Global prevalence of mental health problems among healthcare workers during the Covid-19 pandemic: A systematic review and meta-analysis

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ABSTRACT

Background: Healthcare workers are at high risk of developing mental health issues during the coronavirus disease 2019 (COVID-19) pandemic. However, there is a need for a full picture of mental health problems with comprehensive analysis among healthcare workers during the COVID-19 pandemic.

Objective: This review aimed to systematically identify the mental health problems among healthcare workers in various countries during the COVID-19 pandemic.

Design: Systematic review and meta-analysis.

Methods: A systematic literature search was performed of the following databases: PubMed, Academic Search Complete, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science, MEDLINE Complete, and SocINDEX. The last date of our search was November 2, 2020. We included all cohort, case–control and cross-sectional studies and used the Joanna Briggs Institute tool to assess their quality. A meta-analysis was performed to synthesize the pooled prevalence of mental health problems using a random-effects model. Heterogeneity was measured using the I^2 statistic and Egger's test was used to assess publication bias.

Results: A total of 38 studies were identified that reported the mental health problems of healthcare workers during the COVID-19 pandemic. The distribution of healthcare workers analyzed in this review included 27.9% doctors, 43.7% nurses, and 7.0% allied health workers. The pooled prevalence of mental health problems for post-traumatic stress disorder, anxiety, depression, and distress was 49% (95% confidence interval [CI]: 22–75%), 40% (95% CI: 29–52%), 37% (95% CI: 29–45%), and 37% (95% CI: 25–50%), respectively.

Conclusion: This review yielded evidence that estimated the global prevalence of mental health problems among healthcare workers during the COVID-19 pandemic. Post-traumatic stress disorder was the most common mental health disorder reported by healthcare workers during the COVID-19 pandemic, followed by anxiety, depression, and distress. Additional studies remain necessary to assess the appropriate management strategies for treating and preventing mental health disorders among healthcare workers during the pandemic.

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What is already known

- Healthcare workers are at high risk of developing mental health disorders during the COVID-19 pandemic.
- The mental health of healthcare workers has become a serious issue during this global COVID-19 pandemic.
- The current pandemic conditions have resulted in physical and mental exhaustion among healthcare workers.

What this paper adds

- More than a quarter of healthcare workforce who served during the COVID-19 pandemic developed mental health problems.
- Post-traumatic stress disorder was the most common mental health disorder associated with the COVID-19 pandemic among health care workers, followed by anxiety, depression, and distress.
- Specifics interventional research is urgently necessary to mitigate the mental health problems on healthcare workers and to help them cope with their burdens.

1. Introduction

Coronavirus disease 2019 (COVID-19) was first identified at the end of December 2019 in the City of Wuhan, China. COVID-19 presents with a pneumonia-like symptoms and signs caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As of June 1, 2021, this disease has been diagnosed in at least 170,426,245 cases globally and was associated with 3548,628 deaths, and these numbers continue to increase on a daily basis (World Health Organization, 2021). Consequently, healthcare workers worldwide have faced excessive workloads and psychological pressure due to the massive number of cases and deaths associated with this pandemic, which has increased the burden on the health care system, resulting in adverse consequences that might impact society (Dubey et al., 2020).

During daily practice, healthcare workers are directly involved in the diagnosis, treatment, and care of patients affected by COVID-19. On average, healthcare workers spend 16 h each day caring for patients infected by COVID-19, which is an overwhelming workload (Huang and Zhao, 2020). In addition, the ever-increasing number of confirmed and suspected cases, the depletion of personal protective equipment, the lack of specific drugs available for COVID-19 treatment, and feelings of being inadequately supported from health care administration have been assumed to contribute to the mental burdens of health care workers (Elkholy et al., 2020). The mental health problems that affect healthcare workers can vary based on the individuals and the circumstances, highlighting the effects that the emergency response to COVID-19 has had on health care workers. This pandemic has been a challenging situation for health care workers, especially for those who work in hospitals caring for suspected or confirmed patients with COVID-19, which not only places healthcare workers at a high risk of becoming infected but also results in fear of contagion and of spreading the virus to their loved ones (Xiang et al., 2020). The current pandemic conditions have also resulted in physical and mental exhaustion among healthcare workers (Huang and Zhao, 2020; Huang and Zhao, 2021). This difficult situation has resulted in the development of mental health problems, such as distress, anxiety, burnout, depression, insomnia, post-traumatic stress disorder, denial, and fear (Johnson et al., 2020; Kang et al., 2020).

The mental health status of healthcare workers has become a serious issue during the global COVID-19 pandemic. Researchers in a previous meta-analysis identified that during the COVID-19 pandemic, mental health problems, such as depression, anxiety, and stress, were common among health care workers. Although this meta-analysis primarily included studies that originated in China, these researchers presented evidence that demonstrated that healthcare workers suffered from mental health problems (Salari et al., 2020). Continued efforts must be made to collect and analyze data regarding the effects of the pandemic on the mental health problems of healthcare workers to obtain a full picture of this phenomenon. Therefore, updated evidence that estimates the global mental health situation among healthcare workers during the COVID-19 pandemic remains necessary. The authors aimed to provide updated estimates of the prevalence of anxiety, depression, distress, and post-traumatic stress disorder among healthcare workers during the COVID-19 pandemic.

2. Material and methods

We conducted this systematic review and meta-analysis by following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines (Moher et al., 2009). The protocol for this review has been registered in the International Prospective Register of Systematic Reviews (PROSPERO): CRD42020219211.

2.1. Search strategy

To locate all relevant studies, specific keywords and Medical Subject Heading (MeSH) terms were used to search the following databases: PubMed, Academic Search Complete, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science, MEDLINE Complete, and socINDEX databases. The literature search was performed from December 1, 2019, to November 2, 2020, with the assistance of a health science librarian. Comprehensive MeSH terms were used, including "Healthcare workers" OR "HCWs" OR "health worker" OR "health care provider" OR "professionals" OR "front line workers" OR "nurses" OR "doctor" OR "paramedic" OR "medical workers" AND "mental health outcome" OR "mental health impact" "mental illness" OR "mental disorder" OR "psychiatric illness" OR "mental health status" AND "COVID-19" OR "SARS-CoV-2" OR "coronavirus disease 2019" OR "con-19" OR "coronavirus disease" OR "2019 n-cov". The search strategy was described in detail in Supplementary Document 1.

2.2. Eligibility criteria

The inclusion criteria were determined according to the PICOS method (Population, Issue of interest, Comparison, Outcome, and Study design) (Liberati et al., 2009). The following eligibility criteria were applied: a) professional workers who served as healthcare workers during the COVID-19 pandemic, including physicians, nurses, midwives, paramedics, and other related professional medical workers; b) cohort studies, case–control studies, or cross-sectional studies; and c) published in the English language. Studies that were not within the scope of the PICOS criteria or for which the full text was unavailable were excluded. Three authors were involved in determining the inclusion and exclusion criteria. We discussed the differences in our opinions and reached a consensus for this study. In addition, we excluded all articles that were either not peer-reviewed or were not original articles, such as editorials or review articles.

2.3. Data extraction

Two authors performed a comprehensive extraction of essential data from each study selected for inclusion in this review, including the authors, year, country, study design, sample size, age, sex, occupation, depression cases, anxiety cases, distress cases, and post-traumatic stress disorder cases.
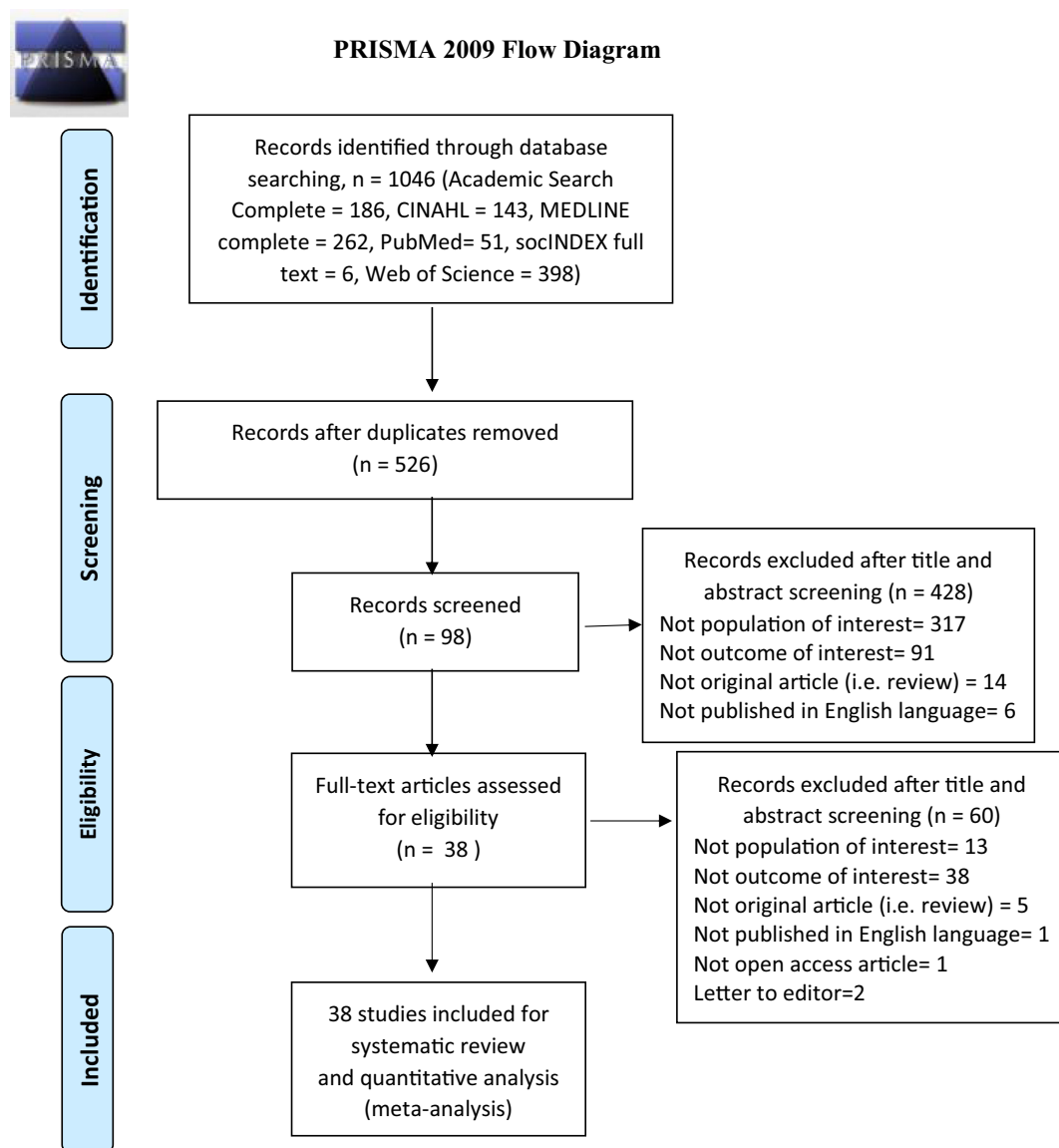
PRISMA 2009 Flow Diagram

Identification

Records identified through database searching, n = 1046 (Academic Search Complete = 186, CINAHL = 143, MEDLINE complete = 262, PubMed= 51, socINDEX full text = 6, Web of Science = 398)

Screening

Records after duplicates removed (n = 526)

Records screened (n = 98)

Records excluded after title and abstract screening (n = 428)
Not population of interest= 317
Not outcome of interest= 91
Not original article (i.e. review) = 14
Not published in English language= 6

Eligibility

Full-text articles assessed for eligibility (n = 38)

Records excluded after title and abstract screening (n = 60)
Not population of interest= 13
Not outcome of interest= 38
Not original article (i.e. review) = 5
Not published in English language= 1
Not open access article= 1
Letter to editor=2

Included

38 studies included for systematic review and quantitative analysis (meta-analysis)

Fig. 1. PRISMA Diagram – process of study selection
From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement.* PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097
For more information, visit www.prisma-statement.org. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

2.4. Quality assessment

In this study, we used the 8-questions of Joanna Briggs Institute tool for cross-sectional studies and the 10-questions of Joanna Briggs Institute tool for case–control studies to assess the level of each article and the quality of each cohort study design (Adelaide, 2020; Buccheri and Sharifi, 2017). Each item is scored between 0 (high risk of bias) and 1 (low risk of bias). For cross-sectional studies, a score of ≤4 is categorized as low quality, whereas a score of >4 points indicates high quality; for case–control studies, a score of ≤5 points is categorized as low quality, whereas a score of >5 points is categorized as high quality. Two authors performed the quality assessments of each selected study included in this review

2.5. Statistical analysis

We calculated the pooled prevalence of mental health problems among healthcare workers during the COVID-19 pandemic.

We used a random-effects model to estimate the pooled prevalence of mental health disorders among health care workers. Further, we used I^2 to determine the heterogeneity of the analysis, in which proportions of 25%, 50%, and 75% indicated low, moderate, and high heterogeneity within the random-effects model (Huedo-Medina et al., 2006). Publication bias was assessed through the visual assessment of funnel plots and Egger's regression test (Sterne and Egger, 2001; Sterne et al., 2000). $P < 0.05$ was considered significant. All statistical analyses were conducted using Stata 16.0.

3. Results

3.1. Search results

The search yielded a total of 1046 studies, of which 526 were removed because they were duplicates. We excluded 428 studies based on title and abstract screening. A total of 317 studies were removed because their populations were not within the scope of

this current study, 91 studies were removed because they did not provide the outcome of interest for this study, 14 studies were removed because they were not original studies, and 6 studies were removed because they were not published in the English language. After the initial title and abstract screening, a total of 98 studies were screened against the full-text eligibility criteria. Of these, 13 studies were removed because their study population did not include health care workers, 38 studies were removed because their findings did not fit within the scope of this review, five studies were removed because they were not original studies, two studies were removed because they were formated as a letter to the editor, and their results were not reported appropriately for the needs of this review, one study each was removed because of not being in the English language and not being an open-access study.

After the full-text review, 38 studies were included in our final analysis (Al-Hanawi et al., 2020; Alzaid et al., 2020; Antonijevic et al., 2020; Azoulay et al., 2020; Badahdah et al., 2021; Cai et al., 2020; Chatterjee et al., 2020; Cunill et al., 2020; Di Tella et al., 2020; Dobson et al., 2021; Evanoff et al., 2020; Holton et al., 2021; Hu et al., 2020; Johnson et al., 2020; Kannampallil et al., 2020; Khanal et al., 2020; Khanna et al., 2020; Lai et al., 2020; Liu et al., 2020; Liu et al., 2020; Magnavita et al., 2020; Mrklas et al., 2020; Ning et al., 2020; Pan et al., 2020; Pouralizadeh et al., 2020; Prasad et al., 2020; Riello et al., 2020, Rossi et al., 2020; Sagaon-Teyssier et al., 2020; Şahin et al., 2020; Shrestha et al., 2020; Song et al., 2020; Suryavanshi et al., 2020; Vafaei et al., 2020; Wankowicz et al., 2020; Yang et al., 2020; Yang et al., 2021; Youssef et al., 2020). A summary of the source selection process is presented in Fig. 1 as a PRISMA flow diagram.

3.2. Studies characteristics

All included studies (*N* = 38) were published in the year 2020, providing a comprehensive overview of the effects of the global pandemic. Since the start of the pandemic, healthcare workers have suffered from mental health disorders. The included studies were primarily cross-sectional studies (37/38) and one case–control study (1/38). Nine studies were conducted in China, four studies were conducted in Italy, three studies each were conducted in India and the USA, two studies each were conducted in Australia, Nepal, Iran, and Saudi Arabia, and one study each was conducted in Canada, Egypt, France, Mali, Norway, Poland, Oman, Serbia, Spain, South Korea, and Turkey.

A total of 53,784 participants were involved across all studies, the majority of whom were women (75%). The distribution of health care occupations was as follows: 27.9% were doctors, 43.7% were nurses, and 7.0% were allied health care workers. Although not all included studies reported age data, the age of participants in those that did ranged from 18 years to 50 years and older. The range of mental health problems among healthcare workers across studies was as follows: depression, 8%–95%; anxiety, 3%–97%; distress, 3%–76%; and post-traumatic stress disorder, 3%–84%. A summary of the characteristics of the selected studies is presented in Table 1.

3.3. Meta-analysis of mental health problems among healthcare workers during the COVID-19 pandemic

3.3.1. Anxiety

We analyzed 34 studies to measure the prevalence of anxiety among healthcare workers during the COVID-19 pandemic, which was estimated at 40% (95% confidence interval [CI]: 29–52%, Fig. 2). Our analysis indicated the presence of heterogeneity (I-square [I2] = 99.86%, $p < 0.001$), and publication bias could be observed on the funnel plot (Supplementary Document, Figure 6). Egger's test was significant ($t = 8.65$, $p < 0.001$).

3.3.2. Depression

We analyzed 30 studies to measure the prevalence of depression among healthcare workers during the COVID-19 pandemic. The pooled prevalence of depression among healthcare workers was 37% (95% CI: 29–45%) with high heterogeneity (I2 = 99.74%, $p < 0.001$, Fig. 3). Publication bias could be observed on the funnel plot (Supplementary Document, Figure 7). The Egger's regression test was significant ($t = 8.40$, $p < 0.001$).

3.3.3. Distress

We identified 15 studies that measured the prevalence of distress among healthcare workers during the COVID-19 pandemic. In the pooled analysis, we estimated the prevalence of distress among healthcare workers to be 37% (95% CI: 25–50%) with the presence of high heterogeneity (I2 = 99.78%, $p < 0.001$, Fig. 4). Publication bias was identified through the analysis in the funnel plot (Supplementary Document, Figure 8). Egger's test was significant ($t = 4.42$, $p = 0.001$).

3.3.4. Post-traumatic stress disorder

We analyzed seven studies to measure the prevalence of post-traumatic stress disorder among healthcare workers during the COVID-19 outbreak. In the pooled analysis, we found estimated the prevalence of post-traumatic stress disorder among healthcare workers to be 49% (95% CI: 22–75%), with the presence of high heterogeneity (I2 = 99.91%, $p < 0.001$, Fig. 5). Publication bias was identified through the funnel plot (Supplementary Document, Figure 9). Egger's test was significant ($t = 3.28$, $p = 0.022$).

3.4. Quality assessment

The 8-questions of the Joanna Briggs Institute tool for cross-sectional studies and the 10-questions of the Joanna Briggs Institute tool for case–control studies were used to appraise the study's quality for 38 included studies. Three studies scored 8 out of 8 among the 37 studies assessed with the Joanna Briggs Institute tool for cross-sectional studies, 20 studies scored 7 out of 8, 13 studies scored 6 out of 8, and four studies scored 5 out of 8. One study with a case–control study design assessed with the Joanna Briggs Institute tool for case–control studies scored 8 out of 10. All of the scores for the assessed studies indicate a low risk of bias. A lack of established criteria for determining the eligibility of participants for study inclusion and the lack of confounding factors identification and strategy to deal with confounding factors were responsible for lower score (Table 2). Another limitation is that the funnel plot showed asymmetry outliers that indicated a potential publication bias in some analyses due to small sample size (Supplementary Document 2, Figures 6–9).

Tables 2a and 2b.

4. Discussion

The pooled analysis included 38 studies with 53,784 participants. The aim of the current study was to conduct a systematic review and meta-analysis to determine the prevalence of mental health problems among healthcare workers during the COVID-19 pandemic. The pooled analysis suggested that pooled prevalence for post-traumatic stress disorder, anxiety, depression, and distress among healthcare workers during the COVID-19 pandemic were 49%, 40%, 37%, and 37%, respectively. The prevalence of mental health problems among healthcare workers in the present study are higher than the previous study by Salari et al. (2020), which suggests that the situation has worsened as pandemic has continued to spread (Salari et al., 2020).

Our study found that the prevalence of anxiety among 34 included studies was 39%. Our finding was higher than the study

Table 1
Summary of selected studies on mental health outcomes among healthcare workers during COVID-19 outbreak.

No	Author/year	Country	Study design	Sample size	Male	Age	Healthcare workers			Anxiety	Depression	Distress	PTSD
							Doctor	Nurse	Allied health	N (%)	N (%)	N (%)	N (%)
1	Al-Hanawi et al., 2020	Saudi Arabia	Cross-sectional study	3036	152	≥18						1217 (40)	
2	Alzaid et al., 2020	Saudi Arabia	Cross-sectional study	441	120	25–65	251	131	59	14 (3)			
3	(Antonijevic et al., 2020)	Serbia	Cross-sectional study	1678	363		320	364	994	625 (37)	589 (35)	639 (38)	
4	Azoulay et al., 2020	France	Cross-sectional study	1058	305	33	204	721	27	531 (50)	323 (31)		
5	(Badahdah et al., 2021)	Oman	Cross-sectional study	509	100		194	315		132 (26)		287 (56)	
6	Cai et al., 2020	China	Case control Study	2346	702					271 (12)	287 (12)		
7	Chatterjee et al., 2020	India	Cross-sectional study	152	119	42.05	152			60 (39)	53 (35)	50 (33)	
8	Cunill et al., 2020	Spain	Cross-sectional study	1452	248	≤30	383	816	217	1403 (97)	1308 (90)		
9	(Di Tella et al., 2020)	Italy	Cross-sectional study	145	40	42.9	72	73		103 (71)	45 (31)		38 (26)
10	(Dobson et al., 2021)	Australia	Cross-sectional study	320	58	≥19	99	86	105	277 (87)	303 (95)		210 (66)
11	Evanoff et al., 2020	USA	Cross-sectional study	5550	772	≤40	870	4470	210	695 (13)	848 (15)		
12	(Holton et al., 2021)	Australia	Cross-sectional study	668	89	40	138	391	139	138 (21)	138 (21)	142 (21)	
13	Hu et al., 2020	China	Cross-sectional study	2014	260	30.9		2014		833 (41)	878 (44)		
14	Johnson et al., 2020	Norway	Cross-sectional study	1773	269	<18	178	770	825	364 (21)	376 (21)		512 (29)
15	Kannampallil et al., 2020	USA	Cross-sectional study	1375	175		393			73 (5)	107 (8)	97 (7)	
16	Khanal et al., 2020	Nepal	Cross-sectional study	475	28.2	225	161	167	147	199 (42)	178 (37)		
17	Khanna et al., 2020	India	Cross-sectional study	2350	1332	42.5	1332				785 (33)		
18	Lai et al., 2020	China	Cross-sectional study	1257	293	≥18	493	764		560 (45)	634 (50)	899 (72)	
19	(Liu et al., 2020)	China	Cross-sectional study	512	79	≥18				372 (73)	301 (59)		
20	(Liu et al., 2020)	China	Cross-sectional study	2031	294	≥20	858	1173				203 (10)	
21	Magnavita et al., 2020	Italy	Cross-sectional study	595	178	<35->55	11	58	13	99 (17)	180 (30)	180 (30)	
22	Mrklas et al., 2020	Canada	Cross-sectional study	1414	105	≤25->60				461 (33)	401 (28)	1079 (76)	
23	Ning et al., 2020	China	Cross-sectional study	612	166	≤40->40	317	295		100 (16)	153 (25)		
24	(Pan et al., 2020)	China	Cross-sectional study	194	36	<30->50	42	148	4	63 (32)	73 (38)		
25	Pouralizadeh et al., 2020	Iran	Cross-sectional study	441	21	<30->40		441		324 (73)	313 (71)		
26	Prasad et al., 2020	USA	Cross-sectional study	347		≥26		248	63	241 (69)	79 (23)	292 (84)	
27	Riello et al., 2020	Italy	Cross-sectional study	1071	108	≥18				503 (47)			680 (63)
28	Rossi et al., 2020	Italy	Cross-sectional study	1379	315	39	433	472	473	273 (20)	341 (25)	302 (22)	681 (49)
29	Sagaon-Teyssier et al., 2020	Mali	Cross-sectional study	135	82	40	35	20	80	99 (73)	97 (72)		
30	Şahin et al., 2020	Turkey	Cross-sectional study	939	319	≥18	580	254	105	565 (60)	729 (78)		717 (76)
31	Shrestha et al., 2020	Nepal	Cross-sectional study	410	265	<30->45	410					13 (3)	
32	Song et al., 2020	China	Cross-sectional study	14,825	5289	≥18	6093	8732			3733 (25)		1353 (9)
33	(Suryavanshi et al., 2020)	India	Cross-sectional study	197	96	≤30->40	66	47	84	56 (28)	44 (22)		
34	Vafaei et al., 2020	Iran	Cross-sectional study	599		≥20	194	275	130	385 (64)			
35	Wankowicz et al., 2020	Poland	Cross-sectional study	441	230					284 (64)	312 (71)		
36	(Yang et al., 2020)	South Korea	Cross-sectional study	54	12	≥20	11	19	26	27 (50)	6 (11)		
37	(Yang et al., 2021)	China	Cross-sectional study	449		≤25->46	285	164		131 29)			
38	Youssef et al., 2020	Egypt	Cross-sectional study	540	294	37.3	416	49	75	230 (43)	319 (59)	201 (37)	

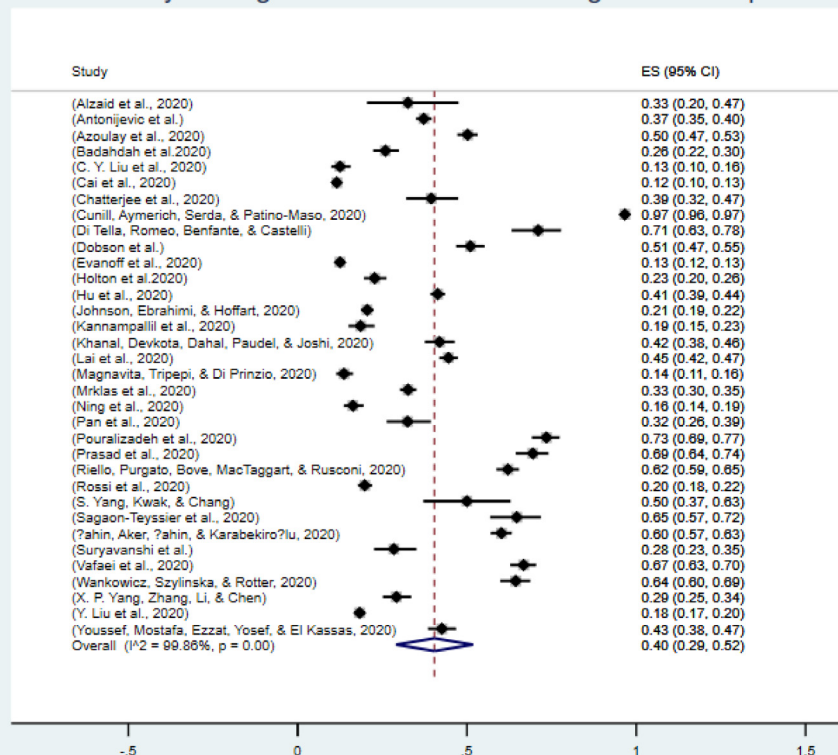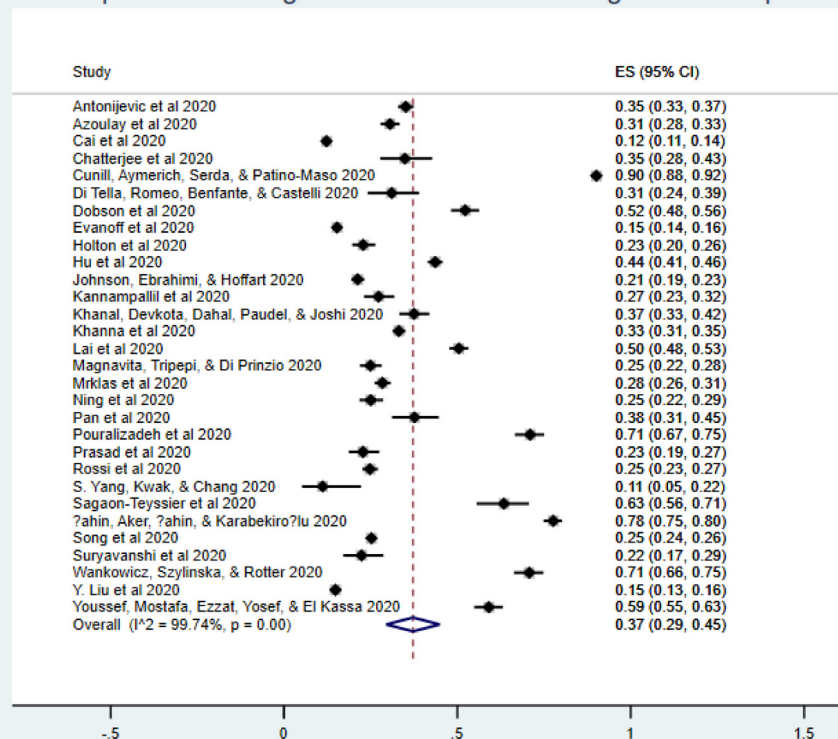**Fig. 2.** Proportion of anxiety among healthcare workers during COVID-19 pandemic.

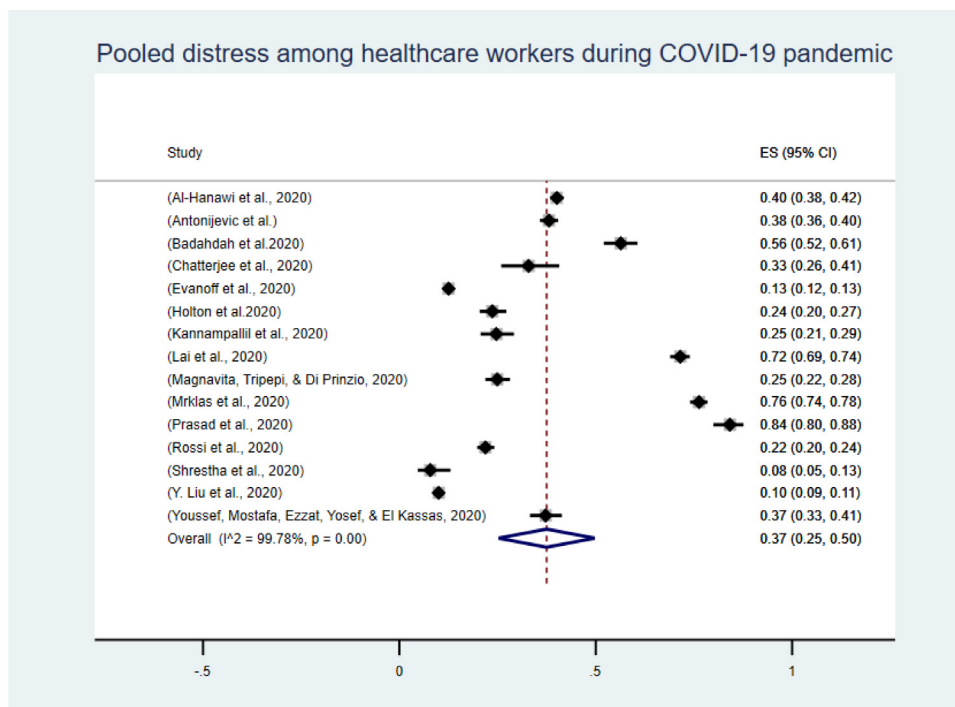**Fig. 3.** Proportion of depression among healthcare workers during COVID-19 pandemic.

Pooled distress among healthcare workers during COVID-19 pandemic

Study	ES (95% CI)
(Al-Hanawi et al., 2020)	0.40 (0.38, 0.42)
(Antonijevic et al.)	0.38 (0.36, 0.40)
(Badahdah et al.2020)	0.56 (0.52, 0.61)
(Chatterjee et al., 2020)	0.33 (0.26, 0.41)
(Evanoff et al., 2020)	0.13 (0.12, 0.13)
(Holton et al.2020)	0.24 (0.20, 0.27)
(Kannampallil et al., 2020)	0.25 (0.21, 0.29)
(Lai et al., 2020)	0.72 (0.69, 0.74)
(Magnavita, Tripepi, & Di Prinzio, 2020)	0.25 (0.22, 0.28)
(Mrklas et al., 2020)	0.76 (0.74, 0.78)
(Prasad et al., 2020)	0.84 (0.80, 0.88)
(Rossi et al., 2020)	0.22 (0.20, 0.24)
(Shrestha et al., 2020)	0.08 (0.05, 0.13)
(Y. Liu et al., 2020)	0.10 (0.09, 0.11)
(Youssef, Mostafa, Ezzat, Yosef, & El Kassas, 2020)	0.37 (0.33, 0.41)
Overall (I^2 = 99.78%, p = 0.00)	0.37 (0.25, 0.50)

Fig. 4. Proportion of distress among healthcare workers during COVID-19 pandemic.

Pooled PTSD among healthcare workers during COVID-19 pandemic

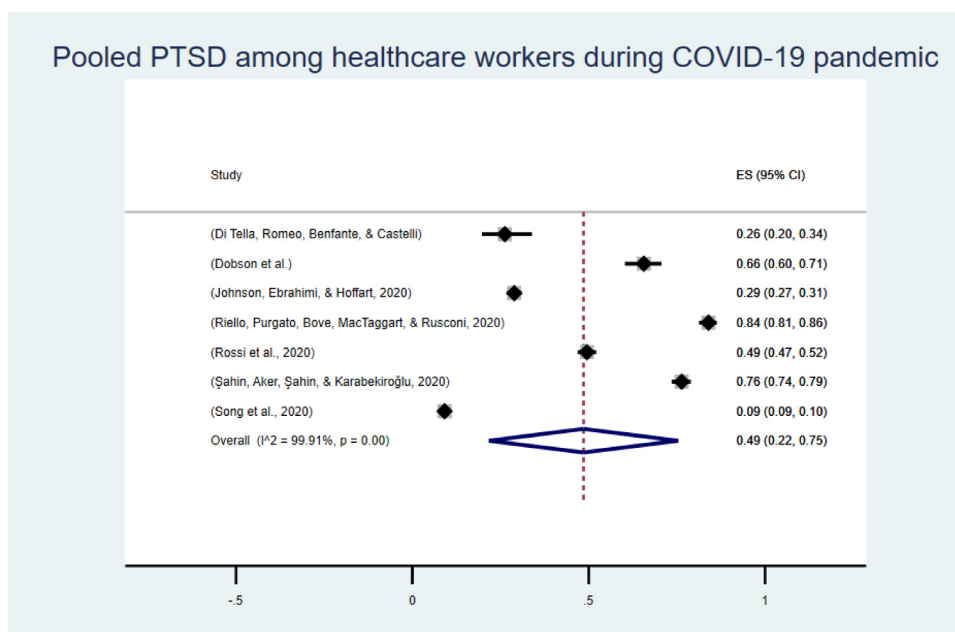| Study	ES (95% CI)
(Di Tella, Romeo, Benfante, & Castelli)	0.26 (0.20, 0.34)
(Dobson et al.)	0.66 (0.60, 0.71)
(Johnson, Ebrahimi, & Hoffart, 2020)	0.29 (0.27, 0.31)
(Riello, Purgato, Bove, MacTaggart, & Rusconi, 2020)	0.84 (0.81, 0.86)
(Rossi et al., 2020)	0.49 (0.47, 0.52)
(Şahin, Aker, Şahin, & Karabekiroğlu, 2020)	0.76 (0.74, 0.79)
(Song et al., 2020)	0.09 (0.09, 0.10)
Overall (I^2 = 99.91%, p = 0.00)	0.49 (0.22, 0.75)

Fig. 5. Proportion of Posttraumatic Stress Disorder (PTSD) among healthcare workers during COVID-19 pandemic.

by Salari and colleagues, which identified a prevalence of anxiety from 23 studies of 25.8% (Salari et al., 2020). Anxiety among healthcare workers during COVID-19 was related to many factors, especially for those directly involved in the care of suspected or confirmed patients with COVID-19, including worry about becoming infected while caring for these patients and the possibility of spreading the infection to their family, uncertainty regarding whether the organization they work for would support or care for their personal or family needs if they became infected with COVID-19 (Shanafelt et al., 2020), and a lack of confidence in the ability to cope with stress (Teshome et al., 2020). Healthcare workers also reported experiencing stigma from society, changes to their regular

job duties, and working overtime as additional circumstances that add to the feeling of anxiety (Khanal et al., 2020). Finally, anxiety among healthcare workers depends on individual, environmental, and social factors. Consequently, they might also experience weakened confidence in health care providers. Health care leaders and organizations must recognize the sources of anxiety, use targeted approaches to address these sources, and provide sufficient support systems to help healthcare workers handle these circumstances (Shanafelt et al., 2020).

The prevalence of depression from 30 studies was 36%. The present study had a higher prevalence, as the previous study that only included 21 studies with a prevalence of depression of 24.3%

Table 2a
Quality assessment of cross-sectional studies.

No	The Joanna Briggs Institute checklist question	Al-Hanawi et al., 2020	Alzaid et al., 2020	Antonijevic et al., 2020	Azoulay et al., 2020	Badahdah et al., 2021	Chatterjee et al., 2020	Cunill et al., 2020
1	Were the criteria for inclusion in the sample clearly defined?	Y	Y	Y	Y	N	Y	N
2	Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	Y
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y
4	Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y
5	Were confounding factors identified?	N	N	Y	Y	N	N	N
6	Were strategies to deal with confounding factors stated?	N	N	N	N	N	N	N
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y
8	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y
	Overall Appraisal	**Include: 6 Exclude: 2**	**Include: 6 Exclude: 2**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 6 Exclude: 2**	**Include: 7 Exclude: 1**	**Include: 5 Exclude: 3**
	Level of evidence	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**

No	The Joanna Briggs Institute checklist question	Di Tella, Romeo, Benfante, and Castelli., 2020	Dobson et al., 2021	Evanoff et al., 2020	Holton et al., 2021	Hu et al., 2020	Johnson et al., 2020
1	Were the criteria for inclusion in the sample clearly defined?	Y	Y	Y	Y	Y	Y
2	Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
4	Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y
5	Were confounding factors identified?	N	N	N	Y	Y	Y
6	Were strategies to deal with confounding factors stated?	N	N	N	N	N	Y
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
8	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y
	Overall Appraisal	**Include: 6 Exclude: 2**	**Include: 6 Exclude: 2**	**Include: 6 Exclude: 2**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 8 Exclude: 0**
	Level of evidence	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**

No	The Joanna Briggs Institute checklist question	Kannampallil et al., 2020	Khanal et al., 2020	Khanna et al., 2020	Lai et al., 2020	(Liu et al., 2020)	(Liu et al., 2020)
1	Were the criteria for inclusion in the sample clearly defined?	Y	Y	Y	Y	Y	Y
2	Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
4	Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y
5	Were confounding factors identified?	N	N	N	Y	Y	N
6	Were strategies to deal with confounding factors stated?	N	N	N	Y	N	N
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
8	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y
	Overall Appraisal	**Include: 6 Exclude: 2**	**Include: 6 Exclude: 2**	**Include: 6 Exclude: 2**	**Include: 8 Exclude: 0**	**Include: 7 Exclude: 1**	**Include: 6 Exclude: 2**
	Level of evidence	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**

Table 2a
(*continued*)

No	The Joanna Briggs Institute checklist question	Magnavita et al., 2020	Mrklas et al., 2020	Ning et al., 2020	Pan et al., 2020	Pouralizadeh et al., 2020	Prasad et al., 2020
1	Were the criteria for inclusion in the sample clearly defined?	Y	N	Y	Y	Y	Y
2	Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
4	Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y
5	Were confounding factors identified?	Y	N	N	Y	Y	Y
6	Were strategies to deal with confounding factors stated?	Y	N	N	N	N	N
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
8	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y
	Overall Appraisal	**Include: 8 Exclude: 0**	**Include: 6 Exclude: 2**	**Include: 6 Exclude: 2**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**
	Level of evidence	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**

No	The Joanna Briggs Institute checklist question	Riello et al., 2020	Rossi et al., 2020	Sagaon-Teyssier et al., 2020	Şahin et al., 2020	Shrestha et al., 2020	Song et al., 2020
1	Were the criteria for inclusion in the sample clearly defined?	Y	Y	Y	Y	Y	Y
2	Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
4	Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y
5	Were confounding factors identified?	Y	Y	Y	Y	N	Y
6	Were strategies to deal with confounding factors stated?	N	N	N	N	N	N
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
8	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y
	Overall Appraisal	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 6 Exclude: 2**	**Include: 7 Exclude: 1**
	Level of evidence	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**

No	The Joanna Briggs Institute checklist question	Suryavanshi et al., 2020	Vafaei et al., 2020	Wankowicz et al., 2020	Yang et al., 2020	Yang et al., 2021	Youssef et al., 2020
1	Were the criteria for inclusion in the sample clearly defined?	Y	Y	Y	Y	Y	Y
2	Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
4	Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y
5	Were confounding factors identified?	Y	Y	Y	Y	Y	Y
6	Were strategies to deal with confounding factors stated?	N	N	N	N	N	N
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y
8	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y
	Overall Appraisal	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**	**Include: 7 Exclude: 1**
	Level of evidence	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**	**4.c case series**

Yes= 1, No = 0
Yes= 1, No = 0
Yes= 1, No = 0
Yes= 1, No = 0
Yes= 1, No = 0
Yes= 1, No = 0.

Table 2b
Quality assessment of the included case-control study.

No	The Joanna Briggs Institute checklist question	Cai et al., 2020
1	Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?	Y
2	Were cases and controls matched appropriately?	Y
3	Were the same criteria used for identification of cases and controls?	Y
4	Was exposure measured in a standard, valid and reliable way?	Y
5	Was exposure measured in the same way for cases and controls?	Y
6	Were confounding factors identified?	N
7	Were strategies to deal with confounding factors stated?	N
8	Were outcomes assessed in a standard, valid and reliable way for cases and controls?	Y
9	Was the exposure period of interest long enough to be meaningful?	Y
10	Was appropriate statistical analysis used?	Y
	Overall Appraisal	**Include: 8** **Exclude: 2**
	Level of evidence	Level 3.d – Case – controlled study

Yes= 1, No = 0.

(Salari et al., 2020). Current evidence suggests that health care workers' fears of getting infected and this leads to occurrence of depression (Ho et al., 2020). Their fear of becoming the source of infection and spreading it to their families or loved ones also resulted in excessive stress (Pappa et al., 2020). It was explained that healthcare workers are more likely to develop depressive symptoms when they work in a high-risk environment and when they are directly involved in the COVID-19 patients' daily care (Di Tella et al., 2020). For example, a larger proportion of nurses reported increased symptoms related to anxiety and depression than other types of healthcare workers who work at the highest altitude of Nepal (Khanal et al., 2020). Moreover, the prevalence of depression also varied significantly across the different types of health care workers, for instance nursing-assistants exhibiting the highest prevalence of depression (Azoulay et al., 2020).

In this study, the prevalence of distress, analyzed by 15 studies, was 35%. Although the present work included more studies than the previous work by Salari and colleagues, we found lower prevalence than the previous study that only included 9 studies and reported a prevalence of 45% for distress (Salari et al., 2020). One possible explanation for this finding was that the previous work included studies that were primarily conducted in Asia, whereas more than 60% of the studies included in the present study were from outside of Asia. Front-line health workers were found to experience severe distress, according to the findings from Italy (Moccia et al., 2020). Being on the front line exposes healthcare workers to the largest risk of COVID-19 infection, resulting in the development of fear and psychological breakdowns (Al-Hanawi et al., 2020). In addition, during this pandemic crisis, the job demands and work environment have transformed, with an increase in the amount of high-pressure work and resulting in inadequate physical environments, which destabilized the mood of health care workers, resulting in distress and emotional-breakdowns associated with the high workloads associated with the increasing number of patients infected with COVID-19 (Ramaci et al., 2020). Among non-physician health care workers, nurses reported the highest level of distress symptoms (Prasad et al., 2020), whereas, among general health care workers, the prevalence of distress was moderate to high (Dobson et al., 2021; Mrklas et al., 2020). There were behaviors that often showed by distressed healthcare workers such as a feeling of worry and compulsive handwashing (Mrklas et al., 2020)

One of the adverse psychological impacts and long-term mental health problems experienced by healthcare workers was post-traumatic stress disorder. From seven studies, the present meta-analysis showed that the prevalence of post-traumatic stress disorder was 50%, which is higher than the previous meta-analysis by Batra and colleagues which included six studies and reported a post-traumatic stress disorder prevalence of 11.4% (Batra et al., 2020). The global COVID-19 pandemic has lasted for a year, and our analysis showed the significant and relevant long-term consequences of the prolonged situation. Those who develop post-traumatic stress disorder symptoms are profoundly affected by other conditions, including severe anxiety and depression (Johnson et al., 2020). Anger, anxiety, fear, and depression might occur at the peak of mental health suffering during an outbreak; however, these symptoms tend to decrease with the stability of the spreading virus, unlike post-traumatic stress disorder, which will continue to affect those with symptoms over the long-term period (Robertson et al., 2004; Wu et al., 2005).

Nurse participants in this study represented the largest population of health care workers. A number of the included studies provided evidence that the prevalence of anxiety, depression, distress, and post-traumatic stress disorder among front-line nurses were high, manifested at moderate to severe levels (Cai et al., 2020; Deying et al., 2020; Dobson et al., 2021; Hoseinabadi et al., 2020; Rossi et al., 2020; Ying et al., 2020). This additional information provided emerging evidence that the COVID-19 is severely affecting the well-being of nurses.

In our meta-analysis, we highlight that the pandemic has taken an immense toll on the overall health and mental health of healthcare workers. Healthcare workers in frontline continue to provide care to patients with COVID-19, many of whom with critical illness succumb to disease in spite of all efforts put in by healthcare workers. This impacts healthcare workers not only at a professional level but also on their overall morale and determination. Many healthcare workers face these challenges in dire conditions where lack of resources, pay or access to basic personal protective equipment adds additional pressures while they are simultaneously trying to save lives. Despite these adverse conditions, we see these frontline workers working round the clock to provide care within their ability to the patient and their family members. We found that more than a quarter of healthcare workforce had mental health problems during the COVID-19 pandemic. To address this critical issue at this crucial juncture, global leaders and all of the stakeholders should develop resources for the healthcare workforce to address their mental health problems. Screening for mental health problems among healthcare workers and providing referrals as needed may be helpful.

This work was also associated with some underlying limitations. Despite searching six major academic databases and manually searching the references of previously published systematic reviews on similar issues, we did not examine any gray literature. Moreover, the screening was focused on articles published in English. Therefore, other relevant references may have been excluded from the analysis. We also did not incorporate other measures

of mental health challenges. Further as many of these were self-report data, many studies might not use standard tools for measuring these outcomes.

Conclusion

In summary, we aimed to study the prevalence of mental health problems among healthcare workers during the COVID-19 pandemic. We showed that the most prevalent mental health disorder experienced by healthcare workers was post-traumatic stress disorder, followed by anxiety, depression, and distress. Future studies remain necessary to assess the factors associated with the development of mental health problem among healthcare workers during COVID-19. The global COVID-19 pandemic has placed the physical health of healthcare workers at the highest risk of being infected by the virus. The global population has responsibility for healing their healers, establishing a resilient work-force environment, and respecting their totality. Strong recommendations are aimed at governments, policy-makers, and relevant stakeholders to pay close attention to and address the mental health burdens of health care workers. Specifics interventional research is urgently necessary to mitigate the mental health impacts on healthcare workers and to help them cope with their burdens.

Declaration of Competing Interest

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijnurstu.2021.104002.

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