Mental disorder symptoms during the COVID-19 pandemic in Latin America – a systematic review and meta-analysis

Stephen X. Zhang1, Kavita Batra2, Wen Xu3, Tao Liu4, Rebecca Kechen Dong5, Allen Yin5, Andrew Yilong Delios6, Bryan Z. Chen8, Richard Z. Chen9, Saylor Miller10, Xue Wan11, Wenping Ye12 and Jiyao Chen13

Abstract

Aims. There is a lack of evidence related to the prevalence of mental health symptoms as well as their heterogeneities during the coronavirus disease 2019 (COVID-19) pandemic in Latin America, a large area spanning the equator. The current study aims to provide meta-analytical evidence on mental health symptoms during COVID-19 among frontline healthcare workers, general healthcare workers, the general population and university students in Latin America.

Methods. Bibliographical databases, such as PubMed, Embase, Web of Science, PsycINFO and medRxiv, were systematically searched to identify pertinent studies up to August 13, 2021. Two coders performed the screening using predefined eligibility criteria. Studies were assigned quality scores using the Mixed Methods Appraisal Tool. The double data extraction method was used to minimise data entry errors.

Results. A total of 62 studies with 196,950 participants in Latin America were identified. The pooled prevalence of anxiety, depression, distress and insomnia was 35%, 35%, 32% and 35%, respectively. There was a higher prevalence of mental health symptoms in South America compared to Central America (36% vs. 28%, p < 0.001), in countries speaking Portuguese (40%) vs. Spanish (30%). The pooled prevalence of mental health symptoms in the general population, general healthcare workers, frontline healthcare workers and students in Latin America was 37%, 34%, 33% and 45%, respectively.

Conclusions. The high yet heterogeneous level of prevalence of mental health symptoms emphasises the need for appropriate identification of psychological interventions in Latin America.

Introduction

Latin America, consisting of 33 countries or territories, has had the second-highest amount of coronavirus disease 2019 (COVID-19) cases and deaths per capita (Burki, 2020; World Health Organization, 2020; Ríos, 2021). Latin America is vulnerable to the destructive outbreak for several reasons including long-standing structural and socioeconomic inequities (Carvalho et al., 2015; Dávila-Cervantes and Agudelo-Botero, 2019; Burki, 2020) over 20% of the population in poverty, lack of healthcare access, underfunded healthcare systems, poor governance or political dynamics, a high burden of chronic and metabolic health conditions and lack of preparedness to fight the pandemic (Malta et al., 2020).

Reportedly, there is a considerable increase in psychological morbidities among several demographic groups, including healthcare workers, the general population and students (Campos et al., 2021b). Latin America is a vast area where tropical regions span across almost all countries and regional disparities on mental health have been reported (Malta et al., 2020), but we still lack evidence on the prevalence of mental health symptoms as well as their heterogeneities during the COVID-19 pandemic.

Recently, meta-analyses have provided early global evidence on the prevalence of mental health symptoms across groups, including healthcare workers, the general population and students (Batra et al., 2020; Luo et al., 2020; Pappa et al., 2020). These reports included very few studies based on Latin American samples. With emerging studies on mental health in Latin America, it is critical to synthesise meta-analytical evidence to provide integrated data on mental health; meta-analysis; prevalence COVID-19; healthcare workers; Latin America;

Key words:

Accepted: 4 December 2021
Revised: 10 October 2021
Received: 7 July 2021

doi.org/10.1017/S2045796021000767

© The Author(s), 2022. Published by Cambridge University Press. This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted re-use, distribution and reproduction, provided the original article is properly cited.

https://doi.org/10.1017/S2045796021000767 Published online by Cambridge University Press
health among key demographic groups in Latin America during the COVID-19 pandemic. Therefore, this meta-analysis aims to investigate the pooled prevalence of mental health symptoms during the COVID-19 pandemic among frontline healthcare workers, general healthcare workers, the general population and university students in Latin America. We first perform subgroup analysis for Latin America based on South America (a majority but not all countries are in tropical regions) and Central America (all countries are entirely tropical).

Methods

Protocol registration

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement 2020 (Liberati et al., 2009) to guide our meta-analysis and registered it with the International Prospective Register of Systematic Reviews (PROSPERO: CRD42020224458).

Eligibility criteria

The search targeted observational studies that assessed the prevalence of psycho-morbid symptoms of anxiety, depression, distress and insomnia among frontline healthcare workers, general healthcare workers, the general population aged 18 years or above and university students in Latin America. A priori inclusion criteria were established to identify eligible studies that used established psychometric survey tools, used the English language, and were available as full-texts. Studies that targeted other populations, including children, adolescents and certain subgroups (e.g., pregnant women), were excluded. Other study designs, such as reviews and meta-analyses, qualitative, mixed methods, case reports, studies published only as abstracts, biochemical and experimental studies, or articles lacking the use of robust psychometric instruments or with an ambiguous methodology to identify prevalence were also excluded. Studies based on non-Latin American countries were excluded. Studies with unclear methodology and results were reviewed carefully, and a researcher (WX) attempted to contact authors to seek the information in several instances: (1) if the study reported estimates for both targeted and excluded populations, posing challenges for us to delineate the prevalence rate for the population of interest to our study; (2) if the study did not report the prevalence as proportions; (3) if the study did not specify cut-off scores for levels of severity; or (4) if the study was missing crucial information such as response rate, duration of data collection and gender distribution.

Data sources and search strategy

This meta-analysis is part of a large project on meta-analysis of mental health symptoms during COVID-19. Bibliographic databases, such as PubMed, Embase, PsycINFO and Web of Science, were searched on 13 August 2021. medRxiv was also searched for preprints. Search algorithms specific to each database were used to yield a comprehensive pool of literature. A detailed search strategy appears in online Supplementary Table S1.

Phases of screening

A researcher (JC) exported the search results from various databases into Endnote to remove duplicates and then imported them into Rayyan for subsequent screening. Two reviewers (AD & BZC) independently screened the titles and abstracts of all papers in accordance with the prespecified eligibility criteria. The eligible abstracts proceeded to full-text screening for possible inclusion. Any conflicts between reviewers were resolved by a third reviewer (RKD).

Data extraction

A codebook was developed for standardisation and consistency. The final studies included from the screening process were sent to three groups (two reviewers in each group, WX & AY, BZC & AD, RZC & SM) for thorough investigation and extraction of relevant data elements into a coding book. Standardised codes were used to record pertinent variables, including author, title, country, duration of data collection, study design, population, sample size, response rate, female proportion, mean age, psychological outcome, severity level of outcome, type of survey instruments with cut-off scores and prevalence of psycho-morbid events. The severity of psychological outcomes of interest was coded as above mild, moderate above and severe levels (if available). The studies that reported only mild, moderate, and severe prevalence data were recoded into mild above, moderate above and severe prevalence for consistency purposes. The severity levels in studies that only reported the overall prevalence were determined based on cut-off scores (if available). After finishing independent coding, all the extracted data elements were subject to a second round of review by the coders to identify any discrepancies. In case of disagreements, a third reviewer (WX or TL) helped to achieve consensus through re-verification and discussion.

Risk of bias (RoB) assessment

The Mixed Methods Appraisal Tool (MMAT) with seven questions was used as a quality assessment tool (Hong et al., 2018; Pablo et al., 2020; Usher et al., 2020). Two reviewers independently assessed and assigned scores to the studies using the tool dictionary and guidelines. Disagreements were resolved through discussion with the lead reviewer (RKD). The quality scores ranged from 0 to 7 (highest quality). Studies were categorised as high, medium, or low quality if they attained the score of 6, 5 to 6, or <5, respectively.

Effect measure and data analysis

Using Version 16.1 of Stata (metaprop package), a random-effects model was used to compute the pooled estimates of outcome prevalence between populations by assuming that these studies are randomly selected from their targeted populations in Latin America to generalise our results to comparable studies in the region (Borenstein et al., 2021). We computed prediction intervals to show the range of the effect sizes across studies (Borenstein et al., 2017). The I² statistic was used to calculate variance difference from effect sizes in order to quantify heterogeneity rather than sampling error (Higgins et al., 2019). Visual inspection of the Doi plot and the Luis Furuya–Kanamori (Furuya-Kanamori et al., 2018) index were used to assess publication bias (Kounou et al., 2020; Yitayi et al., 2020). The event ratio was used as the primary effect measure for the pooled estimates.
Results

Screening of studies

A total of 446 records were identified through searching bibliographic databases and other sources (Fig. 1). After removing 114 duplicates, a total of 332 records advanced to the screening phase. After excluding 225 records that did not pass the title and abstract screening, 107 records were identified as eligible for full-text screening. Among them, 40 papers were excluded for different reasons. For example, we excluded seven papers in Spanish and one paper in Portuguese. We sent emails to the authors of eight studies, to request missing critical information; three studies provided new prevalence data and were included in the final pool. Therefore, 62 studies, focused on populations in Latin America, were used in the final data extraction and analysis (online Supplementary Table S2).

Study characteristics

A total of 65 unique samples from 62 studies involving 196,950 participants from Latin America were included in this meta-analysis (Badellino et al., 2020, 2022; Campos et al., 2020, 2021a, 2021b; Chen et al., 2021a, 2021b; Civantos et al., 2020; Cortés-Álvarez et al., 2020; Dal’Bosco et al., 2020; De Boni et al., 2020; Fernández et al., 2020; Giardino et al., 2020; Guirroy et al., 2020; Malgor et al., 2020; Martinez et al., 2020; Medeiros et al., 2020; Mier-Bolio et al., 2020; Monterrosa-Castro et al., 2020; Mora-Magaña et al., 2020; Passos et al., 2020; Paz et al., 2020; Samaniego et al., 2020; Schuch et al., 2020; Yáñez et al., 2020; Antiporta et al., 2021; Boluarte-Carbajal et al., 2021; Brito-Marques et al., 2021; Gayo-Rojas et al., 2021; Cénat et al., 2021; Dantas et al., 2021; de Oliveira Andrade et al., 2021; Espinosa-Guerra et al., 2021; Esteves et al., 2021; Fernandez et al., 2021; Ferreira et al., 2021; Feter et al., 2021; Flores-Torres et al., 2021; Garcia-Espinosa et al., 2021; Landaeta-Díaz et al., 2021; Loaiza de Mola et al., 2021; Mautong et al., 2021; Mendonca et al., 2021; Mota et al., 2021; Nayak et al., 2021; Puccinelli et al., 2021; Ribeiro et al., 2021; Schmitt Jr et al., 2021; Scotta et al., 2021; Serafim et al., 2021; Souza et al., 2021; Torrente et al., 2021a, 2021b; Villela et al., 2021; Vitorino et al., 2021; Werneck et al., 2021; Zhang et al., 2021a, 2021c; da Silva Júnior et al., 2021; Robles et al., 2021) (Table 1 and online Supplementary Table S2). Some studies include multiple independent samples. For example, one study examined the prevalence of both general healthcare workers and frontline healthcare workers. Among them, 35 samples (53.85%) were of general populations (Passos et al., 2020; Antiporta et al., 2021; Boluarte-Carbajal et al., 2021; de Oliveira Andrade et al., 2021; Espinosa-Guerra...
| Characteristics          | Total number of studies/samples* | Percent | Level of analysis |
|--------------------------|----------------------------------|---------|-------------------|
| Overall                  | 62/65                            | 100     |                   |
| Outcomeb                 | -                                |         | Prevalence        |
| Anxiety                  | 95                               | 42.79   |                   |
| Depression               | 87                               | 39.19   |                   |
| Distress                 | 21                               | 9.46    |                   |
| Insomnia                 | 19                               | 8.56    |                   |
| Severityb                | -                                |         | Prevalence        |
| Above mild               | 77                               | 34.68   |                   |
| Above moderate           | 87                               | 39.19   |                   |
| Above severe             | 52                               | 23.42   |                   |
| Overall                  | 6                                | 2.71    |                   |
| Population               | Sample                           |         |                   |
| Frontline HCWs           | 2                                | 3.08    |                   |
| General HCWs             | 19                               | 29.22   |                   |
| General population       | 35                               | 53.85   |                   |
| Students                 | 9                                | 13.85   |                   |
| Sampling country         | Sample                           |         |                   |
| Argentina                | 8                                | 12.31   |                   |
| Bolivia                  | 1                                | 1.54    |                   |
| Brazil                   | 32                               | 49.22   |                   |
| Chile                    | 1                                | 1.54    |                   |
| Colombia                 | 1                                | 1.54    |                   |
| Ecuador                  | 3                                | 4.62    |                   |
| Haiti                    | 1                                | 1.54    |                   |
| Mexico                   | 8                                | 12.30   |                   |
| Panama                   | 1                                | 1.54    |                   |
| Paraguay                 | 1                                | 1.54    |                   |
| Peru                     | 6                                | 9.23    |                   |
| Trinidad and Tobago      | 1                                | 1.54    |                   |
| Mixed                    | 1                                | 1.54    |                   |
| Quality                  | Study                            |         |                   |
| High                     | 30                               | 48.39   |                   |
| Medium                   | 32                               | 51.61   |                   |
| Design                   | Study                            |         |                   |
| Cohort                   | 3                                | 4.84    |                   |
| Cross-sectional          | 59                               | 95.16   |                   |
| Publication              | Study                            |         |                   |
| Preprint                 | 4                                | 6.45    |                   |
| Published                | 58                               | 93.55   |                   |

(Continued)
et al., 2021; Ferreira et al., 2021; Landaeta-Díaz et al., 2021; Mautong et al., 2021; Ribeiro et al., 2021; Schmitt Jr et al., 2021; Souza et al., 2021; Torrente et al., 2021b; Vitorino et al., 2021; Badellino et al., 2022), two samples (3.08%) were of frontline healthcare workers (Dal’Bosco et al., 2020; Robles et al., 2021), 19 samples (29.22%) were from general healthcare workers (Chen et al., 2020; Civantos et al., 2020; Giardino et al., 2020; Guiroy et al., 2020; Malgor et al., 2020; Monterrosa-Castro et al., 2020; Mora-Magaña et al., 2020; Samaniego et al., 2020; Yáñez et al., 2020; Zhang et al., 2021a; Villela et al., 2021; Nayak et al., 2021; Dantas et al., 2021; Mota et al., 2021; Brito-Marques et al., 2021; Campos et al., 2021b; Mier-Bolio et al., 2020; Robles et al., 2021) and nine samples (13.85%) were based on university students (Medeiros et al., 2020; Campos et al., 2021a; Cayo-Rojas et al., 2021; Esteves et al., 2021;}

---

**Table 1.** (Continued.)

| Characteristics | Total number of studies/samples* | Percent | Level of analysis |
|-----------------|---------------------------------|---------|------------------|
| Overall         | Mean (median)                   | 3030 (671) | 31–57 446 | Sample |
| Number of participants |                   | 67.9% (72.25%) | 3.4–89.8% | Sample |
| Response rate   | 66.0% (73.7%)                   | 11.4–100% | Sample |

*Some studies include multiple independent samples. For example, one study examined the prevalence of both general healthcare workers and frontline healthcare workers.

**Fig. 2.** The square markers indicate the prevalence of insomnia symptoms among population groups of interest. The diamonds represent the pooled estimates.

(a) Forest plot indicating the pooled prevalence of anxiety among included studies. (b) Forest plot indicating the pooled prevalence of depression among included studies. (c) Forest plot indicating the pooled prevalence of distress among included studies. (d) Forest plot indicating the pooled prevalence of insomnia among included studies.
Estimates of pooled prevalence of psychological morbidity symptoms

In Latin America, 56 samples from 54 studies reported the prevalence of anxiety symptoms among 128,060 participants (Badellino et al., 2021; Mendonça et al., 2021; Scotta et al., 2021; da Silva Júnior et al., 2021). Of the 62 studies, 32 were from Brazil (49.22%) (Table 1). Except for three (4.84%) longitudinal cohort studies (Feter et al., 2021; Flores-Torres et al., 2021; Loret de Mola et al., 2021), the majority of the studies were cross-sectional (95.16%). The sample size varied from 62 to 196,950 participants. The participation rates varied from 11.4% to 100.0% with a median value of 72.25%. The female proportions among the 65 samples varied from 3.4% to 89.8% with a median of 72.25%.

Depression, Anxiety and Stress Scale – 21 Items (DASS-21) (18.52%), the Hospital Anxiety and Depression Scale (HADS) (9.26%), Beck Anxiety Inventory (BAI) (3.70%) and nine others (each 1.85%). The cut-off values to determine the overall prevalence as well as severe anxiety varied across studies. In the random-effects model, the pooled prevalence of anxiety was 35% (95% CI: 31−38%) in the 54 studies (Fig. 2a). This finding suggests that, on average, 35% of the adults in Latin America had anxiety symptoms during COVID-19. Based on a normal distribution, its prediction internal is 71%.

A total of 49 samples from 46 studies reported the prevalence of depression among 139,559 respondents (Badellino et al., 2020, 2022; Campos et al., 2020; Civantos et al., 2020; Cortés-Alvarez et al., 2020; Dal’Bosco et al., 2020; De Boni et al., 2020; Fernández et al., 2020; Giardino et al., 2020; Giardino et al., 2021; Goularte et al., 2021; Haddow et al., 2020; Loret de Mola et al., 2020; Medeiros et al., 2020; Mier-Bolio et al., 2020; Monerrosa-Castro et al., 2020; Mora-Magaña et al., 2020; Passos et al., 2020; Paz et al., 2020; Samaniego et al., 2020; Schuch et al., 2020; Antíporta et al., 2021; Boluarte-Carbajal et al., 2021; de Oliveira Andrade et al., 2021; Espinosa-Guerra et al., 2021; Ferreira et al., 2021; Feter et al., 2021; García-Espinosa et al., 2021; Goularte et al., 2021; Loret de Mola et al., 2021; Mautong et al., 2021; Mendonça et al., 2021; Nayak et al., 2021; Puccinelli et al., 2021; Ribeiro et al., 2021; Schmitt Jr et al., 2021; Serafim et al., 2021; Souza et al., 2021; Torrente et al., 2021a, 2021b; Villena et al., 2021). Among all the depression survey tools, the Patient Health Questionnaire (PHQ)-9 was the most frequently used (50%), followed by DASS-21 (21.74%), HADS (10.87%), the Centre for Epidemiologic Studies Depression Scale (CESD) (4.35%) and six others (each 2.17%). Analysing the random-effects model, the pooled prevalence of depression was 35% (95% CI: 31−39%) among the 46 studies (Fig. 2b). This finding suggests that, on average, 35% of the adults in Latin America had depression symptoms during COVID-19. Its prediction internal is 7−71%.
Thirteen studies studied mental distress among 10,335 participants (Chen et al., 2020; Civantos et al., 2020; Cortés-Álvarez et al., 2020; Fernández et al., 2020; Reidy, 2020; Samaniego et al., 2020; Yáñez et al., 2020; Boluarte-Carbajal et al., 2021; Espinosa-Guerra et al., 2021; Ferreira et al., 2021; Zhang et al., 2021). Among all the distress survey tools, DASS-21 was the most frequently used (30.77%), followed by COVID-19 Peritraumatic Distress Index (CPDI), Impact of Event Scale–Revised (IES) and K6 (15.38% each) and three others (7.69% each). In the random-effects model, the pooled prevalence of distress was 32% (95% CI: 25–40%) (Fig. 2c). This finding suggests that, on average, 32% of the adults in Latin America had distress symptoms during COVID-19. Its prediction interval is 1–79%.

Nine samples from seven studies (Giardino et al., 2020; Samaniego et al., 2020; Brito-Marques et al., 2021; Goularte et al., 2021; Mota et al., 2021; Scotta et al., 2021; Robles et al., 2021) studied insomnia among 12,134 respondents. The Insomnia Severity Index (ISI) (71.43%) was used most often, followed by Diagnostic and Statistical Manual (DSM) (28.57%). In the random-effects model, the pooled prevalence of insomnia was 35% (95% CI: 25–46%) (Fig. 2d). Its prediction interval is 1–86%. The finding suggests that, on average, 35% of the adults in Latin America had insomnia symptoms during COVID-19 and the prevalence of insomnia symptoms in any comparable study will fall in this range.

The overall prevalence of mental health symptoms in frontline healthcare workers, general healthcare workers, the general population and students in Latin America was 37%, 34%, 33% and 45%, respectively. The overall prevalence rates of mental health symptoms that exceeded the cut-off values of mild, moderate and severe symptoms were 54%, 32% and 14%, respectively (Table 2). The pooled prevalence rates of mental health symptoms in South America, Central America, countries speaking Spanish and countries speaking Portuguese were 36%, 28%, 30% and 40%, respectively (Table 2). Subgroup analyses results on the anxiety, depression, distress and insomnia by population, severity, region and instrument are reported in Table 3.

### Quality of the studies

Of all studies, 30 studies (48.39%) were of high quality, and 32 studies (51.61%) were of medium quality (Table 1). The subgroup analysis suggests the high-quality studies reported a higher prevalence of mental health symptoms in Latin America (42%) than those of medium quality (31%) (Table 2).

### Detection of publication bias

The Doi plot and Luis Furuya–Kanamori index were used to quantify publication bias rather than the funnel plot and Egger’s statistics (Furuya-Kanamori et al., 2018; Kounou et al., 2020). The symmetrical, hill-shaped Doi plot and a Luis Furuya-Kanamori (LFK) index of −0.81 indicated ‘no asymmetry’ and a lower likelihood of publication bias (Fig. 3).

### Discussion

The analysis of 62 studies with 196,950 participants from Latin America generated pooled prevalence of anxiety, depression, distress and insomnia of 35%, 35%, 32% and 35%, respectively.
Table 3. Subgroup analyses of the prevalence of anxiety, depression and insomnia symptoms

| Groups          | Subgroups          | Anxiety | Depression | Distress | Insomnia |
|-----------------|--------------------|---------|------------|----------|----------|
| Number of studies | 54                 | 46      | 13         | 7        |
| Number of samples | 56                 | 49      | 13         | 9        |
| Number of prevalence | 95               | 87      | 21         | 19       |
| Number of participants | 128 060           | 139 559 | 10 335    | 12 134   |
| Aggregated      | 35%, 95% CI: 31–39%| 35%, 95% CI: 31–39%| 32%, 95% CI: 25–40%| 35%, 95% CI: 25–46%|
| Population      | Frontline HCWs     | 23%, 95% CI: 21–26%| 37%, 95% CI: 34–39%| NA       | NA       |
| General HCWs    | 34%, 95% CI: 26–42%| 34%, 95% CI: 25–44%| 30%, 95% CI: 19–43%| 34%, 95% CI: 21–47%|
| General population | 34%, 95% CI: 29–40%| 33%, 95% CI: 28–37%| 32%, 95% CI: 23–43%| NA       |
| Students        | 43%, 95% CI: 33–53%| 54%, 95% CI: 42–65%| NA       | 31%, 95% CI: 2–75%|
| Severity        | Above mild         | 55%, 95% CI: 48–61%| 51%, 95% CI: 45–56%| 55%, 95% CI: 42–67%| 61%, 95% CI: 52–69%|
|                 | Above moderate     | 32%, 95% CI: 29–36%| 32%, 95% CI: 28–37%| 32%, 95% CI: 19–47%| 32%, 95% CI: 27–37%|
|                 | Severe             | 14%, 95% CI: 11–17%| 17%, 95% CI: 12–23%| 17%, 95% CI: 13–22%| 5%, 95% CI: 3–6%|
| Region          | South America      | 37%, 95% CI: 32–41%| 36%, 95% CI: 32–40%| 33%, 95% CI: 25–41%| 33%, 95% CI: 20–49%|
|                 | Central America    | 27%, 95% CI: 21–32%| 27%, 95% CI: 20–34%| NA       | 45%, 95% CI: 37–53%|
|                 | Countries speaking Spanish | 29%, 95% CI: 23–35%| 29%, 95% CI: 25–34%| 32%, 95% CI: 22–42%| 34%, 95% CI: 21–48%|
|                 | Countries speaking Portuguese | 40%, 95% CI: 35–45%| 41%, 95% CI: 35–47%| 33%, 95% CI: 21–46%| 37%, 95% CI: 18–59%|
| Instrument      | GAD: 32%, 95% CI: 26–38% | PHQ: 37%, 95% CI: 30–45% | CPDI: 35%, 95% CI: 10–65% | IES: 18%, 95% CI: 12–24% | DSM: 48%, 95% CI: 40–55% |

CI, confidence interval.
Notably, this meta-analysis is the first to investigate the prevalence of mental health symptoms during the COVID-19 crisis in Latin America. The anxiety levels in Latin America were significantly higher than other regions, such as China (25%; \( p < 0.001 \)) (We compared the prevalence between two regions using t-test [https://www.medcalc.org/calc/comparison_of_proportions.php]) (Ren et al., 2020) and Spain (20%; \( p < 0.001 \)) (Chen et al., 2021b). Latin America has a long-standing history of scarce resources to deal with mental health symptoms (Alarcón, 2003), which could explain the higher prevalence of mental health symptoms among Latin Americans as revealed by this meta-analysis. Notably, the pooled prevalence of mental health symptoms was lower in Latin America than in Africa and South Asia, as reported by other meta-analyses (Hossain et al., 2020; Chen et al., 2021a). These cross-region differences may be due to multiple reasons, including heterogeneity in COVID-19 infection rate and mortality rate, variations in and timing of containment strategies adopted by countries across regions (Middelburg and Rosendaal, 2020), and the varying degrees of resources available, including personal protective equipment (PPE), to address mental health symptoms (Batra et al., 2020).

The prevalence of mental health symptoms was higher in South America than Central America (36% v. 28%; \( p < 0.001 \)). This difference might be attributed to variations across these countries in the evolution of the pandemic (e.g. some countries such as Peru and Brazil started out well but deteriorated rapidly) (We appreciate a reviewer raising this point of discussion.), the provision and availability of PPE, healthcare facilities and capacities, the stringency of the COVID-19 responses and the political climate (Garcia et al., 2020). Previous research noted that South America generally has a high degree of political polarisation, which resulted in conflicting information being conveyed to the public that could increase the burden of COVID-19 and its associated psychological corollaries (Garcia et al., 2020). In addition, public health actions or decisions were made mostly at municipal and state levels rather than at central government levels, and the lack of central coordination posed several challenges in the control of the pandemic, contributing to an increased psychological burden (Garcia et al., 2020).

Based on the evidence of individual studies, our study found a higher prevalence of mental health symptoms among frontline HCWs (37%, \( p < 0.001 \)) and university students (45%, \( p < 0.001 \)) than the general population and general HCWs (Batra et al., 2020; Luo et al., 2020; Pappa et al., 2020). The vulnerabilities of frontline healthcare workers are often attributed to a higher risk of infection, burnout, the more direct exposure to suffering or dying patients, fear of COVID-19 transmission to their family members and job loss (Xiang et al., 2020; Bhandari et al., 2021). The greater prevalence of mental health symptoms among university students can be explained by the uncertainties surrounding the course of the pandemic and the sudden transition to online education (Adeoyin and Soykan, 2020; Batra et al., 2021). Moreover, many businesses scaled down their recruitment efforts, leading to limited employment opportunities for students and more competition in the graduate labour market (Reidy, 2020). These challenges added to the mental health burden among university students.

**Study limitations**

There are a few limitations that merit discussion. First our analysis reveals substantial heterogeneities across studies in the type of survey instruments used and the cut-off scores, both of which may affect the interpretation of the findings. Second, not all Latin American countries have been well-studied, therefore our results may have limited generalisability for the less studied nations. Third, a majority of the included studies were cross-sectional, which provides no information on the prevalence over time during the pandemic. In addition, studies included in this meta-analysis relied on self-reported data of psychological symptoms by the participants and hence do not constitute mental health diagnosis from clinicians. Fourth, other outcomes, such as post traumatic stress disorder (PTSD), suicidal ideation and burnout, were not studied in this meta-analysis, leaving opportunities for prospective studies. Last, a language bias is expected because of the language restriction (only English) applied in this study. The systematic search uncovered eight papers (7.5%) that were not included for language reasons out of 107 eligible papers.

**Practical implications**

First, our systematic review and meta-analysis support evidence-based medicine by revealing a high proportion of mental health symptoms among the general population and healthcare workers during the COVID-19 pandemic in Latin America. However, our systematic review also reveals there is a lack of evidence in many Latin American countries to guide the relevant practice of evidence-based medicine on this topic. Only 12 of the 33 Latin American countries have been studied, leaving 21 countries without any studies to assist the practice of evidence-based healthcare. For instance, no relevant research has been done in Venezuela, the fifth-biggest South American country with a population of 28 million, in Chile, the sixth biggest South American country with a population of 18 million, nor in Guatemala (18 million population), Cuba (11 million population) and the Dominican Republic (11 million population), respectively the second, fourth and fifth most populous countries in Central America. In practice, healthcare organisations in those unstudied countries may use our results in the same region as approximate evidence before direct evidence in those countries emerges.
Our findings that the prevalence of mental health symptoms was higher in South America than Central America (36% vs. 28%; $p < 0.001$) provide evidence for international healthcare organisations, such as the World Psychiatric Association, on their assistance and resource allocation efforts. Our findings of a higher prevalence of mental health symptoms among frontline healthcare workers (37%, $p < 0.001$) and university students (45%, $p < 0.001$) than the general population (33%) and general healthcare workers (34%) suggest psychiatric and healthcare organisations should prioritise frontline healthcare workers and university students in Latin America.

Conclusions

This meta-analysis, to our knowledge, provides the first pooled estimates of mental health symptoms among key demographic groups during the COVID-19 crisis in Latin America. The meta-analytical findings of this study underscore the high prevalence of mental health symptoms in Latin Americans during the COVID-19 crisis. Hence, we call for more research to identify people vulnerable to mental health symptoms to enable evidence-based medicine during the pandemic.

Supplementary material.

The supplementary material for this article can be found at https://doi.org/10.1017/S2045796021000767

Data.

The meta-analysis does not use primary data. All the secondary data that support the findings of this study are available from the corresponding author, J. C., upon request.

Author contributions.

S. X. Z.: Conceptualisation, Methodology, Validation, Formal analysis, Investigation, Data curation, Visualisation, Writing – original draft, Writing – review & editing, Supervision. K. B.: Writing – original draft, Writing – review & editing, W. X.: Investigation (Data). T. L.: Investigation (Data). R. K. D.: Investigation (Data). AY: Investigation (Data). A. D.: Investigation (Data), Writing – review & editing. B. Z. C.: Investigation (Data). R. Z. C.: Investigation (Data). S. M.: Investigation (Data). X. W.: Investigation (Data). W. Y.: Investigation. Resources J. C.: Methodology, Validation, Formal analysis, Investigation, Data curation, Visualisation, Writing – original draft, Writing – review & editing, Supervision. All authors reviewed and approved the manuscript. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Financial support.

Jiyao Chen has received research support from the College of Business, Oregon State University.

Conflict of interest.

There are no conflicts of interest.

Ethical standards.

Not applicable.

Transparency declaration.

The corresponding author affirms this manuscript is an honest, accurate, and transparent account of the study being reported. No important aspects of the study have been omitted and any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Patient and public involvement.

No patient or public was involved in this systematic review and meta-analysis.

References

Adedoyin OB and Soykan E (2020) COVID-19 pandemic and online learning: the challenges and opportunities. Interactive Learning Environments 2020, 1–13.

Alarcón RD (2003) Mental health and mental health care in Latin America. World Psychiatry 2, 54–56.

Antiporta DA, Cutipe YL, Mendoza M, Celentano DD, Stuart EA and Bruni A (2021) Depressive symptoms among Peruvian adult residents amidst a National Lockdown during the COVID-19 pandemic. BMC Psychiatry 21, 111–122.

Badellino H, Gobbo ME, Torres E and Aschieri ME (2020) Early indicators and risk factors associated with mental health problems during COVID-19 quarantine: is there a relationship with the number of confirmed cases and deaths? The International Journal of Social Psychiatry 67, 547–575.

Badellino H, Gobbo ME, Torres E, Aschieri ME, Biotti M, Alvarez V, Gigante C and Cacciarelli M (2022) ‘It’s the economy, stupid’: lessons of a longitudinal study of depression in Argentina. The International Journal of Social Psychiatry 68, 1–8.

Batra K, Singh TP, Sharma M, Batra R and Schvaneveldt N (2020) Investigating the psychological impact of COVID-19 among healthcare workers: a meta-analysis. International Journal of Environmental Research and Public Health 17, 9096.

Batra K, Sharma M, Batra R, Singh TP and Schvaneveldt N (2021) Assessing the psychological impact of COVID-19 among college students: an evidence of 15 countries. Healthcare (Basel) 9, 222.

Bhandari N, Batra K, Upadhyay S and Cochran C (2021) Impact of COVID-19 on healthcare labor market in the United States: lower paid workers experienced higher vulnerability and slower recovery. International Journal of Environmental Research and Public Health 18, 3894.

Boluarte-Carabajal A, Navarro-Flores A and Villarreal-Zegarra D (2021) Exploratory model of perceived stress in the general population: a cross-sectional study in Peru during the COVID-19 context. Frontiers in Psychology 12, 673945.

Borenstein M, Higgins JPT, Hedges LV and Rothstein HR (2017) Basics of meta-analysis: $I^2$ is not an absolute measure of heterogeneity. Research Synthesis Methods 8, 5–18.

Borenstein LVH, Hedges LV, Higgins JPT and Rothstein HR (2021) Introduction to Meta-Analysis. Hoboken, NJ: John Wiley & Sons.

Brito-Marques J, Franco CMR, de Brito-Marques PR, Martinez SGC and do Prado GF (2021) Impact of COVID-19 pandemic on the sleep quality of medical professionals in Brazil. Arquivos De Neuro-Psiquiatria 79, 149–155.

Burki T (2020) COVID-19 in Latin America. The Lancet Infectious Diseases 5, 547–548.

Campos JADB, Martins BG, Campos LA, Marôco J, Saadig RA and Ruano R (2020) Early psychological impact of the COVID-19 pandemic in Brazil: a national survey. Journal of Clinical Medicine 9, 2976.

Campos J, Campos LA, Bueno JL and Martins BG (2021a) Emotions and mood swings of pharmacy students in the context of the coronavirus disease of 2019 pandemic. Currents in Pharmacy Teaching and Learning 13, 635–642.

Campos J, Martins BG, Campos LA, de Fátima Valadão-Dias F and Marôco J (2021b) Symptoms related to mental disorder in healthcare workers during the COVID-19 pandemic in Brazil. International Archives of Occupational and Environmental Health 94, 1023–1032.

Carvalho RA, Santos VS, Melo CM, Gurgel RQ and Oliveira CC (2015) Inequalities in health: living conditions and infant mortality in Northeastern Brazil. Revista de Saúde Pública 49, 1–9.

Caycho-Rodríguez T, Tomás JM, Vilca LW, García CH, Rojas-Jara C, White JM and Pena-Calero BN (2022) Predictors of mental health during the COVID-19 pandemic in older adults: the role of socio-demographic variables and COVID-19 anxiety. Psychology Health & Medicine 27, 453–465.

Cayo-Rojas CF, Castro-Mena MJ, Agroname-Rosell RC, Aliaga-Mariñas AS, Ladera-Castañeda MI, Cervantes-Ganoza LA and Cervantes-Litán LC (2021) Impact of COVID-19 mandatory social isolation on the development of anxiety in Peruvian dentistry students: a logistic regression analysis. Journal of International Society of Preventive & Community Health 11, 222–229.

Cénat JM, Dalecis RD, Guerrier M, Noorishad P-G, Derivois D, Bukaka J, Birangui J-P, Adansikou K, Clorêmeus LA and Kpoulo Kpoulou CK (2021) Frequency and correlates of anxiety symptoms during the COVID-19 pandemic in low-and middle-income countries: a multinational study. Journal of Psychiatric Research 132, 13–17.

Chen X, Zhang SX, Juhannshahi AA, Alvarez-Risco A, Dai H, Li J and Ibarra VG (2020) Belief in a COVID-19 conspiracy theory as a predictor of intentional online sharing: the challenge and opportunity. Frontiers in Psychology 11, 673945.
of mental health and well-being of health care workers in Europe: cross-sectional survey study. JMIHR Public Health Surveillance 6, e20737.

Chen J, Farah N, Dong RK, Chen RZ, Xu W, Yin A, Chen BZ, Delios A, Miller S, Wan X and Zhang SX (2021a) The mental health under the COVID-19 crisis in Africa: a systematic review and meta-analysis. International Journal of Environmental Research and Public Health 18, 10664.

Chen RZ, Zhang SX, Xu W, Yin A, Dong RK, Chen BZ, Delios A, McIntyre RS, Miller S and Wan X (2021b) A systematic review and meta-analysis of symptoms of anxiety, depression, and insomnia in Spain in the COVID-19 crisis. International Journal of Environmental Research and Public Health 19, 1018.

Civantos AM, Bertelli A, Gonçalves A, Getzen E, Chang C, Long Q and Rajasekaran K (2020) Mental health among head and neck surgeons in Brazil during the COVID-19 pandemic: a national study. American Journal of Otolaryngology 41, 102694.

Cortés-Alvarez NY, Pinedo-Lamas R and Vuelvas-Olmos CR (2020) Psychological effects and associated factors of COVID-19 in a Mexican sample. Journal Disaster Medicine Public Health Preparedness 14, 413–424.

Dal’Bosco EB, Floriano LSM, Skupien SV, Arcaio G, Martins AR and Anselmo ACC (2020) Mental health of nursing in coping with COVID-19 at a regional university hospital. Journal Revista Brasileira de Enfermagem 73, e20200434.

Dantas ESO, Aranjo MBD, Silva G, Silveira MYM, Dantas MNP and Meira KC (2021) Factors associated with anxiety in multiprofessional health care residents during the COVID-19 pandemic. Revista Brasileira de Enfermagem 74S, e2000961.

da Silva Júnior AE, de Lima Macena M, de Oliveira ADS, Praxedes DRS, de Oliveira Maranhão Pureza IR and Bueno NB (2021) Mental health care residents during the COVID-19 pandemic. Enfermagem de Saúde Coletiva 27, e20200752.

Esteves CS, de Oliveira C and Antunes DM (2021) Social distancing: prevalence of depressive, anxiety, and stress symptoms among Brazilian students during the COVID-19 pandemic. Frontiers in Public Health 8, 5.

Fernández RS, Crivelli L, Guimet NM, Allegri RF and Pedreira ME (2020) Psychological distress associated with COVID-19: latent profile analysis, outcome prediction and mediation analysis. Journal of Affective Disorders 277, 75–84.

Fernandes MDS, Vieira IS, Silva N, Cardoso TA, Bilavsky CH, Rakovsky C and Silva AER (2021) Anxiety symptoms and alcohol abuse during the COVID-19 pandemic: a cross-sectional study with Brazilian dental undergraduate students. Journal of Dental Education 2021, 1–10.

Ferreira FD, Lopes-Silva JB, Siquara GM, Manriof EC and de Freitas PM (2021) Coping in the COVID-19 pandemic: how different resources and strategies can be risk or protective factors to mental health in the Brazilian population. Health Psychology and Behavioral Medicine 9, 182–205.

Fetter N, Caputo E, Doring I, Leite J, Cassuariaga J, Reichert F, da Silva M, Coombes J and Rombald A (2021) Sharp increase in depression and anxiety among Brazilian adults during the COVID-19 pandemic: findings from the PAMPA cohort. Public Health 190, 101–107.

Flores-Torres MH, Murchland AR, Espinosa-Tamez P, Jaen J, Brochier M, Bautista-Arredondo S, Lamadrid-Figueroa H, Lajous M and Koenen K (2021) Prevalence and correlates of mental health outcomes during the SARS-Cov-2 epidemic in Mexico City and their association with non-adherence to stay-at-home directives, June 2020. International Journal of Public Health 66, 1–10.

Furuuya-Kanamori L, Barendregt JJ and Doi SAR (2018) A new improved graphical and quantitative method for detecting bias in meta-analysis. International Journal of Evidence-Based Healthcare 16, 195–203.

García-Espinosa P, Ortiz-Jiménez X, Botello-Hernández E, Aguayo-Samaniego R, Leija-Herrera J and Góngora-Rivera F (2021) Psychosocial impact on health-related and non-health related university students during the COVID-19 pandemic. Results of an electronic survey. Revista Colombiana de Psiquiatría 50, 214–224.

Garcia PJ, Alarcón A, Bayer A, Buss P, Guerra G, Ribeiro H, Rojas K, Saenz R, Snyder NS, Solimano G, Torres R, Tobar S, Tuseca R, Vargas G and Atun R (2020) COVID-19 response in Latin America. The American Journal of Tropical Medicine and Hygiene 103, 1765–1772.

Giardino DL, Huck-Iriart C, Riddick M and Garay A (2020) The endless quarantine: the impact of the COVID-19 outbreak on healthcare workers after three months of mandatory social isolation in Argentina. Sleep Medicine 76, 16–25.

Goularte JF, Serafín SD, Colombo R, Hogg B, Calderarzo MA and Rosa AR (2021) COVID-19 and mental health in Brazil: psychiatric symptoms in the general population. Journal of Psychiatric Research 132, 32–37.

Guiry A, Galliardi M, Coombes N, Landriel F, Zanardi C, Camino Willhuber G, Guyot JP and Valacco M (2020) COVID-19 impact among spine surgeons in Latin America. Global Spine Journal 11, 859–865.

Higgins JPT, Thomas J, Chandler J, Cumpston M, Tianjing LI MJ and Page VAW (2019) Cochrane Handbook for Systematic Reviews of Interventions. Hoboken, NJ: John Wiley & Sons.

Hong QN, Fábregues S, Bartlett G, Boardman F, Cargo M, Dagenais P, Gagnon M-P, Griffiths F, Nicolau B, O’Cathain A, Rousseau M-C, Vedel I and Pluye P (2018) The mixed methods appraisal tool (MMAT) version 2018 for information professionals and researchers. Education for Information 34, 285–291.

Hossain M, Purohit N, Sultan A, Ma P, Lisako E, McKyer J and Ahmed HU (2020) Prevalence of mental disorders in South Asia: an umbrella review of systematic reviews and meta-analyses. Asian Journal of Psychiatry 51, 102041.

Kounou KB, Guédénon KM, Foli AAD and Gnasounou-Akpa E (2020) Mental health of medical professionals during the COVID-19 pandemic in Togo. Psychiatry and Clinical Neurosciences 74, 559–560.

Landaeta-Díaz L, González-Medina G and Agüero SD (2021) Anxiety symptoms and alcohol abuse during the COVID-19 pandemic in Panama: a cross-sectional study. medRxiv, 21254435.

Esteves CS, de Oliveira CR and Argimon IID (2021) Social distancing: prevalence of depressive anxiety, and stress symptoms among Brazilian students during the COVID-19 pandemic. Frontiers in Public Health 8, 5.

Fernández RS, Crivelli L, Guimet NM, Allegri RF and Pedreira ME (2020) Psychological distress associated with COVID-19: latent profile analysis, outcome prediction and mediation analysis. Journal of Affective Disorders 277, 75–84.

Lorete de Mola C, Blumenberg C, Martins RC, Martins-Silva T, Carpena MX, Del Ponte B, Pearson R, Soares AL and Cesar JA (2021) Increased depression and anxiety during the COVID-19 pandemic in Brazilian mothers: a longitudinal study. Brazilian Journal of Psychiatry 43, 337–344.

Luo M, Guo L, Yu M, Jiang W and Wang H (2020) The psychological and mental impact of coronavirus disease 2019 (COVID19) on medical staff and general public - a systematic review and meta-analysis. Psychiatry Research 291, 1–9.

Malgor RD, Sobreira ML, Mouawad NJ, Johnson AP, Wohlauer MV, Coogan SM, Cuff RF, Coleman DM, Sheahan III MG and Woo K (2020) Brazilian vascular surgeons experience during the coronavirus (COVID-19) pandemic. Vascular 29, 451–460.

Malta M, Murray L, Da Silva CM and Strathdee SA (2020) Coronavirus in Brazil: the heavy weight of inequality and unsound leadership. EClinicalMedicine 25, 1–2.

Martínez EZ, Silva EM, Morigli TZ, Zucoloto ML, Silva TL, Joaquim AG, Dell’Agnoil G, Galdino G, Martínez MOZ and Silva WRd (2020) Anxiety, anhedonia and food consumption during the COVID-19 quarantine in Chile. Appetite 164, 105259.

Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotschke PC, Ioannidis JPA, Clarke M, Devereaux PJ, Kleijnen J and Moher D (2009) The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ 362, e1–e43.
Physical activity in periods of social distancing due to COVID-19: a cross-sectional survey. Ciência Saúde Coletiva 25, 4157–4168.

Mautong H, Gallardo-Rumbea JA, Alvarado-Villa GE, Fernández-Cadena JC, Andrade-Molina D, Orellana-Román CE and Cherriz-Ojeda I (2021) Assessment of depression, anxiety and stress levels in the Ecuadorian general population during social isolation due to the COVID-19 outbreak: a cross-sectional study. BMC Psychiatry 21, 1–15.

Medeiros RAD, Vieira DL, Silva EVFP, Rezende LVMDL, Santos RWD and Tabata LF (2020) Prevalence of symptoms of temporoanterior bilateral disorders, oral behaviors, anxiety, and depression in dentistry students during the period of social isolation due to COVID-19. Journal of Applied Oral Science 28, 1–8.

Mendonça VS, Steil A and Gois AFT (2021) Mental health and the COVID-19 pandemic: a medical study of residency training over the years. Clinics 76, 1–6.

Middelburg RA and Rosendaal FR (2020) COVID-19: how to make between-country comparisons. International Journal of Infectious Diseases 96, 477–481.

Mier-Bolío JR, Arroyo-González JM, Baques-Guillén E, Valdez-Lopez JF, Torre-García AJ, Rodriguez-Rodriguez OE and Rivera-Arroyo G (2020) COVID-19 y ansiedad en oftalmólogos. Revista Mexicana de Oftalmología 94, 223–227.

Monteiro-Alvarenga, Jeremias, M, Mora-Magaña I, Lee SA, Maldonado-Castellanos I, Jiménez-Gutierrez C, Mier-Bolío JR, Arroyo-González JM, Baques-Guillén E, Valdez-Lopez JF, Middelburg RA and Rosendaal FR (2020) Sintomatologia asociada a trastornos de salud mental en trabajadores sanitarios en Paraguay: efecto COVID-19. Revista Interamericana de Psicologia/Interamerican Journal of Psycholog 54, e1298–e1298.

Schmitt Jr AA, Brenner AM, Primo de Carvalho Alves L, Claudioino FCDa, Fleck MPdA and Rocha NS (2021) Potential predictors of depressive symptoms during the initial stage of the COVID-19 outbreak among Brazilian adults. Journal of Affective Disorders 282, 1090–1095.

Schuch FB, Bulzlng RA, Meyer J, Vancampfort D, Firth J, Stubbs B, Grabovac I, Willett P, Tavares VDO and Calegaro VC (2020) Associations of moderate to vigorous physical activity and sedentary behavior with depressive and anxiety symptoms in self-isolating people during the COVID-19 pandemic: a cross-sectional survey in Brazil. Psychiatry Research 292, 113339.

Scotta AV, Cortez MV and Miranda AR (2021) Insomnia is associated with worry, cognitive avoidance and low academic engagement in Argentinian university students during the COVID-19 social isolation. Psychology Health Medicine 2021, 1–16.

Serafín AM, Dourães RS, Roca CC, Gonçalves PD, Sáfi F, Cappellozza A, Paulino M, Dumas-Diniz R, Brissos S and Brites R (2021) Exploratory study on the psychological impact of COVID-19 on the general Brazilian population. Plos One 16, e0245868.

Souza ASR, Souza GFA, Souza GA, Cordeiro ALN, Praciano GAF, Alves ACS, Santos ACD, Silva Junior JR and Souza MBR (2021) Factors associated with stress, anxiety, and depression during social distancing in Brazil. Revista de Saúde Pública 55, 5.

Torrone F, Yoris A, Low D, Lopez P, Bekinschtein P, Manes F and Cetkovich M (2021a) Sooner than you think: a very early affective reaction to the COVID-19 pandemic and quarantine in Argentina. Journal of Affective Disorders 282, 495–503.

Torrone F, Yoris A, Low D, Lopez P, Bekinschtein P, Vázquez G, Manes F and Cetkovich M (2021b) Emotional symptoms, mental fatigue and behavioral adherence after 72 continuous days of strict lockdown during the COVID-19 pandemic in Argentina. medRxiv, 21255866.

Usner K, Jackson D, Durkin J, Gyamfi N and Bhullar N (2020) Pandemic-related behaviours and psychological outcomes: a rapid literature review to explain COVID-19 behaviours. Journal of Mental Health Nursing 29, 1018–1034.

Villela EFD, da Cunha IR, Fodjo JNS, Obimpeh M, Colebunders R and Van Hees S (2021) Impact of COVID-19 on healthcare workers in Brazil between August and November 2020: a cross-sectional survey. International Journal of Environmental Research and Public Health 18, 6515–6522.

Vittorino LM, Yoshinari GH, Gonzaga G, Dias IF, Pereira JPL, Ribeiro IMG, Franca AB, Al-Zaben F, Koenig HG and Trzesniak C (2021) Factors associated with mental health and quality of life during the COVID-19 pandemic in Brazil. Bipolar Open 7, 1–8.

Wernick AO, Silva DR, Malta DC, Souza-Júnior PR, Azvedo LO, Barros MB and Szwarcold CL (2021) Physical inactivity and elevated TV-viewing reported changes during the COVID-19 pandemic are associated with mental health: a survey with 43,995 Brazilian adults. Journal of Psychosomatic Research 140, 110292.

World Health Organization (2020) Global health estimates: Leading causes of death. Available at https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/gho-leading-causes-of-death.

Xiang Y-T, Yang Y, Li W, Zhang L, Zhang Q, Cheung T and Ng CH (2020) Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. The Lancet. Psychiatry 7, 228–229.

Yañez JA, Jahnshahai AA, Alvarez-Risco A, Li J and Zhang SX (2020) Anxiety, distress, and turnover intention of healthcare workers in Peru by their distance to the epicenter during the COVID-19 crisis. The American Journal of Tropical Medicine and Hygiene 103, 1614–1620.

https://doi.org/10.1017/S2045796021000767 Published online by Cambridge University Press
Yitayih Y, Mekonen S, Zeynudin A, Mengistie E and Ambelu A (2020) Mental health of healthcare professionals during the early stage of the COVID-19 pandemic in Ethiopia. *The British Journal of Psychiatry* 7, 1–6.

Zhang SX, Chen J, Jahanshahi AA, Alvarez-Risco A, Dai H, Li J and Patty-Tito RM (2021a) Succumbing to the COVID-19 pandemic – healthcare workers not satisfied and intend to leave their jobs. *International Journal of Environmental Research and Public Health* 2021, 1–10.

Zhang SX, Huang H, Li J, Antonelli-Ponti M, Paiva SFd and Silva JAd (2021b) Predictors of depression and anxiety symptoms in Brazil during COVID-19. *International Journal of Environmental Research and Public Health* 18, 7026.

Zhang SX, Wang Y, Jahanshahi AA, Li J and Schmitt VGH (2021c) Early evidence and predictors of mental distress of adults one month in the COVID-19 epidemic in Brazil. *Journal of Psychosomatic Research* 142, 110366.