Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Review Article

Prevalence of anxiety during the COVID-19 pandemic: A systematic review and meta-analysis of over 2 million people

Felipe Mendes Delpino [a,*], Carine Nascimento da Silva [b], Jeferson Santos Jerônimo [d], Eliete Stark Mulling [d], Larissa Leal da Cunha [d], Marina Krause Weymar [d], Ricardo Alt [c], Eduardo L. Caputo [d], Natan Feter [e]

[a] Postgraduate Program in Nursing, Federal University of Pelotas, Rio Grande do Sul, Brazil
[b] Postgraduate Program in Health Sciences, Federal University of Rio Grande, Rio Grande do Sul, Brazil
[c] Postgraduate Program in Epidemiology, Federal University of Pelotas, Rio Grande do Sul, Brazil
[d] Postgraduate Program in Physical Education, Federal University of Pelotas, Rio Grande do Sul, Brazil
[e] Postgraduate Program in Epidemiology, Federal University of Rio Grande do Sul, Rio Grande do Sul, Brazil

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ABSTRACT

Introduction: Uncertainty, disruptions in daily routines, and concerns for the health and well-being during the COVID-19 pandemic are likely associated with increases in generalized anxiety. The present study aimed to systematically review the literature in order to identify the update prevalence of anxiety in the general population during the COVID-19 pandemic.

Methods: A systematic review and meta-analysis. It included studies that assessed the prevalence of anxiety among the general population during the COVID-19 pandemic.

Results: In total, we included 194 studies. The general prevalence of anxiety was 35.1 %, affecting approximately 851,000 participants. The prevalence in low and middle-income countries (35.1 %; 95%CI: 29.5 % to 41.0 %) was similar compared to high-income countries (34.7 %; 95%CI: 29.6 % to 40.1 %). In studies that provided the proportion of cases in each level of anxiety disorder, mild-to-moderate anxiety affected one quarter of the participants. One in ten cases with anxiety during the COVID-19 may be living with severe or extremely anxiety disorder. Most instruments estimated similar prevalence of anxiety disorders with notable difference in the prevalence estimated by the Generalized Anxiety Disorder 2-item (GAD-2), Zung Self-Rating Anxiety Scale (SAS), and State-Trait Anxiety Inventory (STAI).

Conclusion: One in three adults were living with anxiety disorder during the COVID-19 pandemic worldwide.

1. Introduction

Anxiety disorders are the most prevalent mental disorder and were a leading cause of health loss worldwide in 2019, reaching approximately 301 million (Yang et al., 2021). It is characterized by feelings of anxiety and fear, including phobias, generalized anxiety, panic, and social anxiety disorder (WHO, 2017). The duration of symptoms typically experienced by people with anxiety disorders characterized it as a chronic condition (Cheng et al., 2020). The long-term consequences of anxiety include chemical changes in the brain such as increased release of stress hormones, resulting in increased frequency or intensity of other conditions such as dizziness, headache, and depression (Racine et al., 2021).

The COVID-19 pandemic has tackled the global health as one of the greatest public health crises. Uncertainty, disruptions in daily routines, and concerns for the health and well-being of family and loved ones during the COVID-19 pandemic are likely associated with increases in generalized anxiety (Santomauro et al., 2021). Previous study estimated a significant correlation between human mobility and daily SARS-CoV-2 infection rate with the change in anxiety disorder prevalence (Matthew et al., 2021). Between 2010 and 2019, the number of people living with anxiety disorder increased by 11.2 %, summing roughly 30 million new cases worldwide (Yang et al., 2021). In the first year of the COVID-19 pandemic (March 2020 to January 2021), approximately 76 million new cases of anxiety disorder were identified, representing a 25 % upsurge in cases (Matthew et al., 2021). Therefore, this study aimed to

* Corresponding author at: Department of Nursing in Public Health, Federal University of Pelotas, Gomes Carneiro, 01, Pelotas, RS, Brazil.
E-mail address: fmdsocial@outlook.com (F.M. Delpino).

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update the prevalence of anxiety in the general population during the COVID-19 pandemic up to January 2022.

2. Methods

2.1. Search strategy

We conducted a systematic review and meta-analysis that followed the new PRISMA statement (Matthew et al., 2021). The searches were concluded in June 2021 by two reviewers (FMD and CNS) and included the following databases: Pubmed, Lilacs, Web of Science, and PsycINFO. We utilized two groups of keywords, based on MeSH and non-MeSH terms, to perform the searches: Anxiety OR Angst OR Social Anxiety AND COVID-19 OR COVID 19 OR Pandemics. The present systematic review and meta-analysis were registered and approved by the PROSPERO under the protocol number: CRD42021261660.

2.2. Inclusion and exclusion criteria

We included studies that met the following criteria: 1- investigated the prevalence of anxiety in the general population during the COVID-19 pandemic; 2- Observational studies (cross-sectional and/or longitudinal); 3- Samples with adults aged 18 or above.

The criteria for exclusion were: 1- Duplicated studies or those with the same database; 2- Studies conducted with individuals with specific characteristics (e.g., nurses, healthcare workers, cancer patients, COVID-19 patients, pregnant women, students); 3- Articles that full-text was not available; 4- Articles that lacked data to include in the meta-analysis.

2.3. Study selection

Studies selection (i.e. title, abstract and full-text screening) was performed independently by two reviewers (FMD and CNS); any disagreements between reviewers were solved by consensus.

2.4. Meta-analysis

We performed a meta-analysis to assess the prevalence of anxiety during the COVID-19 pandemic. The results were presented as relative frequencies (%) with their respective 95 % confidence intervals (95% CI). The I^2 test was used to assess heterogeneity between studies, considering values above 50 % and p-value <0.05 as high heterogeneity. If more than one study used the same database, only one was included in the review to avoid overlapping participants. For studies that reported prevalence in %, we estimated the total number of individuals with anxiety.

We performed sub-group analyzes according to country income (low and middle income vs. high-income country vs mixed (studies that included countries of different income level), anxiety measurement instrument, and level of anxiety (mild, moderate, severe, and extremely severe). Analyzes were performed using the Meta package (Schwarzer, 2016), through the R programming language.

2.5. Quality of evidence

The Newcastle-Ottawa Scale (NOS) was used to assess the quality of evidence (Wells et al., 2000). This scale consists of eight items related to study selection, comparability, and outcome. For cohort studies, the original version of the NOS scale was used; for cross-sectional studies we used an adapted version from the original scale, based on a previous publication (Herzog et al., 2013). In NOS, the study received a star if classified as high quality in each item, except for the comparability item, which it can score two stars. Thus, the total NOS score varies from 0 to 9 for cohort studies and from 0 to 8 for cross-sectional studies. We also performed a funnel plot and Egger's test to determine the publication bias across the studies.

3. Results

3.1. Study description

We found 3740 original papers and 3570 after excluding duplicates (see Fig. 1). After titles, abstract and full-text screening, 194 were included in this review (Alamri et al., 2020; Alhalafi, 2020; Alkhamees et al., 2020; Alsalman et al., 2020; Barros et al., 2020; Başer et al., 2020; Bäuerle et al., 2020; Benke et al., 2020; Bigalke et al., 2020; Casagrande et al., 2020; Castelli et al., 2020; Chauhan et al., 2020; Choi et al., 2020; Cortés-Álvarez et al., 2020; Dababseh et al., 2020; Daly and Robinson, 2020; Every-Palmer et al., 2020; Ey et al., 2020; Fiorillo et al., 2020; Galindo-Vázquez et al., 2020; Gallagher et al., 2020; Gao et al., 2020; García-Álvarez et al., 2020; González-Sanguino et al., 2020; Gorrochategi et al., 2020; Gualano et al., 2020; Guo et al., 2020; Hammarberg et al., 2020; Hossain et al., 2020; Hou et al., 2020; Huang and Zhao, 2020; J. Huang et al., 2020; Y. Huang et al., 2020; Hyland et al., 2020; Idrissi et al., 2020; Jiang et al., 2020; Li and Abir, 2020; Jia et al., 2020; Karatzias et al., 2020; Kujawa, 2020; Lei et al., 2020; Liu et al., 2020; Losada-Baltar et al., 2020; Lu et al., 2020; Madani et al., 2020; Mani et al., 2020; Massad et al., 2020; Mazza et al., 2020; McCracken et al., 2020; Mirhosseini et al., 2020; Moghanibashi-Mansourieh, 2020; Mohammadzadeh et al., 2020; Nagasu et al., 2020; Nwachukwu et al., 2020; Ozamiz-Etxebarria et al., 2020; Özdin and Bayrak Özdin, 2020; Pandey, 2020; Papandreou et al., 2020; Passos et al., 2020; Paulino et al., 2020; Pérez-Cano et al., 2020; Petzold et al., 2020; Ping Wong et al., 2020; Planchuelo-Gómez et al., 2020; Qian et al., 2020; Ran et al., 2020; Ran et al., 2020; Riaz et al., 2020; Robb et al., 2020; Sayeed et al., 2020; Shangguan et al., 2020; Sherman et al., 2020; Shevlin et al., 2020; Shi et al., 2020; Silva et al., 2020; Sinawi et al., 2020; Solomou and Constantinidou, 2020; Stanton et al., 2020; Steinmetz et al., 2020; Su et al., 2020; Szabó et al., 2020; Tee et al., 2020; Thomas et al., 2020; Tian et al., 2020; Traunmüller et al., 2020; Twenge and Joiner, 2020; Velikonja et al., 2020; Verma and Mishra, 2020; C. Wang et al., 2020; S. Wang et al., 2020; Wong et al., 2020; Zhang et al., 2020a, b; H. Zhao et al., 2020; S. Z. Zhao et al., 2020; Abdullah et al., 2021; Akalu et al., 2021; Al-Ajlouni et al., 2020; Aharon et al., 2021; Alfawaz et al., 2021; Alqahtani et al., 2021; Alyami et al., 2021; Anindyajati et al., 2021; Batterham et al., 2021; Bendau et al., 2021; Birhanu et al., 2021; Blbas et al., 2021; Boateng et al., 2021; Bonati et al., 2021; Brown et al., 2021; Burkova et al., 2021; Cai et al., 2021; Cansel et al., 2021; Cárdaba-García et al., 2021; Cénat et al., 2021; Chen et al., 2021; Chodkiewicz et al., 2021; Chopra et al., 2021; Cordaro et al., 2021; Das et al., 2021; Dubovi et al., 2021; El Desouky et al., 2021; El Keshky et al., 2021; Ernstsen and Havnen, 2021; Fancourt et al., 2021; Feter et al., 2021; Fountoulakis et al., 2021; Freitas et al., 2021; Fu et al., 2021; Gogola et al., 2021; Gong et al., 2021; Goularte et al., 2021; Grover et al., 2021; Horigian et al., 2021; Hou et al., 2021; Hubbard et al., 2021; Huong et al., 2021; Hu and Umeda, 2021; Hyland et al., 2021; Jané-Llopis et al., 2021; Kar et al., 2021; Kaufman-Shriqui et al., 2021; Khademian et al., 2021; Khubchandani et al., 2021; Korkmaz and Güloğlu, 2021; Lemieux et al., 2021; C. H. Liu et al., 2021; Y. Liu et al., 2021; Mautong et al., 2021; McEachran et al., 2021; Moayed et al., 2021; Mongkhon et al., 2021; Monterrosa-Castro et al., 2021; Moya-Lacasa et al., 2021; Nam et al., 2021; Nkire et al., 2021; Oyetunji et al., 2021; Porter et al., 2021; Puccinelli et al., 2021a; Puccinelli et al., 2021b; Ramiz et al., 2021; Reagu et al., 2021; Rehman et al., 2021; Ren et al., 2020; Reppas-Rindlisbacher et al., 2021; Ribeiro et al., 2021; Rondung et al., 2021; Sain and Dey, 2021; Santini and Koyanagi, 2021; Shah et al., 2021; Shi et al., 2021; Somma et al., 2021; Song et al., 2021; Souza et al., 2021; Stanley et al., 2021; Terán-Pérez et al., 2021; Toledo-Fernández et al., 2021; Turna et al., 2021; Vahratian et al., 2021. Varga et al., 2021; Varma et al., 2021; Vujčić et al., 2021; M. Wang et al., 2021; Q. Wang et al., 2021; S. Wang et al., 2021; Y. Wang et al., 2021; Winkler et al., 2021;

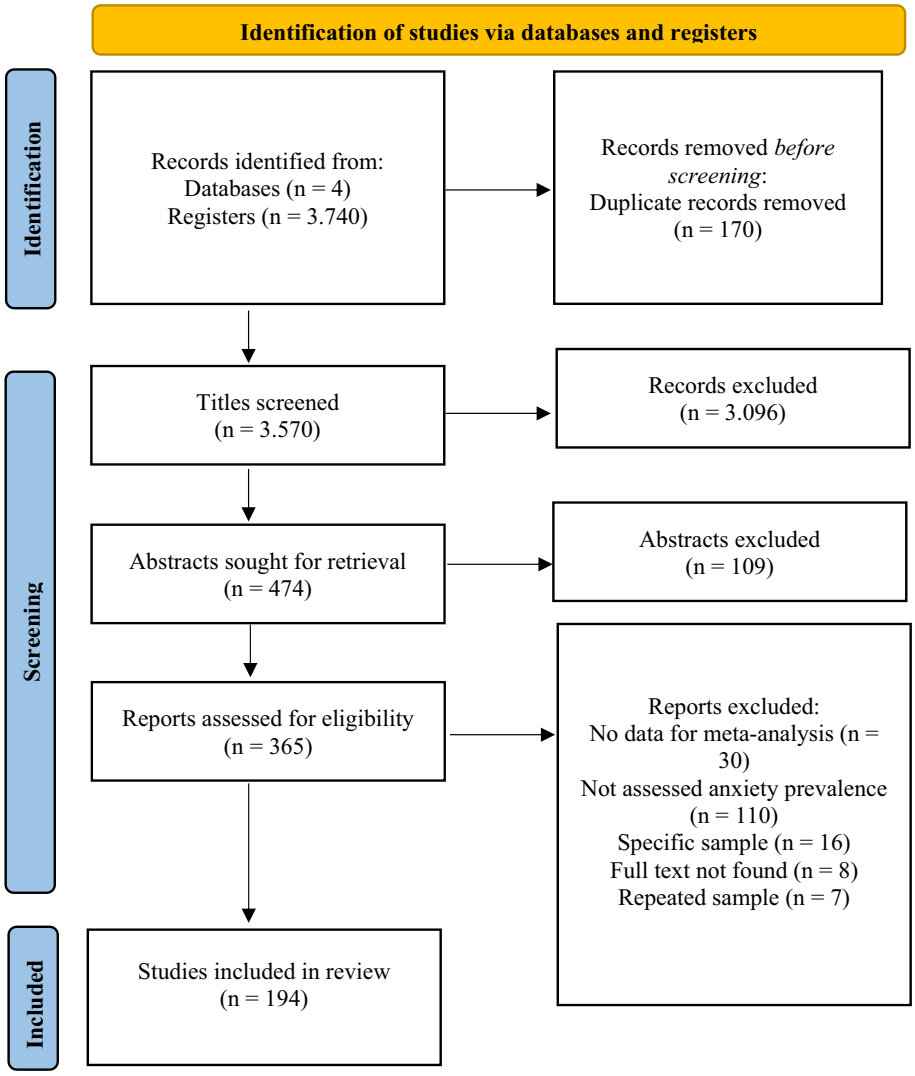

Fig. 1. Flow diagram of articles selection stages.

Wolfson et al., 2021; Wong et al., 2021; Yan et al., 2021; Zarrouq et al., 2021; Zhong et al., 2021; J. Zhu et al., 2021; K. Zhu et al., 2021; Zou et al., 2021. Most studies (n = 110) were removed because they did not assess the prevalence of anxiety, followed by 29 studies that did not provide data for meta-analysis.

3.2. Studies characteristics

Of the 194 studies included, 106 were published in 2020 and 88 were published in 2021. Most studies (n = 176, 89.3 %) had a cross-sectional design and 21 (10.7 %) were longitudinal. The studies samples ranged from 71 (Freitas et al., 2021) to 790,633 (Vahratian et al., 2021) participants. The most used instrument to assess anxiety symptoms was the GAD-7 (General Anxiety Disorder-7) (n = 74), followed by DASS-21 (Depression, Anxiety and Stress Scale) (n = 42). Most studies were carried out with both sexes (n = 193), four were only with women and none with men only. The studies were conducted in the South and North America, Europe, Africa, Asia, and Oceania continents. Most of the studies were carried out in Chine (n = 37), followed by United Stated (n = 18) and Brazil (n = 11).

3.3. Meta-analysis

Fig. 2 shows the forest plot for the general prevalence of anxiety during COVID-19 and the stratified prevalence according to the anxiety scale. The general analysis included >2.4 million people, of which 35.12 % had anxiety. When stratified by measurement scale, the STAI scale presented the higher prevalence, 66.66 % (95%CI: 57.88–74.43), whereas the GAD-2 showed the lower prevalence, 19.93 % (95%CI: 13.24–28.87).

As illustrated in Fig. 3, the analysis stratified by country's income showed that the prevalence of anxiety in low- and middle-income countries was 35.06 % (95%CI: 29.54–41.00), while the prevalence in high-income countries was 34.66 % (95%CI: 29.59–40.10). In Fig. 4, the prevalence of mild anxiety disorder was 15.45 % (95%CI: 13.21–17.98), affecting approximately 513,000 participants, followed by moderate (12.63 %; 95%CI: 10.41–15.26), severe (6.74 %; 95%CI: 5.32–8.51), and extremely severe (5.65 %; (95%CI: 4.09–7.75).

3.4. Risk of bias

Regarding longitudinal studies, the NOS score ranged from two to eight points, with a media of six points. Concerning the cross-sectional studies, four of them scored only one point, while four scored eight points. The mean score of cross-sectional studies was five points. Our funnel plot (Fig. 5) presented an asymmetry to the left, and the results were confirmed by Egger's test (p = 0.0001), which may be due to heterogeneity among the studies.

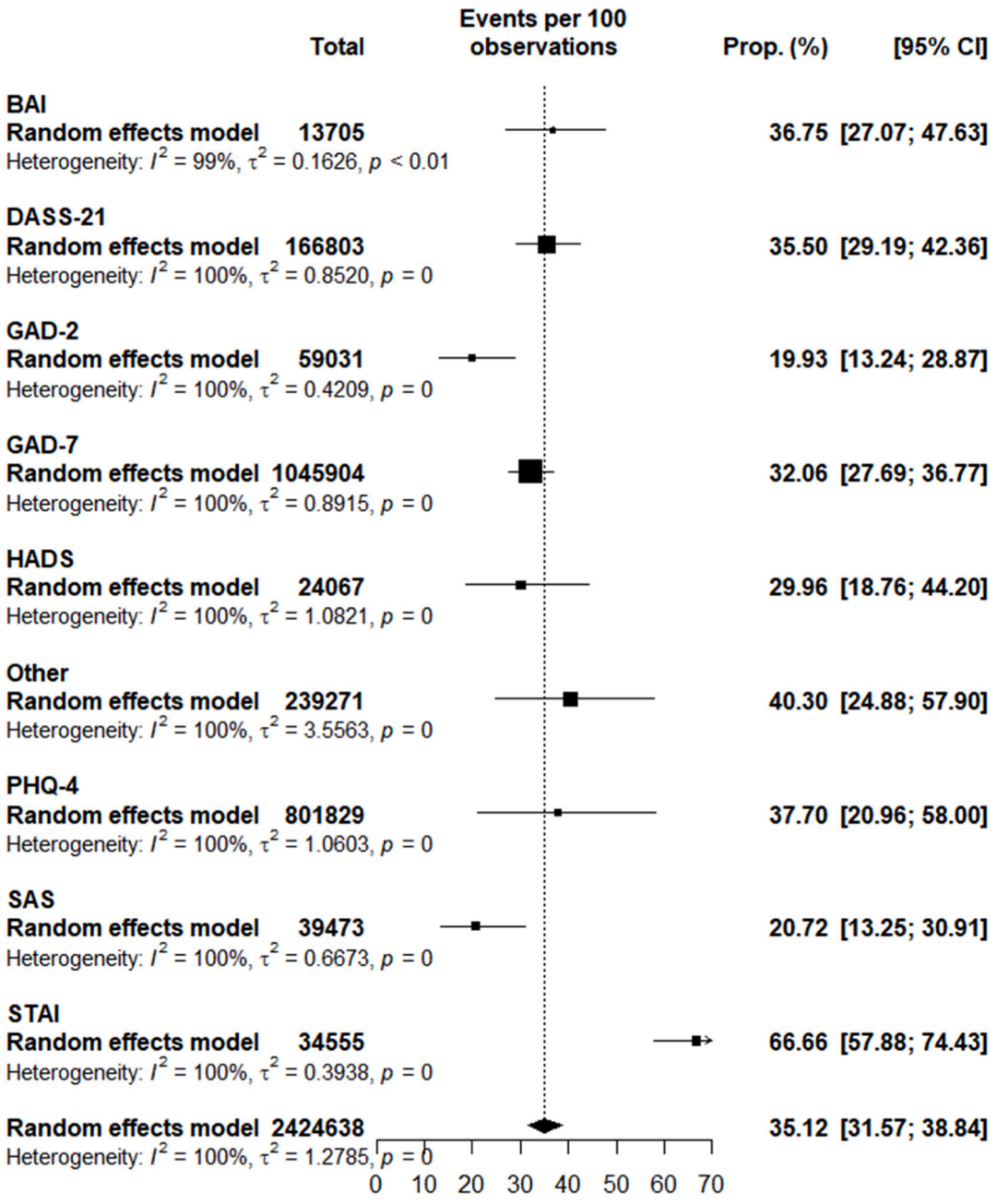

Fig. 2. Forest plot showing the general prevalence of anxiety and the stratified prevalence according to the scale of measurement.

4. Discussion

In this study, we evaluated the prevalence of anxiety across the general population during the COVID-19 pandemic. We found that around 35 % of the sample presented anxiety during the COVID-19 pandemic, which represents roughly 851,000 people with this condition worldwide. We also found that >500,000 participants suffered from mild anxiety levels (15.45 %), and 112,000 (5.65 %) suffered from extremely severe anxiety levels. No differences were observed in anxiety prevalence based on countries' income. We showed that the studies utilizing the STAI scale presented a higher anxiety prevalence, whereas those with the GAD-2 showed a lower prevalence.

A recent meta-analysis with 48 studies estimated an additional 76.2 million cases of anxiety disorders, causing >44.5 million disability-adjusted life-years (Santomauro et al., 2021). Another previous meta-analysis found an anxiety prevalence of 21 % for the general population (Dragioti et al., 2022), smaller results than our findings. The differences in the number of participants may explain the prevalence of anxiety. We included >2.4 million participants, whereas the previous meta-analysis evaluated anxiety, depression, stress, sleep problems, and posttraumatic symptoms, included ~500 thousand participants. Moreover, the number of subjects for anxiety was not specified. Another hypothesis for the differences is that the searches for the previous meta-analysis occurred until late September 2020, only six months since the beginning of the COVID-19. Meanwhile, our searches were conducted until the end of June 2021, when the pandemic had been going on for 1.3 years. Another meta-analysis with 43 studies published until august 2020, found an overall prevalence of anxiety of 25 %, with significant differences concerning the anxiety measurement methods (Santabárbara et al., 2021). Recently, a meta-analysis with 103 studies published until February 2021, and ~140 thousand participants, found a prevalence of anxiety was 27.3 % among the general population (Pashazadeh Kan

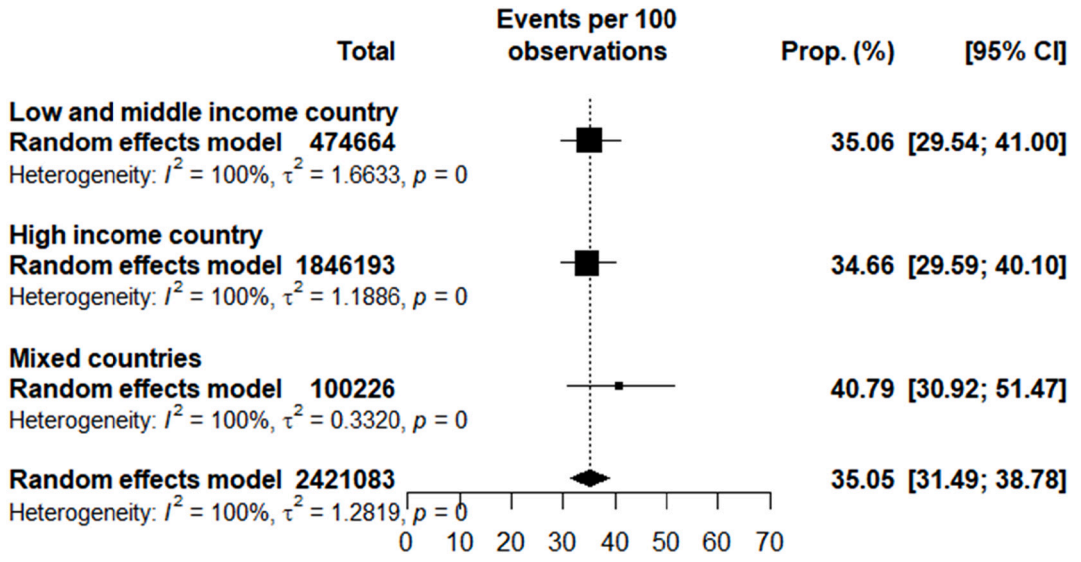

Fig. 3. Forest plot showing the prevalence of anxiety stratified according to the country's income.

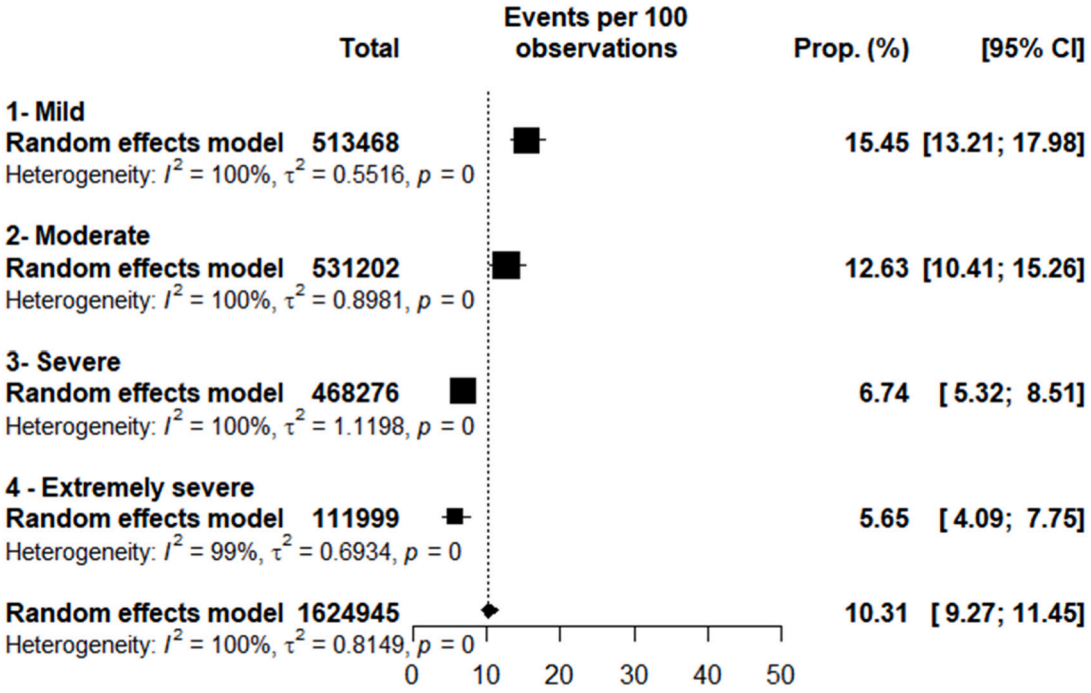

Fig. 4. Forest plot showing the prevalence of anxiety stratified by level.

et al., 2021).

Overall, our findings suggested that one in three people worldwide suffered from anxiety disorder during the COVID-19 pandemic. By the time of this study, the curve of cases and deaths were attenuated or even declining in most countries. However, the long-term consequences of this rapidly increase in anxiety prevalence are still unknown. High prevalence of anxiety disorders and the associated excessive mortality have a huge impact on public health (Higgins and Thompson, 2002). For example, people with anxiety disorders are more likely to suffer from other chronic conditions such as depression. Also, people with an anxiety disorder are three to five times more likely to go to the doctor and six times more likely to be hospitalized for psychiatric disorders than individuals without anxiety. In addition, persistent symptoms of COVID-19 infection, also known as long COVID-19, may exacerbate the pandemic impact in mental health at populational level. A protocol study proposed to evaluate this interaction and future results may confirm this hypothesis (Merikanto et al., 2022). On the other hand, pharmacological and non-pharmacological treatments for anxiety disorders are widely recognized. Further, public policies and campaigns to improve awareness about anxiety disorder should be encouraged in order to reduce stigma and provide adequate access to diagnosis and treatment.

Furthermore, our study does not observe a significant association between the prevalence of anxiety disorder and countries' income, corroborating previous findings (Yang et al., 2021; WHO, 2017; Matthew et al., 2021). An investigation with data from the Global Burden of Disease Study showed the highest prevalence of anxiety disorder in countries with middle socio-demographic index (a composite indicator of income per capita, years of education, and fertility). However, no differences were observed in the prevalence of anxiety in any

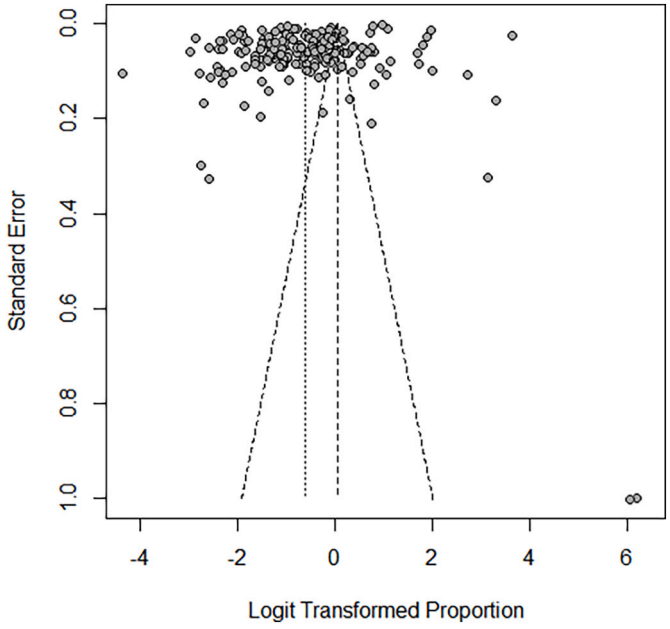

Fig. 5. Funnel plot assessing the publication bias for the prevalence of anxiety during the COVID-19 pandemic.

other socio-demographic index category (Yang et al., 2021). Even though no difference was observed in the prevalence of anxiety disorders between low, middle, and high-income countries, awareness campaigns to recognize and demystifying anxiety disorders are required especially in low and middle-countries. It is known that factors associated with the COVID-19 pandemic including loss of income and jobs were more pronounced in less favorable populations (Schwarzer, 2016). In addition, population from high-income regions have higher self-awareness of anxiety symptoms, higher diagnosis rate of anxiety disorders, and improved access to effective treatments (Yang et al., 2021). Hence, strategies to reduce the burden of anxiety especially in low and middle-income countries are recommended. Early prevention is expected to be very cost effective by offsetting the functional impairments associated with anxiety disorders (Wells et al., 2000).

Moreover, a similar prevalence of anxiety disorder was estimated by different instruments. Only GAD-2, SAS, and STAI revealed prevalence statistically different than the overall prevalence. A previous study examined the variations of three different instruments used to screen anxiety symptoms and disorder: Hospital Anxiety and Depressive Scale (HADS), the Depression, Anxiety and Stress Scale (DASS), and the Generalized Anxiety Disorder (GAD) (Herzog et al., 2013). The authors reinforce that the instruments assess comparable concepts of anxiety, which may explain the similarities in the prevalence of anxiety estimated by these three questionnaires. Anxiety disorders is an umbrella chronic condition that covers different aspects of mental health. Accurate and validated instruments are required in order to precisely estimate the prevalence in general population.

The present review stands out for including almost 200 studies that assessed the prevalence of anxiety during the COVID-19 pandemic, contemplating >2 million participants. Nevertheless, important limitations such as the high heterogeneity among studies, which was confirmed by the I^2 and funnel plot tests, require caution in interpreting the results. Furthermore, although the search included the main databases, publications in the gray literature were not considered, which may mean that conference papers, dissertations, and thesis were not included.

The overall burden of anxiety disorders is very staggering and continues to increase, and it presents a huge heterogeneity in different sexes, locations and age groups. Understanding the specific characteristics of anxiety disorders burden across the world and reducing risk factors such as bullying, establishing effective mental health knowledge dissemination, improving early diagnosis and performing diversified intervention strategies are of utmost importance to formulate more effective and targeted intervention and control of anxiety disorders.

5. Conclusion

In conclusion, 35.12 % of the general population had anxiety during the COVID-19 pandemic. We also found significant differences regarding the anxiety scale of measurement, whereas no differences were observed concerning low and middle-income countries compared to high-income countries.

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None.

CRediT authorship contribution statement

FMD and CNS were the reviewers of the article. JSJ, ESM, LLC, MKW, RA, ELC, and NF contributed to the writing and preparation of the manuscript. All authors reviewed and contributed fully to the preparation of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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