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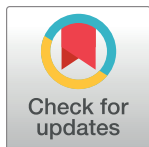
COVID-19 and common mental health symptoms in the early phase of the pandemic: An umbrella review of the evidence

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Abstract

Background

There remains uncertainty about the impact of the Coronavirus Disease 2019 (COVID-19) pandemic on mental health. This umbrella review provides a comprehensive overview of the association between the pandemic and common mental disorders. We qualitatively summarized evidence from reviews with meta-analyses of individual study-data in the general population, healthcare workers, and specific at-risk populations.

Methods and findings

A systematic search was carried out in 5 databases for peer-reviewed systematic reviews with meta-analyses of prevalence of depression, anxiety, and post-traumatic stress disorder (PTSD) symptoms during the pandemic published between December 31, 2019 until August 12, 2022. We identified 123 reviews of which 7 provided standardized mean differences (SMDs) either from longitudinal pre- to during pandemic study-data or from cross-sectional study-data compared to matched pre-pandemic data. Methodological quality rated with the Assessment of Multiple Systematic Reviews checklist scores (AMSTAR 2) instrument was generally low to moderate. Small but significant increases of depression, anxiety, and/or general mental health symptoms were reported in the general population, in people with pre-existing physical health conditions, and in children (3 reviews; SMDs ranged from 0.11 to

0.28). Mental health and depression symptoms significantly increased during periods of social restrictions (1 review; SMDs of 0.41 and 0.83, respectively) but anxiety symptoms did not (SMD: 0.26). Increases of depression symptoms were generally larger and longer-lasting during the pandemic (3 reviews; SMDs depression ranged from 0.16 to 0.23) than those of anxiety (2 reviews: SMDs 0.12 and 0.18). Females showed a significantly larger increase in anxiety symptoms than males (1 review: SMD 0.15). In healthcare workers, people with preexisting mental disorders, any patient group, children and adolescents, and in students, no significant differences from pre- to during pandemic were found (2 reviews; SMD's ranging from −0.16 to 0.48). In 116 reviews pooled cross-sectional prevalence rates of depression, anxiety, and PTSD symptoms ranged from 9% to 48% across populations. Although heterogeneity between studies was high and largely unexplained, assessment tools and cut-offs used, age, sex or gender, and COVID-19 exposure factors were found to be moderators in some reviews. The major limitations are the inability to quantify and explain the high heterogeneity across reviews included and the shortage of within-person data from multiple longitudinal studies.

Conclusions

A small but consistent deterioration of mental health and particularly depression during early pandemic and during social restrictions has been found in the general population and in people with chronic somatic disorders. Also, associations between mental health and the pandemic were stronger in females and younger age groups than in others. Explanatory individual-level, COVID-19 exposure, and time-course factors were scarce and showed inconsistencies across reviews. For policy and research, repeated assessments of mental health in population panels including vulnerable individuals are recommended to respond to current and future health crises.

Author summary

Why was this study done?

The Coronavirus Disease 2019 (COVID-19) pandemic has been one of the greatest global public health challenges of the last century and has impacted multiple aspects of health and public life.

An adverse association between the pandemic and global mental health was expected and many research projects have been rapidly developed to assess this.

There is uncertainty about the degree and extent of the associations between the pandemic and its associated measures and mental health.

What do these findings mean?

This umbrella review could help clinicians, researchers, and policy makers to better understand the current evidence on the association between the COVID-19 pandemic and mental health, particularly in specific vulnerable subpopulations.

The interpretability of the included systematic reviews was limited by the great variation in prevalence rates and associations between studies and because of the scarcity of longitudinal data.

Policy makers and researchers should address common pitfalls of research designs prior to implementation of systematic mental health assessments in future population panels.

What did the researchers do and find?

We synthesized evidence from 123 systematic reviews of individual studies on symptoms of common mental disorders, including depression, anxiety, and PTSD, in general and specific populations and in healthcare workers. Seven reviews compared differences in mental health outcomes during the COVID-19 pandemic or during implementation of public health and social measures to pre-pandemic periods or periods with minimal restrictions. Another 116 reviews provided combined data on during pandemic prevalence rates of mental health outcomes.

Mental health and particularly mood of the general population slightly deteriorated in the first half year of the pandemic, and symptom increases were associated with periods of public health measures and social restrictions. Also, people with preexisting physical health conditions, females, and young people showed pandemic-associated increases in symptoms.

Variation in pandemic-associated mental health prevalence rates between individual studies was large and often unexplained. In several reviews, methodological, individual-level, and COVID-19 exposure factors did explain some of the variation but in others this was not the case. Quality of the systematic reviews was poor to moderate.

Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has led to world-wide human suffering. Besides the physical impact, COVID-19 disease may have a direct mental health impact [1,2] as well as an indirect psychological impact through implementation of public health measures and social restrictions and its longer-term socioeconomic consequences [3]. Although findings from population-based studies in the initial stages of the pandemic indicate that most people were resilient and did not experience increases in distress [4], findings also suggest an increase of common mental health symptoms such as depression and anxiety symptoms [5]. Specifically vulnerable populations such as people dealing with financial problems, suffering from poverty, being from ethnic or racial minorities, or having preexisting health conditions have been challenged more than others, both in terms of infection and death rate from COVID-19 disease and in terms of mental health impact [4,6,7].

 Since the start of the pandemic, the evidence base on the association between COVID-19 and mental health has evolved rapidly. A large number of cross-sectional and longitudinal studies have been published assessing associations between mental health and COVID-19 across the general population and vulnerable groups. These studies have been integrated in numerous systematic reviews and meta-analyses and suggest a significant adverse association between the pandemic and mental health mainly by presenting pooled prevalence rates from cross-sectional studies. However, the few reviews of longitudinal pooled data show less pronounced increases or are contradictory in terms of association between mental health symptoms and the pandemic, for example, in subgroups [8–10]. The main difficulty in getting a more accurate picture of the association between COVID-19 and mental health, is that many studies included in these reviews have methodological weaknesses. Importantly, most individual studies have cross-sectional designs and lack pre- to during pandemic longitudinal data,

which makes causal inferences to the pandemic difficult. Furthermore, even when multiple during- and pre-pandemic assessments have been performed in surveys, respondents often come from nonrepresentative convenience samples while a probability sampling approach is lacking [11]. Assessments of mental health outcomes are often not based on structured clinical interviews or validated questionnaires with established cut-offs and methodological quality or risk of bias assessment of primary studies is often lacking. These shortcomings lead to conflicting conclusions, and therefore to confusion among policy makers and clinicians [12].

A more comprehensive overview of the large amount of meta-analyses of pooled estimates of mental health problems during the COVID-19 pandemic may increase further understanding of the relation between COVID-19 and mental health. A critical evaluation of the current research evidence is needed to correctly inform the global mental health response to mitigate (future) disruptions and to adapt research strategies and implementation of interventions to address COVID-19–related mental health problems in populations where needed most, such as in young people [13,14]. We aimed to provide an overview of the evidence base on common mental health disorder symptoms during the pandemic, ideally compared to pre-pandemic periods, using an umbrella review approach. With this qualitative approach, inconsistencies and gaps of knowledge in the evidence may be recognized [15–18].

The aim of this umbrella review was to integrate the findings of separate reviews with meta-analyses on the prevalence of mental health affected by the pandemic in the general population and in populations at risk for increased psychological distress related to the pandemic, such as healthcare workers, people with preexisting physical or mental conditions, patients with COVID-19 infections, and young people. In addition to providing a more accurate and complete picture of the association between the COVID-19 pandemic and mental health, we aimed to identify gaps in knowledge for further scientific research and to identify targets for clinical and policy interventions.

Methods

Umbrella review design

We followed guidelines for umbrella reviews [12,17,19]. This umbrella review was part of a broader umbrella review registered with a protocol in the Open Science Framework platform (https://doi.org/10.17605/OSF.IO/JF4Z2) developed to collate evidence on mental health impact of COVID-19 in a scientific brief of the World Health Organization (WHO) [20]. This study was reported as per the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline [21] (**S1 PRISMA** Checklist).

Literature search strategy and eligibility criteria

A systematic search was carried out in Ovid MEDLINE All, Embase (Ovid), PsycINFO (Ovid), CINAHL, and Web of Science published between December 31, 2019 until October 6, 2021, using a general search string for mental health and COVID-19 by combining a broad range of text and keywords for COVID-19 pandemic and mental health and mental disorders (see **S1 Text** for the search strings). An update of the search was performed between October 7, 2021 and August 12, 2022. Couples of independent researchers (SY and FB, SW and MC, CP and CC, DF and JW, ND and MG) screened titles and abstracts independently with use of software tool Rayyan and Endnote for deduplication. Full texts of eligible records were screened by 2 independent researchers. Disagreements were resolved via discussion and consensus, involving a third, senior team member. Papers were included based on the following eligibility criteria: (1) published in a peer-reviewed international journal; (2) included study selection criteria; (3) systematically searched at least 1 bibliographic database; (4) included a list and

synthesis of included studies; (5) included primary studies with longitudinal cohort- or cross-sectional data or data from time-series designs (studies including other designs as well were only eligible when results were synthesized separately); (6) included primary studies with data collected after December 31, 2019 (first WHO report of Chinese outbreak [22]) in the general population, healthcare workers, or vulnerable groups such as people who have experienced "severe" Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infections, people with post-COVID condition, specific mental disorders or living in psychiatric institutions, children, adolescents and young adults (e.g. students) or people at risk due to being marginalized (e.g., on race/ethnicity, sex, or gender) or due to chronic medical conditions; and (7) reported the following outcomes (a) from longitudinal cohort or time series studies, i.e., a standardized mean change (SMC) or difference in prevalence of any mental disorder (excluding substance related and addictive disorders, degenerative neurological disorders, and sleep disorders) based on a validated diagnostic interview, change in proportion of participants above a cut-off on a validated mental health symptom questionnaire, or change in scores on a validated mental health questionnaire at multiple time points during COVID-19 or compared to pre-COVID-19 outcomes; or (b) from cross-sectional studies, i.e., prevalence of any mental disorder based on validated diagnostic interview or proportion of participants above a cut-off on a validated mental health symptom questionnaire on a single time point. There were no language restrictions. Reviews from other infectious disease epidemics were only eligible if they also included separate data from COVID-19 studies. During the course of the development of this umbrella review, we deviated from the a priori protocol in a few instances. First, we decided not to include reviews with meta-analyses published online in 2020 because of the multitude of reviews available and because most primary studies from 2020 will have been included in reviews from 2021 and 2022. Second, instead of critically assessing systematic reviews from non-peer–reviewed data repositories before inclusion, we excluded non-peer–reviewed systematic reviews because of potential bias due to quality issues or invalid results. Third, although our protocol mentions Chinese search terms, these have been omitted since we did not search Chinese databases (e.g., Wanfang). Fourth, the AMSTAR 2 classification of ratings based on critical and non-critical criteria mentioned in the protocol was adapted in the process of quality assessment for reasons explained below and in **S1 Text** (see note Table C in S1 Text).

Quality assessment

Included reviews were rated by 2 independent assessors for their quality using the Assessment of Multiple Systematic Reviews checklist (AMSTAR 2) [23]. The 16-item AMSTAR 2 considers the quality of the search, description of individual studies, assessment of publication bias, use of appropriate statistical methods, assessment of risk of bias in individual studies, and reporting of sources of funding and conflicts of interest. The items were scored as No (0 points), Partial yes (0.5 points), or Yes (1 point). Discrepancies were resolved by consensus and after discussion with another reviewer in the team. Although the AMSTAR 2 authors put more emphasis on the critical item scores [23], this approach is debated and we therefore also calculated total scores for each individual systematic review included [24] (see Table C in **S1 Text**).

Data extraction and synthesis

For included reviews, 2 researchers independently extracted name of the first author, publication year, number of primary studies included, sample size per pooled outcome, pooled prevalence of main outcomes, or statistics used in original paper with corresponding 95% CI (e.g., SMC or difference, Hedges' g, Cohens' d). Results of statistical tests for heterogeneity as well as narrative summaries of meta-regression results, subgroup or moderator analyses were

extracted as well (Tables A, B, and C in **S2 Text**). Individual study designs of meta-analyses (e.g., cross-sectional or longitudinal cohort, case-control) were also extracted, as well as countries or continents covered in each meta-analysis (**Table 1**). In case of disagreements between the 2, consensus was reached, including consultation of a third senior investigator as necessary. Data was extracted as reported in the reviews. The characteristics and major findings of the included reviews are presented using tables and figures.

Results

Characteristics of included studies

From the initial and updated searches, 77.758 records were retrieved (**Fig 1**). For the umbrella review, we identified 904 systematic reviews with or without meta-analyses. Of those, 781 reviews were excluded for several reasons such as not including a meta-analysis or wrong outcome (**Fig 1**), retaining 123 eligible reviews with meta-analyses of primary studies published in 2021 and 2022 (initial search [9,10,25–80]; updated search [5,81–144]).

Characteristics of the 123 included studies are provided in **Table 1**. Of the included studies, 44 performed meta-analyses assessing the association between COVID-19 and mental health symptoms in the general population, 103 in healthcare worker populations, and 68 in specific populations. The searches of the systematic reviews with meta-analyses covered the period up to and including the second or third quarters of 2020 (35 reviews), last quarter of 2020 (15 reviews), the first or second quarter of 2021 (51 reviews), the third and fourth quarter of 2021 (15 reviews), and 5 reviews searched for studies up to the first quarter of 2022 (2 not reported [39,125]). Of the 123 eligible review articles, the majority provided pooled prevalence rates for depression and anxiety (i.e., 108 and 101 reviews, respectively) and fewer for PTSD symptom levels (35 reviews). Meta-analyses included a mean of 43 primary studies and a median of 27 studies with a variety of designs. Only 7 systematic reviews either exclusively focused on providing pooled difference estimates based on longitudinal studies with during- and pre-pandemic assessments or also included cross-sectional studies with matched pre-pandemic or pre-implementation of public health and social measures prevalence data [5,10,43,59,89,98,113]. The majority of reviews reported pooled prevalence rates based on above cut-off values of validated measures from surveys or cohort studies with mainly cross-sectional designs (k = 116). Some of these reviews included longitudinal studies as well but without pooling the data. A range of countries and continents were covered by the meta-analyses although most studies were performed in China, United States of America, and Europe. Representation of individual studies from low- and middle-income countries (LMICs) (i.e., South America and Africa) was low (**Table 1**).

Quality assessment of included studies

The AMSTAR 2 rated level of methodological quality assessment by outcome across all included systematic reviews and meta-analyses. **Fig 2** shows that, concerning the 7 critical domains of AMSTAR 2, an a priori protocol was established in 61% of systematic reviews with meta-analyses, 53% performed a comprehensive literature search, none of systematic reviews with meta-analyses provided a list of excluded studies with justification, 75% used satisfactory techniques for assessment of risk of bias in individual studies, 94% used appropriate methods for meta-analysis, 30% discussed risk of bias in interpretation of findings, and 71% investigated and discussed publication bias. Each AMSTAR 2 domain judgment for each included systematic review with meta-analyses is available in Table C in **S1 Text**. The total AMSTAR 2 score and sub-scores of critical items have been provided for each included review (**Table 1**). Total scores on AMSTAR 2 ranged from 2 to 13 with a mean total score of 8.5. Only the review of

Table 1. Characteristics of included systematic reviews with meta-analyses.

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Abdulla 2021 [81]	Feb 2021	23	8,855	CS, OBS, L	Validated/ unvalidated	Dep, Anx,	HCW	India	3,5	9,5
Adibi 2021 [25]	June 2020	19	21,866	NR	Validated measures	Anx	HCW	China, USA, European countries, United Kingdom, South-Korea, Turkey, Brazil, India, Japan, Hong Kong, Singapore, Israel	3	8
Adrianto 2022 [82]	June 2021	54	95.326	CS, CC, cohort, mixed	Validated	Dep	Pregnant, postpartum, perinatal	China, Hong Kong, Japan, Iran, Qatar, Israel, Egypt, Turkey, Italy, Switzerland, the Netherlands, Greece, Spain, UK, Ireland, Norway, Poland, USA, Canada, and Mexico	2,5	9
Afridi 2022 [83]	Jan 2022	10	12,507	CS	Validated	Dep	HCW	Pakistan	2,5	7,5
Alzahrani 2022 [84]	August 2021	15	262,656	CS	Validated/ unvalidated	Dep, Anx	GP	Saudi	2,5	6
Arora 2022 [85]	April 2020	28	97,173	CS, OBS	Validated/ unvalidated	Dep, Anx, PTSD	HCW, GP, COVID Patients	China, Hong Kong, Italy, Iran, Vietnam, India, Singapore, USA, UK,	1,5	7
Aymerich 2022 [86]	March 2021	239	271,319	CS	Validated	Dep, Anx, PTSD	HCW	Five continents: 150 (62.76%) from Asia, 55 (23.01%) from Europe, 20 (8.37%) from America, 11 (4.60%) from Africa, and 2 (0.84%) from Oceania; there was also 1 multicontinental study	4,5	11
Ayubi 2021 [26]	Jan 2021	21	NR	CS, L, CC, OBS	Validated self-report	Dep, Anx	Patients (cancer)	South Korea, UK, China, USA, Europe, Turkey, Slovenia, Tunisia, Brazil, India, Japan, Germany, Hong Kong, Singapore, Italy, Israel, Poland, International, the Netherlands	0,5	4,5
Bello 2022 [87]	Sept 2021	78	62380	NR	Validated/ unvalidated	Dep, Anx	GP	Ethiopia, Nigeria, Egypt, Libya, South Africa, Ghana, Uganda, Morocco, Kenya, Tunisia, Libya, Cameroon, Zambia, Algeria, Togo, Sudan, Mali. Four studies covered more than 1 African country	2,5	7,5
Balakrishnan 2022 [88]	March 2021	82	201,953	CS, L	Validated	Dep	HCW, students, GP	China, Japan, Hong Kong, South Korea, USA, Canada, Bangladesh, India, Nepal, Sri Lanka, Australia, Malaysia	3,5	8
Bareeqa 2021 [29]	Apr 2020	19	62,382	CS	Validated self-report	Dep, Anx	GP, HCW	China	3	8

(Continued)

Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Batra 2021 [27]	July 2020	27	90,879	OBS	Unspecified	Dep, Anx, PTSS	Students	China, Israel, Turkey, Jordan, USA, Italy, India, Albania, Brazil, Saudi Arabia, Greece, France, Russia, Belarus	5	9
Bussières 2021 [89]	June 2021	28	14209	L, CS, RC	Validated	Dep, Anx internalizing problems	Children (GP and at-risk)	The Netherlands, UK, Italy, China, S. Korea, Switzerland, USA, Israel, Spain, Singapore, Canada, Argentina, Japan, Turkey, Germany	2,5	5,5
Carvalho 2022 [90]	Jun 2021	13	18,220	CS	Validated self-report	Dep/Anx	Students	Kosovo, France, Turkey, Greece, Italy, Switzerland, Spain, Albania, Germany	2	5
Castaldelli Maia 2021 [30]	July 2020	58	193,137	CS, RCT, L, CC	Self-report	Dep, Anx	GP, students, patients (mixed), HCW	China, Japan, Switzerland, Saudi Arabia, Serbia, Cyprus, Nepal, Brazil, Pakistan, UAE, Nigeria, Vietnam, Austria, Jordan, Spain, Albania, USA, Norway, India, Bangladesh, UK, Italy, Germany, Russia, Iran, Korea	2,5	8,5
Cenat 2021 [91]	May 2020	55	189.159	CS	Validated	Dep, Anx, PTSD	HCW, GP	China, Italy, India, Singapore, France, USA, Iran, Vietnam, Spain, Turkey, Italy, Israel, Bolivia, Ecuador, Malaysia, Pakistan, Peru, and multiple country studies	3	8,5
Cenat 2022 [92]	Sep 2021	64	170,827	L	Validated self-report structured clinical interviews	Dep, Anx, PTSD	Any population	North America (20), UK (7), and Italy (6). Four from: China, Spain; 3 from the Netherlands, Australia, Germany, Japan. Two from Argentina. One paper from: Estonia, Austria, Japan, France, Brazil, Colombia, Singapore, Ireland, and Sweden.	4,5	11
Cevik 2022 [144]	May 2021	48	77,616	CS, L	Validated measures	Dep, Anx	Pregnant women	Israel, Turkey, Ethiopia, Bangladesh, Italy, China, Denmark, USA, S Africa, Ethiopia, Iran, ABD, Finland, Ghana, Vietnam, Croatia, Turkey, Malaysia, India, Pakistan, Poland	2,5	8
Chai 2021 [93]	March 2021	12	34,276	CS	Validated	Dep, Anx	Children and adolescents	China	2,5	7
Chang 2021 [28]	Nov 2020	16	135 018	CS, L	Validated measures	Dep, Anx	Students	France, Malaysia, Turkey, America, China, Poland, India, Bangladesh, Greece	2,5	8

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Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Chekole and Abate 2021 [79]	Apr 2020	21	72,999	CS, OBS	Self-report	Dep, Anx	GP, patients (Cov), students, women, HCW, children	China, India, Lebanon, Singapore, Mexico, USA, Spain, Iran, Jordan, Vietnam, Italy, UK, Ethiopia, Saudi	4	11
Chen 2021 [71]	Feb 2021	28	15,071	CS, Cohort	Validated measures	Dep, Anx	HCW, gen pop, students	Cameroon, Egypt, Ethiopia, Libya, Mali, Morocco, Nigeria, RDC, Rwanda, S Africa, Togo, Tunisia	2	7,5
Chen 2022 [95]	May 2021	13	41.729	CS	Validated measures	Dep	Children, adolescents	China	2,5	7,5
Chen 2022 [96]	Nov 2021	8	6,480	CS	Validated measures	Dep, Anx	Postpartum women	Mexico, Myanmar, Turkey, UK, Ireland, Norway, Switzerland, the Netherlands, Italy, Canada	1,5	6,5
Ching 2021 [97]	March 2021	148	159,194	CS	CS	Dep Anx	HCW	China, Turkey, Saudi Arabia, India, Pakistan, Indonesia, Nepal, Malaysia, Singapore, Japan, Iran, Oman, Jordan, Philippines, Bangladesh, Korea, Qatar, Iraq, Egypt	4,5	10,5
Dal Santo 2021 [98]	Aug 2021	12	48,344	L	Validated measures	Dep, Anx	Any population	China, USA, Australia, Spain, UK, India, Switzerland, the Netherlands	4,5	10,5
da Silva 2021 [99]	May, 2021	7	7,102	CS	Validated self-report	Dep Anxiety	Students	China	1,5	4,5
Demissie 2021 [31]	Sept 2020	19	18,335	CS	Self-report	Dep, Anx,	Perinatal women	Colombia, Sri Lanka, Belgium, China, Canada, Iran, Turkey, Bosnia Herzegovina, Serbia, Ireland, UK, USA, Italy	3	9,5
Deng 2021 [33]	May 2020	34	29,996	CS	NR	Dep, Anx	GP, HCW	China	5	12,5
Deng 2021 [32]	Jan 2021	89	1,441,828	CS, L	Validated self-report	Dep, Anx	University Students	Italy, Turkey, Ethiopia, USA, France, China, Bangladesh, Spain, Switzerland, Ireland, Malaysia, Taiwan, South Korea, the Netherlands, Lebanon, UK, Slovakia, Egypt, Russia, Belarus, Saudi Arabia, Jordan, India, Ukraine, Poland, UAE, Pakistan, Argentina	4,5	11
de Sousa 2021 [100]	March 2021	18	NR	MA	NR	Dep, Anx, PTSD	GP, HCW	Asia, Europe, South America, Central America, North America, Oceania	3,5	7
Delanerolle 2022 [101]	Aug 2021	188	NR	PC	NR	Dep, Anx, PTSD	HCW, GP, Patients	NR	4,5	8
Dong 2021 [34]	Oct 2020	22	NR	CS, L	Validated measures	Dep, Anx, PTSS	HCW	China	2,5	9,5
Dong 2021 [35]	Oct 2020	38	NR	CS, L		Dep, Anx, PTSS	Patients (Cov)	China, Italy, Iran, India, Korea, Ecuador, Switzerland, Germany	2,5	10

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Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Dragioti 2022 [102]	Sep 2020	173	502,261	OBS	NR	Dep, Anx, PTSD	HCW, GP, patients (COVID and other), students, caregivers/ family	China, Italy, India, USA, Australia, Brazil, Canada, Egypt, Turkey, Iran, Japan, S Korea, UK, Ireland, Spain, France, Germany, Poland, Sweden, Croatia, Greece, Cyprus, Jordan	6	12
Dutta 2021 [36]	Aug 2020	33	39,703	CS	Validated measures	Dep, Anx,	HCW	Singapore, India, China, Turkey, Brazil, Italy, Poland, Pakistan, Iran, Jordan, Nepal, USA	3	9,5
Ebrahim 2022 [103]	Sep 2020	90	46,284	Quantitative	Validated	Dep, Anx, PTSD	University students	USA, India, Turkey, Israel, Iran, Jordan, Australia, Russia, China, KSA, Egypt, Poland, Brazil, Canada, Pakistan, Philippines, Morocco, Italy, Albania		
El-Qushayri 2021 [37]	Jan 2021	8	3,137	CS	Validated measures	Dep, Anx	HCW	Egypt	2,5	7
Fan 2021 [38]	Oct 2020	158	515,452	CS, SR	Validated self-report	Dep, Anx, PTSS	GP, HCW, patients (COVID)	China, India, Spain, Greece, Turkey	1,5	3,5
Fang 2022 [104]	March 2022	104	2,088,032	CS	Validated self-report	Dep, Anx, stress	Students	China, Korea, Malaysia, Italy, Ethiopia, America, Asia, Australia, Palestine, Saudi Arabia, India, Lithuania, Poland, Germany, Bhutan, Bengal, Spain, Brazil, Uganda, Nigeria, Thailand, Japan, Mexico, Switzerland, Czech	6	12
Ghahramani 2022 [143]	February 2022	44	NR	CS, CC	Validated self-report	Dep, Anx, PTSD, stress	HCW	China, Italy, USA, Oman, India, Iran, Turkey, Pakistan, Israel, Singapore, Russia, Nepal, global, South Korea, Jordan, Iraq, Japan	4	10
Ghazanfarpour 2021 [39]	NR	11	NR	CS, OBS	Validated/ unvalidated self-report	Dep, Anx	Pregnant women	Belgium, Greece, Iran, Pakistan, Canada, Italy, Sri Lanka, China, Turkey	3,5	7,5
Guo 2021 [40]	Jul 2020	11	25,020	CS	Validated self-report	Dep (levels)	Students	China	2,5	7
Halemani 2021 [105]	April 2021	13	90,601	CS	Validated self-report	Dep, Anx, stress	HCW (doctors, nurses)	China, Singapore, India, Nepal, Turkey, Japan, UK, Saudi Arabia	5	10
Hao 2021 [41]	Apr 2021	20	10,886	CS	Validated measures	Dep, Anx, OCD, phobia	HCW	China, Singapore	4	10,5
Hosen 2021 [106]	March 2021	24	49,806	CS	Validated self-report	Dep, Anx, stress	Students, GP (incl COVID-19 patients, quarantined people), HCW	Bangladesh	3	8
Hossain 2021 [42]	Oct 2020	35	41,402	CS	Validated self-report	Dep, Anx	GP, HCW	India, Bangladesh, Pakistan, Nepal, Sri Lanka	2,5	8
Hu 2022 [107]	March 2021	71	98,533	Empirical studies	Validated self-report	Dep, Anx	HCW	China	5	10

(Continued)

Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Huang 2022 [108]	2022	17	8,096	CS, PC	Validated self-report	Dep, Anx, stress	HCW	Qatar, Peru, Germany, India, USA, Ecuador, Australia, Sri Lanka, Pakistan, Nepal, Germany, Ethiopia, China	6	12
Jia 2022 [109]	August 2021	41	36,608	CS, LS	Validated self-report	Dep, Anx	(Medical) students	Nepal, Jordan, Turkey, Libya, China, America, India, Brazil, Germany, Pakistan, Iran, Japan, Greece, Spain, Albania, France, Bangladesh	5	12
Johns 2021 [110]	March 2021	33	31,447 (Dep); 33,281 (Anx)	CS	Validated self-report	Dep, Anx	HCW (doctors)	Cyprus, Brazil, USA, Turkey, Libya, Malaysia, France, UK, South America, India, Pakistan, China, Columbia, Germany, Croatia, global	5	12
Kan 2021 [111]	Feb 2021	103	140,732	CS, CC, L, cohort	NR	Anx	General public, COVID-19 patients	Continents: Africa, America, Europe, Asia/ WHO regions: AFRO, EMRO, SEARO, EURO, PAHO, WPRO	3,5	8
Khraisat 2022 [112]	August 2021	13	3,056	CS, L	Validated self-report, DSM-5 criteria	Dep, Anx	Patients with eating disorders	Germany, Australia, Spain, USA, the Netherlands, Canada, UK, Italy, Sweden	4	8
Knox 2022 [113]	March 2021	33	131,844	CS, L	Validated self-report	Dep, Anx, stress	GP (under social restrictions)	Italy, Germany, Brazil, USA, Switzerland, Greece, UK, Norway, China, Argentina, Australia, Spain, New Zealand, Hong Kong, international	4	9
Kunzler 2021 [43]	May 2020	43	71,613	CS, L	Validated self-report	Dep, Anx	GP, HCW, students,	Iraq, UK, Germany, Italy, Spain, Croatia, Iran, USA, Turkey, Taiwan, Hong Kong, Macao, Russia, Belarus, India, Bangladesh, Italy, Greece, France, Oman, international, Canada, Saudi Arabia, Pakistan, Singapore, Jordan, Israel	2,5	10
Kuroda 2021 [114]	March 2021	28	7,959	CS, cohort, case	Validated self-report	Dep, Anx	Patients (epilepsy)	Kuwait, Spain, Saudi Arabia, Italy, China, Malaysia, USA, Lithuania, India, UK, Iran, Brazil, Belgium, the Netherlands, Turkey, Australia, international	3	8

(Continued)

Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/WHO regions	AMSTAR 2 scores	
									Critical	Total
Lee 2021 [44]	Sept 2020	114	640,037	NR	Validated self-report	Dep	GP	USA, Vietnam, China, Italy, UK, Albania, Austria, Bangladesh, Bosnia and Herzegovina, Brazil, Canada, Ecuador, France, Greece, Germany, Hong Kong, India, Iran, Ireland, Israel, Japan, Jordan, Kenya, Mexico, Nepal, Norway, Pakistan, Poland, Saudi Arabia, South Korea, Spain, Sweden, Switzerland, Turkey, USA	4	6
Lee 2022 [115]	April 2021	6	3,127	CS	Validated self-report, not reported	Dep, Anx	Patients (HIV)	USA, Argentina, Italy, Kenya, Turkey, India, Belgium	3	7
Li 2021 [47]	Aug 2020	65	97,333	NR	Validated self-report	Dep, Anx, PTSS	HCW	Italy, Thailand, China, Spain, Oman, India, UK, Singapore, Hong Kong, Italy, Argentina, Brazil, Mexico, Chile, Togo, Turkey, USA, Jordan, Iran, Pakistan, Taiwan, Switzerland, Saudi Arabia	4	9
Li 2021 [45]	Dec 2020	66	599,679	CS	Validated self-report	Dep, Anx	GP	China	3,5	10,5
Li 2021 [46]	Oct 2020	27	706,415	CS	Validated self-report	Dep, Anx	Students	China, France, USA, Jordan, South Korea, Japan, Spain, Bangladesh, Lebanon, Switzerland, Israel	4,5	9,5
Liyanage 2022 [116]	Feb 2021	36	NR	CS	Validated self-report	Anx	University students	China, Bangladesh, Malaysia, Turkey, India, Nepal, Saudi Arabia, Jordan, USA, Egypt	2,5	8
Liu 2021 [48]	Jul 2020	71	146,139	CS, L	Validated self-report	Dep, Anx, PTSS	GP, patients (COVID-19)	China, Italy, Turkey, Spain, Greece, India, Singapore, USA	3,5	10
Liu 2021 [49]	Apr 2021	21	38,372	NR	Validated self-report	Dep, Anx	HCW	India, USA, China, Turkey	2	5
Liu 2021 [48]	Dec 2020	22	4,318	NR	Validated self-report	Dep, Anx,	Patients (COVID-19)	China, South Korea, India, Ecuador, Jordan, Turkey, Italy, Iran	4,5	10
Luo 2021 [51]	Feb 2021	84	1,292,811	CS	Validated self-report	Dep, severe Dep	Students	South Korea, China	5	13
Ma 2021 [52]	Sep 2020	23	46 to 9,554	CS, L	Validated measures	Dep, Anx, PTSS	Children, adolescents	Turkey, China	3,5	9,5
Ma 2022 [117]	July 2021	54	256,896	CS, L	Validated/unvalidated measures	Dep, Anx	Teachers	China, Italy, USA, Spain, Turkey, Canada, Chile, Australia, Ecuador, Brazil, India, Israel, Greece, Germany, Japan, Jordan, Mexico, Pakistan, Philippines, Portugal, Saudi Arabia, Slovakia, UK	2,5	8

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Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Mahmud 2021 [53]	Sep 2020	83	160,477	CS	Validated measures	Dep, Anx	HCW	China, Singapore, India, Lebanon, Greece, Bangladesh, Philippines, Nepal, Egypt, Oman, Turkey, Canada, USA, Poland, Spain, Pakistan, Italy, Jordan, Korea, South Korea, Saudi Arabia, UK, Vietnam, Finland, Australia, Ghana, Iran, Croatia, Germany	3	10
Makwana 2022 [118]	Mar 2022	6	3,248	CS	Validated measures	Dep	Medical students	India	1	5,5
Marvaldi 2021 [78]	Oct 2020	70	101,017	CS	Validated measures	Dep, Anx	HCW	Iraqi Kurdistan, Saudi Arabia, Thailand, Egypt, France, Turkey, India, Ireland, Italy, China, Singapore, Spain, Pakistan, Bahrain, Nepal, USA, Philippines, Iran, Oman, Germany	4	10,5
Mulyadi 2021 [119]	Jun 2021	17	13,247	CC, CS, Cohort	Validated/ unvalidated measures	Dep, Anx, PTSS	Nurses	China, Turkey, India, Nepal, USA, Australia, Indonesia, Israel	2,5	8,5
Nagarajan 2022 [120]	May 2021	13	1,093	Obs, CS	Validated measures	PTSS	Severe COVID-19 patients	Italy, the Netherlands, UK, France, Turkey, China, Iran, USA	3,5	9
Natarajan 2022 [121]	Jun 2021	36	11,598	Cohort, CS	NR	Dep, Anx	Long COVID patients	NR	3,5	9,5
Necho 2021 [54]	Nov 2020	16	78,225	CS, L	Validated self-report	Dep, Anx, PTSS	GP	China, Italy, Australia, Turkey, France, India, Iran	2	5
Nochaiwong 2021 [55]	Jul 2020	107	398,771	CS, L	Validated self-report	Dep, Anx, PTSS	GP	Nigeria, South Africa, Brazil, Mexico, USA, Bangladesh, India, Nepal, Thailand, Germany, Greece, Ireland, Italy, Norway, Portugal, Spain, Sweden, Turkey, UK, Egypt, Iran, Jordan, Pakistan, Saudi Arabia, Tunisia, United Arab Emirates, Australia, China (including Hong Kong, Macau, Taiwan), Japan, Malaysia, New Zealand, Vietnam	5	10,5
Norhayati 2021 [56]	Apr 2021	80	149,925	CS, CC, L	Validated self-report	Dep, Anx, PTSS	HCW	Western Asia, Southern Asia, Eastern Asia, South-Eastern Asia	2,5	5
Olaya 2021 [57]	Sept 2020	57	46 to 14,825	CS	Validated self-report	Dep	HCW (3 groups)	USA, China, Italy, Russia, Spain, Japan, Mexico, The Republic of Korea, Turkey, Malaysia, Singapore, India, Canada, Egypt, Australia, Portugal, Libya, international	1,5	6

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Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Ozamiz-Etxebarria 2021 [58]	June 2021	8	93,886	CS	Validated self-report	Dep, Anx	Teachers	International, Jordan, Brazil, USA, India, China, Spain	2,5	7
Panda 2021 [122]	August 2020	15	22,996	CS	Validated/ unvalidated	Dep, Anx	Children, caregivers	France, Italy, China, Spain, India, Hong Kong, Brazil, Turkey, Bangladesh, Korea	3,5	7,5
Pappa 2022 [123]	Feb 2021	25	20,352	CS, cohort	Validated self-report	Dep, Anx	General public, Frontline HCW, General HCW, students	Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam	5	12,5
Phiri 2021 [9]	Jan 2021	206	NR	CS, L	Validated self-report	Dep, Anx, PTSS	GP, HCW	International, China, Singapore, India, Spain, Turkey, Italy, Germany, Iran, Bangladesh, USA, Pakistan, Denmark, UK, Australia, Egypt, Jordan, Malaysia, Poland, Portugal, New Zealand, Ireland, Brazil, Switzerland, Norway, Oman, Saudi Arabia, UAE, Iraq, Canada, Austria, Argentina, Chile, Sweden, Philippines, UK, Vietnam, Colombia, Hong Kong, Morocco, France, Russia, Taiwan, Japan, Georgia, Tunisia, South Korea, Indonesia, Peru, Paraguay, DCR, Ethiopia, the Netherlands, Belgium, Israel, Togo, Rwanda, Haiti, Greece, Palestine, Iran, Czech Republic, Nepal, Serbia, Mexico	3,5	9
Prati 2021 [59]	Jun 2020	25	72,004	CS, L, CT	Unspecified	Dep, Anx, PTSS	GP	Europe, North America, Asia, Oceania	1,5	7
Premraj 2022 [124]	Aug 2021	18	10,530	CS, CC, L, cohort	NR	Dep, Anx	COVID-19 patients	NR	3,5	7,5
Qi 2022 [125]	NR	28	20,891	CS	Validated self-report	PTSD	HCW	Saudi Arabia, Ethiopia, France, Turkey, China, Italy, Canada, the Netherlands, USA, Korea, UK	4	10
Qiu 2021 [60]	Apr 2020	27	34 842	CS, L, CC	Validated self-report	PTSS	GP, HCW	China, India, Singapore, Greece, Ireland unreported	3	9,5
Qiu 2021 [60]	Oct 2020	106	NR	CS, L	Validated self-report	PTSS	GP, HCW, patients	China, Singapore, Japan, Canada, Hong Kong, Taiwan, Greece, South Korea, Brazil, Mexico, International, Australia, Italy, Japan, Spain, Tunisia, Egypt, USA, Ireland, Israel, France, Vietnam, Germany, Austria, Saudi Arabia, India, Philippines	3	8,5

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Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Racine 2021 [63]	Feb 2021	29	80,879	NR	Validated self-report	Dep	Children, adolescents	China, USA, Jordan, Ecuador, Italy, Spain, Portugal, Brazil, Greece, Canada, Germany	2	8
Racine 2021 [126]	March 2021	18	8,987	NR	Validated self-report	Dep, Anx	Mothers of young children	Europe, East Asia, North America, the Middle East, South Asia, Southeast Asia, South America	5	11,5
Rezaei-Hachesu 2022 [127]	June 2021	10	4,816	NR	Validated self-report	Dep, Anx	HCW	Iran	1	7
Robinson 2021 [10]	Jan 2021	61	55,015	L	Validated self-report	Dep, Anx, MHS, PTSS	GP, HCW	Europe, North America, China	5,5	10
Raoofi 2021 [62]	Feb 2021	46	61,551	CS, L		Anx	HCW	North America, South America, Europe, Africa, Southeast Asia, Asia, Eastern Mediterranean	2	7
Shorey 2021 [68]	Dec 2020	26	24,040	CS, CC, Mixed	Self-report	Dep, Anx	Ante-, peri-, and postnatal women	Canada, Belgium, Greece, Turkey, China, Iran, USA, Hong Kong, Italy, Japan, Israel, Sri Lanka	3,5	8,5
Salehi 2021 [64]	May 2020	13	11,217	CS, CC	Validated self-report	PTSS	GP	Canada, Singapore, China, India, Spain, South Korea, Taiwan, Hong Kong	3,5	8
Santabárbara 2021 [65]	Sep 2020	71	46 to 8,817	CS	Validated self-report	Anx	HCW	Thailand, Turkey, Oman, China, Ecuador, India, Singapore, Italy, Spain, Libya, Kosovo, Nepal, USA, Cameroon, Jordan, Croatia, Germany, Serbia, Saudi Arabia, Poland, South Korea, Bolivia, Peru	4	8
Santabarbara 2021 [128]	Aug 2021	15	6,141	CS	Validated self-report	Anx	Dental students	USA, Peru, Malaysia, Brazil, Saudi Arabia, Turkey, Italy, Palestine, Germany, UAE	3,5	8,5
Santabarbara 2021 [130]	Dec 2020	11	6,576	CS	Validated self-report	Dep	Medical students	Kazakhstan, Libya, Morocco, China, Iran, India, Japan, Brazil	3,5	7,5
Santabarbara 2021 [129]	Aug 2021	13	4.147	CS	Validated self-report	Dep	Dental students	Iran, India, USA, Turkey, Saudi Arabia, Palestine, Brazil, Germany, Malaysia	4	9
Santomauro 2021 [5]	Jan 2021	48	NR	L, CS	Validated screening measures	Dep, Anx	General population	China, Australia, USA, New Zealand, Japan, Norway, UK, Ireland, Germany, the Netherlands, France, Spain, Austria, Denmark, Czech Republic	4	10,5
Safi-Keykalah [131]	Aug 2021	24	13.169	CS, RC, CC	Validated self-report	Dep (postpartum)	Perinatal women	China, Italy, UK, Saudi Arabia, Ireland, Norway, Switzerland, the Netherlands, Serbia, Turkey, Japan, Brazil, Spain, Israel, Belgium, Hong Kong, Argentina, Mexico, Poland	2,5	8

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Table 1. (*Continued*)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Saragih 2021 [66]	Nov 2020	38	53,784	CS, CC	Validated instrument	Dep, Anx, PTSS	HCW	China, Italy, India, USA, Australia, Nepal, Iran, Saudi Arabia, Canada, Egypt, France, Mali, Norway, Poland, Oman, Serbia, Spain, South Korea, and Turkey	1,5	5,5
Schafer 2022 [132]	July 31 2020	36	NR	CS, L	Self-report	Anx, Dep	GP, HCW	Americas, Eastern Mediterranean, Europe, Pacific	1	2
Sharma 2022 [133]	Oct 2021	22	16,424	CS, L	Validated self-report	Anx	GP	India	4	8
Sideli 2021 [69]	Jan 2021	26	3,399	CS, L, CC,	Validated/ unvalidated measures	Dep, Anx	Eating disorder patients/obesity	Spain, Italy, Portugal, UK, USA, Ireland, Australia, Germany, Canada, the Netherlands	3,5	8,5
Singh 2021 [67]	Oct 2020	22	9,947	CS	Validated self-report	Dep	GP, HCW	India	3	4,5
Ślusarska 2022 [134]	Feb 2021	23	44,165	CS, L (1)	Validated self-report	Dep, Anx	HCW (nurses)	China, Philippines, USA, Turkey, Saudi Arabia, Iran, Great Britain, Brazil, and Canada	4	10
Sun 2021 [80]	Sep 2020	47	81,277	CS	Validated measures	Dep, Anx	HCW	Iran, China, Singapore, France, Ecuador, Libya, Italy, Philippines, Jordan, Pakistan, Poland, Brazil, America	1,5	6,5
Tomfohr-Madsen 2021 [70]	Feb 2021	46	NR	CS, OBS	Validated self-report/clinical interview	Dep, Anx	Antenatal women	International, Iran, China, Spain, Greece, Canada, Ireland, the Netherlands, Switzerland, Norway, Belgium, Turkey, Qatar, USA, UK, Japan, Argentina, Italy, Mexico, Singapore, Sri Lanka, Pakistan, Poland	3,5	8
Varghese 2021 [73]	Oct 2020	27	NR	CS		Dep, Anx, PTSS	HCW	Germany, Croatia, Poland, Russia, Italy, Jordan, China, Vietnam, Turkey, Singapore, Philippines, Oman, Iran, India	3,5	9
Wang 2021 [71]	Sep 2020	28	436,799	CS	Validated self-report	Dep, Anx	College students	China, non-China	2,5	5
Xie 2021 [72]	Mar 2021	12	1,705	CS, OBS, RCT	Validated self-report	Dep, Anx	COVID-19 patients	China	2,5	8
Xiong 2022 [135]	June 2020	44	65,706	CS, interventions	Validated self-report	Anx, Dep, PTSS	HCW	China	4,5	10,5
Yan 2021 [136]	Sep 2020	28	436,799	CS, L	Validated self-report	Dep, Anx	HCW	China, Hong Kong	4	9
Yan 2022 [136]	March 2021	17	11,237	OBS	Validated tools	Anx, Dep	Older adults (COVID-19, GP, chronic disease)	Mainland China, Hong Kong	4	9

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Table 1. (Continued)

Study	End date search	Studies	Sample size	Study designs	Assessment	Outcomes[1]	Study populations	Countries/continents/ WHO regions	AMSTAR 2 scores	
									Critical	Total
Yang 2022 [137]	May 2021	10	17,385	CS, case OBS	Validated tools/clinical diagnosis	PTSD	Children	China, USA, Italy	2,5	8
Yunitri 2022 [138]	June 2021	63	124,952	CS, L	Validated self-report	PTSD	Patients (cov), HCW, GP	China (24), Singapore, India, Malaysia, Indonesia, South Korea, Vietnam, Europe (i.e., France, Greece, Italy, Norway, Spain, Ireland, Poland), Canada, USA, Tunisia, Saudi Arabia, Brazil, Mexico, Israel, Turkey	4,5	9,5
Zhang 2021 [75]	May 2020	26	22,062	CS	Validated self-report	Dep, Anx	HCW	China	4	9,5
Zhang 2021 [76]	Aug 2020	11	NR	CS	Self-report	PTSD	GP	China, Italy, Spain, Israel, USA, Ireland	4	10,5
Zhang, Chen 2022 [139]	Feb 2021	28	86,323	CS, L	Validated self-report	Dep, Anx	GP, HCW, students	Spain	3	9
Zhang 2022 [140]	Aug 2021	62	196,950	CS, L	Validated self-report	Dep, Anx	GP, HCW (general and frontline), students	Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Haiti, Mexico, Panama, Paraguay, Peru, Trinidad and Tobago, mixed)	3	9
Zhang 2022 [141]	Feb 2021	21	NR	CS, L	Validated self-report	Dep, Anx	GP, HCW (general and frontline), students	Eastern Europe and Russia (Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Georgia, Hungary, Kosovo, Moldova, Montenegro, North Macedonia, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Turkey, and Ukraine).	3	9
Zhao 2021 [77]	May 2020	36	NR	CS	Validated self-report	Dep, Anx, PTSS	GP	China, Hong Kong, Vietnam, Israel, Spain, Italy, Taiwan, Singapore, India, Canada	4,5	12
Zhu 2021 [142]	May 2021	176	1,732,456	CS, L	Validated self-report	Dep, Anx	Students	Countries from East Asia, Europe, South Asia, Middle East, North America, Southeast Asia, Africa (4), Central America (3), Oceania (1), multiple geographical regions (2)	4,5	11

[1] Selected common mental disorders outcomes (depression, anxiety and PTSD).

CC, case-control; CS, cross-sectional; L, longitudinal; NR, not reported; OBS, observational; PC, prospective cohort; RC, retrospective cohort; RCT, randomized controlled trial.

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Robinson and colleagues [10] with changes estimated from longitudinal data and the reviews of Fang and colleagues [104] and Huang and colleagues [108] with pooled prevalence rates based on cross-sectional data, fulfilled all critical AMSTAR 2 ratings.
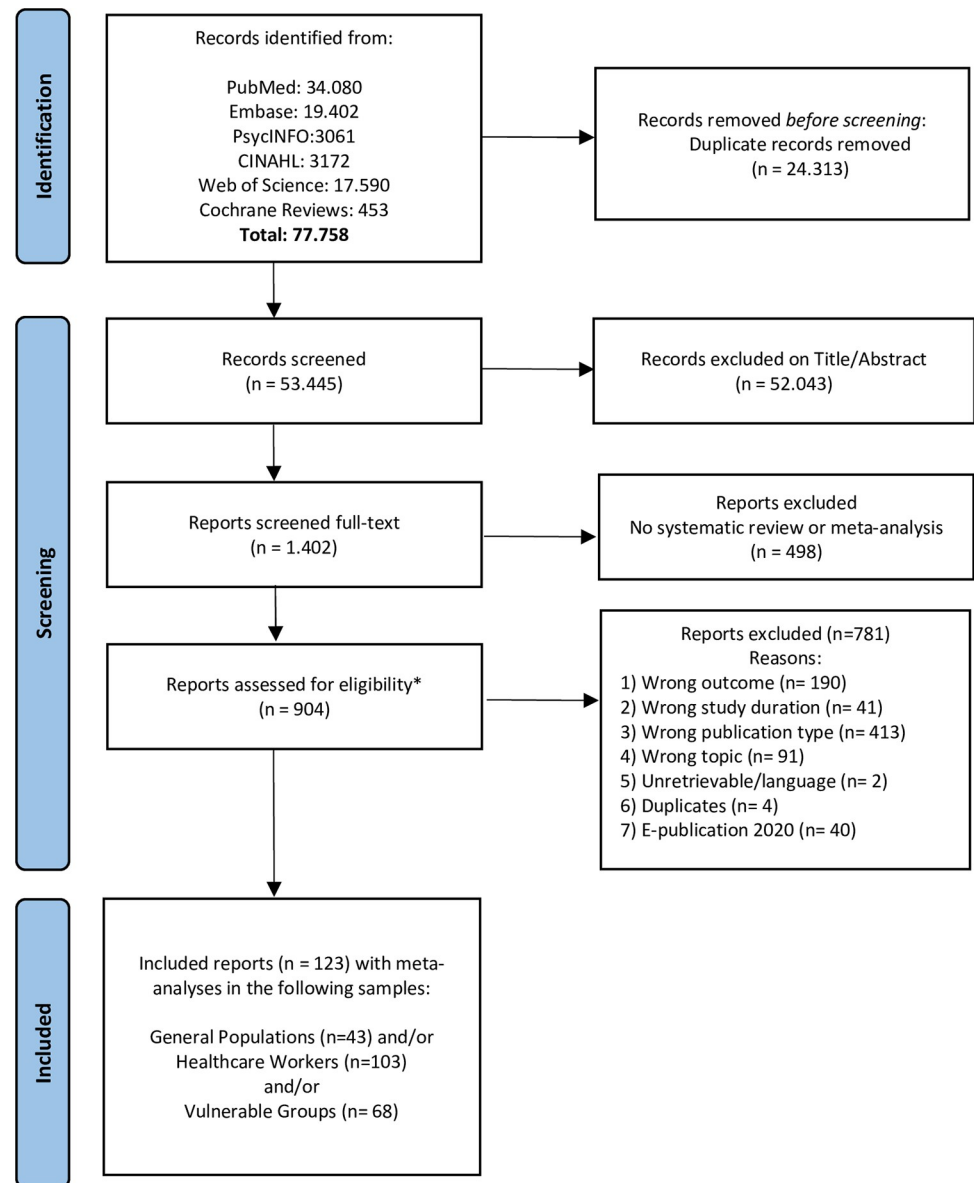
Fig 1. PRISMA flow chart of study selection based on both the initial and updated search. Caption credit: Page and colleagues [21]. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372: n71. https://doi-org.vu-nl.idm.oclc.org/10.1136/bmj.n71.

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Association between COVID-19 and symptoms of common mental disorders

General (or mixed) population. Reviews with meta-analyses of longitudinal (within-person) data showed that symptoms of depression or mood disorder were increased during- compared to pre-pandemic periods (SMC: 0.22, 95% CI: 0.13 to 0.30 [10]; Hedges' g: 0.16, 95% CI: 0.01 to 0.30 [59]; increase of 27.6%, 95% CI: 25.1 to 30.3 [5]) and remained increased over time in the first half year of 2020 (March to April SMC: 0.23, 95% CI: 0.11 to 0.34 and May to July SMC: 0.20, 95% CI: 0.10 to 0.30) [10] (**Table 2**). During social restrictions, depression symptoms were higher than in pre-implementation of public health and social measures or pre-pandemic periods (Cohen's d: 0.83, 95% CI: 0.30 to 1.37 [113]) and during pandemic
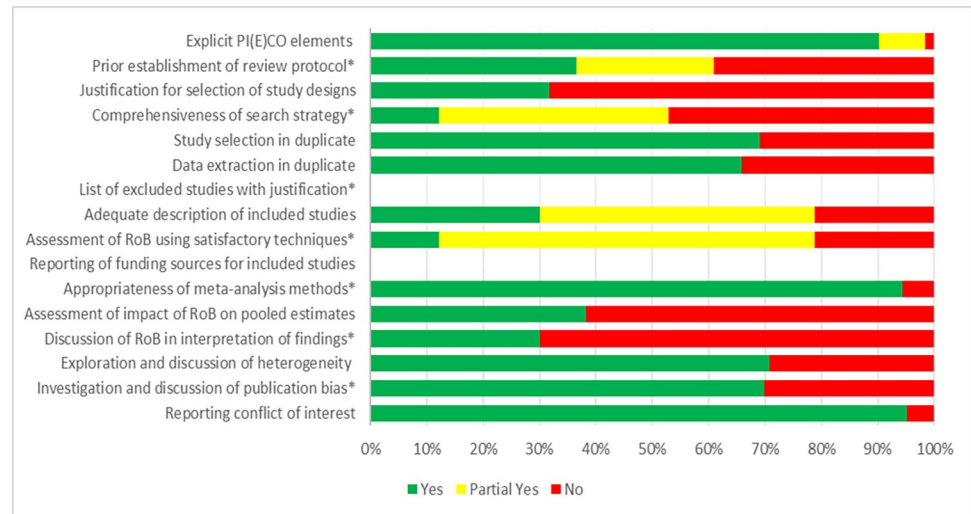
Fig 2. Quality assessments by outcome as percentages across all included systematic reviews with meta-analyses. P (I)ECO, Population, (Intervention) or Exposure, Comparator, Outcome; RoB, Risk of Bias.

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depression symptoms compared to matched pre-pandemic cross-sectional data were significantly increased as well (standardized mean difference (SMD): 0.67, 95% CI: 0.07 to 1.27 [43]). Anxiety disorder symptoms were also higher during- compared to pre-pandemic periods (SMC 0.12, 95% CI: 0.02 to 0.23 [10]; 25.6% increase, 95% CI: 23.2 to 28.0 [5]) as were anxiety and posttraumatic stress symptoms when pooled together (Hedges' g: 0.18, 95% CI: 0.07 to 0.27) [59]. Anxiety symptoms during pandemic were also increased compared to pre-pandemic data (SMD: 0.40, 95% CI: 0.15 to 0.65) [43]. The effect size of social restrictions on anxiety symptoms was however not significant (Cohen's d: 0.26, −0.04 to 0.56) [113] and not higher in March to April 2020 (SMC: 0.14, 95% CI: −0.02 to 0.30) nor in May to July 2020 (SMC: 0.05, 95% CI: −0.04 to 0.14) [10]. For general mental health symptoms, significant differences during- versus pre-pandemic periods (SMC 0.11, 95% CI: 0.04 to 0.17 and SMC 0.17, 95% CI: 0.07 to 0.26) [59] and during social restrictions versus pre-implementation of public health and social measures or pre-pandemic (Cohen's d: 0.41, 95% CI: 0.17 to 0.65) [113] were found. High heterogeneity across studies was found in all reviews ($I^2 > 94\%$). Moderation analyses showed a significantly larger increase in depression than anxiety symptoms during the pandemic [10]. Pooled estimates of differences in change from during- to pre-pandemic by sex or gender showed that females had a significantly greater during pandemic increase in anxiety symptoms (SMD 0.15; 95% CI: 0.07 to 0.22) and in general mental health than males (SMD: 0.15, 95% CI: 0.12 to 0.18) [98]. Females worsened more during the pandemic in terms of anxiety and depression symptoms, as well as younger compared to older age groups [5]. The largest changes in prevalence rates of depression and anxiety symptoms were found in studies with data from early stages of pandemic [10], or when prevalence rates were compared with studies of older pre-pandemic data [43,10]. Changes in PTSD symptom levels could not be adequately assessed due to a lack of aftermath macro-stressors similar to the COVID-19 situation [43]. Country-level COVID-19 exposure factors (e.g., death rate, stringency measures) and individual-level factors (e.g., age, sex or gender) could not significantly explain heterogeneity in changes of depression and anxiety symptoms across studies in 2 reviews [10,59], while in other reviews, depression symptoms were higher in people exposed to strict compared to moderate restrictions [113] and anxiety and depression prevalence increased when human

Table 2. Outcomes from meta-analyses on during- versus pre-pandemic longitudinal or comparative data.

Variables	Population	Studies (*n*)	Designs of included studies	Pooled sample size	Metric	Pooled effect	95% CI change/ increase
Depression							
During- vs. pre-pandemic [10]	Mixed	58	Longitudinal (within person)		SMC	**0.22**	**0.13 to 0.30**
March–April 2020 vs. pre-pandemic	Mixed	58	Longitudinal (within person)		SMC	**0.23**	**0.11 to 0.34**
May–July 2020 vs. pre-pandemic	Mixed	58	Longitudinal (within person)		SMC	**0.20**	**0.10 to 0.30**
During- vs. pre-pandemic [5]	General	57	Longitudinal (within person) or cross-sectional (if pre-pandemic available)		% increase	**27.6**	**25.1 to 30.3**
During- vs. pre-pandemic [59]	General	9	Longitudinal (within-person), experimental (restrictions vs. no restrictions)		Hedges' g	**0.16**	**0.01 to 0.30**
During- vs. pre-pandemic [98]	Mixed	4	Longitudinal (>90% within-person)	4,475	SMD	0.12[1]	−0.09 to 0.33
	Mixed	1	Longitudinal (>90% within-person)	139	PCD	0.12[1]	−0.03 to 0.28
Social restrictions vs. pre-pandemic/pre-PHSM [113]	General	27	Longitudinal, cross-sectional		Cohen's d	**0.83**	**0.30 to 1.37**
During- vs. pre-pandemic [43]	General	25	Cross-sectional-observational (p) (c)	60,213 (p) 183,747 (c)	SMD	**0.67**	**0.07 to 1.27**
During- vs. pre-pandemic [43]	HCW	14	Cross-sectional-observational (p) (c)	2,226 (p) 4,605 (c)	SMD	-0.16	−0.59 to 0.26
During- vs. pre-pandemic [43]	Patients	7	Cross-sectional-observational (p) (c)	1,461 (p) 21,934 (c)	SMD	0.48	−0.08 to 1.04
Anxiety							
During- vs. pre-pandemic [10]	Mixed	52	Longitudinal (within person)		SMC	**0.13**	**0.02 to 0.23**
March–April 2020 vs. before pandemic	Mixed	52	Longitudinal (within person)		SMC	0.14	−0.02 to 0.30
May–July 2020 vs. before pandemic	Mixed	52	Longitudinal (within person)		SMC	0.05	−0.04 to 0.14
During pandemic vs. pre-pandemic [5]	General	34	Longitudinal (within person) or cross-sectional (if pre-pandemic available)		% increase	**25.6**	**23.2 to 28.0**
During- vs. pre-pandemic[2] [59]	General	10	Longitudinal (within-person)/experimental (restrictions vs. no restrictions)		Hedges' g	**0.18**[2]	**0.07 to 0.27**
During- vs. pre-pandemic [43]	General	23	Cross-sectional-observational (p) (c)	49,746 (p) 132,145 (c)	SMD	**0.40**	**0.15 to 0.65**
During- vs. pre-pandemic [43]	HCW	13	Cross-sectional-observational (p) (c)	5,508 (p) 22,204 (c)	SMD	−0.08	−0.66 to 0.49
During- vs. pre-pandemic [43]	Patients	6	Cross-sectional-observational (p) (c)	1,845 (p) 12,458 (c)	SMD	0.31	−0.07 to 0.69
During- vs. pre-pandemic [98]	Mixed	4	Longitudinal (>90% within-person)	4,344	SMD	**0.15**[1]	**0.07 to 0.22**
	Mixed	1	Longitudinal (>90% within-person)	217	PCD	−0.05[1]	−0.20 to 0.11
Social restrictions vs. pre-pandemic/pre-PHSM [113]	General	19	Longitudinal, cross-sectional		Cohen's d	0.26	−0.04 to 0.56
Mental health problems (non-specific)							
During- vs. pre-pandemic [10]	Mixed (total)	61	Longitudinal (within person)	55,015	SMC	**0.11**	**0.04 to 0.17**
During- vs. pre-pandemic[2] [98]	Mixed	12	Longitudinal (within person) or cross-sectional (if pre-pandemic available)	15,692	SMD	**0.15**[1]	**0.12 to 0.18**
	Mixed	12	Longitudinal (within person) or cross-sectional (if pre-pandemic available)	18,985	PCD	−0.03[1]	−0.09 to 0.04
During- vs. pre-pandemic [59]	General	20	Longitudinal (within-person), experimental (restrictions vs. no restrictions)	72,004	Hedges' g	**0.17**	**0.07 to 0.26**
Social restrictions vs. pre-pandemic/pre-PHSM [113]	General	33	Longitudinal, cross-sectional		Cohen's d	**0.41**	**0.17 to 0.65**

(*Continued*)

Table 2. (Continued)

Variables	Population	Studies (*n*)	Designs of included studies	Pooled sample size	Metric	Pooled effect	95% CI change/ increase
During- vs. pre-pandemic [10]	General	75	Longitudinal (within person)		SMC	**0.12**	**0.04 to 0.19**
During- vs. pre-pandemic [10]	Preexisting physical	14	Longitudinal (within person)		SMC	**0.25**	**0.07 to 0.43**
During- vs. pre-pandemic [10]	Preexisting mental	25	Longitudinal (within person)		SMC	−0.02	−0.21 to 0.18
During- vs. pre-pandemic [10]	University students	40	Longitudinal (within person)		SMC	0.13	−0.01 to 0.27
During- vs. pre-pandemic [10]	Children/ adolescents	38	Longitudinal (within person)		SMC	0.11	−0.03 to 0.26
PHSM vs. pre-PHSM or pre-pandemic [89]	Children	21	Longitudinal and cross-sectional with retrospective pre-pandemic measures	10,425	Hedges' g	**0.28**	**0.15 to 0.41**

[1] Deterioration for females compared to males.

[2] Anxiety and PTSD symptoms.

Bold represents significant effects.

(c), control participants; PCD, proportion change difference; PHSM, public health and social measures; (p), pandemic participants; SMC, standardized mean change; SMD, standardized mean difference; (n), equals number of studies or comparisons.

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mobility decreased and daily SARS-CoV-2 infection rate increased [5] (Tables A and B in **S2 Text**).

Pooled prevalence rates based on cross-sectional data showed that above cut-off depression, anxiety, and PTSD symptom levels in the general population ranged respectively from 16% to 48%, from 15% to 47% and 9% to 33% (see **Fig 3** and **Table 3**). Despite some inconsistencies, the high heterogeneity of prevalence rates of depression, anxiety, and PTSD symptomatology across studies was partly explained by differences in assessment tools and cut-offs used [42,54,84,92] (Tables A, B, and C in **S2 Text**). Prevalence rates were often higher in females [50,77,102,106], in studies collected earlier in the pandemic [92,94], in younger age groups [9,92,102], in studies of lower quality or higher risk of bias [9,92,94,139,141], and in certain areas (e.g., European compared to Asian countries) [30,55,86,87,92]. In terms of COVID-19 exposure factors, prevalence rates of anxiety and PTSD symptoms were higher after peak of COVID-19 infections or when survey was taken closer to outbreak [33,138]. Anxiety prevalence was higher when public transportation was closed [30] and depression when government responded with more stringent measures [44].

Healthcare workers. No meta-analyses of longitudinal studies in healthcare workers were available. Based on during pandemic prevalence data and pre-pandemic comparative data, no significant differences in symptoms of depression and anxiety were found (SMD: −0.16, 95% CI: −0.59 to 0.26 and SMD: −0.08, 95% CI: −0.66 to 0.49, respectively, **Table 2**) and rates were not affected by COVID-19 patient contact [43]. As shown in **Table 3**, apart from some outliers, pooled cross-sectional prevalence of above cut-off depression, anxiety, and PTSD symptom levels during pandemic ranged from 19% to 42%, from 15% to 47%, and from 15% to 39%, respectively. Explanatory factors of the high heterogeneity and moderators were roughly similar to those in the general population such as different scales and cutoffs (e.g., [33]), non-random sampling or sample (size) differences (e.g., [34,36]), region of study (e.g., [74,135]), and quality or risk of bias scores of studies [9,42]. Similarly, prevalence rates were higher in studies with larger proportions of female versus male workers, medical versus non-medical professionals, frontline versus non-frontline workers, and nurses versus doctors (e.g., [27,41,56,97,102,105,107,123]). Prevalence rates of above cut-off PTSD level were related to
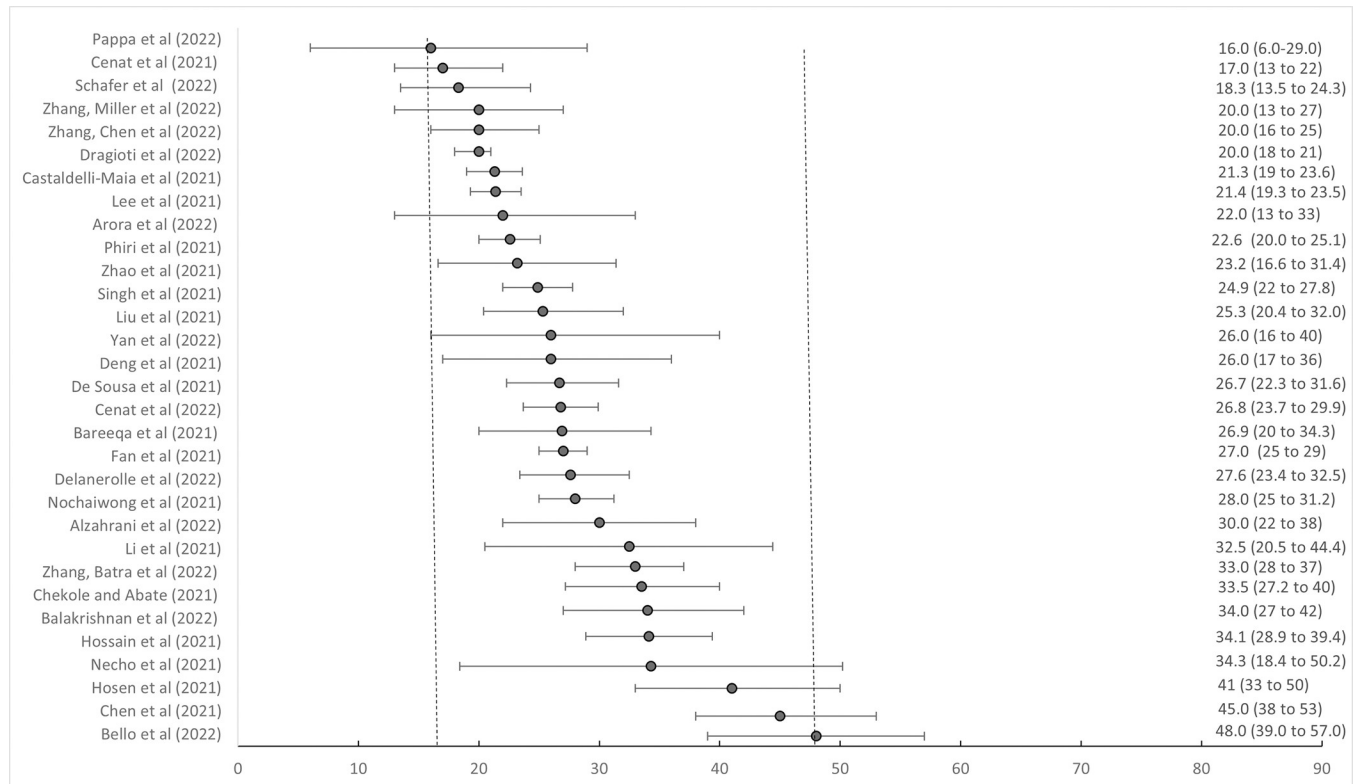
Fig 3. Cross-sectional pooled prevalence rates of above cut-offs of symptoms of depression during COVID-19 pandemic in general populations. Pooled prevalence rates from cross-sectional studies in general population with 95% confidence intervals.

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COVID-19 mortality rate [60] and inconsistently to age (e.g., higher in older [61,143] or in younger health professionals [138]).

People with preexisting physical or mental health disorders, or people infected with COVID-19. A small but significant pre- to during pandemic increase in mental health symptoms in people with preexisting physical health conditions (SMC: 0.25, 95% CI: 0.07 to 0.43) was found, while for people with preexisting mental disorders, no such increase was found (SMC: −0.02, 95% CI: −0.21 to 0.18) [10] (**Table 2**). In a mixed population of patients with mental, physical, or COVID-19 diseases [43], depression and anxiety symptom levels were higher but not significantly different from those in matched studies with pre-pandemic prevalence data (SMD: 0.48, 95% CI: −0.08 to 1.04; SMD: 0.31, 95% CI: −0.07 to 0.69, respectively) [43] (**Table 2**). Apart from some outliers, pooled prevalence rates of depression, anxiety, and PTSD symptoms in COVID-19 patients ranged from 17% to 38%, from 23% to 40%, and from 15% to 42%, respectively (**Table 3**). In patients with physical diseases, pooled prevalence rates ranged from 31% to 37% and from 23% to 37% for depression and anxiety symptoms, respectively, over 50% in patients with eating disorders and roughly between 20% and 40% in perinatal women (**Table 3**). Although the high heterogeneity in patient populations remained often unexplained, some explanatory factors were different scales and cut-offs used (e.g., [48,50]) and sampling procedures (e.g., [35]). Higher prevalence rates of depression and anxiety in females (e.g., [102,111]), in certain regions of studies [102,111,120], in clinically severe, hospitalized and acute COVID-19 patients [35,124] and when COVID-19 mortality rates were higher [60]. High heterogeneity in during pandemic prevalence rates among perinatal women

Table 3. Ranges of prevalence rates (of above cut-off scores) during pandemic from meta-analyses of pooled cross-sectional data.

Populations	Pooled prevalence range — Depression symptoms	References	Pooled prevalence range — Anxiety symptoms	References	Pooled prevalence range — PTSD symptoms	References
General populations	16% to 48%	[9,29,30,33,38,42,44,50,54,55,67,77,84,85,88,91,92,94,100–102,106,123,132,136,139–141]	15% to 47%	[9,29,30,33,38,42,45,50,54,55,77,79,84,85,87,91,92,94,100–102,106,111,123,133,136,139–141]	9% to 33%	[9,38,50,55,60,61,64,76,77,85,86,91,100–102,138]
Healthcare workers	19% to 42%	[29,30,33,34,36,38,41,42,79,81,83,86,88,97,99–102,105–107,110,143]	15% to 47%	[9,25,29,30,33,34,36,41,42,47,49,50,53,56,62,65–67,78,79,81,86,91,97,99–102,105–107,110,123,127,143]	15% to 38%	[9,34,38,47,50,56,60,61,73,74,77,78,91,101,102,125,135,138,143]
	Outliers: 14% and 65%	[37,91]	*Outlier:* 72%	[37]	49%	[66]
Patients:						
COVID-19 infection	17% to 38%	[35,38,50,79,102,121,124,136]	23% to 40%	[35,48,79,102,111,121,124]	15% to 42%	[35,60,61,120,138]
	Outlier: 55%	[48]	*Outliers:* 14% and 64%	[50,136]	94%	[102]
Somatic disorders	31% to 37%	[26,102,114]	23% to 39%	[102,111,114,115]		
	Outlier: 17%	[115]				
Eating disorders	55%	[69,112]	50 and 64%	[69,112]		
Mixed disorders	22%	[30]				
Perinatal women	23% to 34%	[31,39,68,70,82,96,102,131]	17% to 40%	[31,39,68,70,102,111,144]		
	Outliers: 17% and 40%	[68,144]	*Outlier:* 50%	[68]		
Students	23% to 39%	[27,28,30,32,40,46,51,71,79,88,103,104,109,118,123,129,130,142]	28% to 44%	[28,32,46,71,79,90,103,104,109,111,116,119,128,130,142]	30%	[27]
	Outliers: 50%,52%,63%,65%	[79,90,106,119]	*Outliers:* 18% and 52%, 55%	[90,106,123]		
Children/adolescents	22% to 29%	[52,63,93,95]	21% to 34%	[28,52,63,93,122]	28%, 48%	[52,137]
	Outlier: 42%	[122]				

Pooled prevalence rates with 95% confidence intervals from each review with meta-analyses of mental health outcomes in all populations can be found in the S2 Text (Tables A, B, and C in S2 Text).

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was infrequently explained by region of study (lower in Asian than in western countries and higher in low- versus high-income countries [39,68,102]).

Students.   A nonsignificant small increase from pre- to during pandemic in mental health problems (including anxiety and depression) was found for university students (SMC: 0.13, 95% CI: −0.01 to 0.27) [10]. Apart from outliers, cross-sectional prevalence rates of above cut-off depression and anxiety symptoms in students ranged from 23% to 39% and from 28% to 44%, respectively, and prevalence for above cut-off PTSD level was 30% (**Table 3**). Prevalence rates were higher in certain regions (e.g., non-China) [71,109,130], in females [28,104], and for specific assessment tools [32,90,109].

Children and adolescents.   During- compared to pre-pandemic mental health symptoms in children and adolescents were not significantly increased in a meta-analysis of exclusively longitudinal data (SMC: 0.11, 95% CI: −0.03 to 0.26) [10], but in children between 5 and 13 years of age, symptoms were significantly higher when based on longitudinal and cross-sectional compared to retrospective pre-pandemic data ([89]; SMC 0.28; 95% CI: 0.15 to 0.41) (**Table 2**). In children and adolescents combined, pooled prevalence of above cut-off depression and anxiety levels ranged from 22% to 29% and from 21% to 34%, respectively, and for above cut-offs PTSD symptom level 28% resp. 30% (**Table 3** and Tables A, B, and C in **S2 Text**). High heterogeneity was found [52,63,93,95,122] and subgroup analyses showed higher prevalence rates of depression and anxiety symptoms in studies with a higher proportion of girls/females and in adolescents compared to children. PTSD symptom prevalence rate was higher in children and adolescents from Northern America and Europe compared to Southeast Asia [52,63,93,137]. In only few reviews with meta-analyses, a pooled prevalence rate in caregivers (e.g., mothers of young children [126]) and in working populations (e.g., teachers [58,108]) was calculated (Tables A, B, and C in **S2 Text**).

Discussion

Summary of key findings

In this umbrella review, we narratively summarized outcomes of 123 systematic reviews with meta-analyses to assess the association between COVID-19 and symptoms of common mental health disorders. The few reviews that pooled longitudinal data consistently showed a small increase in symptoms of depression and anxiety (and partly PTSD) during the early pandemic compared to pre-pandemic periods in the general population [5,10,59]. The increase of depression symptoms was generally larger and longer lasting than for anxiety [5,10]. Strict measures compared to less social restrictions resulted in higher depression symptoms as well [113]. Subgroup analyses of pooled during- to pre-pandemic or pre-implementation of public health and social measures data showed that mental health symptoms deteriorated more for people with preexisting physical but not for people with mental health conditions [10]. During pandemic, depression and anxiety symptoms were not different in healthcare workers nor in subgroups of any patients (including COVID-19), but these findings were based on cross-sectional data compared to pre-pandemic matched data [43]. Although the high heterogeneity between studies with pre- and during pandemic data could not be explained by differences in age and sex or gender in some reviews [10,59], other reviews did show that mental health of females and younger age groups including children between 5 and 13 years was more affected by the pandemic or by social restrictions [5,43,89,98,113]. Similar discrepancies were found in terms of country-level or COVID-19 exposure factors with some meta-analyses showing no evidence that factors such as continent, COVID-19 case/death rate, or economic situation explained the heterogeneity between longitudinal studies of general populations [10,59]. Others however found that region (e.g., Europe versus Southeast Asia) decreased human mobility

and higher daily SARS-CoV-2 infection rates were associated with depression and anxiety symptoms during the pandemic or during social restrictions [5,113].

Pooled cross-sectional data from general and specific populations and healthcare workers indicated wide ranges of prevalence rates. High heterogeneity was often explained by assessment tools and cut-offs used, sampling procedures, and quality of reviews. Also, higher rates were found in females, in certain regions, in acute or clinically severe COVID-19 patients, in frontline versus non-frontline healthcare workers and related to some COVID-19 exposure factors such as mortality rate. However, these findings need to be interpreted with caution and no causal inferences can be made due to the cross-sectional designs of the studies pooled in these meta-analyses.

Interpretation of findings

The small increases of depression and anxiety symptoms are in line with population-based studies showing peaks of symptom prevalence during implementation of public health measures and social restrictions [145,146] and with recent meta-analytic findings of lower self-reported mental health in the first 2 months of the pandemic [147]. However, our umbrella review findings are in contrast with recent studies from local (mostly Northern European) countries that found no change or a decrease in during- compared to pre-pandemic mental health disorders and symptoms, e.g., for depression based on diagnostic interviews, or only an increase in subgroups of females or younger age groups [148,149]. Sampling and measurement differences may explain these discrepancies. For example, reviews pooling longitudinal symptom level data from multiple studies perhaps picked up more subtle nonclinical changes on self-report measures than individual longitudinal studies with outcomes based on clinical interviews. We also conclude, in line with the pooled longitudinal data in the reviews of Cénat and colleagues and Salanti and colleagues [92,147], that largest increases of mental health symptoms such as depression took place in the early phases of the pandemic [10] and during periods of social restrictions [113]. In May to July 2020, the SMD for depression was however still increased and only marginally lower than in March to April 2020 [10] and this is not in line with the continuous decline in anxiety and depression reported by Cenát [92] and Salanti [147]. An explanation may be that the more recent reviews that included studies with longer follow-up times were able to capture long-term trends of symptoms during the pandemic [92,147] specifically among more vulnerable individuals, such as females and young people [7].

Important issues to address in our umbrella review are the very high heterogeneity scores between studies (>90%) [10,59,113] and the lack of assessment and interpretation of risk of bias of primary studies [10,43,113], as this may compromise the certainty of the evidence. Across reviews, methodological and individual-level factors such as assessment tools used or age and sex or gender, explained some of the heterogeneity although inconsistently. Also, COVID-19 exposure factors such as daily COVID-19 cases and mobility indices and strictness of social restrictions, were associated with increases of depression and anxiety symptom levels in some reviews of longitudinal [5,113] and cross-sectional studies [30,44,60]. This is in line with the longitudinal study of Aknin and colleagues and the meta-analysis of Salanti and colleagues [147,150] but in contrast with other reviews of longitudinal data [10,59]. The Bayesian meta-regression and meta-analysis approaches in the Santomauro and colleagues and Salanti and colleagues reviews that use additional informative data (e.g., from cross-sectional samples or during pandemic longitudinal data) are more powerful and this may explain the differences with other reviews of longitudinal data with conventional random-effects meta-analysis. Still, heterogeneity in most reviews was high and largely unexplained. This may be due to the sparse

assessment of multiple COVID-19 exposure or individual-level factors such as economic support or situation on mental health symptoms in longitudinal studies. Also, COVID-19 exposure factors such as numbers of cases and stringency of the measures are strongly correlated over time in terms of their influence on mental health outcomes and difficult to disentangle [5,10]. This issue with the COVID-19 exposure factors calls for a more integrative approach to examine the inter-relatedness of several social, economic, and behavioral factors that may explain the association between public health measures and social restrictions during pandemics and mental health [113,151].

That females and younger age groups experienced a larger deterioration in mental health during the pandemic is a rather consistent finding across reviews presented here and in line with recent longitudinal studies with national representative or probabilistic samples [4,146]. In students, however, no significant worsening of mental health was found [10]. During pandemic, worsened or sustained deterioration of anxiety and depression has however been found in students with feelings of loneliness during the pandemic [152], indicating individual variation of impact of the pandemic even within specific subgroups.

Furthermore, in healthcare workers and in a mixed patient population, the during pandemic mental health symptoms were not significantly higher compared to matched pre-pandemic data [43]. It needs to be emphasized here that longitudinal within-person during- and pre-pandemic data were lacking among health workers and mixed patient populations, impeding strong conclusions regarding the pandemic-related changes in mental health in these groups. However, subgroup findings of cross-sectional prevalence rates cautiously suggested that pandemic exposure factors (e.g., COVID-19 mortality rate, region) negatively affected specific workers and patients (i.e., females, nurses, younger workers, or more severely infected patients). This is in line with recent individual longitudinal studies in these populations showing that anxiety among healthcare workers including females and young people was increased when exposure rates were highest, particularly shortly before a phase of implementing public health and social measures [7,153,154].

That the mental health of people with preexisting physical diseases was significantly deteriorated during the pandemic [10], is in line with other longitudinal studies and explained by higher loneliness and isolation scores [7,145]. However, that patients with mental disorders showed no such deterioration [10], seems inconsistent with findings indicating greater vulnerability in people with a history of mental disorders at least on the longer run during the pandemic [7]. This inconsistency may be explained by several phenomena. One is that pandemic mental health indicators like suicidality, although outside the scope of this review, tend to decrease in the initial phase of a disaster when people are less self-focused but may rise again when the situation is normalized and more long-term negative (socioeconomic) consequences become apparent [155]. This inconsistency may also be explained by great individual variation among people with mental disorders, with pandemic or implementation of public health and social measures related increases of anxiety and depression symptoms for some but beneficial effects for others (e.g., due to reduced social pressures). A ceiling effect may play a role as well, with symptoms already being that high that large increases cannot be expected [156]. That people with physical and mental disorders were less reactive to social restrictions in terms of depression symptoms than people who had no such disorders [113] may be explained by resilient adaptation and less loneliness in people with chronic somatic diseases during later phases of implementing public health and social measures [157] and by the less reactive peaks in mental health during public health and social measures in people with mental disorders [145].

For the association between the pandemic and mental health in other vulnerable groups from different specific sociodemographic backgrounds, meta-analyses of longitudinal data were lacking [10,43]. Findings are inconsistent, with some longitudinal studies suggesting that

people with ethnic diverse backgrounds, low level of education, and financial difficulties showed longer-lasting poorer mental health during the pandemic [7], while other studies indicate significant mental health deterioration in all sociodemographic groups [146].

Implications of the findings

The findings presented here have implications for mental health researchers, policy makers, and public health professionals involved in current and future public health crises. First, more powerful meta-analysis methods with, e.g., Bayesian approaches, individual participant data from multiple countries, and linear and nonlinear assessments of change, should be employed to more accurately plot mental health trajectories. Second, individual-level socioeconomic and pandemic exposure factors including time as continuous factor (instead of estimations based on time-intervals or averages [5,59]) should be assessed more comprehensively and accurately. Third, accurate exposure trackers such as the OXFORD COVID-19 Government Response Stringency and Google mobility indices should be linked to longitudinal within-person data from probabilistic or national representative samples [11]. Finally, policy interventions could be developed in such a way that it includes repeated and systematic data collection in vulnerable groups, for example, through population panels. Since a digital and tele-mental health revolution unfolded during the pandemic [158], these developments may be incorporated in remote mental healthcare interventions making monitoring and prevention and treatment scalable and cost-effective socioeconomic approach for vulnerable individuals [159].

Strengths and limitations

The broad scope of our search, rigorous rating of methodological quality, and complete overview of the evidence from available systematic reviews and meta-analyses until August 12, 2022, are clear strengths of our umbrella review. Certain limitations need to be taken into account as well. First, because we summarized the pooled prevalence rates and SMCs and the heterogeneity metrics and subgroup analyses from each individual meta-analysis qualitatively, quantitative reduction of inconsistencies or biases across reviews was lacking. Second, very few reviews pooled within-person data from multiple longitudinal studies and almost all pooled cross-sectional data from validated screening instruments often with different cut-offs for case-finding. These are unavoidable limitations inherited from the source reviews but warrant caution when interpreting findings as a cause-and-effect relationship to the pandemic. Importantly, prevalence rates are often higher in studies with more females and lower in studies from Asia irrespective of the pandemic [160] and screening instruments with different cut-offs for case-finding often reflect only a mild level of symptomatology of a disorder with short-term duration [161,162]. Third, we did not calculate the overlap between individual studies included in the systematic reviews with meta-analyses of our umbrella review. This potential for non-independence in the primary studies across similar reviews [163], may however be less problematic when analyzing outcomes from reviews in a narrative instead of a quantitative way, and the meta-analyses with pooled longitudinal data were inherently different in nature making overlap less likely. Finally, findings synthesized from meta-analyses presented here do not equally represent all regions across the world with a lack of studies from LMICs, making it difficult to infer conclusions in terms of mental health in relation to COVID-19. In resource-limited settings, however, people suffer from the greatest burden of mental illness although treatment and prevention of mental health problems is often lacking [164].

Conclusions

Evidence suggests increased prevalence of mental health outcomes, particularly depression symptoms, during the pandemic and during implementation of public health measures and social restrictions, predominantly in young people, females, and people with chronic somatic disorders. Pooled prevalence rates of common mental health symptoms during the pandemic ranged from about 10% to 50% but lacked pre-pandemic comparison and true clinical value. At the time of writing this article, the COVID-19 pandemic in most regions worldwide has subsided and data collection of COVID-19 cases and deaths has been discontinued. In some areas, however, COVID-19 infection rates are still elevated, may increase again or new variants may keep emerging. The implications mentioned in our review, in terms of research and clinical and policy interventions, such as the implementation of scalable and widely accessible (remote) psychological interventions, are thus still timely and may offer more sound and definite policy directives to mitigate the impact of global public health disasters on mental health.

Supporting information

S1 PRISMA checklist. Prisma 2020 checklist.
(DOCX)

S1 Text. Search strategy, data extraction protocols, quality assessment. Table A. Search strategies used to retrieve papers from different databases. **Table B.** List of excluded meta-analyses by full-text screening with exclusion reason.**Table C.** AMSTAR 2 ratings.
(DOCX)

S2 Text. Results from reviews on prevalence of depression, anxiety, and PTSD symptoms during COVID-19. Table A. Pooled prevalence rates and changes in depression symptoms, with heterogeneity scores and main subgroup findings. **Table B.** Pooled prevalence rates and changes in anxiety symptoms, with heterogeneity scores and main subgroup findings. **Table C**. Pooled prevalence rates and changes in PTSD symptoms, with heterogeneity scores and main subgroup findings. **Fig 1.** PRISMA flow chart initial search December 31, 2019 until October 6, 2021. **Fig 2.** PRISMA flow chart updated search October 7, 2021 until August 12, 2022.
(DOCX)

Acknowledgments

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References

1. Janiri D, Carfì A, Kotzalidis GD, Bernabei R, Landi F, Sani G. Posttraumatic Stress Disorder in Patients after Severe COVID-19 Infection. JAMA Psychiatry. 2021; 78(5):567–569. https://doi.org/10.1001/jamapsychiatry.2021.0109 PMID: 33599709.

2. Rogers JP, Chesney E, Oliver D, Pollak TA, McGuire P, Fusar-Poli P, et al. Psychiatric and neuropsychiatric presentations associated with severe coronavirus infections: a systematic review and meta-analysis with comparison to the COVID-19 pandemic. Lancet Psychiatry. 2020; 7(7):611–627. https://doi.org/10.1016/S2215-0366(20)30203-0 PMID: 32437679.

3. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet. 2020; 395 (10227):912–920. https://doi.org/10.1016/S0140-6736(20)30460-8 PMID: 32112714.

4. Pierce M, McManus S, Hope H, Hotopf M, Ford T, Hatch SL, et al. Mental health responses to the COVID-19 pandemic: a latent class trajectory analysis using longitudinal UK data. Lancet Psychiatry. 2021; 8(7):610–619. https://doi.org/10.1016/S2215-0366(21)00151-6 PMID: 33965057.

5. Santomauro DF, Mantilla Herrera AM, Shadid J, Zheng P, Ashbaugh C, Pigott DM, et al. Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. Lancet. 2021; 398(10312):1700–1712. https://doi.org/10.1016/S0140-6736(21)02143-7 PMID: 34634250.

6. Adhikari S, Pantaleo NP, Feldman JM, Ogedegbe O, Thorpe L, Troxel AB. lJAMA Netw Open. 2020; 3 (7):e2016938. https://doi.org/10.1001/jamanetworkopen.2020.16938

7. Saunders R, Buckman JEJ, Fonagy P, Fancourt D. Understanding different trajectories of mental health across the general population during the COVID-19 pandemic. Psychol Med. 2021;Mar 3:1–9. https://doi.org/10.1017/S0033291721000957 PMID: 33653426.

8. Sun Y, Wu Y, Bonardi O, Krishnan A, He C, Boruff JT, et al. Comparison of Mental Health Symptoms prior to and during COVID-19: Evidence from a Living Systematic Review and Meta-analysis. medRxiv 2021.05.10.21256920 [Preprint]. 2022 [cited 2022 Jun 23]. https://doi.org/10.1101/2021.05.10.21256920

9. Phiri P, Ramakrishnan R, Rathod S, Elliot K, Thayanandan T, Sandle N, et al. An evaluation of the mental health impact of SARS-CoV-2 on patients, general public and healthcare professionals: A systematic review and meta-analysis. EClinicalMedicine. 2021; 34:100806. https://doi.org/10.1016/j.eclinm.2021.100806 PMID: 33842872.

10. Robinson E, Sutin AR, Daly M, Jones A. A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. J Affect Disord. 2022; 296:567–576. https://doi.org/10.1016/j.jad.2021.09.098 PMID: 34600966.

11. Pierce M, McManus S, Jessop C, John A, Hotopf M, Ford T, et al. Says who? The significance of sampling in mental health surveys during COVID-19. Lancet Psychiatry. 2020; 7(7):567–568. https://doi.org/10.1016/S2215-0366(20)30237-6 PMID: 32502467.

12. Solmi M, Correll CU, Carvalho AF, Ioannidis JPA. The role of meta-analyses and umbrella reviews in assessing the harms of psychotropic medications: beyond qualitative synthesis. Epidemiol Psychiatr Sci. 2018; 27(6):537–542. https://doi.org/10.1017/S204579601800032X PMID: 30008278.

13. Holmes EA O'Connor RC, Perry VH, Tracey I, Wessely S, Arseneault L, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. Lancet Psychiatry. 2020; 7(6):547–560. https://doi.org/10.1016/S2215-0366(20)30168-1 PMID: 32304649.

14. Xiang YT, Yang Y, Li W, Zhang L, Zhang Q, Cheung T, et al. Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. Lancet Psychiatry. 2020; 7(3):228–229. https://doi.org/10.1016/S2215-0366(20)30046-8 PMID: 32032543.

15. Fusar-Poli P, Radua J. Ten simple rules for conducting umbrella reviews. Evid Based Ment Health. 2018; 21(3):95–100. https://doi.org/10.1136/ebmental-2018-300014 PMID: 30006442.

16. Barbui C, Purgato M, Abdulmalik J, Acarturk C, Eaton J, Gastaldon C, et al. Efficacy of psychosocial interventions for mental health outcomes in low-income and middle-income countries: an umbrella review. Lancet Psychiatry. 2020; 7(2):162–172. https://doi.org/10.1016/S2215-0366(19)30511-5 PMID: 31948935.

17. Ioannidis JPA. Integration of evidence from multiple meta-analyses: a primer on umbrella reviews, treatment networks and multiple treatments meta-analyses. CMAJ. 2009; 181(8):488–493. https://doi.org/10.1503/cmaj.081086 PMID: 19654195.

18. Hoare E, Collins S, Marx W, Callaly E, Moxham-Smith R, Cuijpers P, et al. Universal depression prevention: An umbrella review of meta-analyses. J Psychiatr Res. 2021; 144:483–493. https://doi.org/10.1016/j.jpsychires.2021.10.006 PMID: 34768070.

19. Papatheodorou S. Umbrella reviews: what they are and why we need them. Eur J Epidemiol. 2019; 34:543–546. https://doi.org/10.1007/s10654-019-00505-6 PMID: 30852716.

20. World Health Organization. Mental Health and COVID-19: Early evidence of the pandemic's impact. 2022 [cited 2022 May 5]; 2(March):1–11. Available from: https://apps.who.int/iris/handle/10665/352189.

21. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021:372. https://doi.org/10.1136/bmj.n71 PMID: 33782057.

22. World Health Organization. Listings of WHO's response to COVID-19. World Health Organization. 2020. [cited 2022 July 22] Available from: https://www.who.int/news/item/29-06-2020-covidtimeline.

23. Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. Br Med J. 2017; 358:j4008. https://doi.org/10.1136/bmj.j4008 PMID: 28935701.

24. Banzi R, Cinquini M, Gonzalez-Lorenzo M, Pecoraro V, Capobussi M, Minozzi S. Quality assessment versus risk of bias in systematic reviews: AMSTAR and ROBIS had similar reliability but differed in their construct and applicability. J Clin Epidemiol. 2018; 99:24–32. https://doi.org/10.1016/j.jclinepi.2018.02.024 PMID: 29526556.

25. Adibi A, Golitaleb M, Farrahi-Ashtiani I, Pirani D, Yousefi K, Jamshidbeigi Y, et al. The Prevalence of Generalized Anxiety Disorder Among Health Care Workers During the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. Front Psych. 2021; 12:658846. https://doi.org/10.3389/fpsyt.2021.658846 PMID: 34135784.

26. Ayubi E, Bashirian S, Khazaei S. Depression and Anxiety Among Patients with Cancer During COVID-19 Pandemic: A Systematic Review and Meta-analysis. J Gastrointest Cancer. 2021; 52(2):499–507. https://doi.org/10.1007/s12029-021-00643-9 PMID: 33950368.

27. Batra K, Sharma M, Batra R, Singh TP, Schvaneveldt N. Assessing the Psychological Impact of COVID-19 among College Students: An Evidence of 15 Countries. Healthcare (Basel). 2021; 9(2):222. https://doi.org/10.3390/healthcare9020222 PMID: 33671363.

28. Chang JJ, Ji Y, Li YH, Pan HF, Su PY. Prevalence of anxiety symptom and depressive symptom among college students during COVID-19 pandemic: A meta-analysis. J Affect Disord. 2021; 292:242–254. https://doi.org/10.1016/j.jad.2021.05.109 PMID: 34134022.

29. Bareeqa SB, Ahmed SI, Samar SS, Yasin W, Zehra S, Monese GM, et al. Prevalence of depression, anxiety and stress in china during COVID-19 pandemic: A systematic review with meta-analysis. Int J Psychiatry Med. 2021; 56(4):210–227. https://doi.org/10.1177/0091217420978005 PMID: 33243029.

30. Castaldelli-Maia JM, Marziali ME, Lu Z, Martins SS. Investigating the effect of national government physical distancing measures on depression and anxiety during the COVID-19 pandemic through meta-analysis and meta-regression. 2021; 51(6):881–893. https://doi.org/10.1017/S0033291721000933 PMID: 33648613.

31. Demissie DB, Bitew ZW. Mental health effect of COVID-19 pandemic among women who are pregnant and/or lactating: A systematic review and meta-analysis. SAGE Open Med. 2021; 9:205031212110261. https://doi.org/10.1177/20503121211026195 PMID: 34262762.

32. Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, et al. The prevalence of depressive symptoms, anxiety symptoms and sleep disturbance in higher education students during the COVID-19 pandemic: A systematic review and meta-analysis. Psychiatry Res. 2021; 301:113863. https://doi.org/10.1016/j.psychres.2021.113863 PMID: 33984824.

33. Deng Y, Chen Y, Zhang B. Different prevalence trend of depression and anxiety among healthcare workers and general public before and after the peak of COVID-19 occurred in China: A meta-analysis. Asian J Psychiatr. 2021; 56:102547. https://doi.org/10.1016/j.ajp.2021.102547 PMID: 33465749.

34. Dong F, Liu HL, Yang M, Lu CL, Dai N, Zhang Y, et al. Immediate Psychosocial Impact on Healthcare Workers During COVID-19 Pandemic in China: A Systematic Review and Meta-Analysis. Front Psychol. 2021; 12:645460. https://doi.org/10.3389/fpsyg.2021.645460 PMID: 34122233.

35. Dong F, Liu H-L, Dai N, Yang M, Liu J-P. A living systematic review of the psychological problems in people suffering from COVID-19. J Affect Disord. 2021; 292:172–188. https://doi.org/10.1016/j.jad.2021.05.060 PMID: 34126309.

36. Dutta A, Sharma A, Torres-Castro R, Pachori H, Mishra S. Mental health outcomes among healthcare workers dealing with COVID-19/severe acute respiratory syndrome coronavirus 2 pandemic: A systematic review and meta-analysis. Indian J Psychiatry. 2021; 63(4):335–347. https://doi.org/10.4103/psychiatry.IndianJPsychiatry_1029_20 PMID: 34456346.

37. El-Qushayri AE, Dahy A, Reda A, Mahmoud MA, Mageed SA, Kamel AMA, et al. A closer look at the high burden of psychiatric disorders among healthcare workers in Egypt during the COVID-19 pandemic. Epidemiol Health. 2021; 43:e2021045. https://doi.org/10.4178/epih.e2021045 PMID: 34265893.

38. Fan FC, Zhang SY, Cheng Y. Incidence of psychological illness after coronavirus outbreak: a meta-analysis study. J Epidemiol Community Health. 2021; 75(9):836–842. https://doi.org/10.1136/jech-2020-215927 PMID: 33632722.

39. Ghazanfarpour M, Bahrami F, Rashidi Fakari F, Ashrafinia F, Babakhanian M, Dordeh M, et al. Prevalence of anxiety and depression among pregnant women during the COVID-19 pandemic: a meta-analysis. J Psychosom Obstet Gynaecol. 2022; 43(3):315–326. https://doi.org/10.1080/0167482X.2021.1929162 PMID: 34165032.

40. Guo S, Kaminga AC, Xiong J. Depression and Coping Styles of College Students in China During COVID-19 Pandemic: A Systemic Review and Meta-Analysis. Front Public Health. 2021; 9:613321. https://doi.org/10.3389/fpubh.2021.613321 PMID: 34307268.

41. Hao Q, Wang D, Xie M, Tang Y, Dou Y, Zhu L, et al. Prevalence and Risk Factors of Mental Health Problems Among Healthcare Workers During the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. Front Psych. 2021; 12:567381. https://doi.org/10.3389/fpsyt.2021.567381 PMID: 34211406.

42. Hossain MM, Rahman M, Trisha NF, Tasnim S, Nuzhath T, Hasan NT, et al. Prevalence of anxiety and depression in South Asia during COVID-19: A systematic review and meta-analysis. Heliyon. 2021; 7(4):e06677. https://doi.org/10.1016/j.heliyon.2021.e06677 PMID: 33898819.

43. Kunzler AM, Röthke N, Günthner L, Stoffers-Winterling J, Tüscher O, Coenen M, et al. Mental burden and its risk and protective factors during the early phase of the SARS-CoV-2 pandemic: systematic review and meta-analyses. Global Health. 2021; 17(1):1–29. https://doi.org/10.1186/s12992-021-00670-y PMID: 33781283.

44. Lee Y, Lui LMW, Chen-Li D, Liao Y, Mansur RB, Brietzke E, et al. Government response moderates the mental health impact of COVID-19: A systematic review and meta-analysis of depression outcomes across countries. J Affect Disord. 2021; 290:364–377. https://doi.org/10.1016/j.jad.2021.04.050 PMID: 34052584.

45. Li W, Zhang H, Zhang C, Luo J, Wang H, Wu H, et al. The Prevalence of Psychological Status During the COVID-19 Epidemic in China: A Systemic Review and Meta-Analysis. Front Psychol. 2021; 12:614964. https://doi.org/10.3389/fpsyg.2021.614964 PMID: 34017278.

46. Li Y, Wang A, Wu Y, Han N, Huang H. Impact of the COVID-19 Pandemic on the Mental Health of College Students: A Systematic Review and Meta-Analysis. Front Psychol. 2021; 12:669119. https://doi.org/10.3389/fpsyg.2021.669119 PMID: 34335381.

47. Li Y, Scherer N, Felix L, Kuper H. Prevalence of depression, anxiety and post-traumatic stress disorder in health care workers during the COVID-19 pandemic: A systematic review and meta-analysis. PLoS ONE. 2021; 16(3):e0246454. https://doi.org/10.1371/journal.pone.0246454 PMID: 33690641.

48. Liu C, Pan W, Li L, Li B, Ren Y, Ma X. Prevalence of depression, anxiety, and insomnia symptoms among patients with COVID-19: A meta-analysis of quality effects model. J Psychosom Res. 2021; 147:110516. https://doi.org/10.1016/j.jpsychores.2021.110516 PMID: 34023580.

49. Liu X, Wang G, Zhang J, Wang S. Prevalence of depression and anxiety among health care workers in designated hospitals during the COVID-19 epidemic: A meta-analysis. Chin J Evid Based Med. 2021; 21(9):1035–1042. Available from: https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/pt/covidwho-1449172?lang=en.

50. Liu X, Zhu M, Zhang R, Zhang J, Zhang C, Liu P, et al. Public mental health problems during COVID-19 pandemic: a large-scale meta-analysis of the evidence. Transl Psychiatry. 2021; 11(1):384. https://doi.org/10.1038/s41398-021-01501-9 PMID: 34244469.

51. Luo W, Zhong BL, Chiu HFK. Prevalence of depressive symptoms among Chinese university students amid the COVID-19 pandemic: A systematic review and meta-analysis. Epidemiol Psychiatr Sci. 2021; 30:e31. https://doi.org/10.1017/S2045796021000202 PMID: 33766163.

52. Ma L, Mazidi M, Li K, Li Y, Chen S, Kirwan R, et al. Prevalence of mental health problems among children and adolescents during the COVID-19 pandemic: A systematic review and meta-analysis. J Affect Disord. 2021; 293:78–89. https://doi.org/10.1016/j.jad.2021.06.021 PMID: 34174475.

53. Mahmud S, Hossain S, Muyeed A, Islam MM, Mohsin M. The global prevalence of depression, anxiety, stress, and, insomnia and its changes among health professionals during COVID-19 pandemic: A rapid systematic review and meta-analysis. Heliyon. 2021; 7(7):e07393. https://doi.org/10.1016/j.heliyon.2021.e07393 PMID: 34278018.

54. Necho M, Tsehay M, Birkie M, Biset G, Tadesse E. Prevalence of anxiety, depression, and psychological distress among the general population during the COVID-19 pandemic: A systematic review and meta-analysis. Int J Soc Psychiatry. 2021 Nov; 67(7):892–906. https://doi.org/10.1177/00207640211003121 PMID: 33794717.

55. Nochaiwong S, Ruengorn C, Thavorn K, Hutton B, Awiphan R, Phosuya C, et al. Global prevalence of mental health issues among the general population during the coronavirus disease-2019 pandemic: a systematic review and meta-analysis. Sci Rep. 2021; 11(1):10173. https://doi.org/10.1038/s41598-021-89700-8 PMID: 33986414.

56. Norhayati MN, Yusof RC, Azman MY. Prevalence of psychological impacts on healthcare providers during COVID-19 pandemic in Asia. Int J Environ Res Public Health. 2021; 18(17):9157. https://doi.org/10.3390/ijerph18179157 PMID: 34501747.

57. Olaya B, Pérez-Moreno M, Bueno-Notivol J, Gracia-García P, Lasheras I, Santabárbara J. Prevalence of depression among healthcare workers during the covid-19 outbreak: A systematic review and meta-analysis. J Clin Med. 2021; 10(15):3406. https://doi.org/10.3390/jcm10153406 PMID: 34362188.

58. Ozamiz-Etxebarria N, Mondragon NI, Bueno-Notivol J, Pérez-Moreno M, Santabárbara J. Prevalence of anxiety, depression, and stress among teachers during the covid-19 pandemic: A rapid systematic review with meta-analysis. Brain Sci. 2021; 11(9):1172. https://doi.org/10.3390/brainsci11091172 PMID: 34573192.

59. Prati G, Mancini AD. The psychological impact of COVID-19 pandemic lockdowns: A review and meta-analysis of longitudinal studies and natural experiments. Psychol Med. 2021; 51(2):201–211. https://doi.org/10.1017/S0033291721000015 PMID: 33436130.

60. Qiu D, Li Y, Li L, He J, Ouyang F, Xiao S. Infectious Disease Outbreak and Post-Traumatic Stress Symptoms: A Systematic Review and Meta-Analysis. Front Psychol. 2021; 12:668784. https://doi.org/10.3389/fpsyg.2021.668784 PMID: 34421723.

61. Qiu D, Li Y, Li L, He J, Ouyang F, Xiao S. Prevalence of post-traumatic stress symptoms among people influenced by coronavirus disease 2019 outbreak: A meta-analysis. Eur Psychiatry. 2021; 64(1):e30. https://doi.org/10.1192/j.eurpsy.2021.24 PMID: 33843547.

62. Raoofi S, Pashazadeh Kan F, Rafiei S, Khani S, Hosseinifard H, Tajik F, et al. Anxiety during the COVID-19 pandemic in hospital staff: systematic review plus meta-analysis. BMJ Support Palliat Care. 2021:bmjspcare-2021-003125. https://doi.org/10.1136/bmjspcare-2021-003125 PMID: 34312187.

63. Racine N, McArthur BA, Cooke JE, Eirich R, Zhu J, Madigan S. Global Prevalence of Depressive and Anxiety Symptoms in Children and Adolescents during COVID-19: A Meta-analysis. JAMA Pediatr. 2021; 175(11):1142–1150. https://doi.org/10.1001/jamapediatrics.2021.2482 PMID: 34369987.

64. Salehi M, Amanat M, Mohammadi M, Salmanian M, Rezaei N, Saghazadeh A, et al. The prevalence of post-traumatic stress disorder related symptoms in Coronavirus outbreaks: A systematic-review and meta-analysis. J Affect Disord. 2021; 282:527–538. https://doi.org/10.1016/j.jad.2020.12.188 PMID: 33433382.

65. Santabárbara J, Bueno-Notivol J, Lipnicki DM, Olaya B, Pérez-Moreno M, Gracia-García P, et al. Prevalence of anxiety in health care professionals during the COVID-19 pandemic: A rapid systematic review (on published articles in Medline) with meta-analysis. Prog Neuropsychopharmacol Biol Psychiatry. 2021; 107:110244. https://doi.org/10.1016/j.pnpbp.2021.110244 PMID: 33453320.

66. Saragih ID, Tonapa SI, Saragih IS, Advani S, Batubara SO, Suarilah I, et al. Global prevalence of mental health problems among healthcare workers during the Covid-19 pandemic: A systematic review and meta-analysis.International Journal of Nursing Studies. Int J Nurs Stud. 2021; 121:104002. https://doi.org/10.1016/j.ijnurstu.2021.104002 PMID: 34271460.

67. Singh RK, Bajpai R, Kaswan P. COVID-19 pandemic and psychological wellbeing among health care workers and general population: A systematic-review and meta-analysis of the current evidence from India. Clin Epidemiol Glob Health. 2021; 11:100737. https://doi.org/10.1016/j.cegh.2021.100737 PMID: 33898866.

68. Shorey SY, Ng ED, Chee CYI. Anxiety and depressive symptoms of women in the perinatal period during the COVID-19 pandemic: A systematic review and meta-analysis. Scand J Public Health. 2021; 49 (7):730–740. https://doi.org/10.1177/14034948211011793 PMID: 33966511.

69. Sideli L, Coco G, Bonfanti RC, Borsarini B, Fortunato L, Sechi C, et al. Effects of COVID-19 lockdown on eating disorders and obesity: A systematic review and meta-analysis. Eur Eat Disord Rev. 2021; 29 (6):826–841. https://doi.org/10.1002/erv.2861 PMID: 34460991.

70. Tomfohr-Madsen LM, Racine N, Giesbrecht GF, Lebel C, Madigan S. Depression and anxiety in pregnancy during COVID-19: A rapid review and meta-analysis. Psychiatry Res. 2021; 300:113912. https://doi.org/10.1016/j.psychres.2021.113912 PMID: 33836471.

71. Wang C, Wen W, Zhang H, Ni J, Jiang J, Cheng Y, et al. Anxiety, depression, and stress prevalence among college students during the COVID-19 pandemic: A systematic review and meta-analysis. J Am Coll Health. 2021:1–8. https://doi.org/10.1080/07448481.2021.1960849 PMID: 34469261.

72. Xie Q, Liu XB, Xu YM, Zhong BL. Understanding the psychiatric symptoms of COVID-19: a meta-analysis of studies assessing psychiatric symptoms in Chinese patients with and survivors of COVID-19 and SARS by using the Symptom Checklist-90-Revised. Transl Psychiatry. 2021; 11(1):290. https://doi.org/10.1038/s41398-021-01416-5 PMID: 34001863.

73. Varghese A, George G, Kondaguli S, Naser AY, Khakha DC, Chatterji R. Decline in the mental health of nurses across the globe during COVID-19: A systematic review and meta-analysis. J Glob Health. 2021; 10(11):05009. https://doi.org/10.7189/jogh.11.05009 PMID: 33884193.

74. Yan H, Ding Y, Guo W. Mental Health of Medical Staff during the Coronavirus Disease 2019 Pandemic: A Systematic Review and Meta-Analysis. Psychosom Med. 2021; 83(4):387–396. https://doi.org/10.1097/PSY.0000000000000922 PMID: 33818054.

75. Zhang H, Li W, Li H, Zhang C, Luo J, Zhu Y, et al. Prevalence and dynamic features of psychological issues among Chinese healthcare workers during the COVID-19 pandemic: A systematic review and cumulative meta-analysis. Gen Psychiatr. 2021; 34(3):e100344. https://doi.org/10.1136/gpsych-2020-100344 PMID: 34192242.

76. Zhang L, Pan R, Cai Y, Pan J. The prevalence of post-traumatic stress disorder in the general population during the COVID-19 pandemic: A systematic review and single-arm meta-analysis. Psychiatry Investig. 2021; 18(5):426–433. https://doi.org/10.30773/pi.2020.0458 PMID: 33910325.

77. Zhao YJ, Jin Y, Rao WW, Li W, Zhao N, Cheung T, et al. The prevalence of psychiatric comorbidities during the SARS and COVID-19 epidemics: a systematic review and meta-analysis of observational studies. J Affect Disord. 2021; 287:145–157. https://doi.org/10.1016/j.jad.2021.03.016 PMID: 33799032.

78. Marvaldi M, Mallet J, Dubertret C, Moro MR, Guessoum SB. Anxiety, depression, trauma-related, and sleep disorders among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. Neurosci Biobehav Rev. 2021; 126:252–264. https://doi.org/10.1016/j.neubiorev.2021.03.024 PMID: 33774085.

79. Chekole YA, Abate SM. Global prevalence and determinants of mental health disorders during the COVID-19 pandemic: A systematic review and meta-analysis. Ann Med Surg (Lond). 2021; 68:102634. https://doi.org/10.1016/j.amsu.2021.102634 PMID: 34386226.

80. Sun P, Wang M, Song T, Wu Y, Luo J, Chen L, et al. The Psychological Impact of COVID-19 Pandemic on Health Care Workers: A Systematic Review and Meta-Analysis. Front Psychol. 2021; 12:626547. https://doi.org/10.3389/fpsyg.2021.626547 PMID: 34305703.

81. Abdulla EK, Velladath SU, Varghese A, Anju M. Depression and anxiety associated with COVID-19 pandemic among healthcare professionals in India- A systematic review and meta-analysis. Clin Epidemiol Glob Health. 2021; 12:100888. https://doi.org/10.1016/j.cegh.2021.100888 PMID: 34751253.

82. Adrianto N, Caesarlia J, Pajala FB. Depression in pregnant and postpartum women during COVID-19 pandemic: systematic review and meta-analysis. Obstet Gynecol Sci. 2022; 65(4):287–302. https://doi.org/10.5468/ogs.21265 PMID: 35754363.

83. Afridi MZ, Akhtar P, Khan MN. A Systematic Review and Meta-Analysis of Prevalence of Depressive Symptoms among Healthcare Workers in Pakistan during Covid Pandemic. Pak J Med Health Sci. 2022; 16(02):2–5. https://doi.org/10.53350/pjmhs221622

84. Alzahrani F, Alshahrani NZ, Abu Sabah A, Zarbah A, Abu Sabah S, Mamun MA. Prevalence and factors associated with mental health problems in Saudi general population during the coronavirus disease 2019 pandemic: A systematic review and meta-analysis. Psychol J. 2022; 11(1):18–29. https://doi.org/10.1002/pchj.516 PMID: 34986503.

85. Arora T, Grey I, Östlundh L, Lam KBH, Omar OM, Arnone D. The prevalence of psychological consequences of COVID-19: A systematic review and meta-analysis of observational studies. J Health Psychol. 2022; 27(4):805–824. https://doi.org/10.1177/1359105320966639 PMID: 33118376.

86. Aymerich C, Pedruzo B, Pérez JL, Laborda M, Herrero J, Blanco J, et al. COVID-19 pandemic effects on health worker's mental health: Systematic review and meta-analysis. Eur Psychiatry. 2022; 65(1): e10. https://doi.org/10.1192/j.eurpsy.2022.1 PMID: 35060458.

87. Bello UM, Kannan P, Chutiyami M, Salihu D, Cheong AMY, Miller T, et al. Prevalence of Anxiety and Depression Among the General Population in Africa During the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. Front Public Health. 2022; 10:814981. https://doi.org/10.3389/fpubh.2022.814981 PMID: 35655463.

88. Balakrishnan V, Ng KS, Kaur W, Govaichelvan K, Lee ZL. COVID-19 depression and its risk factors in Asia Pacific–A systematic review and meta-analysis. J Affect Disord. 2022; 298:47–56. https://doi.org/10.1016/j.jad.2021.11.048 PMID: 34801606.

89. Bussières EL, Malboeuf-Hurtubise C, Meilleur A, Mastine T, Hérault E, Chadi N, et al. Consequences of the COVID-19 Pandemic on Children's Mental Health: A Meta-Analysis. Front Psych. 2021; 12:2125. https://doi.org/10.3389/fpsyt.2021.691659 PMID: 34925080.

90. Carvalho PO, Hülsdünker T, Carson F. The impact of the COVID-19 lockdown on European students' negative emotional symptoms: A systematic review and meta-analysis. Behav Sci (Basel). 2022; 12 (1):3. https://doi.org/10.3390/bs12010003 PMID: 35049614.

91. Cénat JM, Blais-Rochette C, Kokou-Kpolou CK, Noorishad PG, Mukunzi JN, McIntee SE, et al. Prevalence of symptoms of depression, anxiety, insomnia, posttraumatic stress disorder, and psychological distress among populations affected by the COVID-19 pandemic: A systematic review and meta-analysis. Psychiatry Res. 2021; 295:113599. https://doi.org/10.1016/j.psychres.2020.113599 PMID: 33285346.

92. Cénat JM, Farahi SMMM, Dalexis RD, Darius WP, Bekarkhanechi FM, Poisson H, et al. The global evolution of mental health problems during the COVID-19 pandemic: A systematic review and meta-analysis of longitudinal studies. J Affect Disord. 2022; 315:70–95. https://doi.org/10.1016/j.jad.2022.07.011 PMID: 35842064.

93. Chai J, Xu H, An N, Zhang P, Liu F, He S, et al. The Prevalence of Mental Problems for Chinese Children and Adolescents During COVID-19 in China: A Systematic Review and Meta-Analysis. Front Pediatr. 2021; 9:661796. https://doi.org/10.3389/fped.2021.661796 PMID: 34692601.

94. Chen J, Farah N, Dong RK, Chen RZ, Xu W, Yin J, et al. Mental health during the covid-19 crisis in Africa: A systematic review and meta-analysis. Int J Environ Res Public Health. 2021; 18(20):10604. https://doi.org/10.3390/ijerph182010604 PMID: 34682357.

95. Chen J, Yang K, Cao Y, Du Y, Wang N, Qu M. Depressive Symptoms Among Children and Adolescents in China During the Coronavirus Disease-19 Epidemic: A Systematic Review and Meta-Analysis. Front Psych. 2022; 13:870346. https://doi.org/10.3389/fpsyt.2022.870346 PMID: 35463512.

96. Chen Q, Li W, Xiong J, Zheng X. Prevalence and Risk Factors Associated with Postpartum Depression during the COVID-19 Pandemic: A Literature Review and Meta-Analysis. Int J Environ Res Public Health. 2022; 19(4):2219. https://doi.org/10.3390/ijerph19042219 PMID: 35206407.

97. Ching SM, Ng KY, Lee KW, Yee A, Lim PY, Ranita H, et al. Psychological distress among healthcare providers during COVID-19 in Asia: Systematic review and meta-analysis. PLoS ONE. 2021; 16(10): e0257983. https://doi.org/10.1371/journal.pone.0257983 PMID: 34648526.

98. Dal Santo T, Sun Y, Wu Y, He C, Wang Y, Jiang X, et al. Systematic review of mental health symptom changes by sex or gender in early-COVID-19 compared to pre-pandemic. Sci Rep. 2022; 12 (1):11417. https://doi.org/10.1038/s41598-022-14746-1 PMID: 35794116.

99. da Silva FCT, Neto MLR. Psychological effects caused by the COVID-19 pandemic in health professionals: A systematic review with meta-analysis. Biol Psychiatry. 2021; 104:110062. https://doi.org/10.1016/j.pnpbp.2020.110062 PMID: 32771337.

100. de Sousa Júnior GM, Tavares VDO, de Meiroz Grilo MLP, Coelho MLG, Lima-Araújo GL, Schuch FB, et al. Mental Health in COVID-19 Pandemic: A Meta-Review of Prevalence Meta-Analyses. Front Psychol. 2021; 12:703838. https://doi.org/10.3389/fpsyg.2021.703838 PMID: 34621212.

101. Delanerolle G, Zeng Y, Shi JQ, Yeng X, Goodison W, Shetty A, et al. Mental health impact of the Middle East respiratory syndrome, SARS, and COVID-19: A comparative systematic review and meta-analysis. World J Psychiatry. 2022; 12(5):739–765. https://doi.org/10.5498/wjp.v12.i5.739 PMID: 35663292.

102. Dragioti E, Li H, Tsitsas G, Lee KH, Choi J, Kim J, et al. A large-scale meta-analytic atlas of mental health problems prevalence during the COVID-19 early pandemic. J Med Virol. 2022; 94(5):1935–1949. https://doi.org/10.1002/jmv.27549 PMID: 34958144.

103. Ebrahim AH, Dhahi A, Husain MA, Jahrami H. The Psychological Well-Being of University Students amidst COVID-19 Pandemic Scoping review, systematic review and meta-analysis. Sultan Qaboos Univ Med J. 2022; 22(2):179–197. https://doi.org/10.18295/squmj.6.2021.081 PMID: 35673293.

104. Fang Y, Ji B, Liu Y, Zhang J, Liu Q, Ge Y, et al. The prevalence of psychological stress in student populations during the COVID-19 epidemic: a systematic review and meta-analysis. Sci Rep. 2022; 12(1):12118. https://doi.org/10.1038/s41598-022-16328-7 PMID: 35840641.

105. Halemani K, Issac A, Mishra P, Dhiraaj S, Mavinatop S. Prevalence of Anxiety, Depression, Stress, and Insomnia among Healthcare Workers during Covid-19: A Systematic Review and Meta-Analysis. Nurs J India. 2021; CXII(06):269–277. https://doi.org/10.48029/NJI.2021.CXII605

106. Hosen I, Al-Mamun F, Mamun MA. Prevalence and risk factors of the symptoms of depression, anxiety, and stress during the COVID-19 pandemic in Bangladesh: a systematic review and meta-analysis. Glob Ment Health (Camb). 2021; 8:e47. https://doi.org/10.1017/gmh.2021.49 PMID: 35145709.

107. Hu N, Deng H, Yang H, Wang C, Cui Y, Chen J, et al. The pooled prevalence of the mental problems of Chinese medical staff during the COVID-19 outbreak: A meta-analysis. J Affect Disord. 2022; 303:323–330. https://doi.org/10.1016/j.jad.2022.02.045 PMID: 35183620.

108. Huang G, Chu H, Chen R, Liu D, Banda KJ, O'Brien AP, et al. Prevalence of depression, anxiety, and stress among first responders for medical emergencies during COVID-19 pandemic: A meta-analysis. J Glob Health. 2022; 12:05028. https://doi.org/10.7189/jogh.12.05028 PMID: 35871411.

109. Jia Q, Qu Y, Sun H, Huo H, Yin H, You D. Mental Health Among Medical Students During COVID-19: A Systematic Review and Meta-Analysis. Front Psychol. 2022; 13:846789. https://doi.org/10.3389/fpsyg.2022.846789 PMID: 35619776.

110. Johns G, Samuel V, Freemantle L, Lewis J, Waddington L. The global prevalence of depression and anxiety among doctors during the covid-19 pandemic: Systematic review and meta-analysis. J Affect Disord. 2022; 298:431–441. https://doi.org/10.1016/j.jad.2021.11.026 PMID: 34785264.

111. Pashazadeh Kan F, Raoofi S, Rafiei S, Khani S, Hosseinifard H, Tajik F, et al. A systematic review of the prevalence of anxiety among the general population during the COVID-19 pandemic. J Affect Disord. 2021; 293:391–398. https://doi.org/10.1016/j.jad.2021.06.073 PMID: 34246947.

112. Khraisat BR, Al-Jeady AM, Alqatawneh DA, Toubasi AA, AlRyalat SA. The prevalence of mental health outcomes among eating disorder patients during the COVID-19 pandemic: A meta-analysis. Clin Nutr ESPEN. 2022; 48:141–147. https://doi.org/10.1016/j.clnesp.2022.01.033 PMID: 35331484.

113. Knox L, Karantzas GC, Romano D, Feeney JA, Simpson JA. One year on: What we have learned about the psychological effects of COVID-19 social restrictions: A meta-analysis. Curr Opin Psychol. 2022; 46:101315. https://doi.org/10.1016/j.copsyc.2022.101315 PMID: 35398753.

114. Kuroda N, Kubota T. Psychological impact of the COVID-19 pandemic for patients with epilepsy: A systematic review and meta-analysis. Epilepsy Behav. 2021; 124:108340. https://doi.org/10.1016/j.yebeh.2021.108340 PMID: 34600283.

115. Lee KW, Ang CS, Lim SH, Siau CS, Ong LTD, Ching SM, et al. Prevalence of mental health conditions among people living with HIV during the COVID-19 pandemic: A rapid systematic review and meta-analysis. HIV Med. 2022; 23(9):990–1001. https://doi.org/10.1111/hiv.13299 PMID: 35304829.

116. Liyanage S, Saqib K, Khan AF, Thobani TR, Tang WC, Chiarot CB, et al. Prevalence of anxiety in university students during the covid-19 pandemic: A systematic review. Int J Environ Res Public Health. 2022; 19(1):62. https://doi.org/10.3390/ijerph19010062 PMID: 35010323.

117. Ma K, Liang L, Chutiyami M, Nicoll S, Khaerudin T, Ha XV. COVID-19 pandemic-related anxiety, stress, and depression among teachers: A systematic review and meta-analysis. Work. 2022; 73(1):3–27. https://doi.org/10.3233/WOR-220062 PMID: 35527618

118. Makwana K, Jain S, Makwana A, Rathod NM. Prevalence of depression among Indian medical students in COVID-19 pandemic–A meta-analysis. Natl J Physiol Pharm Pharmacol. 2022; 12(7):916–916. http://dx.doi.org/10.5455/njppp.2022.12.052331202210062022

119. Mulyadi M, Tonapa SI, Luneto S, Lin WT, Lee BO. Prevalence of mental health problems and sleep disturbances in nursing students during the COVID-19 pandemic: A systematic review and meta-analysis. Nurse Educ Pract. 2021; 57:103228. https://doi.org/10.1016/j.nepr.2021.103228 PMID: 34653783.

120. Nagarajan R, Krishnamoorthy Y, Basavarachar V, Dakshinamoorthy R. Prevalence of post-traumatic stress disorder among survivors of severe COVID-19 infections: A systematic review and meta-analysis. J Affect Disord. 2022; 299:52–59. https://doi.org/10.1016/j.jad.2021.11.040 PMID: 34800571.

121. Natarajan A, Shetty A, Delanerolle G, Zeng Y, Zhang Y, Raymont V, et al. A systematic review and meta-analysis of Long COVID symptoms. medRxiv. 2022 [cited 2022 Dec 12]. 2022.03.08. [Preprint]. https://doi.org/10.1101/2022.03.08.22272091

122. Panda PK, Gupta J, Chowdhury SR, Kumar R, Meena AK, Madaan P, et al. Psychological and Behavioral Impact of Lockdown and Quarantine Measures for COVID-19 Pandemic on Children, Adolescents and Caregivers: A Systematic Review and Meta-Analysis. J Trop Pediatr. 2021; 67(1):fmaa122. https://doi.org/10.1093/tropej/fmaa122 PMID: 33367907.

123. Pappa S, Chen J, Barnett J, Chang A, Dong RK, Xu W, et al. A systematic review and meta-analysis of the mental health symptoms during the Covid-19 pandemic in Southeast Asia. Psychiatry Clin Neurosci. 2022; 76(2):41–50. https://doi.org/10.1111/pcn.13306 PMID: 34704305.

124. Premraj L, Kannapadi NV, Briggs J, Seal SM, Battaglini D, Fanning J, et al. Mid and long-term neurological and neuropsychiatric manifestations of post-COVID-19 syndrome: A meta-analysis. J Neurol Sci. 2022; 434:120162. https://doi.org/10.1016/j.jns.2022.120162 PMID: 35121209.

125. Qi G, Yuan P, Qi M, Hu X, Shi S, Shi X. Influencing Factors of High PTSD Among Medical Staff During COVID-19: Evidences From Both Meta-analysis and Subgroup Analysis. Saf Health Work. 2022; 13 (3):269–278. https://doi.org/10.1016/j.shaw.2022.06.003 PMID: 35784492.

126. Racine N, Eirich R, Cooke J, Zhu J, Pador P, Dunnewold N, et al. When the Bough Breaks: A systematic review and meta-analysis of mental health symptoms in mothers of young children during the COVID-19 pandemic. Infant Ment Health J. 2022; 43(1):36–54. https://doi.org/10.1002/imhj.21959 PMID: 34962649.

127. Rezaei-Hachesu V, Fe'li SN, Maajani K, Hokmabadi R, Golbabaei F. The Global Prevalence of Anxiety, Depression, and Insomnia among Healthcare Workers during the Covid-19 Pandemic: A Systematic Review and Meta-Analysis. J Occup Health Epidemiol. 2022; 11(1):48–66. Available from: https://doi.org/10.52547/johe.11.1.48.

128. Santabarbara J, Idoiaga N, Ozamiz-Etxebarria N, Bueno-Notivol J. Prevalence of anxiety in dental students during the covid-19 outbreak: A meta-analysis. Int J Environ Res Public Health. 2021; 18 (20):10978. https://doi.org/10.3390/ijerph182010978 PMID: 34682726.

129. Santabárbara J, Ozamiz-Etxebarria N, Idoiaga N, Olaya B, Bueno-Novitol J. Meta-analysis of prevalence of depression in dental students during covid-19 pandemic. Medicina (Lithuania). 2021; 57 (11):1278. https://doi.org/10.3390/medicina57111278 PMID: 34833496.

130. Santabárbara J, Olaya B, Bueno-Notivol J, Pérez-Moreno M, Gracia-García P, Ozamiz-Etxebarria N, et al. Prevalence of depression among medical students during the COVID-19 pandemic. A systematic review and meta-analysis. Rev Med Chil. 2021; 149(11):1579–1588. https://doi.org/10.4067/S0034-98872021001101579 PMID: 35735320.

131. Safi-Keykaleh M, Aliakbari F, Safarpour H, Safari M, Tahernejad A, Sheikhbardsiri H, et al. Prevalence of postpartum depression in women amid the COVID-19 pandemic: A systematic review and meta-analysis. Int J Gynaecol Obstet. 2022; 157(2):240–247. https://doi.org/10.1002/ijgo.14129 PMID: 35122433.

132. Schafer KM, Lieberman A, Sever AC, Joiner T. Prevalence rates of anxiety, depressive, and eating pathology symptoms between the pre- and peri-COVID-19 eras: A meta-analysis. J Affect Disord. 2022; 298:364–372. https://doi.org/10.1016/j.jad.2021.10.115 PMID: 34740748.

133. Sharma S, Joseph J, Dhandapani M, Varghese A, Radha K, Mathews E, et al. COVID-19 and psychological distress among the general population of India: Meta-Analysis of observational studies. Indian J Community Med. 2022; 47(2):160–165. https://doi.org/10.4103/ijcm.ijcm_1365_21 PMID: 36034249.

134. Ślusarska B, Nowicki GJ, Niedorys-Karczmarczyk B, Chrzan-Rodak A. Prevalence of Depression and Anxiety in Nurses during the First Eleven Months of the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2022; 19(3):1154. https://doi.org/10.3390/ijerph19031154 PMID: 35162183.

135.   Xiong N, Fritzsche K, Pan Y, Löhlein J, Leonhart R. The psychological impact of COVID-19 on Chinese healthcare workers: a systematic review and meta-analysis. Soc Psychiatry Psychiatr Epidemiol. 2022; 57(8):1515–1529. https://doi.org/10.1007/s00127-022-02264-4 PMID: 35325261.

136.   Yan Y, Du X, Lai L, Ren Z, Li H. Prevalence of depressive and anxiety symptoms among Chinese older adults during the COVID-19 pandemic: A systematic review and meta-analysis. J Geriatr Psychiatry Neurol. 2022; 35(2):182–195. https://doi.org/10.1177/08919887221078556 PMID: 35245999.

137.   Yang F, Wen J, Huang N, Riem MME, Lodder P, Guo J. Prevalence and related factors of child post-traumatic stress disorder during COVID-19 pandemic: A systematic review and meta-analysis. Eur Psychiatry. 2022; 65(1):e37. https://doi.org/10.1192/j.eurpsy.2022.31 PMID: 35726735.

138.   Yunitri N, Chu H, Kang XL. Global prevalence and associated risk factors of posttraumatic stress disorder during COVID-19 pandemic: A meta-analysis. Int J Nurs Stud. 2022; 126:104136. https://doi.org/10.1016/j.ijnurstu.2021.104136 PMID: 34856503.

139.   Zhang SX, Chen RZ, Xu W, Yin A, Dong RK, Chen BZ, et al. A Systematic Review and Meta-Analysis of Symptoms of Anxiety, Depression, and Insomnia in Spain in the COVID-19 Crisis. Int J Environ Res Public Health. 2022; 19(2):1018. https://doi.org/10.3390/ijerph19021018 PMID: 35055841.

140.   Zhang SX, Batra K, Xu W, Liu T, Dong RK, Yin A, et al. Mental disorder symptoms during the COVID-19 pandemic in Latin America—a systematic review and meta-analysis. Epidemiol Psychiatr Sci. 2022; 31:e23. https://doi.org/10.1017/S2045796021000767 PMID: 35438066.

141.   Zhang SX, Miller SO, Xu W, Yin A, Chen BZ, Delios A, et al. Meta-analytic evidence of depression and anxiety in Eastern Europe during the COVID-19 pandemic. Eur J Psychotraumatol. 2022; 13 (1):2000132. https://doi.org/10.1080/20008198.2021.2000132 PMID: 35186214.

142.   Zhu J, Racine N, Xie EB, Park J, Watt J, Eirich R, et al. Post-secondary Student Mental Health During COVID-19: A Meta-Analysis. Front Psych. 2021; 12:777251. https://doi.org/10.3389/fpsyt.2021.777251 PMID: 34955924.

143.   Ghahramani S, Lankarani KB, Yousefi M, Heydari K, Shahabi S, Azmand S. A Systematic Review and Meta-Analysis of Burnout Among Healthcare Workers During COVID-19. Front Psych. 2021; 12:758849. https://doi.org/10.3389/fpsyt.2021.758849 PMID: 34858231.

144.   Cevik A, Onat Koroglu C, Karacam Z, Gokyildiz Surucu S, Alan S. Effects of the Covid-19 Pandemic on the Prevalence of Insomnia, Anxiety, and Depression During Pregnancy: A Systematic Review and Meta-Analysis. Clin Nurs Res. 2022; 31(8):1405–1421. https://doi.org/10.1177/10547738221112748 PMID: 35912813.

145.   Pedersen MT, Andersen TO, Clotworthy A, Jensen AK, Strandberg-Larsen K, Rod NH, et al. Time trends in mental health indicators during the initial 16 months of the COVID-19 pandemic in Denmark. BMC Psychiatry. 2022; 22(1):25. https://doi.org/10.1186/s12888-021-03655-8 PMID: 35012486.

146.   Daly M, Sutin AR, Robinson E. Longitudinal changes in mental health and the COVID-19 pandemic: evidence from the UK Household Longitudinal Study. Psychol Med. 2022; 52(13):2549–2558. https://doi.org/10.1017/S0033291720004432 PMID: 33183370.

147.   Salanti G, Peter N, Tonia T, Holloway A, White IR, Darwish L, et al. The Impact of the COVID-19 Pandemic and Associated Control Measures on the Mental Health of the General Population. Ann Intern Med. 2022; 175(11):1560–1571. https://doi.org/10.7326/M22-1507 PMID: 36252247.

148.   Vloo A, Alessie RJM, Mierau JO, Boezen MH, Mierau JO, Franke L, et al. Gender differences in the mental health impact of the COVID-19 lockdown: Longitudinal evidence from the Netherlands. SSM Popul Health. 2021; 15:100878. https://doi.org/10.1016/j.ssmph.2021.100878 PMID: 34471666.

149.   Kristin A, Knudsen S, Stene-Larsen K, Gustavson K, Hotopf M, Kessler RC, et al. Prevalence of mental disorders, suicidal ideation and suicides in the general population before and during the COVID-19 pandemic in Norway: A population-based repeated cross-sectional analysis. Lancet Reg Health Eur. 2021; 4:100071. https://doi.org/10.1016/j.lanepe.2021.100071 PMID: 34557811.

150.   Aknin LB, Andretti B, Goldszmidt R, Helliwell JF, Petherick A, de Neve JE, et al. Policy stringency and mental health during the COVID-19 pandemic: a longitudinal analysis of data from 15 countries. Lancet Public Health. 2022; 7(5):e417–e426. https://doi.org/10.1016/S2468-2667(22)00060-3 PMID: 35461592.

151.   Bavel JJV, Baicker K, Boggio PS, Capraro V, Cichocka A, Cikara M, et al. Using social and behavioural science to support COVID-19 pandemic response. Nat Hum Behav. 2020; 4(5):460–471. https://doi.org/10.1038/s41562-020-0884-z PMID: 32355299.

152.   Weber M, Schulze L, Bolzenkötter T, Niemeyer H, Renneberg B. Mental Health and Loneliness in University Students During the COVID-19 Pandemic in Germany: A Longitudinal Study. Front Psych. 2022; 13:848645. https://doi.org/10.3389/fpsyt.2022.848645 PMID: 35492687.

153.   Canal-Rivero M, Armesto-Luque L, Rubio-García A, Rodriguez-Menéndez G, Garrido-Torres N, Capitán L, et al. Trauma and stressor-related disorders among health care workers during COVID-19

pandemic and the role of the gender: A prospective longitudinal survey. J Affect Disord. 2022; 302:110–122. https://doi.org/10.1016/j.jad.2022.01.021 PMID: 35032507.

154. Maunder RG, Heeney ND, Hunter JJ, Strudwick G, Jeffs LP, Ginty L, et al. Trends in burnout and psychological distress in hospital staff over 12 months of the COVID-19 pandemic: a prospective longitudinal survey. J Occup Med Toxicol. 2022; 17(1):11. https://doi.org/10.1186/s12995-022-00352-4 PMID: 35614505.

155. Travis-Lumer Y, Kodesh A, Goldberg Y, Frangou S, Levine SZ. Attempted suicide rates before and during the COVID-19 pandemic: interrupted time series analysis of a nationally representative sample. Psychol Med. 2021; 1:1–7. https://doi.org/10.1017/S0033291721004384 PMID: 34664545.

156. Pan KY, Kok AAL, Eikelenboom M, Horsfall M, Jörg F, Luteijn RA, et al. The mental health impact of the COVID-19 pandemic on people with and without depressive, anxiety, or obsessive-compulsive disorders: a longitudinal study of three Dutch case-control cohorts. Lancet Psychiatry. 2021; 8(2):121–129. https://doi.org/10.1016/S2215-0366(20)30491-0 PMID: 33306975.

157. Luchetti M, Lee JH, Aschwanden D, Sesker A, Strickhouser JE, Terracciano A, et al. The trajectory of loneliness in response to COVID-19. Am Psychol. 2020; 75(7):897–908. https://doi.org/10.1037/amp0000690 PMID: 32567879.

158. Witteveen AB, Young S, Cuijpers P, Ayuso-Mateos JL, Barbui C, Bertolini F, et al. Remote mental health care interventions during the COVID-19 pandemic: An umbrella review. Behav Res Ther. 2022; 159:104226. https://doi.org/10.1016/j.brat.2022.104226 PMID: 36410111.

159. McCartan C, Adell T, Cameron J, Davidson G, Knifton L, McDaid S, et al. A scoping review of international policy responses to mental health recovery during the COVID-19 pandemic. Health Res Policy Syst. 2021; 19(1):58. https://doi.org/10.1186/s12961-020-00652-3 PMID: 33823855.

160. Hofmann SG, Anu Asnaani MA, Hinton DE. Cultural aspects in social anxiety and social anxiety disorder. Depress Anxiety. 2010; 27(12):1117–1127. https://doi.org/10.1002/da.20759 PMID: 21132847.

161. Levis B, Yan XW, He C, Sun Y, Benedetti A, Thombs BD. Comparison of depression prevalence estimates in meta-analyses based on screening tools and rating scales versus diagnostic interviews: A meta-research review. BMC Med. 2019; 17(1):65. https://doi.org/10.1186/s12916-019-1297-6 PMID: 30894161.

162. Brehaut E, Neupane D, Levis B, Wu Y, Sun Y, Krishnan A, et al. Depression prevalence using the HADS-D compared to SCID major depression classification: An individual participant data meta-analysis. J Psychosom Res. 2020; 139:110256. https://doi.org/10.1016/j.jpsychores.2020.110256 PMID: 33069051.

163. Hennessy EA, Johnson BT, Keenan C. Best Practice Guidelines and Essential Methodological Steps to Conduct Rigorous and Systematic Meta-Reviews. Appl Psychol Health Well Being. 2019; 11 (3):353–381. https://doi.org/10.1111/aphw.12169 PMID: 31290288.

164. Vigo D, Thornicroft G, Atun R. Estimating the true global burden of mental illness. Lancet Psychiatry. 2016; 3(2):171–178. https://doi.org/10.1016/S2215-0366(15)00505-2 PMID: 26851330.