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# Prevalence of anxiety in the COVID-19 pandemic: An updated meta-analysis of community-based studies

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ABSTRACT

*Background:* The unprecedented worldwide crisis caused by the rapid spread of COVID-19 and the restrictive public health measures enforced by some countries to slow down its transmission have severely threatened the physical and mental wellbeing of communities globally.
*Methods:* We conducted a systematic review and meta-analysis to determine the prevalence of anxiety in the general population during the COVID-19 pandemic. Two researchers independently searched for cross-sectional community-based studies published between December 1, 2019 and August 23, 2020, using PubMed, WoS, Embase, and other sources (e.g., grey literature, manual search).
*Results:* Of 3049 records retrieved, 43 studies were included. These studies yielded an estimated overall prevalence of anxiety of 25%, which varied significantly across the different tools used to measure anxiety. Consistently reported risk factors for the development of anxiety included initial or peak phase of the outbreak, female sex, younger age, marriage, social isolation, unemployment and student status, financial hardship, low educational level, insufficient knowledge of COVID-19, epidemiological or clinical risk of disease and some lifestyle and personality variables.
*Conclusions:* As the overall global prevalence of anxiety disorders is estimated to be 7.3% normally, our results suggest that rates of anxiety in the general population could be more than 3 times higher during the COVID-19 pandemic. These findings suggest a substantial impact on mental health that should be targeted by individual and population-level strategies.

## 1. Introduction

COVID-19, the coronavirus-transmitted infectious disease, was first identified in Wuhan, China, and declared a pandemic by the World Health Organization on March 11, 2020 (WHO, 2020a). To date (September 7th, 2020), there have been 27.032.617 confirmed cases of COVID-19 worldwide, from which 881.464 people have died (WHO, 2020b). Public health measures designed to slow down or prevent the

*Abbreviations:* COVID-19, coronavirus infectious disease 2019; SARS-CoV-1, severe acute respiratory syndrome coronavirus 1; MERS-CoV, Middle East respiratory syndrome coronavirus; GAD, Generalized Anxiety Disorder scale; DASS, Depression Anxiety and Stress Scale; SAS, Zung Self-rating Anxiety Scale; STAI, State-Trait Anxiety Inventory; BAI, Beck Anxiety Inventory; HADS, Anxiety and Depression Scale; BSI-53, Brief Symptom Inventory-53.

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spread of COVID-19 have deeply changed our lifestyle and threatened our physical and mental wellbeing, with a restriction of freedom and large economic losses.

The psychological impact of previous epidemic outbreaks on the general public is relatively understudied, as most research has focused on frontline health workers and patients. Nonetheless, many stressors have been linked to disease outbreaks and pandemics. In early stages, this includes the unpredictable nature of the disease and lack of clarity about the seriousness of the risk, as well as concern about the health and isolation of oneself and one's family and loved ones (Huremović, 2019; Zandifar and Badrfam, 2020). Similarly, the severity of the disease outcome, its transmissibility and the presence of public fatigue due to prolonged pandemic warnings in those areas suffering from several virus outbreaks are sources of variability in the public psychological response in past outbreaks (Chan et al., 2015). Thus, negative mental health outcomes (i.e., posttraumatic stress, depression, and avoidance behaviors) were reported during the SARS-CoV-1 outbreak in 2003 in Toronto, Singapore and Hong Kong, where strict infection-containment measures were enforced on the population, including quarantine (Hawryluck et al., 2004; Lau et al., 2006; Lau et al., 2005; Sim et al., 2010), whereas low anxiety levels were found for the A/H5N1 avian, A/H1N1 and H7N9 influenza (Bults et al., 2015; Chan et al., 2015) and Ebola (Quian Hui et al., 2020) epidemics in most areas, possibly due to lower infection rates and quick disease containment, respectively (Huremović, 2019). Likewise, anxiety symptoms and feelings of anger were present in noninfected but quarantined individuals during the MERS-CoV outbreak in 2015 (Jeong et al., 2016).

In the current situational framework, the rapid spread and number of deaths caused by COVID-19, the imposition of home confinement for indefinite periods of time, and the growing financial losses can convey an increased risk for psychiatric conditions among all layers of society (Pfefferbaum and North, 2020). In fact, several systematic reviews and meta-analyses have been published, revealing increased stress, post-traumatic stress disorder (PTSD), anxiety, and depression in health-care workers (Chew et al., 2020), higher risk of distress, anxiety, depression, and sleep disturbance in nurses (Rasmussen, 2020), and a 7-fold increase in depression rates in the general population (Bueno-Notivol et al., 2020).

Previous reviews have been published with data on anxiety and COVID-19 in the general population. However, one review covered epidemic outbreaks since 2007 and included only one study on COVID-19 (Fardin, 2020), and the other one included only two Chinese studies conducted in the general population (Rajkumar, 2020). These reviews were followed by a systematic review and meta-analysis published in July 2020 (Salari et al., 2020), which reported a prevalence of anxiety in the general population of 32%. However, several studies on the prevalence of anxiety have been published afterward, which highlights the pertinence of an updated meta-analysis on this topic. Therefore, this study aims to conduct a systematic review and meta-analysis to ascertain the impact of the COVID-19 outbreak on the prevalence of anxiety in the general population.

## 2. Materials and methods

This study was conducted following the PRISMA guidelines for reporting systematic reviews and meta-analyses (Moher et al., 2009) (Supplementary Table 1).

### 2.1. Search strategy

Two researchers (JBN and IL) searched for all cross-sectional studies reporting the prevalence of anxiety published from December 1, 2019, to June 15, 2020, using MEDLINE via PubMed, Web of Science, and Embase. The search strategies are shown in Table 1. No language restriction was made. References from selected articles were inspected to detect additional potential studies. We then performed a manual search of the "grey literature" (e.g., medRxiv) to detect other potentially eligible investigations. Any disagreement was resolved by consensus among a third and fourth reviewer (JS and PGG). This search was updated on August 23, 2020.

**Table 1**
Search strategies.

| |
|---|
| MEDLINE vía PubMed: |
| (covid or covid-19 OR coronavirus OR "corona virus" OR SARSCoV-2 OR "Coronavirus"[Mesh] OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR "COVID-19"[Supplementary Concept] OR "Coronavirus Infections/epidemiology"[Mesh] OR "Coronavirus Infections/prevention and control"[Mesh] OR "Coronavirus Infections/psychology"[Mesh] OR "Coronavirus Infections/statistics and numerical data"[Mesh]) AND (anxiety OR anxiety symptoms OR anxiety disorders OR anxious OR "Trauma and Stressor Related Disorders"[Mesh] OR "Anxiety"[Mesh] OR "Anxiety Disorders"[Mesh] OR "Anxiety/epidemiology"[Mesh] OR "Anxiety/statistics and numerical data"[Mesh]) |
| Web of Science: |
| ALL = (covid or covid-19 OR coronavirus OR "corona virus" OR SARSCoV-2 OR "severe acute respiratory syndrome coronavirus 2") AND ALL = (anxiety OR "anxiety symptoms" OR "anxiety disorders" OR anxious OR trauma) |
| Embase: |
| (covid:ab,ti OR 'covid 19':ab,ti OR coronavirus:ab,ti OR 'corona virus':ab,ti OR 'sarscov 2':ab,ti OR 'severe acute respiratory syndrome coronavirus 2':ab,ti) AND (anxiety:ab,ti OR 'anxiety symptoms':ab,ti OR 'anxiety disorders':ab,ti OR anxious:ab,ti OR trauma:ab,ti) AND [2019–2020]/py |

### 2.2. Selection criteria

Studies were included if: (1) they reported cross-sectional data on the prevalence of anxiety during the COVID-19 outbreak; (2) they were focused on community-based samples; (3) they described the methods used to assess or diagnose anxiety; (4) the full-text was available. We excluded studies focusing on specific samples (e.g., medical professionals, patients), and review articles.

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

### 2.3. 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 (Moola et al., 2017). 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 to address the target population? 2: Were study participants recruited appropriately? 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 the statistical analysis appropriate? 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).

### 2.4. Data extraction and statistical analysis

A generic inverse variance method with a random effect model was used (DerSimonian and Laird, 1986) and the I2 statistic and 95% confidence interval were employed to quantify heterogeneity (von Hippel, 2015). I2 values between 25%–50% are considered as low, 50%–75% as moderate, and 75% or more as high (Higgins et al., 2003). 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 (Thompson and Higgins, 2002) to explore the sources of heterogeneity expected in meta-analyses of observational studies (Egger et al., 1998). 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 (Egger et al., 1997) and Begg tests (Begg and Mazumdar, 1994) ($p$ values $<0.05$ indicate publication bias) since because funnel plots were found to be an inaccurate method for assessing publication bias in meta-analyses of proportion studies (Hunter et al., 2014).

Statistical analyses were conducted by JS and run with STATA statistical software (version 10.0; College Station, TX, USA) and R (R Core Team, 2019).

## 3. Results

### 3.1. Identification and selection of articles

Fig. 1 shows a flow chart of the literature search strategy and study selection process up to 23 August 2020. Initially, 1017 potential records were identified in multiple databases, to which 2032 records were added in the August 23 update. After removing 382 duplicate items in June and 867 in August ($n = 1249$), 635 and 1165 items were respectively identified for selection ($n = 1800$). The titles and abstracts of these articles were read and 564 articles in June and 1071 in August were excluded for failure to meet the inclusion criteria ($n = 1635$). To the remaining 165 articles (71 in June and 94 in August) was added 1 more found by manual search of other databases and reference lists. After reading the remaining 72 articles in June and 94 in August ($n = 166$), we included 15 and 28 articles in our study, respectively ($n = 43$). (Ahmed et al., 2020a; Alkhamees et al., 2020; Arafa et al., 2020; Ayhan Başer et al., 2020; Al Banna et al., 2020; Bäuerle et al., 2020; Choi et al., 2020; Cortés-Álvarez et al., 2020; Elhai et al., 2020; Fernández et al., 2020; Forte et al., 2020; Fu et al., 2020; Fullana et al., 2020; Galindo-Vázquez et al., 2020; Gao et al., 2020; Horesh et al., 2020; Huang and Zhao, 2020; Huarcaya-Victoria et al., 2020; Hyland et al., 2020; Islam et al., 2020; Kazmi et al., 2020; Lei et al., 2020; Liu et al., 2020; Moghanibashi-Mansourieh, 2020; Newby et al., 2020; Orellana and Orellana, 2020; Ozamiz-Etxebarria et al., 2020; Özdin and Bayrak Özdin, 2020; Palgi et al., 2020; Papandreou et al., 2020; Paulino et al., 2020; Pieh et al., 2020; Rettie and Daniels, 2020; Rodríguez-Rey et al., 2020; Shevlin et al., 2020; Shi et al., 2020; Solomou and Constantinidou, 2020; Stanton et al., 2020; Verma and Mishra, 2020; C. Wang et al., 2020a; Y. Wang et al., 2020; Zhao et al., 2020).

### 3.2. Characteristics of the studies included

The characteristics of the 43 included studies are summarized in

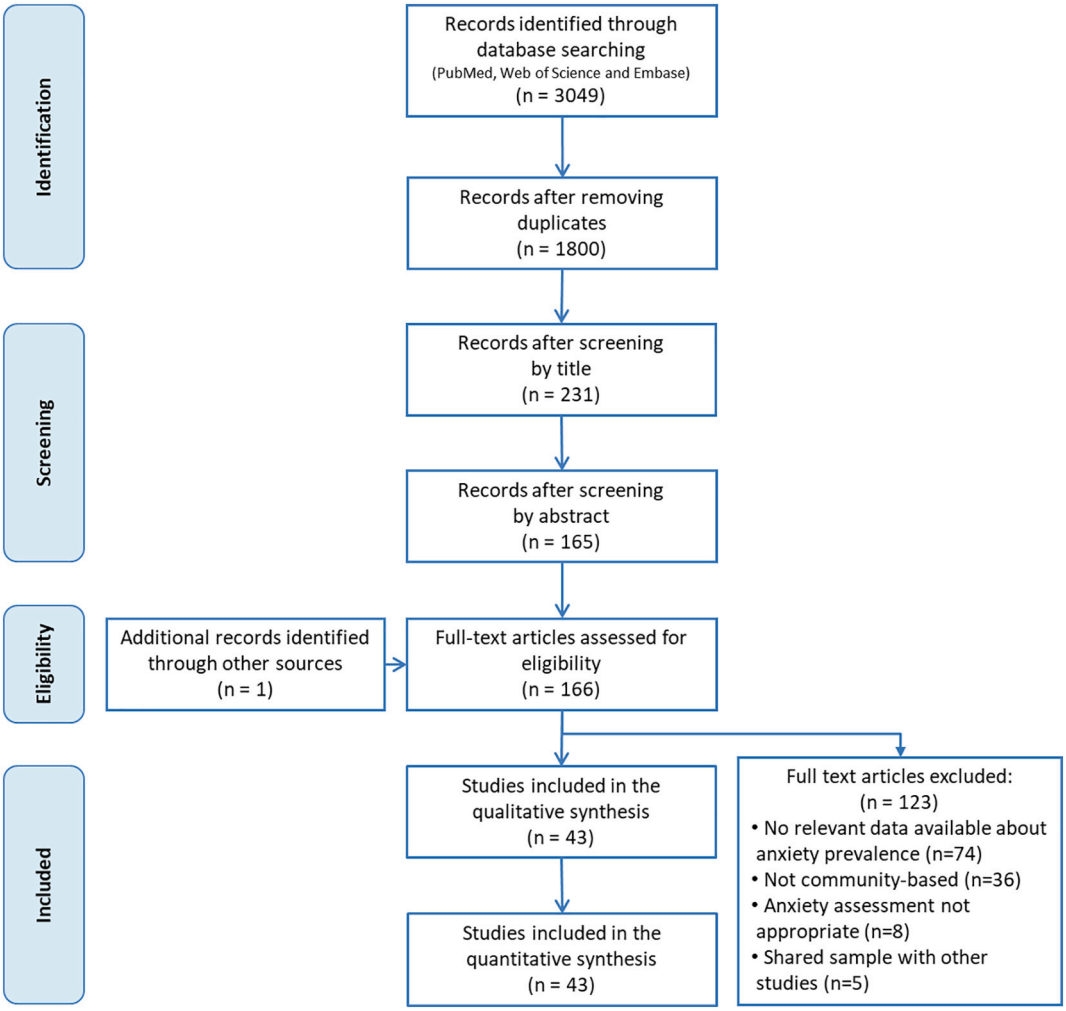


**Fig. 1.** Flowchart of the study selection.

**Table 2**
Characteristics of included studies in the meta-analysis.

| Author (Publication year) | Country | Mean age (SD) | % Females (n) | Sample size (n) | Response rate (%) | Sampling method | Anxiety assessment | Anxiety Diagnostic Criteria | Prevalence of anxiety | | Quality assessment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | % | n | |
| Ahmed et al. (2020a) | China | 33.54 (11.13) | 46.8% (503) | 1074 | Not reported | Convenience sampling | BAI | 8–15: mild; 16–25: moderate; 26–63: severe anxiety | 29.05% | 312 | 7 |
| Alkhamees et al. (2020) | Saudi Arabia | Not reported | 63.9% (741) | 1160 | Not reported | Convenience sampling | DASS-21 | 10–14: moderate; 15–19: severe; 20–42: extremely severe anxiety | 24.05% | 279 | 7 |
| Arafa et al. (2020) | Egypt | Not reported | 57.6% (939) | 1629 | 95.8% | Snowball sampling | DASS-21 | >8: mild-moderate; >16: severe and extremely severe anxiety | 53.50% | 872 | 7 |
| Ayhan Başer et al. (2020) | Turkey | 39.85 (11.95) | 64.5% (690) | 1070 | 98.0% | Convenience sampling | BAI | 8–15: mild; 16–25: moderate; 26–63: severe anxiety | 21.31% | 228 | 7 |
| Al Banna et al. (2020) | Bangladesh | 25.75 (6.75) | 28.5% (407) | 1427 | Not reported | Snowball sampling | DASS-21 | Not reported | 33.70% | 481 | 7 |
| Bäuerle et al. (2020) | Germany | Not reported | 70.7% (10633) | 15,037 | 83.1% | Not reported | GAD-7 | ≥10: presence of anxiety | 16.77% | 2522 | 8 |
| Choi et al. (2020) | China | 47.26 (15.82) | 54.8% (274) | 500 | 64.60% | Random sampling | GAD-7 | ≥10: presence of anxiety | 14.00% | 70 | 9 |
| Cortés-Álvarez et al. (2020) | Mexico | Not reported | 62.1% (686) | 1105 | 99.6% | Snowball sampling | DASS-21 | ≥10 moderate-severe anxiety | 22.60% | 250 | 7 |
| Elhai et al. (2020) | China | 43.37 (9.3) | 82.8% (752) | 908 | Not reported | Convenience sampling | DASS-21 | >5: moderate; >7: severe anxiety | 30.95% | 281 | 6 |
| Fernández et al. (2020) | Argentina | Not reported | 78.4% (3456) | 4408 | Not reported | Not reported | BSI-53 | ≥63 presence severe anxiety | 31.76% | 1400 | 7 |
| Forte et al. (2020) | Italy | 30.00 (11.5) | 74.6% (1708) | 2291 | 98.24% | Convenience sampling | STAI-S | >55: presence of anxiety | 37.19% | 852 | 8 |
| Fu et al. (2020) | China | Not reported | 69.7% (866) | 1242 | Not reported | Convenience sampling | GAD-7 | ≥5: presence of anxiety | 27.38% | 340 | 6 |
| Fullana et al. (2020) | Spain | 47 (NR) | 73% (NR) | 4399 | 79.3% | Not reported | GAD-7 | ≥10: presence of anxiety | 15.00% | 660 | 5 |
| Galindo-Vázquez et al. (2020) | Mexico | 34.46 (NR) | 74.5% (1123) | 1508 | Not reported | Convenience sampling | GAD-7 | ≥10: presence of anxiety | 48.41% | 730 | 7 |
| Gao et al. (2020) | China | 32.2 (10.0) | 67.7% (3267) | 4872 | 83.27% | Convenience sampling | GAD-7 | ≥10: presence of anxiety | 22.60% | 1101 | 8 |
| Guo et al. (2020) | China | 34.4 (11.1) | 56.1% (1307) | 2331 | 95.5% | Snowball sampling | HADS-A | ≥8: presence of anxiety | 25.40% | 592 | 8 |
| Horesh et al. (2020) | Israel | 45.86 (19.6) | 71.1% (145) | 204 | Not reported | Snowball sampling | BAI | Not reported | 16.18% | 33 | 6 |
| Huang and Zhao (2020) | China | 35.3 (5.6) | 54.6% (3952) | 7236 | 85.30% | Convenience sampling | GAD-7 | ≥9: presence of anxiety | 35.10% | 2540 | 8 |
| Huarcaya-Victoria et al. (2020) | Peru | 38.37 (12.75) | 65.6% (546) | 832 | 99.3% | Convenience sampling | GAD-7 | ≥10: presence of anxiety | 13.10% | 109 | 8 |
| Hyland et al. (2020) | Ireland | 44.97 (15.8) | 51.5% (536) | 1041 | Not reported | Quota sampling | GAD-7 | ≥10: presence of anxiety | 19.98% | 208 | 7 |
| Islam et al. (2020) | Bangladesh | 23.54 (5.0) | 39.6% (519) | 1311 | 97.4% | Not reported | GAD-7 | ≥10: presence of anxiety | 37.30% | 489 | 7 |
| Kazmi et al. (2020) | India | Not reported | 62% (620) | 1000 | 66.66% | Random sampling | DASS-21 | Not reported | 43.00% | 430 | 8 |
| Lei et al. (2020) | China | 32.3 (9.8) | 61.3% (976) | 1593 | 80.17% | Convenience sampling | SAS | 50–59: low; 60–69: moderate; ≥70: severe anxiety | 8.35% | 133 | 8 |
| Liu et al. (2020) | China | Not reported | 58.7% (357) | 569 | 98.06% | Snowball sampling | STAI-S | Not reported | 15.80% | 90 | 8 |
| Moghanibashi-Mansourieh (2020) | Iran | Not reported | 65.8% (7073) | 10,754 | 90% | Convenience sampling | DASS-21 | Not reported | 50.88% | 5472 | 8 |
| Newby et al. (2020) | Australia | Not reported | 85.8% (4348) | 5049 | 84.6% | Not reported | DASS-21 | Not reported | 49.57% | 2503 | 8 |
| | El Salvador | 31.1 (11.8) | 61.9% (210) | 339 | 98.8% | Snowball sampling | DASS-21 | Not reported | 26.84% | 91 | 7 |

(*continued on next page*)

**Table 2** (*continued*)

| Author (Publication year) | Country | Mean age (SD) | % Females (n) | Sample size (n) | Response rate (%) | Sampling method | Anxiety assessment | Anxiety Diagnostic Criteria | Prevalence of anxiety | | Quality assessment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | % | n | |
| Orellana and Orellana (2020) | | | | | | | | | | | |
| Ozamiz-Etxebarria et al. (2020) | Spain | 33.8 (16.6) | 79.5% (1584) | 1985 | 90.2% | Snowball sampling | DASS-21 | Not reported | 26.90% | 534 | 7 |
| Özdin and Bayrak Özdin (2020) | Turkey | 37.16 (10.3) | 49.3% (169) | 343 | Not reported | Not reported | HADS | Not reported | 45.19% | 155 | 7 |
| Palgi et al. (2020) | Israel | 46.21 (16.5) | 75.2% (798) | 1059 | Not reported | Snowball sampling | GAD-7 | ≥10: presence of anxiety | 18.98% | 201 | 7 |
| Papandreou et al. (2020) | Greece | 42.4 (11.7) | 66.7% (560) | 839 | Not reported | Convenience sampling | GAD-7 | ≥10: presence of anxiety | 13.23% | 111 | 7 |
| | Spain | 46.1 (13.3) | 70.3% (704) | 1002 | Not reported | Not reported | GAD-7 | ≥10: presence of anxiety | 12.28% | 123 | 7 |
| Paulino et al. (2020) | Portugal | 31.2 (9.7) | 83.4% (8834) | 10,529 | 95.6% | Not reported | DASS-21 | 10–14: moderate; 15–19: severe; 20–42: extremely severe anxiety | 16.96% | 1786 | 8 |
| Pieh et al. (2020) | Austria | Not reported | 52.2% (530) | 1009 | Not reported | Not reported | GAD-7 | ≥10: presence of anxiety | 19.13% | 193 | 7 |
| Rettie and Daniels (2020) | United Kingdom | 38.06 (14.7) | 79.9% (673) | 842 | 86.4% | Snowball sampling | GAD-7 | ≥10: presence of anxiety | 24.30% | 205 | 8 |
| Rodríguez-Rey et al. (2020) | Spain | 32.15 (12.9) | 71.5% (NR) | 3055 | Not reported | Snowball sampling | DASS-21 | 10–14: moderate; 15–19: severe; 20–42: extremely severe anxiety | 25.37% | 775 | 7 |
| Shevlin et al. (2020) | United Kingdom | 45.45 (15.9) | 51.7% (1047) | 2025 | Not reported | Quote sampling | GAD-7 | ≥10: presence of anxiety | 21.63% | 438 | 6 |
| Shi et al. (2020) | China | 35.97 (8.2) | 52.1% (29530) | 56,679 | 79.9% | Convenience sampling | GAD-7 | ≥10: presence of anxiety | 10.36% | 5871 | 8 |
| Solomou and Constantinidou (2020) | Cyprus | Not reported | 71.6% (1176) | 1642 | 99.4% | Mixed random and snowball sampling | GAD-7 | ≥10: presence of anxiety | 23.14% | 380 | 8 |
| Stanton et al. (2020) | Australia | 50.5 (14.9) | 67.0% (999) | 1491 | Not reported | Convenience sampling | DASS-21 | 4–5: mild; 6–7: moderate; 8–9: severe; ≥10: extremely severe anxiety | 21.19% | 316 | 7 |
| Verma and Mishra (2020) | India | Not reported | 48.3% (171) | 354 | 93.9% | Convenience sampling | DASS-21 | 10–14: moderate; 15–19: severe; 20–42: extremely severe anxiety | 28.00% | 99 | 7 |
| Wang et al. (2020a) | China | Not reported | 67.3% (814) | 1210 | 92.79% | Snowball sampling | DASS-21 | 7–9: mild; 10–14: moderate; 15–19: severe; ≥20: extremely severe anxiety | 36.36% | 440 | 8 |
| Wang et al. (2020b) | China | 34 (12) | 55.5% (333) | 600 | 99.17% | Not reported | SAS | 50–59: low; 60–69: moderate; ≥70: severe anxiety | 6.33% | 38 | 8 |
| Zhao et al. (2020) | China | Not reported | 64.1% (1284) | 2003 | Not reported | Not reported | BAI | 10–18: mild to moderate; 19–29: moderate to severe; 30–63: severe anxiety | 9.39% | 188 | 7 |

Abbreviations: BAI: Beck Anxiety Inventory; DASS: Depression Anxiety and Stress Scale; GAD: Generalized Anxiety Disorder scale; HADS: Hospital Anxiety and Depression Scale; SAS: Self-rating Anxiety Scale; STAI-S: State-Trait Anxiety Inventory, State subscale

Table 2. They reported 44 prevalence rates (2 from one study (Papandreou et al., 2020)), making a total of 161,556 individuals. Regarding study location, China was the most frequent country with 13 studies (Ahmed et al., 2020a; Choi et al., 2020; Elhai et al., 2020; Fu et al., 2020; Gao et al., 2020; Guo et al., 2020; Huang and Zhao, 2020; Lei et al., 2020; Liu et al., 2020; Shi et al., 2020; C. Wang et al., 2020a; Y. Wang et al., 2020; Zhao et al., 2020), followed by 12 European studies (Bäuerle et al., 2020; Forte et al., 2020; Fullana et al., 2020; Hyland et al., 2020; Ozamiz-Etxebarria et al., 2020; Papandreou et al., 2020; Paulino et al., 2020; Pieh et al., 2020; Rettie and Daniels, 2020; Rodríguez-Rey et al., 2020; Shevlin et al., 2020; Solomou and Constantinidou, 2020), 7 Middle Eastern studies (Alkhamees et al., 2020; Arafa et al., 2020;

Ayhan Başer et al., 2020; Horesh et al., 2020; Moghanibashi-Mansourieh, 2020; Özdin and Bayrak Özdin, 2020; Palgi et al., 2020), 4 Central and South American studies(Cortés-Álvarez et al., 2020; Fernández et al., 2020; Galindo-Vázquez et al., 2020; Huarcaya-Victoria et al., 2020; Orellana and Orellana, 2020), 5 South Asian studies (Al Banna et al., 2020; Islam et al., 2020; Kazmi et al., 2020; Verma and Mishra, 2020) and 2 Australian studies (Newby et al., 2020; Stanton et al., 2020). The sample size ranged from 204 to 56,679 participants, and the mean age ranged from 23.54 ± 5 years to 50.5 ± 14.9 years in the twenty-nine studies that did report it. All studies included both men and women, and the percentage of women was over 50% in 39 of the 44 studies, ranging from 28.5% to 85.8%. All studies were conducted using online questionnaires, and all but two (Choi et al., 2020; Kazmi et al., 2020) carried out non-randomised sampling. 26 studies reported the response rate, which averaged out at 89.81 and ranged from 64.6% to 99.6%. All studies measured anxiety using symptom-based scales: 17 used the Generalized Anxiety Disorder scale (GAD) (Bäuerle et al., 2020; Choi et al., 2020; Fu et al., 2020; Fullana et al., 2020; Galindo-Vázquez et al., 2020; Gao et al., 2020; Huang and Zhao, 2020; Huarcaya-Victoria et al., 2020; Hyland et al., 2020; Islam et al., 2020; Palgi et al., 2020;

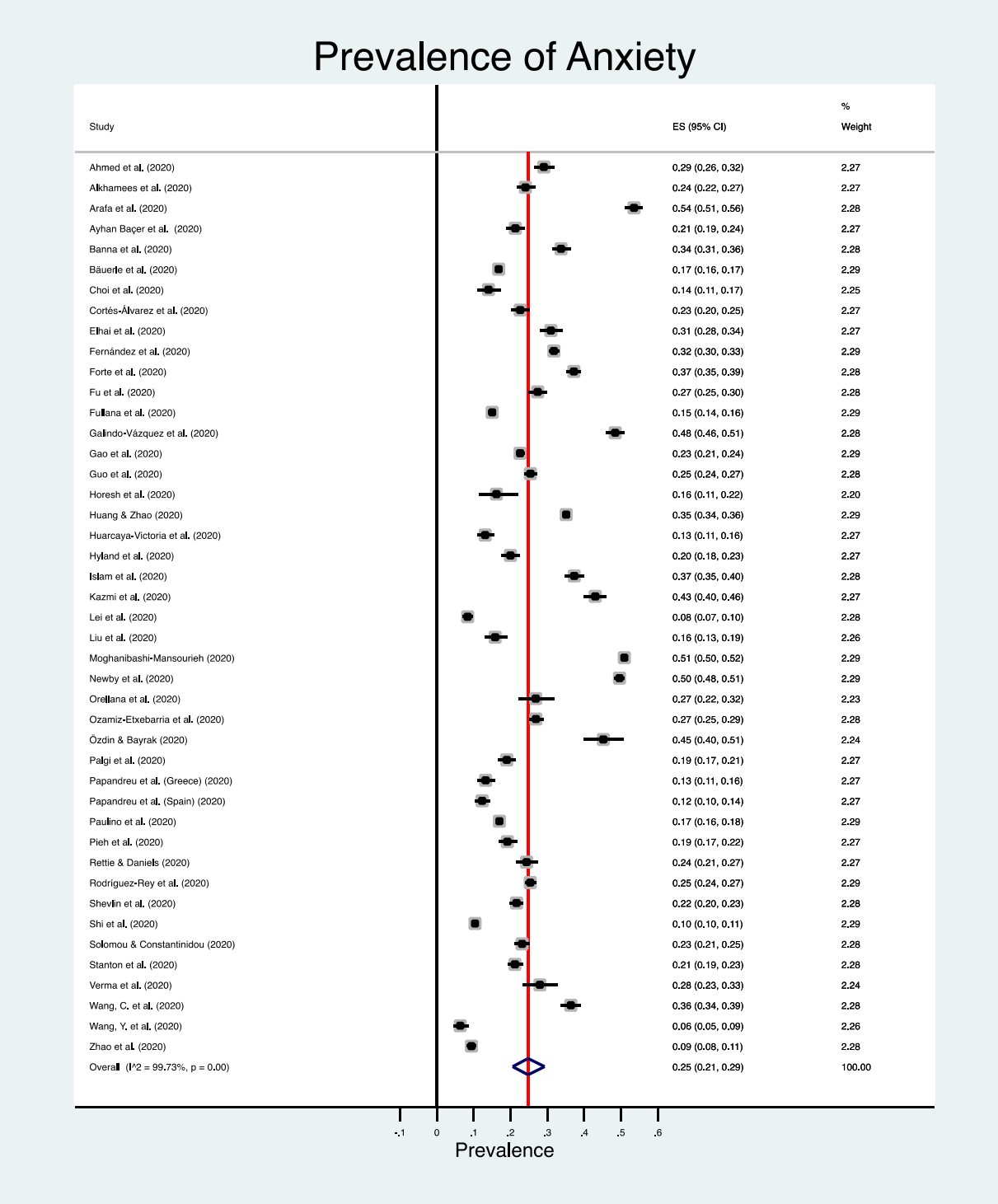


**Fig. 2.** Forest plot of the prevalence of anxiety.

Papandreou et al., 2020; Pieh et al., 2020; Rettie and Daniels, 2020; Shevlin et al., 2020; Shi et al., 2020; Solomou and Constantinidou, 2020), 15 used the Depression, Anxiety and Stress Scale (DASS) (Alkhamees et al., 2020; Arafa et al., 2020; Al Banna et al., 2020; Cortés-Álvarez et al., 2020; Elhai et al., 2020; Kazmi et al., 2020; Moghanibashi-Mansourieh, 2020; Newby et al., 2020; Orellana and Orellana, 2020; Ozamiz-Etxebarria et al., 2020; Paulino et al., 2020; Rodríguez-Rey et al., 2020; Stanton et al., 2020; Verma and Mishra, 2020; C. Wang et al., 2020a), 2 used the Zung Self-rating Anxiety Scale (SAS) (Lei et al., 2020; Y. Wang et al., 2020), 2 used State-Trait Anxiety Inventory (STAI) (Forte et al., 2020; Liu et al., 2020), 4 used the Beck Anxiety Inventory (BAI) (Ahmed et al., 2020b; Ayhan Başer et al., 2020; Horesh et al., 2020; Zhao et al., 2020), 2 used Hospital Anxiety and Depression Scale (HADS) (Guo et al., 2020; Özdin and Bayrak Özdin, 2020) and one used Brief Symptom Inventory-53 (BSI-53) (Fernández et al., 2020). The reported cut-off points used to classify anxiety are shown in Table 2. The studies reported highly diverse values of anxiety prevalence, ranging from 6.33% to 53.50%.

### 3.3. Quality assessment

The risk of bias scores ranged from 6 to 9 out of a possible total of 9, with a mean score of 7.3 (Supplementary Table 2). The most common limitations were: (a) sampling and recruitment of participants not appropriate or not specified and (b) response rate not reported, or large number of non-responders.

### 3.4. Meta-analysis of the prevalence of anxiety

The estimated overall prevalence of anxiety was 25% (95% CI: 21%–29%), with significant heterogeneity between studies ($I^2 = 99.7\%$, $p < 0.001$) (Fig. 2).

### 3.5. Meta-regression

Our meta-regression showed that prevalence of anxiety was independent of a study's percentage of women ($p = 0.980$), mean age at baseline ($p = 0.102$), response rate ($p = 0.848$), or methodological quality ($p = 0.950$).

### 3.6. Subgroup analysis

Neither study location nor sampling method was a significant moderator according to subgroup analysis. The only significant finding was a lower prevalence of anxiety for studies using the SAS (8% [95% CI: 7%–9%]) (Lei et al., 2020; Y. Wang et al., 2020) compared to those using the BAI (18% [95% CI: 9%–30%]) (Arafa et al., 2020; Ayhan Başer et al., 2020; Horesh et al., 2020; Zhao et al., 2020), the GAD (21% [95% CI: 17%–26%]) (Bäuerle et al., 2020; Choi et al., 2020; Fu et al., 2020; Fullana et al., 2020; Galindo-Vázquez et al., 2020; Gao et al., 2020; Huang and Zhao, 2020; Huarcaya-Victoria et al., 2020; Hyland et al., 2020; Islam et al., 2020; Palgi et al., 2020; Papandreou et al., 2020; Pieh et al., 2020; Rettie and Daniels, 2020; Shevlin et al., 2020; Shi et al., 2020; Solomou and Constantinidou, 2020), the HADS (28% [95% CI: 26%–29%]) (Guo et al., 2020; Özdin and Bayrak Özdin, 2020), the DASS (32% [95% CI: 24%–41%]) (Alkhamees et al., 2020; Arafa et al., 2020; Al Banna et al., 2020; Cortés-Álvarez et al., 2020; Elhai et al., 2020; Kazmi et al., 2020; Moghanibashi-Mansourieh, 2020; Newby et al., 2020; Orellana and Orellana, 2020; Ozamiz-Etxebarria et al., 2020; Paulino et al., 2020; Rodríguez-Rey et al., 2020; Stanton et al., 2020; Verma and Mishra, 2020; C. Wang et al., 2020a) or BSI (32% [95% CI: 30%–33%]) (Fernández et al., 2020), and the STAI (33% [95% CI: 31%–34%]) (Forte et al., 2020; Liu et al., 2020).

### 3.7. Sensitive analysis

Excluding each study one-by-one from the analysis did not substantially change the pooled prevalence of anxiety, which varied between 24% (95% CI: 20% - 29%), with Arafa et al. (2020) excluded, to 25% (95% CI: 21% - 30%), with Y. Wang et al. (2020) excluded. This indicates that no single study had a disproportional impact on the overall prevalence.

### 3.8. Risk of publication bias

Visual inspection of the funnel plot (Supplementary Fig. 1) suggested no presence of publication bias for the estimate of prevalence, confirmed by non-significant Begg ($p = 0.059$) and Egger ($p = 0.119$) test results.

## 4. Discussion

### 4.1. Main findings

The present meta-analysis of 43 large studies finds that the prevalence of anxiety in the general population during the COVID-19 outbreak is 25% (95% CI 21%–29%).

The main source of heterogeneity in rates of anxiety between studies was the scale used to assess anxiety, with the highest rates for studies using the DASS-21 and the lowest rates for studies using the SAS. This is consistent with the cut-off point in the SAS used for classifying anxiety in these studies (SAS 50+) having a much lower sensitivity (31%) than the diagnostic sensitivity of the DASS (74% for mild anxiety) (Dunstan et al., 2017).

### 4.2. Comparison with previous epidemiological data

Given that the overall prevalence of anxiety disorders around the globe is estimated to be normally around 7.3% (95% CI: 4.8% to 10.9%) (Stein et al., 2017), our results suggest that rates of anxiety in the general population could be more than 3 times higher during the COVID-19 outbreak.

The reported rates of anxiety in the general population during previous epidemic outbreaks (Severe Acute Respiratory Syndrome, SARS; H1N1 influenza, Ebola) ranged between 3.2% and 12.6% (Chew et al., 2020), which is lower than the rates of anxiety during COVID-19 that we have identified here. This could be because in past epidemics, despite higher fatality rates, infection rates were lower (such as H1N1 influenza, in 2009–2010) or the disease was quickly contained (such as Ebola, in 2014–2016) (Huremović, 2019). Long and undetermined periods of lockdown imposed by governments around the world could be contributing to higher rates of anxiety during COVID-19, consistent with the negative psychological effects of quarantine reported during the SARS outbreak in Toronto, Canada (Hawryluck et al., 2004). A previous meta-analysis (Salari et al., 2020) of the prevalence of anxiety in general population during the COVID-19 pandemic, including 17 studies, found even higher rates of anxiety than ours (31.9% (95%CI 27.5 to 36.7%)). A potential explanation for these differences might be that Asiatic samples were overrepresented and European samples underrepresented in comparison with our study. They found similar rates of anxiety that our meta-analysis when they analyzed separately European studies (23.8% (95%CI 16.2 to 33.5%)) (Salari et al., 2020).

### 4.3. Association between anxiety levels and COVID-19 relevant factors

#### 4.3.1. Time point of data collection

In the studies herein assessed, data were collected from January 7th to May 7th, coinciding with different time points of the pandemic in their respective areas, as represented in Fig. 3. As previous evidence on the H1N1 epidemic shows, anxiety tends to reach its highest point at the peak of the epidemic, then waning in concert with its decline (Liao et al.,

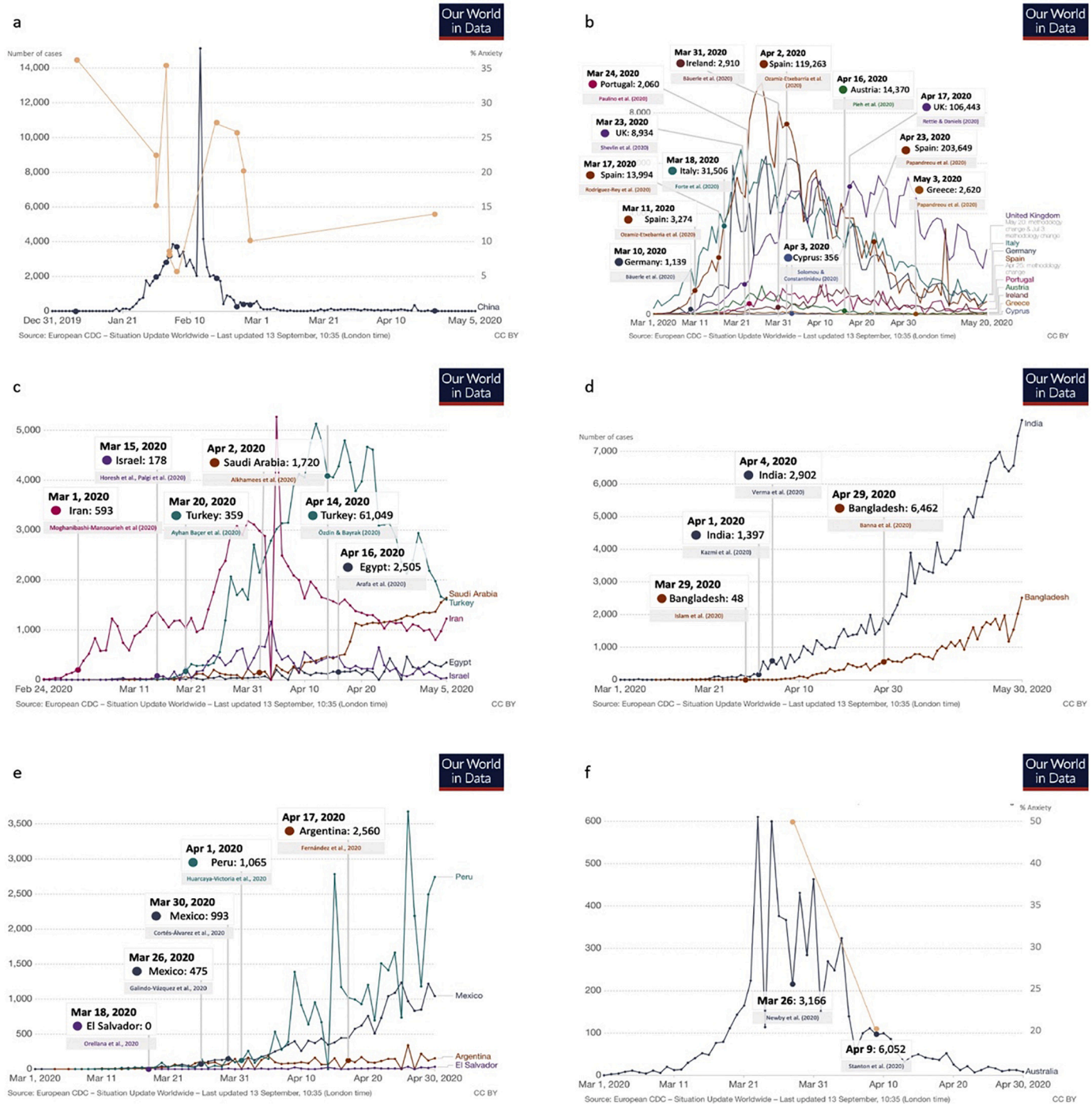


**Fig. 3.** Time point of data collection in the different studies within the epidemic curve of the pandemic in their respective countries. Epidemic curves show a linear depiction of the daily new cases of COVID-19 and the data indicate the total number of confirmed cases the day the study began. Adapted from existing graphs from Our World in Data (https://ourworldindata.org/coronavirus) (Roser et al., 2020). (a) Chinese studies (blue) and their prevalence of anxiety (orange). (b) European studies. (c) Middle East studies. (d) South Asian studies. (e) Central and South American studies. (f) Australian studies (blue) and their prevalence of anxiety (orange). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

2014). Thus, disparities in time of data collection could account for some of the heterogeneity among the prevalence values retrieved. For example, a Spanish study examining anxiety prevalence between March 11th and 18th (right before the declaration of the state of alarm and the imposition of mandatory quarantine) and April 2nd and 12th, found significantly higher scores for depression, anxiety, and stress symptoms during the second time interval, when the curve had a negative slope (Ozamiz-Etxebarria et al., 2020). Similar trends can be observed when comparing the studies conducted in the United Kingdom (Rettie and Daniels, 2020; Shevlin et al., 2020), Turkey (Ayhan Başer et al., 2020; Özdin and Bayrak Özdin, 2020) and Australia (Newby et al., 2020; Stanton et al., 2020) (see Fig. 3b,c,f). With regard to Chinese studies (see Fig. 3a), juxtaposition may be equivocal, as three of the studies carried out at the peak of the pandemic use tools of lower sensitivity, as has been explained above (Lei et al., 2020; Y. Wang et al., 2020; Zhao et al., 2020). Variance may also stem from the different provinces assessed. Even so, the high anxiety levels during the initial phase of the pandemic can be attributed to a higher degree of uncertainty regarding COVID-19

because the first study revealed that nearly all respondents desired additional information about the disease (C. Wang et al., 2020a). High anxiety levels are expected to remain high, or even increase as the epidemic spreads, consistent with findings of C. Wang et al., who found no significant difference in the anxiety levels of two separate samples of the Chinese general population at different time points, the first during the initial outbreak and the second during the epidemic's peak four weeks later (C. Wang et al., 2020a, 2020b). Contrarily, a decreasing trend can be observed for those studies taking place after the pandemic had peaked (Choi et al., 2020; Elhai et al., 2020; Fu et al., 2020; Guo et al., 2020; Shi et al., 2020).

#### 4.3.2. Sex

Most studies show significantly higher anxiety levels in women (Alkhamees et al., 2020; Arafa et al., 2020; Ayhan Başer et al., 2020; Al Banna et al., 2020; Bäuerle et al., 2020; Cortés-Álvarez et al., 2020; Fernández et al., 2020; Forte et al., 2020; Fu et al., 2020; Fullana et al., 2020; Galindo-Vázquez et al., 2020; Gao et al., 2020; Guo et al., 2020; Horesh et al., 2020; Huang and Zhao, 2020; Huarcaya-Victoria et al., 2020; Hyland et al., 2020; Islam et al., 2020; Kazmi et al., 2020; Lei et al., 2020; Liu et al., 2020; Moghanibashi-Mansourieh, 2020; Newby et al., 2020; Orellana and Orellana, 2020; Ozamiz-Etxebarria et al., 2020; Özdin and Bayrak Özdin, 2020; Palgi et al., 2020; Papandreou et al., 2020; Paulino et al., 2020; Pieh et al., 2020; Rettie and Daniels, 2020; Rodríguez-Rey et al., 2020; Shevlin et al., 2020; Shi et al., 2020; Solomou and Constantinidou, 2020; Stanton et al., 2020; C. Wang et al., 2020a; Y. Wang et al., 2020; Zhao et al., 2020). This is consistent with previous epidemiological data (Bandelow and Michaelis, 2015).

Many arguments have been put forward to justify this finding. First, females are socialized to more openly and strongly experience their emotions (Fu et al., 2020). Second, differences in brain chemistry and hormones between men and women have been hypothesized to mediate the higher anxiety rates in females (Fu et al., 2020; Stanikova et al., 2019). Third, women are usually the main caregivers within families, which could make them more vulnerable to the increased burden at home following the closure of schools and other facilities (Rodríguez-Rey et al., 2020). In this sense, one study found that women perceived a stronger deterioration of family ties during the quarantine, which correlated with a greater perception of their routine being altered (Orellana and Orellana, 2020), and the two Bangladeshi studies reported the greatest anxiety levels for housewives (Al Banna et al., 2020; Islam et al., 2020). In another study, women showed higher stress levels than men (Stanton et al., 2020). This could substantially reduce a woman's ability to perform their work, hindering their economic stability (Rodríguez-Rey et al., 2020), which can also explain why, in one study, women showed higher levels of worry about the effect of the virus on their financial status (Horesh et al., 2020). Fourth, feelings of anxiety could be mediated by an increased psychological impact of COVID-19 (Paulino et al., 2020; Shevlin et al., 2020), possibly due to an intensified fear of the virus and worry about close relatives and friends being infected (Horesh et al., 2020). In one study, however, females only scored higher for general anxiety, not COVID-19 anxiety (Hyland et al., 2020), and another study reported increased anxiety scores in men (C. Wang et al., 2020a). This could be related to lower compliance with precautionary measures (Solomou and Constantinidou, 2020), more frequency of risky behaviors (e.g., going to crowded places or not wearing masks), or a higher infective rate in males (Shi et al., 2020). Finally, many studies concluded that women were also at a higher risk of developing depression during the pandemic (Salari et al., 2020), which is a risk factor for anxiety (Jacobson and Newman, 2017). Nevertheless, in one case, higher female higher levels of anxiety remained present, even though stress and depression where higher in males (Kazmi et al., 2020).

#### 4.3.3. Age

Increased rates of anxiety were also consistently found to be associated with younger age (Ahmed et al., 2020b; Alkhamees et al., 2020; Al Banna et al., 2020; Bäuerle et al., 2020; Cortés-Álvarez et al., 2020; Fernández et al., 2020; Forte et al., 2020; Fullana et al., 2020; Guo et al., 2020; Horesh et al., 2020; Huang and Zhao, 2020; Hyland et al., 2020; Islam et al., 2020; Kazmi et al., 2020; Lei et al., 2020; Liu et al., 2020; Moghanibashi-Mansourieh, 2020; Newby et al., 2020; Orellana and Orellana, 2020; Ozamiz-Etxebarria et al., 2020; Palgi et al., 2020; Paulino et al., 2020; Pieh et al., 2020; Rettie and Daniels, 2020; Rodríguez-Rey et al., 2020; Shi et al., 2020; Solomou and Constantinidou, 2020; Stanton et al., 2020; Y. Wang et al., 2020; Zhao et al., 2020). This may stem from uncertainty about the future of jobs and careers (Kazmi et al., 2020), as younger individuals also show more financial worries (Horesh et al., 2020),; or because this segment of the population tends to collect information from social media (Ahmed et al., 2020b; Elhai et al., 2020; Liu et al., 2020). Whereas younger participants' excessive smartphone use appeared to be driven by increased every-day anxiety (e.g. financial worry, worry about social and intimate relationship formation and maintenance, missing out on rewarding experiences, etc.), rather than worry about COVID-19 itself (Elhai et al., 2020), which was higher among older individuals (Hyland et al., 2020; Shevlin et al., 2020), it can also reinforce their anxiety. For instance, being frequently exposed to social media or following coronavirus news for more than 2 or 3 h per day was found to increase the odds of anxiety up to 3 times (Arafa et al., 2020; Fullana et al., 2020; Gao et al., 2020; Huang and Zhao, 2020; Moghanibashi-Mansourieh, 2020; Rodríguez-Rey et al., 2020). This is consistent with "emotional epidemiology" defined by Ofri: social media can generate immediate flooding of fear during the rapid spread of a disease, independent of real risk (Ofri, 2009).

#### 4.3.4. Marital status, living arrangements, and social support

The effect of civil status on anxiety varied from study to study, possibly due to cultural differences. In two Chinese reports, anxiety was highest in individuals who were divorced or widowed (Lei et al., 2020; Zhao et al., 2020), whereas in one Australian and another Spanish study, this group was surpassed by those who had never been married, or those who were in a relationship but not cohabiting (Rodríguez-Rey et al., 2020; Stanton et al., 2020).

Most of the studies investigating marital status found increased anxiety in married residents compared to their unmarried counterparts (Al Banna et al., 2020; Fu et al., 2020; Gao et al., 2020; Islam et al., 2020; Palgi et al., 2020; Zhao et al., 2020). One reason for this could be an increased sense of responsibility for their families, for married participants tended to worry about their family members' health instead of themselves (Fu et al., 2020). Higher anxiety levels in married participants could also be related to household size, although this effect is not homogeneous, For example, two studies reported higher anxiety for subjects with children (Fullana et al., 2020; Shevlin et al., 2020), and another one for individuals living with more than 3 people (Solomou and Constantinidou, 2020). On the other hand, one Spanish study found that having children mitigated anxiety levels only for those who had two or fewer children, whose children were over 10 years old or who did not live with them (Rodríguez-Rey et al., 2020). This is likely to be due to increased family burden with the closure of schools and increased family conflicts in areas where mandatory confinement gathers several people under the same roof (Guo et al., 2020; Orellana and Orellana, 2020). Interestingly, people whose houses' were sized was more than 120 square meters and had open-air space showed lower psychological impact, stress, anxiety, and depression (Rodríguez-Rey et al., 2020).

Finally, it is noteworthy to mention that the negative effect of marriage and uninterrupted cohabitation on anxiety might be reduced by the protective effect of marriage on depression (Cortés-Álvarez et al., 2020; Galindo-Vázquez et al., 2020; Hyland et al., 2020; Lei et al., 2020; Shi et al., 2020), which provides a rationale for why increased anxiety in married respondents did not reach significant levels in some cases (Alkhamees et al., 2020; Cortés-Álvarez et al., 2020; Fernández et al., 2020; Horesh et al., 2020; Lei et al., 2020; Moghanibashi-Mansourieh,

2020; Özdin and Bayrak Özdin, 2020; Shi et al., 2020; Verma and Mishra, 2020; C. Wang et al., 2020a). In this sense, several studies reported that feelings of loneliness and lack of social support were among the strongest correlators with anxiety during the pandemic (Arafa et al., 2020; Fullana et al., 2020; Horesh et al., 2020; Newby et al., 2020; Palgi et al., 2020), which is in line with previous research showing that social isolation influences negative affectivity (Elhai et al., 2020). Remarkably, anxiety was found to be reduced by communicating frequently through online video, which should be encouraged in times of social isolation (Fu et al., 2020).

#### 4.3.5. Occupational status and financial stability

Anxiety appeared to reach higher levels among unemployed individuals and those who had not been able to return to work or work from home when confinement was imposed (Al Banna et al., 2020; Choi et al., 2020; Kazmi et al., 2020; Papandreou et al., 2020; Paulino et al., 2020; Pieh et al., 2020; Shi et al., 2020; Solomou and Constantinidou, 2020), as well as those who perceived a high risk of job loss or had suffered loss of income due to COVID-19 (Fullana et al., 2020; Guo et al., 2020; Hyland et al., 2020; Lei et al., 2020; Rodríguez-Rey et al., 2020; Shevlin et al., 2020). The lack of work can not only affect a person's financial stability, which is a predictor of anxiety, but can also affect the psycho-social functioning of individuals through a lack of daily routine and scheduling (Kazmi et al., 2020).

Furthermore, individuals who were teleworking showed less psychological impact and anxiety than those working in their ordinary workplace (Paulino et al., 2020; Rodríguez-Rey et al., 2020).

High levels of anxiety and distress were also found in Saudi Arabian, Salvadorian, Chinese, and Spanish students (Alkhamees et al., 2020; Lei et al., 2020; Liu et al., 2020; Orellana and Orellana, 2020; Rodríguez-Rey et al., 2020; C. Wang et al., 2020a), but not in Portuguese or Bangladeshi students (Al Banna et al., 2020; Islam et al., 2020; Paulino et al., 2020). It is likely that the relationship between student status and anxiety is mediated by age. Interestingly, an opposite tendency was found for anxiety in Medicine students, whose greater perceived sufficiency of information on COVID-19's prognosis and transmission and higher use of reliable sources of information, rather than social media alone (Saddik, 2020) have been hypothesized to act as protective factors against anxiety (Lasheras et al., 2020).

In addition, the majority of studies did not find any significant differences between anxiety levels in frontline health workers and the rest (Alkhamees et al., 2020; Forte et al., 2020; Huang and Zhao, 2020; Shi et al., 2020; Solomou and Constantinidou, 2020). It is possible that the effect on anxiety of poor sleep quality and high risk of infection in this group (Huang and Zhao, 2020; Lai et al., 2020) may have been reduced by the protective effect of working on the preservation of routine and financial stability.

Finally, most studies agreed that high income is a protective factor against anxiety during the pandemic (Fernández et al., 2020; Horesh et al., 2020; Lei et al., 2020; Pieh et al., 2020; Rodríguez-Rey et al., 2020; Shevlin et al., 2020; Shi et al., 2020).

#### 4.3.6. Education

The level of education negatively correlated with anxiety in most studies (Alkhamees et al., 2020; Arafa et al., 2020; Gao et al., 2020; Islam et al., 2020; Newby et al., 2020; Paulino et al., 2020; Rodríguez-Rey et al., 2020; Shi et al., 2020; Solomou and Constantinidou, 2020; Zhao et al., 2020). Opposite results were found in one case, where the association between education and pro-active coping styles for anxiety (e.g., reading, physical activity, and seeking psychological support from family) was mitigated by a higher proportion of sleep disorders (Fu et al., 2020), and in another study where, with the increase in years of education, the level of anxiety also increased due to a majority of female participants (Moghanibashi-Mansourieh, 2020).

#### 4.3.7. Knowledge on COVID

Ensuring that the general population receive enough timely and transparent information during Health Emergencies is critical for healthy psychological self-adaptation (Lasheras et al., 2020). This is underpinned by all of the studies included investigating this issue, where regular updates of the latest information were preferred by nearly all the respondents and were associated with lower levels of anxiety (Bäuerle et al., 2020; Cortés-Álvarez et al., 2020; Liu et al., 2020; Rodríguez-Rey et al., 2020; C. Wang et al., 2020a). Similarly, a low level of satisfaction or trust concerning the actions and information provided by the government correlated with high anxiety scores (Bäuerle et al., 2020; Cortés-Álvarez et al., 2020).

Regarding the main source of information, one study found a non-significant tendency for increased anxiety levels when information was retrieved from less reliable sources, that is, social media, parents, and friends, followed by the Internet or the TV, newspapers and magazines, and scientific journals (Cortés-Álvarez et al., 2020). On the contrary, a Saudi Arabian study found higher anxiety scores for those retrieving information from the World Health Organization versus local news (Alkhamees et al., 2020). This might reflect the high level of satisfaction with government reports in this population (Alkhamees et al., 2020), or an increased awareness of the pandemic severity in other areas, which could possibly lead to anticipated worry, as has occurred in the past (Liao et al., 2014).

#### 4.3.8. Epidemiological risk, clinical risk and worry about infection

As expected, worry about infection of oneself or loved ones was common in the respondents and correlated strongly with anxiety (Choi et al., 2020; Elhai et al., 2020; Fernández et al., 2020; Huarcaya-Victoria et al., 2020; Islam et al., 2020; Lei et al., 2020; Liu et al., 2020; Newby et al., 2020; Paulino et al., 2020; Rodríguez-Rey et al., 2020; C. Wang et al., 2020a). People were also concerned that the health care system could not cope with the COVID-19 pandemic (Choi et al., 2020), its economic impact, and uncertainty about when the crisis is going to end (Newby et al., 2020; Rodríguez-Rey et al., 2020). In this sense, those who had negative perceptions regarding the pandemic (e.g. "the worst of the crisis has not yet passed") or perceived threat of death from COVID-19 showed higher anxiety scores (Al Banna et al., 2020; Elhai et al., 2020; Liu et al., 2020).

Similarly, high anxiety levels were found in respondents with certain epidemiological risk factors, such as exposure to other people at work (Shi et al., 2020), history of direct or indirect contact (Cortés-Álvarez et al., 2020; Shi et al., 2020; C. Wang et al., 2020a), having friends or relatives with COVID (Moghanibashi-Mansourieh, 2020; Özdin and Bayrak Özdin, 2020; Rodríguez-Rey et al., 2020), having a shortage of surgical masks for personal protection (Choi et al., 2020); as well as among those having COVID symptoms with no diagnosis (Alkhamees et al., 2020; Cortés-Álvarez et al., 2020; Fullana et al., 2020; Shi et al., 2020) or a confirmed infection (Hyland et al., 2020; Paulino et al., 2020). In this sense, only some studies, mostly Chinese, reported higher odds of anxiety in respondents located closer to the infection focus (Fu et al., 2020; Gao et al., 2020; Guo et al., 2020; Lei et al., 2020; Moghanibashi-Mansourieh, 2020; Shi et al., 2020; Zhao et al., 2020).

Finally, individuals with pre-existing chronic diseases or who reported having poor health showed increased anxiety in most studies (Alkhamees et al., 2020; Gao et al., 2020; Guo et al., 2020; Horesh et al., 2020; Lei et al., 2020; Newby et al., 2020; Ozamiz-Etxebarria et al., 2020; Özdin and Bayrak Özdin, 2020; Palgi et al., 2020; Rettie and Daniels, 2020; Rodríguez-Rey et al., 2020; Shevlin et al., 2020; Solomou and Constantinidou, 2020; Stanton et al., 2020; C. Wang et al., 2020a). In some cases, living with people with chronic health problems had the same effect (Guo et al., 2020; Horesh et al., 2020; Hyland et al., 2020; Shevlin et al., 2020). Likewise, having a history of previous or current psychiatric illness increased anxiety levels (Alkhamees et al., 2020; Ayhan Başer et al., 2020; Fernández et al., 2020; Fullana et al., 2020; Newby et al., 2020; Özdin and Bayrak Özdin, 2020; Rettie and Daniels,

2020; Shi et al., 2020; Solomou and Constantinidou, 2020).

#### 4.3.9. Lifestyle determinants

In most studies, participants had been put under mandatory quarantine, which can have a detrimental impact on mental health through alteration of routines and a reduction in social interactions (Guo et al., 2020; Lei et al., 2020; Orellana and Orellana, 2020; Zhao et al., 2020). In fact, one study found that distress levels increased on a par with the amount of days without leaving the house (Rodríguez-Rey et al., 2020). This is consistent with previous research that concluded that the psychological effects of quarantine are proportional to its duration (Hawryluck et al., 2004).

Interestingly, those who remained physically active or took the opportunity to pursue hobbies showed reduced anxiety levels (Fu et al., 2020; Fullana et al., 2020; Guo et al., 2020; Papandreou et al., 2020; Pieh et al., 2020; Rodríguez-Rey et al., 2020; Stanton et al., 2020). This can be explained by several physiological mechanisms: first, exercise helps maintain an adequate energy and brain oxygen supply; also, it can divert attention from the epidemic and reduce panic; and third, it is associated with better sleep quality (Fu et al., 2020). In this sense, practicing exercise can be a practical strategy to prevent sleep disorders, which are independent risk factors for anxiety during the pandemic (Guo et al., 2020; Papandreou et al., 2020; Stanton et al., 2020). Other adaptive coping strategies involve acceptance, active coping (e.g., support seeking, taking actions to improve the situation), and religion (Rettie and Daniels, 2020).

Alcohol intake and smoking were associated with anxiety (Fernández et al., 2020; Papandreou et al., 2020; Stanton et al., 2020; Verma and Mishra, 2020). Similarly, unhealthy eating behaviors (e.g., food restraint, emotional and external eating, binge eating, snacking between meals, etc.) and following an unbalanced diet correlated with greater levels of anxiety in Greece and Spain (Fullana et al., 2020; Papandreou et al., 2020).

#### 4.3.10. Personality

Higher scores on neuroticism, agreeableness, and conscientiousness were associated with more intense psychological distress, whereas higher levels on resilience and active coping skills during the quarantine had the opposite effect (Fernández et al., 2020). Similarly, individuals with high intolerance of uncertainty were more likely to use maladaptive coping strategies, such as self-distraction, denial, behavioral disengagement (e.g., giving up), which mediated increased rates of anxiety and depression (Rettie and Daniels, 2020).

### 4.4. Clinic and public health implications

Our study supports the need for integration of mental health considerations into COVID-19 care, including the monitoring of psychological symptoms and social needs within the general population (Pfefferbaum and North, 2020). Anxiety is a normal reaction to a stressful situation, and the response to supportive interventions and coping strategies is generally positive (Huremović, 2019; Pfefferbaum and North, 2020). For example, increased anxiety levels during the pandemic are associated with fuller compliance with governmental measures and hygienic practices (Orellana and Orellana, 2020; Paulino et al., 2020). Nevertheless, anxiety about health matters can easily become excessive during an outbreak of infectious disease. At an individual level, this can manifest as panic behaviors (repeated medical consultations, avoiding health care even if needed, hoarding of specific items, etc.); at a social level, it can lead to mistrust of public authorities, non-adherence to infection control measures, and stigmatization of particular groups (Asmundson and Taylor, 2020).

Given that some of the factors correlating with anxiety have been clearly identified, efforts should be made to reduce their impact. First, strategies should be developed to ensure early diagnosis of mental health problems, especially among the most vulnerable groups herein described. In this sense, current guidelines of cognitive-behavioral therapy for generalized anxiety may benefit from incorporating intolerance of uncertainty and maladaptive coping as modifiable risk factors (Rettie and Daniels, 2020). Second, under strict lockdown and with the closure of schools, resources should be gathered for parents who have to continue working and cannot leave their children unsupervised. Third, social support networks should be enhanced and established within population subgroups to safeguard their mental wellbeing (Sim et al., 2010). Similarly, basic (e.g., problem-solving, confrontation, family interventions, relaxation techniques, etc.) and more complex psychotherapeutic interventions (e.g., cognitive-behavior therapy) could be delivered online or via telephone to counteract anxiety in the home environment. Fourth, authorities should make efforts to deliver timely, transparent, and comprehensive information to the community regarding the disease outbreak in order to decrease uncertainty about the disease. Fifth, strict confinement should be avoided whenever possible, providing individuals with the possibility of spending some time outdoors, especially for those who do not have a residence with open-air space. Likewise, exercising, pursuing leisure activities, and communicating frequently through telephone or online video should be encouraged in times of social isolation and confinement. Finally, alcohol, tobacco, and drug consumption should be discouraged and disincentivized, at the same time as resources are ensured for those suffering from an addiction in times when access to drugs is limited.

### 4.5. Strengths and limitations

To our knowledge, this is the second meta-analysis of all available studies of anxiety in the general population during the COVID-19 outbreak. As a meta-analysis, it has greater power than any individual study to estimate more accurate rates of anxiety, by considering a much larger population drawn from across different countries. Moreover, this is the first study to systematically report all factors correlating with anxiety that have been identified so far during the COVID-19 pandemic, and to assess results with regard to the time of data collection within the epidemic curve in each country.

However, there are some limitations that should be considered when interpreting our results. Firstly, only 8 out of the 21 countries included were subject to more than one study, and sometimes direct comparison between them was hindered by methodological differences (e.g., several anxiety scales). Even so, the use of different scales to assess anxiety was a major source of the heterogeneity in the prevalence rates reported by the studies. Secondly, all studies had particular constraints derived from the unusual circumstances surrounding the COVID-19 outbreak. These include randomization of the sample being rarely used (Choi et al., 2020; Kazmi et al., 2020) and obtaining data via online surveys, which could entail selection biases such as oversampling of younger or more educated people (Moghanibashi-Mansourieh, 2020; Wang et al., 2020a). Also, the assessment of anxiety by self-reported scales rather than clinical interviews might bias prevalence rates, because respondents may not respond truthfully, but in a socially acceptable way (Demetriou et al., 2015). Finally, all of the included studies were cross-sectional and may have assessed anxiety at different stages of the outbreak and after a different duration of quarantine.

## 5. Conclusions

Given an overall global prevalence of anxiety disorders estimated to be normally around 7.3%, our results suggest that rates of anxiety in the general population could be 3 times higher during the COVID-19 outbreak. Therefore, several individual and population-level strategies should be implemented in order to preserve the mental wellbeing of vulnerable groups and decrease the impact of several modifiable factors associated with anxiety.

## Ethical statement

Given that the work herein presented is a meta-analysis and systematic review of existing studies, no ethical considerations apply.

## Author statement

JS, IL and JBN designed the review, developed the inclusion criteria, screened titles and abstracts, appraised the quality of included papers, and drafted the manuscript.

DML and RLA reviewed the study protocol and inclusion criteria and provided substantial input to the manuscript.

CDL, PGG and AL reviewed the study protocol. MPM read and screened articles for inclusion. All authors critically reviewed drafts and approved the final manuscript.

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## Declaration of Competing Interest

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pnpbp.2020.110207.

## References

Ahmed, M.Z., Ahmed, O., Aibao, Z., Hanbin, S., Siyu, L., Ahmad, A., 2020a. Epidemic of COVID-19 in China and associated psychological problems. Asian J. Psychiatr. 51, 102092. https://doi.org/10.1016/j.ajp.2020.102092.

Ahmed, M.Z., Ahmed, O., Aibao, Z., Hanbin, S., Siyu, L., Ahmad, A., 2020b. Epidemic of COVID-19 in China and associated psychological problems. Asian J. Psychiatr. 51, 102092. https://doi.org/10.1016/j.ajp.2020.102092.

Al Banna, M.H., Sayeed, A., Kundu, S., Christopher, E., Hasan, M.T., Begum, M.R., Kormoker, T., Dola, S.T.I., Hassan, M.M., Chowdhury, S., Khan, M.S.I., 2020. The impact of the COVID-19 pandemic on the mental health of the adult population in Bangladesh: a nationwide cross-sectional study. Int. J. Environ. Health Res. 1–12. https://doi.org/10.1080/09603123.2020.1802409.

Alkhamees, A.A., Alrashed, S.A., Alzunaydi, A.A., Almohimeed, A.S., Aljohani, M.S., 2020. The psychological impact of COVID-19 pandemic on the general population of Saudi Arabia. Compr. Psychiatry 102, 152192. https://doi.org/10.1016/j.comppsych.2020.152192.

Arafa, A., Mohamed, A., Saleh, L., Senosy, S., 2020. Psychological impacts of the COVID-19 pandemic on the public in Egypt. Community Ment. Health J. https://doi.org/10.1007/s10597-020-00701-9.

Asmundson, G.J.G., Taylor, S., 2020. How health anxiety influences responses to viral outbreaks like COVID-19: what all decision-makers, health authorities, and health care professionals need to know. J. Anxiety Disord. 71, 102211. https://doi.org/10.1016/j.janxdis.2020.102211.

Ayhan Başer, D., Çevik, M., Gümüştakim, Ş., Başara, E., 2020. Assessment of individuals' attitude, knowledge and anxiety towards COVID-19 at the first period of the outbreak in Turkey: a web-based cross-sectional survey. Int. J. Clin. Pract. 1–8. https://doi.org/10.1111/ijcp.13622.

Bandelow, B., Michaelis, S., 2015. Epidemiology of anxiety disorders in the 21st century. Dialogues Clin. Neurosci. 17, 327–335. https://doi.org/10.1016/j.siny.2015.10.004.

Bäuerle, A., Teufel, M., Musche, V., Weismüller, B., Kohler, H., Hetkamp, M., Dörrie, N., Schweda, A., Skoda, E., 2020. Increased generalized anxiety, depression and distress during the COVID-19 pandemic: a cross-sectional study in Germany. J. Public Health (Bangkok) 1–7. https://doi.org/10.1093/pubmed/fdaa106.

Begg, C.B., Mazumdar, M., 1994. Operating characteristics of a rank correlation test for publication bias. Biometrics 50, 1088–1101.

Bueno-Notivol, J., Gracia-García, P., Olaya, B., Lasheras, I., López-Antón, R., Santabárbara, J., 2020. Prevalence of depression during the COVID-19 outbreak: a meta-analysis of community-based studies. Int. J. Clin. Health Psychol. https://doi.org/10.1016/j.ijchp.2020.07.007.

Bults, M., Beaujean, D.J.M.A., Richardus, J.H., Voeten, H.A.C.M., 2015. Perceptions and Behavioral responses of the general public during the 2009 influenza a (H1N1) pandemic: a systematic review. Disaster Med. Public Health Prep. 9, 207–219. https://doi.org/10.1017/dmp.2014.160.

Chan, E.Y.Y., Cheng, C.K.Y., Tam, G., Huang, Z., Lee, P., 2015. Knowledge, attitudes, and practices of Hong Kong population towards human a/H7N9 influenza pandemic preparedness, China, 2014. BMC Public Health 15, 943. https://doi.org/10.1186/s12889-015-2245-9.

Chew, N.W.S., Lee, G.K.H., Tan, B.Y.Q., Jing, M., Goh, Y., Ngiam, N.J.H., Yeo, L.L.L., Ahmad, A., Ahmed Khan, F., Napolean Shanmugam, G., Sharma, A.K., Komalkumar, R.N., Meenakshi, P.V., Shah, K., Patel, B., Chan, B.P.L., Sunny, S., Chandra, B., Ong, J.J.Y., Paliwal, P.R., Wong, L.Y.H., Sagayanathan, R., Chen, J.T., Ying Ng, A.Y., Teoh, H.L., Tsivgoulis, G., Ho, C.S., Ho, R.C., Sharma, V.K., 2020. A multinational, multicentre study on the psychological outcomes and associated physical symptoms amongst healthcare workers during COVID-19 outbreak. Brain Behav. Immun. 1. https://doi.org/10.1016/j.bbi.2020.04.049.

Choi, E.P.H., Hui, B.P.H., Wan, E.Y.F., 2020. Depression and anxiety in Hong Kong during covid-19. Int. J. Environ. Res. Public Health 17. https://doi.org/10.3390/ijerph17103740.

Cortés-Álvarez, N.Y., Piñeiro-Lamas, R., Vuelvas-Olmos, C.R., 2020. Psychological effects and associated factors of COVID-19 in a Mexican sample. Disaster Med. Public Health Prep. 1–12. https://doi.org/10.1017/dmp.2020.215.

Demetriou, C., Ozer, B.U., Essau, C.A., 2015. Self-report questionnaires. Encycl. Clin. Psychol. https://doi.org/10.1002/9781118625392.wbecp507. Major Reference Works.

DerSimonian, R., Laird, N., 1986. Meta-analysis in clinical trials. Control. Clin. Trials 7, 177–188. https://doi.org/10.1016/0197-2456(86)90046-2.

Dunstan, D.A., Scott, N., Todd, A.K., 2017. Screening for anxiety and depression: reassessing the utility of the Zung scales. BMC Psychiatry 17, 329. https://doi.org/10.1186/s12888-017-1489-6.

Egger, M., Davey Smith, G., Schneider, M., Minder, C., 1997. Bias in meta-analysis detected by a simple, graphical test. BMJ 315, 629–634. https://doi.org/10.1136/bmj.315.7109.629.

Egger, M., Schneider, M., Davey Smith, G., 1998. Spurious precision? Meta-analysis of observational studies. BMJ 316, 140–144. https://doi.org/10.1136/bmj.316.7125.140.

Elhai, J.D., Yang, H., McKay, D., Asmundson, G.J.G., 2020. COVID-19 anxiety symptoms associated with problematic smartphone use severity in Chinese adults. J. Affect. Disord. 274, 576–582. https://doi.org/10.1016/j.jad.2020.05.080.

Fardin, M.A., 2020. Covid-19 and anxiety: a review of psychological impacts of infectious disease outbreaks. Arch. Clin. Infect. Dis. 15, 15–17. https://doi.org/10.5812/archcid.102779.

Fernández, R.S., Crivelli, L., Guimet, N.M., Allegri, R.F., Pedreira, M.E., 2020. Psychological distress associated with COVID-19 quarantine: latent profile analysis, outcome prediction and mediation analysis. J. Affect. Disord. 277, 75–84. https://doi.org/10.1016/j.jad.2020.07.133.

Forte, G., Favieri, F., Tambelli, R., Casagrande, M., 2020. The enemy which sealed the world: effects of COVID-19 diffusion on the psychological state of the Italian population. J. Clin. Med. 9, 1802. https://doi.org/10.3390/jcm9061802.

Fu, W., Wang, C., Zou, L., Guo, Y., Lu, Z., Yan, S., Mao, J., 2020. Psychological health, sleep quality, and coping styles to stress facing the COVID-19 in Wuhan, China. Transl. Psychiatry 10. https://doi.org/10.1038/s41398-020-00913-3.

Fullana, M.A., Hidalgo-Mazzei, D., Vieta, E., Radua, J., 2020. Coping behaviors associated with decreased anxiety and depressive symptoms during the COVID-19 pandemic and lockdown. J. Affect. Disord. 275, 80–81. https://doi.org/10.1016/j.jad.2020.06.027.

Galindo-Vázquez, O., Ramírez-Orozco, M., Costas-Muñiz, R., Mendoza-Contreras, L.A., Calderillo-Ruíz, G., Meneses-García, A., 2020. Síntomas de ansiedad, depresión y conductas de autocuidado durante la pandemia de COVID-19 en la población general. Gac. Med. Mex. 156, 298–305. https://doi.org/10.24875/GMM.20000266.

Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., Wang, Y., Fu, H., Dai, J., 2020. Mental health problems and social media exposure during COVID-19 outbreak. PLoS One 15, 1–10. https://doi.org/10.1371/journal.pone.0231924.

Guo, Y., Cheng, C., Zeng, Y., Li, Y., Zhu, M., Yang, W., Xu, H., Li, X., Leng, J., Monroe-Wise, A., Wu, S., 2020. Mental health Disorders and associated risk factors in quarantined adults during the COVID-19 outbreak in China: cross-sectional study. J. Med. Internet Res. 22, e20328. https://doi.org/10.2196/20328.

Hawryluck, L., Gold, W.L., Robinson, S., Pogorski, S., Galea, S., Styra, R., 2004. SARS control and psychological effects of quarantine, Toronto, Canada. Emerg. Infect. Dis. 10, 1206–1212. https://doi.org/10.3201/eid1007.030703.

Higgins, J.P.T., Thompson, S.G., Deeks, J.J., Altman, D.G., 2003. Measuring inconsistency in meta-analyses. BMJ 327, 557–560. https://doi.org/10.1136/bmj.327.7414.557.

Horesh, D., Kapel Lev-Ari, R., Hasson-Ohayon, I., 2020. Risk factors for psychological distress during the COVID-19 pandemic in Israel: loneliness, age, gender, and health status play an important role. Br. J. Health Psychol. 1–9. https://doi.org/10.1111/bjhp.12455.

Huang, Y., Zhao, N., 2020. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. Psychiatry Res. 288, 112954. https://doi.org/10.1016/j.psychres.2020.112954.

Huarcaya-Victoria, J., Villarreal-Zegarra, D., Podestà, A., Luna-Cuadros, M.A., 2020. Psychometric properties of a Spanish version of the fear of COVID-19 scale in general population of Lima, Peru. Int. J. Ment. Heal. Addict. 19 https://doi.org/10.1007/s11469-020-00354-5.

Hunter, J.P., Saratzis, A., Sutton, A.J., Boucher, R.H., Sayers, R.D., Bown, M.J., 2014. In meta-analyses of proportion studies, funnel plots were found to be an inaccurate method of assessing publication bias. J. Clin. Epidemiol. 67, 897–903. https://doi.org/10.1016/j.jclinepi.2014.03.003.

Huremović, D., 2019. Mental Health of Quarantine and Isolation. In: Psychiatry of Pandemics. Springer Nature Switzerland.

Hyland, P., Shevlin, Mark, McBride, O., Murphy, J., Karatzias, T., Bentall, R.P., Martinez, A., Vallières, F., 2020. Anxiety and depression in the Republic of Ireland during the COVID-19 pandemic. PsyArXiv 1–22. https://doi.org/10.31234/osf.io/8yqxr.

Islam, M.S., Ferdous, M.Z., Potenza, M.N., 2020. Panic and generalized anxiety during the COVID-19 pandemic among Bangladeshi people: an online pilot survey early in the outbreak. J. Affect. Disord. 276, 30–37. https://doi.org/10.1016/j.jad.2020.06.049.

Jacobson, N.C., Newman, M.G., 2017. Anxiety and depression as bidirectional risk factors for one another: a meta-analysis of longitudinal studies. Psychol. Bull. 143, 1155–1200. https://doi.org/10.1037/bul0000111.

Jeong, H., Yim, H.W., Song, Y., Ki, M., Min, J., Cho, J., Chae, J., 2016. Mental health status of people isolated due to Middle East respiratory syndrome. Epidemiol. Health 38, e2016048. https://doi.org/10.4178/epih.e2016048.

Kazmi, S.S.H., Hasan, K., Talib, S., Saxena, S., 2020. COVID-19 and Lockdwon: a study on the impact on mental health. SSRN Electron. J. https://doi.org/10.2139/ssrn.3577515.

Lai, J., Ma, S., Wang, Y., Cai, Z., Hu, J., Wei, N., Wu, J., Du, H., Chen, T., Li, R., Tan, H., Kang, L., Yao, L., Huang, M., Wang, H., Wang, G., Liu, Z., Hu, S., 2020. Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. JAMA Netw. Open 3, e203976. https://doi.org/10.1001/jamanetworkopen.2020.3976.

Lasheras, I., Gracia-García, P., Lipnicki, D.M., Bueno-Notivol, J., López-Antón, R., De La Camara, C., Lobo, A., Santabárbara, J., 2020. Prevalence of anxiety in medical students during the COVID-19 pandemic: a rapid systematic review with meta-analysis. Int. J. Environ. Res. Public Health 12 (18), 1–12. https://doi.org/10.3390/ijerph17186603.

Lau, J.T.F., Yang, X., Pang, E., Tsui, H.Y., Wong, E., Yun, K.W., Wing, Y.K., 2005. SARS-related perceptions in Hong Kong. Emerg. Infect. Dis. 11, 417–424. https://doi.org/10.3201/eid1103.040675.

Lau, J.T.F., Yang, X., Tsui, H.Y., Pang, E., Wing, Y.K., 2006. Positive mental health-related impacts of the SARS epidemic on the general public in Hong Kong and their associations with other negative impacts. J. Inf. Secur. 53, 114–124. https://doi.org/10.1016/j.jinf.2005.10.019.

Lei, L., Huang, X., Zhang, S., Yang, J., Yang, L., Xu, M., 2020. Comparison of prevalence and associated factors of anxiety and depression among people affected by versus people unaffected by quarantine during the COVID-19 epidemic in southwestern China. Med. Sci. Monit. 26, 1–12. https://doi.org/10.12659/msm.924609.

Liao, Q., Cowling, B.J., Lam, W.W.T., Ng, D.M.W., Fielding, R., 2014. Anxiety, worry and cognitive risk estimate in relation to protective behaviors during the 2009 influenza A/H1N1 pandemic in Hong Kong: ten cross-sectional surveys. BMC Infect. Dis. 14, 1–11. https://doi.org/10.1186/1471-2334-14-169.

Liu, X., Luo, W.T., Li, Y., Li, C.N., Hong, Z.S., Chen, H.L., Xiao, F., Xia, J.Y., 2020. Psychological status and behavior changes of the public during the COVID-19 epidemic in China. Infect. Dis. Poverty 9, 1–11. https://doi.org/10.1186/s40249-020-00678-3.

Moghanibashi-Mansourieh, A., 2020. Assessing the anxiety level of Iranian general population during COVID-19 outbreak. Asian J. Psychiatr. 51, 102076. https://doi.org/10.1016/j.ajp.2020.102076.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., Altman, D., Antes, G., Atkins, D., Barbour, V., Barrowman, N., Berlin, J.A., Clark, J., Clarke, M., Cook, D., D'Amico, R., Deeks, J.J., Devereaux, P.J., Dickersin, K., Egger, M., Ernst, E., Gøtzsche, P.C., Grimshaw, J., Guyatt, G., Higgins, J., Ioannidis, J.P.A., Kleijnen, J., Lang, T., Magrini, N., McNamee, D., Moja, L., Mulrow, C., Napoli, M., Oxman, A., Pham, B., Rennie, D., Sampson, M., Schulz, K.F., Shekelle, P.G., Tovey, D., Tugwell, P., 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 6. https://doi.org/10.1371/journal.pmed.1000097.

Moola, S., Munn, Z., Tufanaru, C., Aromataris, E., Sears, K., Sfetc, R., Currie, M., Lisy, K., Qureshi, R., Mattis, P., Mu, P.-F., 2017. Chapter 7: systematic reviews of etiology and risk. In: Aromataris, E., Munn, Z. (Eds.), Joanna Briggs Institute Reviewer's Manual. The Joanna Briggs Institute, pp. 219–226.

Newby, J.M., O'Moore, K., Tang, S., Christensen, H., Faasse, K., 2020. Acute mental health responses during the COVID-19 pandemic in Australia. PLoS One 15, e0236562. https://doi.org/10.1371/journal.pone.0236562.

Ofri, D., 2009. The emotional epidemiology of H1N1 influenza vaccination. N. Engl. J. Med. 361, 2594–2595. https://doi.org/10.1056/NEJMp0911047.

Orellana, C.I., Orellana, L.M., 2020. Predictores de síntomas emocionales durante la cuarentena domiciliar por pandemia de COVID-19 en El Salvador. Actual. En Psicol. 34, 103–120. https://doi.org/10.15517/ap.v34i128.41431.

Ozamiz-Etxebarria, N., Idoiaga Mondragon, N., Dosil Santamaría, M., Picaza Gorrotxategi, M., 2020. Psychological symptoms during the two stages of lockdown in response to the COVID-19 outbreak: an investigation in a sample of citizens in Northern Spain. Front. Psychol. 11, 1–9. https://doi.org/10.3389/fpsyg.2020.01491.

Özdin, S., Bayrak Özdin, Ş., 2020. Levels and predictors of anxiety, depression and health anxiety during COVID-19 pandemic in Turkish society: the importance of gender. Int. J. Soc. Psychiatry 66, 504–511. https://doi.org/10.1177/0020764020927051.

Palgi, Y., Shrira, A., Ring, L., Bodner, E., Avidor, S., Bergman, Y., Cohen-Fridel, S., Keisari, S., Hoffman, Y., Disorders, A., Since, I., Using, M., Board, I.R., 2020. The loneliness pandemic: loneliness and other concomitants of depression, anxiety and their comorbidity during the COVID-19 outbreak. J. Affect. Disord. 275, 109–111. https://doi.org/10.1016/j.jad.2020.06.036.

Papandreou, C., Arija, V., Aretouli, E., Tsilidis, K.K., Bulló, M., 2020. Comparing eating behaviours, and symptoms of depression and anxiety between Spain and Greece during the COVID-19 outbreak: cross-sectional analysis of two different confinement strategies. Eur. Eat. Disord. Rev. 1–11. https://doi.org/10.1002/erv.2772 n/a.

Paulino, M., Dumas-Diniz, R., Brissos, S., Brites, R., Alho, L., Simões, M.R., Silva, C.F., 2020. COVID-19 in Portugal: exploring the immediate psychological impact on the general population. Psychol. Health Med. https://doi.org/10.1080/13548506.2020.1808236.

Pfefferbaum, B., North, C.S., 2020. Mental health and the Covid-19 pandemic. N. Engl. J. Med. https://doi.org/10.1056/NEJMp2008017.

Pieh, C., Budimir, S., Probst, T., 2020. The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria. J. Psychosom. Res. 136, 110186. https://doi.org/10.1016/j.jpsychores.2020.110186.

Quian Hui, C., Ker Chiah, W., Vasoo, S., Chua, H.C., Sim, K., 2020. Narrative synthesis of psychological and coping responses towards emerging infectious disease outbreaks in the general population: practical considerations for the COVID-19 pandemic. Singap. Med. J. 1–31. https://doi.org/10.11622/smedj.2020046.

R Core Team, 2019. R Development Core Team (2019). R: A Language and Environment for Statistical Computing. R Found. Stat. Comput, Vienna, Austria.

Rajkumar, R.P., 2020. COVID-19 and mental health: a review of the existing literature. Asian J. Psychiatr. 52, 102066. https://doi.org/10.1016/j.ajp.2020.102066.

Rasmussen, Sonja A., 2020. Since January 2020 Elsevier has created a COVID-19 resource Centre with free information in English and mandarin on the novel coronavirus COVID. Ann. Oncol. 19–21. https://doi.org/10.1007/s00134-020-05991-x.Bizzarro.

Rettie, H., Daniels, J., 2020. Coping and tolerance of uncertainty: predictors and mediators of mental health during the COVID-19 pandemic. Am. Psychol. https://doi.org/10.1037/amp0000710.

Rodríguez-Rey, R., Garrido-Hernansaiz, H., Collado, S., 2020. Psychological impact and associated factors during the initial stage of the coronavirus (COVID-19) pandemic among the general population in Spain. Front. Psychol. 11. https://doi.org/10.3389/fpsyg.2020.01540.

Roser, M., Ritchie, H., Ortiz-Ospina, E., Hasell, J., 2020. Coronavirus Pandemic (COVID-19). Available online: (accessed on). [WWW document]. OurWorldInData.org. URL. https://ourworldindata.org/coronavirus.

Saddik, B., 2020. Increased Levels of Anxiety Among Medical and Non-Medical University Students During the COVID-19 Pandemic in the United Arab Emirates, pp. 1–17.

Salari, N., Hosseinian-far, A., Jalali, R., Vaisi-raygani, A., Rasoulpoor, S., 2020. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. Glob. Health 1–11.

Shevlin, M., McBride, O., Murphy, J., Miller, J.G., Hartman, T.K., Levita, L., Mason, L., Martinez, A.P., McKay, R., Stocks, T.V., Bennett, K.M., Hyland, P., Karatzias, T., Bentall, R.P., 2020. Anxiety, depression, traumatic stress, and COVID-19 related anxiety in the UK general population during the COVID-19 pandemic. PsyArXiv 1–27.

Shi, L., Lu, Z.A., Que, J.Y., Huang, X.L., Liu, L., Ran, M.S., Gong, Y.M., Yuan, K., Yan, W., Sun, Y.K., Shi, J., Bao, Y.P., Lu, L., 2020. Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. JAMA Netw. Open 3, e2014053. https://doi.org/10.1001/jamanetworkopen.2020.14053.

Sim, K., Huak Chan, Y., Chong, P.N., Chua, H.C., Wen Soon, S., 2010. Psychosocial and coping responses within the community health care setting towards a national outbreak of an infectious disease. J. Psychosom. Res. 68, 195–202. https://doi.org/10.1016/j.jpsychores.2009.04.004.

Solomou, I., Constantinidou, F., 2020. Prevalence and predictors of anxiety and depression symptoms during the COVID-19 pandemic and compliance with precautionary measures: age and sex matter. Int. J. Environ. Res. Public Health 17, 1–19. https://doi.org/10.3390/ijerph17144924.

Stanikova, D., Luck, T., Pabst, A., Bae, Y.J., Hinz, A., Glaesmer, H., Stanik, J., Sacher, J., Engel, C., Enzenbach, C., Wirkner, K., Ceglarek, U., Thiery, J., Kratzsch, J., Riedel-Heller, S.G., 2019. Associations between anxiety, body mass index, and sex hormones in women. Front. Psychiatry 10, 1–9. https://doi.org/10.3389/fpsyt.2019.00479.

Stanton, R., Tom, Q.G., Khalesi, S., Williams, S.L., Alley, S.J., Thwaite, T.L., Fenning, A.S., Vandelanotte, C., 2020. Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. Int. J. Environ. Res. Public Health 17, 1–13. https://doi.org/10.3390/ijerph17114065.

Stein, D.J., Scott, K.M., de Jonge, P., Kessler, R.C., 2017. Epidemiology of anxiety disorders: from surveys to nosology and back. Dialogues Clin. Neurosci. 19, 127–136.

Thompson, S.G., Higgins, J.P.T., 2002. How should meta-regression analyses be undertaken and interpreted? Stat. Med. 21, 1559–1573. https://doi.org/10.1002/sim.1187.

Verma, S., Mishra, A., 2020. Depression, anxiety, and stress and socio-demographic correlates among general Indian public during COVID-19. Int. J. Soc. Psychiatry. https://doi.org/10.1177/0020764020934508.

von Hippel, P.T., 2015. The heterogeneity statistic I(2) can be biased in small meta-analyses. BMC Med. Res. Methodol. 15, 35. https://doi.org/10.1186/s12874-015-0024-z.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C.S., Ho, R.C., 2020a. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. Int. J. Environ. Res. Public Health 17. https://doi.org/10.3390/ijerph17051729.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R.S., Choo, F.N., Tran, B., Ho, R., Sharma, V.K., Ho, C., 2020b. A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. Brain Behav. Immun. https://doi.org/10.1016/j.bbi.2020.05.004.

Wang, Y., Di, Y., Ye, J., Wei, W., 2020. Study on the public psychological states and its related factors during the outbreak of coronavirus disease 2019 (COVID-19) in some regions of China. Psychol. Health Med. 8506 https://doi.org/10.1080/13548506.2020.1746817.

WHO, 2020a. World Health Organization WHO Director-General's Opening Remarks at the Media Briefing on COVID-19 - 11 March 2020 [WWW Document]. URL. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020.

WHO, 2020b. World Health Organization Coronavirus Disease (COVID-19) Situation Dashboard [WWW Document]. URL. https://covid19.who.int/.

Zandifar, A., Badrfam, R., 2020. Iranian mental health during the COVID-19 epidemic. Asian J. Psychiatr. 51, 101990. https://doi.org/10.1016/j.ajp.2020.101990.

Zhao, H., He, X., Fan, G., Li, L., Huang, Q., Qiu, Q., Kang, Z., Du, T., Han, L., Ding, L., Xu, H., 2020. COVID-19 infection outbreak increases anxiety level of general public in China: involved mechanisms and influencing factors. J. Affect. Disord. 276, 446–452. https://doi.org/10.1016/j.jad.2020.07.085.