Funnel plot for the prevalence of depression in medical students.

lower prevalence of depression was found for studies located in Asia (25% [95% CI: 18%-38%]) compared to those located in other continents (51% [95% CI: 40%-62%]). In particular, studies conducted in China (21% [IC95%: 18-24%]) showed a lower prevalence of depression compared with studies conducted in other countries (35% [IC95%: 26-44%]). We also observed lower prevalence of depression for studies using the DASS-21 (24% [95% CI: 20%-28%]) compared to those using the PHQ-9 (29% [95% CI: 18%-41%]), although this difference did not reach statistical significance. No comparison with BDI-II or CES-D was performed since only one study using each one was found.

Excluding each study one-by-one from the analysis did not substantially change the pooled prevalence of depression, which varied between 28% (95% CI: 21-36%), with Sartorão-Filho et al.[33] excluded, and 34% (95% CI: 26-42%), with Liu et al.[14] excluded. This indicates that no single study had a disproportional impact on the overall prevalence.

Visual inspection of the funnel plot (Figure 3) suggested no publication bias presence for the estimate of prevalence in medical students, confirmed by non-significant results from the Egger's test ($p = 0.603$).

Discussion

The present study provides an up-to-date meta-analysis of studies reporting the prevalence of depression in medical students during the COVID-19 pandemic. Based on a total of 11 studies, we found an estimated overall prevalence of depression of 31% in this population, relatively high compared to studies conducted with medical students before the pandemic.

Several systematic reviews and meta-analyses on depression levels in medical students prior to the pandemic have shown a prevalence of depression of 28.0% overall in all countries, 26.8% in South America, 30.3 in North America, 31.8% in Middle East, 20% in Europe and 26.8 in South America[13]. Furthermore, in a pre-pandemic study of medical students in Chile, 23% of students were found to have depression symptoms[35]. However, our pooled prevalence is slightly higher compared with the above-mentioned prevalences and with the pooled proportion of 27.2% reported in a meta-analysis with 195 studies from 41 countries[11]. Regarding the prevalence of depression among undergraduate students during the COVID-19 pandemic, it has been found that it could range from 34.2 to 35.5%, similar to the one reported here[36]. Considering the general

population, a recent systematic review with meta-analysis reported a pooled prevalence of depression of 25%[5], lower than the proportion found in this meta-analysis. Thus, our findings would indicate that the COVID-19 pandemic might have a negative impact on mental health in medical students.

Several factors could contribute to this higher prevalence of depression in medical students during the COVID-19 pandemic. For example, the transition to online teaching, long hours in front of screens, lack of social interactions, unhealthy habits[37] and fear of losing the academic year[38]. As for medical students, high-risk ward rotations[39] or direct contact with patients infected with COVID-19 can increase the risk of depression[40,41].

Contrary to what has been found in the general population[42], the analyses of the prevalence of depression according to age and gender did not yielded significant differences. This lack of differences between men and women could be because Medical students are usually younger and with no family responsibilities, whereas these factors are thought to contribute to higher rates of depression in women from the general population[43,44]. As for the age, previous studies have reported higher levels of depression in undergraduate students compared with graduated students during the pandemic, contrary with what we found[45].

It is important to consider that we found significant heterogeneity between studies related to the country where the study was conducted. Lower prevalence rates of depression were reported in Asia (25%), compared to those studies located in other continents (51%). Previous studies have suggested a great variability among college students in terms of depressive symptomatology during the COVID-19 pandemic, with Asian countries reporting the lowest prevalence rates, with a rate of 21.6% in China[7] and 15% in Bangladesh[46]. Conversely, the highest levels of depression were found in the USA whit a rate of 48.1%[47].

The reasons for this finding could be that Asian university students adapt more easily to a setting of less social contact than Western countries. Indeed, several studies suggest that Chinese students have different cultural values in relation to university learning[48-52] being more accustomed to dialectical education[53], in which "there is fragmented,

linear, competency-oriented, authority-centred teaching, with little collaboration, creativity or communication among students"[54] and lecture is the primary teaching method[48,50,55], a methodology easy to maintain during a pandemic situation[56]. In contrast, Western universities are more likely to use dialogic teaching[53] being more oriented towards interactive communication, cooperative tasks and practical application[54,57] being much more difficult to carry out during pandemic.

Strengths and limitations

Some strengths of our meta-analysis are the inclusion of a large body of literature and the use of a rigorous approach to identify publication bias (i.e., Egger's test). These results show that there is no bias in the estimation of the pooled prevalence of depression for medical students. Moreover, to our knowledge, there is no meta-analysis performed so far on depressive symptoms in medical students.

However, some limitations should be considered when interpreting our results due to the biases presented in the grouped estimation of the results. One of the major limitations of the study is the quality of the available literature. Since the systematic review requires previously existing scientific publications, when evaluating any condition during the pandemic using this methodology, there will be a scarce availability of information and a high risk of including literature of moderate-low methodological quality. This is reflected in the high bias score of the papers evaluated. Another important limitation is the external validity of the study. Given that the Revista Médica de Chile is mainly aimed at the Chilean and Latin American public, it is important to make a comparison of the results and their applicability in this population. The study has scarce local data (1 study is from Brazil), which is probably given by the lag of the onset of the pandemic in Latin America with respect to Asia (origin of most of the data).

Also, the fact that most studies are based on self-reporting, with cross-sectional non-probabilistic sampling and the heterogeneity of samples also has an impact on the confidence of the results. This review is a first approximation that will need to be revised as the pandemic progresses.

Conclusions

This meta-analysis shows that the proportion of medical students with depression during the COVID-19 pandemic is considerable having obtained higher data than before the pandemic. However, no differences have been seen in terms of age and gender, but in terms of countries.

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