BMJ Open

Prevalence of burnout and mental health problems among medical staff during the COVID-19 pandemic: a systematic review and meta-analysis

Hongjin Zhu,[1] Xiaoyun Yang,[2] Shiqi Xie ,[3] Jianrong Zhou [3]

To cite: Zhu H, Yang X, Xie S, *et al*. Prevalence of burnout and mental health problems among medical staff during the COVID-19 pandemic: a systematic review and meta-analysis. *BMJ Open* 2023;**13**:e061945. doi:10.1136/bmjopen-2022-061945

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-061945).

Received 11 February 2022
Accepted 06 July 2023

[1]Department of Obstetrics and Gynecology, Women and Children's Hospital of Chongqing Medical University, Chongqing, China
[2]Southwest Hospital, Third Military Medical University (Army Medical University), Chongqing, China
[3]School of Nursing, Chongqing Medical University, Chongqing, China

Correspondence to
Dr Jianrong Zhou; 202028@cqmu.edu.cn and Dr Shiqi Xie; 102835@cqmu.edu.cn

ABSTRACT

Objective The COVID-19 pandemic has had a significant impact on the burnout and mental health of medical staff. This meta-analysis aims to provide additional (and updated) evidence related to burnout and mental health problems among medical staff using a broader data pool.

Design Systematic review and meta-analysis.

Data sources PubMed, Embase, Cochrane Library, CNKI, Wanfang data and three preprint databases (SSRN, bioRxiv and medRxiv) were searched from 1 January 2020 to 17 May 2021.

Eligibility criteria We included observational studies investigating the prevalence of burnout and mental health problems among medical staff during the COVID-19 pandemic, including cross-sectional study, cohort study and case–control study.

Data extraction and synthesis Two independent reviewers used a self-designed form to extract the primary data. The Joanna Briggs Institute quality appraisal tool was used to assess the quality of selected studies. Heterogeneity among studies was assessed by I^2 statistic. A random-effects model was used to pool the prevalence. Subgroup analysis was performed to explore between-group differences.

Results 250 studies were included, with a sample of 292 230 participants from 46 countries. The pooled prevalence of burnout, anxiety, depression, insomnia, stress, post-traumatic stress disorder symptoms and somatic symptoms was 43.6% (95% CI 36.3% to 51.2%), 37.1% (95% CI 34.7% to 39.7%), 37.6% (95% CI 35.0% to 40.4%), 43.7% (95% CI 39.1% to 48.5%), 41.3% (95% CI 35.1% to 47.9%), 30.6% (95% CI 23.6% to 38.5%) and 25.0% (95% CI 16.7% to 35.6%), respectively. Subgroup analysis showed a higher prevalence of anxiety, depression and insomnia in frontline workers than in non-frontline workers, and a higher prevalence of anxiety in females than males. Mild cases accounted for the most significant proportion of the outcomes except for stress.

Conclusions This study highlights that identifying the risks of burnout and mental health problems and adopting preventive interventions are priorities for policymakers and medical staff to avoid long-term occupational, health and social impacts.

PROSPERO registration number CRD42021254425.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This systematic review and meta-analysis used a comprehensive search for articles on mental health and burnout of the medical staff but was limited to observational studies.
⇒ For different types of observational studies, we used targeted quality appraisal tools to evaluate the strength and quality of the evidence.
⇒ Due to the heterogeneity of the studies, we used random effects to pool the prevalence for each outcome.
⇒ The majority of studies use online self-reported questionnaires, and the results may be influenced by confounding factors.

INTRODUCTION

Since the occurrence of COVID-19, it has spread rapidly worldwide. On 30 January 2020, WHO designated it a 'Public Health Emergency of International Concern'.[1] As of 17 February 2023, about 760 million people have been infected worldwide, of which about 7 million have died.[2] Previous studies have suggested that major public health emergencies can increase people's physical and mental health problems, such as the severe acute respiratory syndrome (SARS) and Ebola virus,[3–6] which was once again confirmed by COVID-19.[7–9]

The disease itself, fear of contagion and public health measures such as isolation, quarantine, social distancing and community containment have had a significant impact on people's social interaction, work, study and lifestyle,[7 10 11] leading to a series of physical and mental health problems. As the main force to fight the epidemic, medical staff bear a more significant burden and may be more prone to physical and mental problems than the general public. For example, studies conducted in the early phase of the epidemic in China found that 30% of the general public suffered from depression and

37% from anxiety.[12] In comparison, the prevalence of depression and anxiety was 50% and 45% among medical staff, respectively.[13] Medical staff also reported other psychological problems such as insomnia, stress, fear and post-traumatic stress disorder (PTSD), and physical discomforts such as skin damage and muscle tension.[14–17] A multinational, multicentre study found that there may be a bidirectional link between physical and psychological symptoms among healthcare workers.[18] In addition, medical staff also faced some unique challenges in this period, including staff shortage, long work shifts, long wearing of personal protective equipment (PPE), an insufficient supply of protective materials, guidelines changing rapidly, the risk of infection spreading to friends or family, lack of sufficient training and psychosocial support.[19–21] These challenges trigger multiple mental health problems and contribute to burnout.[22] Studies have reported that medical staff have experienced high levels of burnout during the COVID-19 crisis.[23 24] Burnout was significantly associated with common mental disorders like anxiety and depression.[25 26]

Burnout and mental health problems are associated with personal and patient care consequences, such as quality of life, job performance, turnover intention and patient safety.[27–29] A more reliable and comprehensive estimate of burnout and mental health problems of medical staff during the COVID-19 pandemic is needed to provide prevention and interventions. Early systematic reviews and meta-analyses provided important data,[30–33] but they need to be updated, especially considering that early research evidence was primarily supplied by China. Furthermore, previous research evidence mainly focused on mental health problems such as anxiety and depression among medical staff, and that a more comprehensive estimate of burnout is needed. Previous studies have inconsistencies in exploring the influencing factors of these outcomes. For example, one study suggested that doctors were more prone to burnout,[34] while in another study, nurses were at higher risk.[35] Therefore, this study will examine data from a range of countries, provide an up-to-date estimate of the prevalence of burnout and mental health problems among medical staff during the COVID-19 pandemic and explore inconsistencies in influencing factors in the literature by subgroup analysis.

METHODS AND ANALYSIS

Search strategy

The supplementary search strategy based on MeSH terms and free-text keywords (shown in online supplemental file 2), and citation retrieval was conducted by two authors. PubMed, Embase, Cochrane Library, CNKI, Wanfang data and three preprint databases (SSRN, bioRxiv and medRxiv) were searched through 17 May 2021, with language restricted to Chinese and English.

Eligibility criteria

Two authors independently screened the titles and abstracts and reviewed the full text of articles that met the inclusion criteria. Any conflict would be discussed and determined by the third author.

Inclusion criteria

1. Observational study, including cross-sectional study, cohort study and case–control study.
2. Use of validated standardised measurement tools to assess burnout and mental health outcomes, including anxiety, depression, insomnia, stress, PTSD and somatic symptoms, among medical staff since the COVID-19 pandemic.
3. Inclusion of point prevalence data for each outcome.

Exclusion criteria

1. Used a non-standard threshold to define anxiety, depression and insomnia.
2. Without available full text and not included after the quality appraisal.

Data extraction

Two authors extracted the primary data independently using a self-designed data extraction form; any disagreement will be resolved by discussion or consultation with a third author. Extract the following data: title, first author, country, date of survey, study design, sampling method, sample sizes, measurement tools, number of positive cases for each symptom (including burnout, anxiety, depression, insomnia, stress, PTSD, somatic symptoms), demographics (eg, gender, profession) and any other crucial noteworthy result (eg, different risk groups, symptom severity).

Quality appraisal

Eligible studies have been critically appraised by two independent reviewers using the Chinese version of the Joanna Briggs Institute (JBI) quality appraisal tool published by the Evidence-based Nursing Centre of Fudan University.[36] Cross-sectional study, cohort study and case–control study were evaluated with 9, 11 and 10-item checklists, respectively. The reviewer makes a judgement of 'yes', 'no', 'unclear' and 'not applicable' for each evaluation item and decides whether to include or exclude the study after group discussion.

Data synthesis and statistical analyses

This study mainly focused on burnout and mental health problems (anxiety, depression, insomnia, stress, PTSD and somatic symptoms). The I^2 statistic assessed the statistical heterogeneity among the included studies.[37] Due to the considerable heterogeneity, we used DerSimonian-Laird random-effects meta-analysis to pool the raw data for each outcome.[38] A forest plot displays the prevalence with a 95% CI for every study and the final pooled prevalence rates. Potential publication bias was assessed by funnel plots and Begg-Mazumdar rank correlation.[39] Sensitivity analysis was performed by one-study-removed

analysis. Subgroup analysis was performed to explore between-group differences of the following variables: gender (male, female), profession category (doctor, nurse, other medical staff), different risk groups (front-line/non-frontline medical staff), symptom severity, measurement tools and sampling methods (random or non-random). Other medical staff included technicians, managers and laboratory personnel. Frontline medical staff refer to those directly engaged in diagnosing, treating or providing care to patients with elevated temperatures or confirmed COVID-19. All statistical tests were two tailed, and p<0.05 would indicate statistical significance. All statistical analyses use CMA V.3.3.070.

Patient and public involvement

This study involved the secondary use of existing or published data and did not include patients or the public as study participants. No patients or the public were involved in setting the research question, the study design or the overall conduct of the study.

Protocol registration

This study was conducted by the Meta-analysis of Observational Studies in Epidemiology. The protocol for this meta-analysis was registered on PROSPERO (CRD42021254425) and can be accessed at: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021254425.

RESULTS

Study selection

A total of 3411 studies were found after the searching process, and 718 duplicates were removed. After screening the titles and abstracts, 374 studies were assessed, and 124 were excluded because of the following reasons: they were research letters; did not report prevalence data; did not evaluate burnout, anxiety, depression or insomnia; used not widely validated tools; data duplicates or contradictions; not English or Chinese; used a non-standard threshold to define specific symptoms (anxiety, depression and insomnia); no full text available; and removed after the JBI quality appraisal. Ultimately, we included 250 studies with a total of 292 230 participants. Figure 1 shows the study selection process.

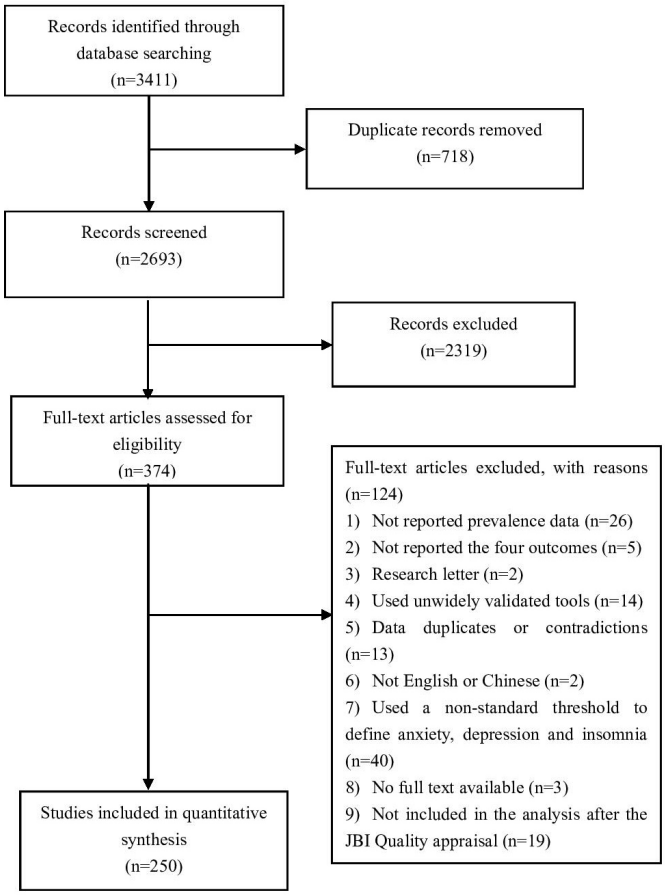

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart of citations selection. JBI, Joanna Briggs Institute.

Characteristics of included studies

The characteristics of included studies are shown in online supplemental table S1. Thirty-six studies reported burnout with 34 490 participants, 188 studies reported anxiety with 214 694 participants, 162 studies reported depression with 212 373 participants and 50 studies reported insomnia with 47 656 participants. In addition to the four primary outcomes, we note some other outcomes: 45 studies reported stress with 32 224 participants, 33 studies reported PTSD symptoms with 48 019 participants and 9 studies reported somatic symptoms with 22 405 participants. Of the included studies, 98.8% were cross-sectional, and most were online surveys; most were unreported sampling methods (56%), and random and non-random sampling methods were 8.8% and 34.8%, respectively; 132 were from China, 111 were from other 45 countries and 7 were cross-national research; surveys were conducted between January 2020 and October 2020, 17 items did not report participant recruitment dates.

Risk of bias in the included studies

The JBI quality appraisal tool was used to assess the quality of selected studies. The supplementary JBI quality appraisal shows the quality of each article.

Prevalence of primary outcomes

The pooled prevalence of burnout was 43.6% (95% CI 36.3% to 51.2%, I^2=99.4%, p<0.001), as shown in table 1 and online supplemental figure S1. In subgroup comparisons, burnout did not show a significant difference among doctors, nurses and other medical staff (Q=4.17, p=0.12), no significant difference between females and males (Q=0.25, p=0.62), no significant difference between frontline and non-frontline medical staff (Q=0.37, p=0.54) and no significant difference between random and non-random sampling (Q=1.41, p=0.23); the prevalence of mild burnout was highest (55.2%, 95% CI 31.9% to 76.4%), followed by moderate (44.3%, 95% CI 16.5%

Table 1 Prevalence of main outcomes and subgroup analyses

Outcomes	Subgroups	Studies (n)	Positive cases	Sample size	Pooled prevalence % (95% CI)	I^2 (%)	Q statistic	P value
Burnout		36	14921	34490	43.6 (36.3 to 51.2)	99.4	5420.80	<0.001
	Doctor	18	2657	8632	32.9 (23.9 to 43.2)	98.6		
	Nurse	14	2663	6138	44.5 (33.2 to 56.4)	98.6	4.17	0.12
	Other	9	652	4679	24.8 (12.8 to 42.5)	98.5		
	Male	17	1525	5390	34.7 (24.8 to 46.2)	98.0		
	Female	17	3639	12623	38.7 (28.3 to 50.2)	99.1	0.25	0.62
	Frontline	19	4184	10204	42.0 (33.2 to 51.4)	98.6		
	Non-frontline	15	1833	8283	36.1 (21.8 to 53.4)	99.1	0.37	0.54
	Mild	6	1396	3708	55.2 (31.9 to 76.4)	99.3		
	Moderate	5	1249	3812	44.3 (16.5 to 76.2)	99.5	9.29	<0.05
	Severe	8	364	4388	13.7 (5.7 to 29.2)	98.1		
	Random	2	973	1751	61.1 (37.0 to 80.7)	98.7		
	Non-random	12	3302	6971	45.6 (38.0 to 53.5)	97.4	1.41	0.23
	EE	11	4025	8198	36.9 (22.1 to 54.6)	99.4		
	DP	11	4358	8198	36.4 (22.3 to 53.3)	99.4	1.83	0.40
	RPA	9	2367	4882	49.8 (35.2 to 64.4)	98.9		
Anxiety		188	67758	214694	37.1 (34.7 to 39.7)	99.1	21370.84	<0.001
	Doctor	51	8990	26112	37.5 (32.6 to 42.7)	98.3		
	Nurse	74	22066	77632	37.8 (34.0 to 41.7)	98.9	0.03	0.99
	Other	24	2254	7758	37.0 (28.0 to 46.9)	98.0		
	Male	63	4045	13636	31.2 (27.2 to 35.5)	95.5		
	Female	67	16548	50144	41.1 (36.7 to 45.6)	98.9	10.94	<0.01
	Frontline	108	24664	75871	41.4 (37.6 to 45.3)	98.8		
	Non-frontline	73	11920	44281	27.6 (24.3 to 31.2)	98.2	26.89	<0.001
	Mild	101	27005	42701	62.8 (58.9 to 66.5)	98.1		
	Moderate	94	9834	39698	25.8 (23.7 to 28.0)	94.9	364.21	<0.001
	Moderate to severe or above	99	7149	44644	14.9 (12.6 to 17.6)	97.8		
	Random	16	3179	8811	35.2 (25.0 to 47.0)	98.9		
	Non-random	69	19863	57730	39.1 (34.6 to 43.8)	99.0	0.38	0.54
	DASS-21	26	7278	20505	36.7 (32.3 to 41.3)	97.6		
	GAD-7	90	39212	111710	40.7 (36.9 to 44.5)	99.2		
	HADS	23	6452	15337	47.3 (41.9 to 52.7)	97.6	52.11	<0.001
	SAS	37	11032	50649	25.3 (22.0 to 28.9)	98.2		
Depression		162	69147	212373	37.6 (35.0 to 40.4)	99.2	21330.49	<0.001
	Doctor	43	9182	23620	40.3 (34.6 to 46.3)	98.5		
	Nurse	66	23989	73548	39.6 (35.5 to 43.9)	99.0	0.29	0.87
	Other	22	1976	6012	42.5 (33.0 to 52.6)	97.7		
	Male	53	5337	15469	34.7 (29.3 to 40.5)	97.5		
	Female	56	18016	53168	39.9 (34.5 to 45.5)	99.2	1.67	0.20
	Frontline	99	33955	96064	41.8 (38.0 to 45.7)	99.1		
	Non-frontline	70	12162	42987	30.7 (27.1 to 34.7)	98.3	15.76	<0.001
	Mild	86	24275	39248	60.0 (56.5 to 63.4)	97.5		
	Moderate	81	9417	36264	28.3 (26.2 to 30.6)	94.2	334.06	<0.001

Continued

Table 1 Continued

Outcomes	Subgroups	Studies (n)	Positive cases	Sample size	Pooled prevalence % (95% CI)	I^2 (%)	Q statistic	P value
	Moderate to severe or above	85	6032	38424	16.2 (13.8 to 19.0)	97.4		
	Random	13	3075	6836	44.5 (35.7 to 53.8)	97.9		
	Non-random	59	23801	69312	38.2 (33.6 to 43.0)	99.2	1.49	0.22
	DASS-21	24	6481	19255	32.9 (27.2 to 39.1)	98.5		
	HADS	22	5416	15075	40.7 (34.4 to 47.3)	98.1		
	PHQ-9	92	44148	130804	40.8 (36.6 to 45.1)	99.4	14.86	0.002
	SDS	18	8543	28819	29.6 (25.2 to 34.4)	97.1		
Insomnia		50	19692	47656	43.7 (39.1 to 48.5)	98.9	4597.72	<0.001
	Doctor	13	3630	9980	38.8 (32.2 to 45.9)	97.5		
	Nurse	16	6375	13920	48.4 (40.8 to 56.0)	98.6	3.62	0.16
	Other	4	251	681	39.1 (28.0 to 51.5)	89.2		
	Male	10	1395	3701	41.7 (33.1 to 50.7)	95.0		
	Female	11	4626	10676	52.3 (41.9 to 62.4)	98.8	2.30	0.13
	Frontline	36	11880	23825	49.5 (44.0 to 55.1)	98.4		
	Non-frontline	21	4469	14658	29.9 (24.8 to 35.4)	97.5	23.50	<0.001
	Mild	25	4586	6942	67.6 (62.8 to 72.1)	93.9		
	Moderate	22	1374	5107	26.1 (22.8 to 29.8)	86.6	211.25	<0.001
	Moderate to severe or above	24	1016	6477	8.50 (5.20 to 13.6)	97.6		
	Random	6	1963	3941	49.5 (33.3 to 65.8)	99.0		
	Non-random	12	3993	11121	37.4 (25.6 to 51.0)	99.3	1.23	0.27
	AIS	8	5701	10357	55.6 (50.2 to 60.9)	96.3		
	ISI	38	12855	35488	40.0 (34.9 to 45.2)	98.8	16.30	<0.001
	PSQI	4	1136	1811	56.2 (37.6 to 73.2)	98.0		

Cut-off score of the tool: SAS:[68] the cut-off value of standard score was 50, with 50–59, 60–69 and ≥70 indicating mild, moderate and severe anxiety, respectively; GAD-7:[69] total scores range from 0 to 21, with 5–9 as 'mild', 10–14 as 'moderate' and 15–21 as 'severe'; SDS:[70] the cut-off value of standard score was 53, with 53–62, 63–72 and ≥73 indicating mild, moderate and severe depression, respectively; PHQ-9:[71] total scores range from 0 to 27, with 5–9 as 'mild', 10–14 as 'moderate', 15–19 as 'moderately severe' and 20–27 as 'severe'; DASS-21:[72] anxiety (8–9 as 'mild', 10–14 as 'moderate', 15–19 as 'severe', ≥20 as 'extremely severe'), depression (10–13 as 'mild', 14–20 as 'moderate', 21–27 as 'severe', ≥28 as 'extremely severe'), stress (15–18 as 'mild', 19–25 as 'moderate', 26–33 as 'severe', ≥34 as 'extremely severe'); HADS:[73] it has seven items each for measurement of anxiety and depression which are scored from 0 to 21. The total scores of these tools were interpreted as normal (0–7), borderline abnormal (8–10) and abnormal (11–21); AIS:[74] total scores range from 0 to 24, with 4–6 as suspicious insomnia and >6 as insomnia; ISI:[75] total scores range from 0 to 28, with 8–14 as 'sub-threshold insomnia', 15–21 as 'moderate clinical insomnia' and 22–28 as 'severe clinical insomnia'; PSQI:[76] a cut-off of the total score at 8 or above for the signs of poor sleep quality.
AIS, the Athens Insomnia Scale; DASS-21, the Depression, Anxiety and Stress Scale- 21; DP, depersonalization; EE, emotional exhaustion; GAD-7, the Generalized Anxiety Disorder Scale-7; HADS, the Hospital Anxiety and Depression Scale; ISI, the Insomnia Severity Index; PHQ-9, the Patient Health Questionnaire-9; PSQI, the Pittsburgh Sleep Quality Index; RPA, reduced personal accomplishment; SAS, the Self-rating Anxiety Scale; SDS, the Self-rating Depression Scale.

to 76.2%) and severe (13.7%, 95% CI 5.7% to 29.2%). We also compared the three dimensions of burnout and did not show a significant difference (Q=1.83, p=0.40).

The pooled prevalence of anxiety was 37.1% (95% CI 34.7% to 39.7%, I^2=99.1%, p<0.001), as shown in table 1 and online supplemental figure S2. In subgroup comparisons, anxiety did not show a significant difference among doctors, nurses and other medical staff (Q=0.03, p=0.99), and no significant difference between random and non-random sampling (Q=0.38, p=0.54); females (41.1%, 95% CI 36.7% to 45.6%) showed higher prevalence of anxiety than males (31.2%, 95% CI 27.2% to 35.5%); frontline medical staff (41.4%, 95% CI 37.6% to 45.3%) showed higher prevalence of anxiety than non-frontline medical staff (27.6%, 95% CI 24.3% to 31.2%); the prevalence of mild anxiety was highest (62.8%, 95% CI 58.9% to 66.5%), followed by moderate (25.8%, 95% CI 23.7% to 28.0%) and moderate to severe or above (14.9%, 95% CI 12.6% to 17.6%). Studies using the Hospital Anxiety and Depression Scale (HADS) had the highest prevalence

of anxiety (47.3, 95% CI 41.9 to 52.7), followed by the 7-item Generalized Anxiety Disorder Scale (40.7, 95% CI 36.9 to 44.5), the Depression, Anxiety and Stress Scale-21 (DASS-21) (36.7, 95% CI 32.3 to 41.3) and the Self-rating Anxiety Scale (25.3, 95% CI 22.0 to 28.9).

The pooled prevalence of depression was 37.6% (95% CI 35.0% to 40.4%, I^2=99.2%, p<0.001), as shown in table 1 and online supplemental figure S3. In subgroup comparisons, depression did not show a significant difference among doctors, nurses and other medical staff (Q=0.29, p=0.87), no significant difference between females and males (Q=1.67, p=0.20) and no significant difference between random and non-random sampling (Q=1.49, p=0.22); frontline medical staff (41.8%, 95% CI 38.0% to 45.7%) showed higher prevalence of depression than non-frontline medical staff (30.7%, 95% CI 27.1% to 34.7%); the prevalence of mild depression was highest (60.0%, 95% CI 56.5% to 63.4%), followed by moderate (28.3%, 95% CI 26.2% to 30.6%) and moderate to severe or above (16.2%, 95% CI 13.8% to 19.0%). Studies using the Patient Health Questionnaire-9 had the highest prevalence of depression (40.8, 95% CI 36.6 to 45.1), followed by HADS (40.7, 95% CI 34.4 to 47.3), DASS-21 (32.9, 95% CI 27.2 to 39.1) and Self-rating Depression Scale (29.6, 95% CI 25.2 to 34.4).

The pooled prevalence of insomnia was 43.7% (95% CI 39.1% to 48.5%, I^2=98.9%, p<0.001), as shown in table 1 and online supplemental figure S4. In subgroup comparisons, insomnia did not show a significant difference among doctors, nurses and other medical staff (Q=3.62, p=0.16), no significant difference between females and males (Q=2.30, p=0.13) and no significant difference between random and non-random sampling (Q=1.23, p=0.27); frontline medical staff (49.5%, 95% CI 44.0% to 55.1%) showed higher prevalence of insomnia than non-frontline medical staff (29.9%, 95% CI 24.8% to 35.4%); the prevalence of mild insomnia was highest (67.6%, 95% CI 62.8% to 72.1%), followed by moderate (26.1%, 95% CI 22.8% to 29.8%) and moderate to severe or above (8.50%, 95% CI 5.20% to 13.6%). Studies using the Pittsburgh Sleep Quality Index had the highest prevalence of insomnia (56.2, 95% CI 37.6 to 73.2), followed by Athens Insomnia Scale (55.6, 95% CI 50.2 to 60.9) and Insomnia Severity Index (40.0, 95% CI 34.9 to 45.2).

Prevalence of other outcomes

The pooled prevalence of stress was 41.3% (95% CI 35.1% to 47.9%, I^2=99.0%, p<0.001), as shown in table 2 and online supplemental figure S5. In subgroup comparisons, stress did not show a significant difference among doctors, nurses and other medical staff (Q=0.48, p=0.79), no significant difference between females and males (Q=0.91, p=0.34) and no significant difference between random and non-random sampling (Q=1.19, p=0.28); frontline medical staff (47.0%, 95% CI 38.2% to 56.0%) showed a higher prevalence of stress than non-frontline medical staff (31.4%, 95% CI 20.0% to 45.5%); the prevalence of moderate stress was highest (54.0%, 95% CI 44.6% to 63.1%), followed by mild (41.6%, 95% CI 34.6% to 48.8%) and severe or above (26.5%, 95% CI 20.5% to 33.4%).

The pooled prevalence of PTSD symptoms was 30.6% (95% CI 23.6% to 38.5%, I^2=99.5%, p<0.001), as shown in table 2 and online supplemental figure S6. In subgroup comparisons, PTSD symptoms did not show a significant difference among doctors, nurses and other medical staff (Q=2.27, p=0.32), no significant difference between females and males (Q=2.17, p=0.14) and no significant difference between frontline and non-frontline medical staff (Q=0.80, p=0.37); no significant difference among mild, moderate and severe or above PTSD symptoms (Q=5.58, p=0.06); random sampling (52.0%, 95% CI 30.0% to 73.2%) reported a higher prevalence of PTSD symptoms than non-random sampling (20.6%, 95% CI 9.10% to 40.0%).

The pooled prevalence of somatic symptoms was 25.0% (95% CI 16.7% to 35.6%, I^2=99.6%, p<0.001), as shown in table 2 and online supplemental figure S7. In subgroup comparisons, there was no significant difference between doctors and nurses (Q=0.41, p=0.52), no significant difference between females and males (Q=0.49, p=0.49) and no significant difference between frontline and non-frontline medical staff (Q=0.05, p=0.83); the prevalence of mild somatic symptoms was highest (50.9%, 95% CI 43.1% to 58.7%), followed by moderate (39.2%, 95% CI 28.1% to 51.5%) and severe or above (13.3%, 95% CI 12.3% to 14.3%).

Sensitivity analysis and publication bias

The sensitivity analysis results showed that the overall effect could not be influenced by omitting any single study for each comparison. No significant publication bias was found in the funnel plots and Begg-Mazumdar rank correlation of these results. The p values and τ values for the prevalence of burnout (p=0.11, τ=−0.19), anxiety (p=0.35, τ=−0.05), depression (p=0.40, τ=−0.04), insomnia (p=0.52, τ=0.06), stress (p=0.65, τ=−0.05), PTSD symptoms (p=0.31, τ=−0.13) and somatic symptoms (p=0.18, τ=−0.36) indicate the Begg-Mazumdar rank correlation. Online supplemental figures S8–S14 show the funnel plots.

DISCUSSION

This systematic review and meta-analysis comprehensively estimated the prevalence of burnout and common mental health problems of medical staff during the COVID-19 pandemic. This study included a large data sample from 46 countries with approximately 290 000 participants. The results found that many medical staff suffer from burnout, anxiety, depression, insomnia, stress, PTSD symptoms and somatic symptoms. Major public health emergencies often exacerbate these symptoms and may have far-reaching consequences for medical staff's physical and mental health and work performance.[40] In subgroup analysis, we obtained the following results: (1)

Table 2 Prevalence of other outcomes and subgroup analyses

Outcomes	Subgroups	Studies (n)	Positive cases	Sample size	Pooled prevalence % (95% CI)	I^2 (%)	Q statistic	P value
Stress		45	13014	32224	41.3 (35.1 to 47.9)	99.0	4668.37	<0.001
	Doctor	12	1304	3552	41.8 (30.9 to 53.6)	97.5		
	Nurse	16	3495	9410	38.4 (28.4 to 49.5)	98.8	0.48	0.79
	Other	4	575	1174	46.6 (26.1 to 68.3)	97.0		
	Male	15	1352	2997	48.7 (36.1 to 61.4)	97.1		
	Female	16	4572	10677	57.7 (44.3 to 70.0)	99.2	0.91	0.34
	Frontline	29	6121	12521	47.0 (38.2 to 56.0)	98.7		
	Non-frontline	15	2122	7066	31.4 (20.0 to 45.5)	99.0	3.41	0.07
	Mild	19	1960	5462	41.6 (34.6 to 48.8)	94.9		
	Moderate	26	3504	6981	54.0 (44.6 to 63.1)	97.6	21.78	<0.001
	Severe or above	27	3002	8286	26.5 (20.5 to 33.4)	97.6		
	Random	4	1197	2693	59.9 (19.3 to 90.4)	99.3		
	Non-random	22	7301	17832	34.7 (28.4 to 41.7)	98.7	1.19	0.28
PTSD symptoms		33	12019	48019	30.6 (23.6 to 38.5)	99.5	7013.36	<0.001
	Doctor	14	2520	6269	39.6 (29.6 to 50.6)	98.3		
	Nurse	13	3628	8729	48.8 (36.1 to 61.6)	99.0	2.27	0.32
	Other	9	1278	4548	35.6 (25.2 to 47.7)	96.6		
	Male	16	1541	5024	33.0 (23.7 to 43.9)	97.8		
	Female	17	6486	16373	44.1 (34.0 to 54.8)	99.3	2.17	0.14
	Frontline	22	6236	26894	35.8 (24.4 to 49.1)	99.6		
	Non-frontline	16	3928	13469	28.7 (20.5 to 38.7)	99.0	0.80	0.37
	Mild	9	1462	3125	42.3 (31.3 to 54.2)	97.2		
	Moderate	8	825	3004	25.7 (18.6 to 34.5)	95.4	5.80	0.06
	Severe or above	9	838	3126	26.8 (15.0 to 43.2)	98.4		
	Random	4	1357	2147	52.0 (30.0 to 73.2)	98.5		
	Non-random	7	2699	19272	20.6 (9.10 to 40.0)	99.7	4.47	0.04
Somatic symptoms		9	7627	22405	25.0 (16.7 to 35.6)	99.6	1785.97	<0.001
	Doctor	2	394	2189	24.4 (10.5 to 47.1)	97.6		
	Nurse	4	2491	6612	32.4 (19.9 to 48.2)	98.8	0.41	0.52
	Male	4	297	1853	22.5 (13.9 to 34.4)	92.0		
	Female	4	2866	9533	29.7 (15.2 to 49.8)	99.6	0.49	0.49
	Frontline	5	2517	6977	30.7 (18.6 to 46.2)	98.8		
	Non-frontline	3	941	5384	27.7 (11.5 to 53.1)	99.3	0.05	0.83
	Mild	4	2550	4511	50.9 (43.1 to 58.7)	84.4		
	Moderate	4	1382	4511	39.2 (28.1 to 51.5)	93.5	156.40	<0.001
	Severe or above	3	579	4359	13.3 (12.3 to 14.3)	0.00		

PTSD, post-traumatic stress disorder.

no statistical difference in prevalence among doctors, nurses and other medical staff in all outcomes; (2) gender differences (in anxiety) and frontline versus non-frontline (in depression, anxiety and insomnia only); (3) significant differences on the level of severity (mild, moderate, severe) on burnout, anxiety, depression, insomnia, PTSD and somatic symptoms; (4) significant differences between anxiety, depression and insomnia measures/tools.

In this study, burnout reported a higher pooled prevalence rate (43.6%, 95% CI 36.3% to 51.2%). Medical staff forms the backbone of the prevention and control of the COVID-19 epidemic, and they were under tremendous psychological pressure, thus increasing the prevalence of

job burnout.[41] Similar to earlier outbreaks of SARS and Middle East respiratory syndrome (MERS), about one-third of medical staff experienced burnout.[42] Burnout is the result of chronic exposure to stress. The longer duration of COVID-19 may also be the reason why this pandemic has more severe effects than those observed in the previous coronavirus epidemics. In previous studies, some uncertainty exists regarding the relationship between burnout and the gender, profession and frontline/non-frontline of medical staff.[34 40 43–45] Therefore, we explored this through subgroup analysis. We did not find any association between the prevalence of burnout and gender, profession and frontline/non-frontline. A possible explanation for this finding may be that the changes and challenges brought by the pandemic to the health system are widespread, and medical staff face the same pressures. Frontline medical staff may suffer more than non-frontline medical staff. Still, they may get more psychological support, more up-to-date information about the epidemic and use of PPE in this group,[40 45] especially during the early stages of the pandemic. Although no statistical differences were found in the comparative analysis of the burnout subscales, reduced personal accomplishment (49.8%) may largely drive the onset of burnout, with higher prevalence than emotional exhaustion (36.9%) and depersonalisation (36.4%). When faced with new, unknown, highly contagious and lethal disease, and lacks effective treatment, medical staff may feel powerless because of their limited experience and dissatisfaction with the patient's cure rate.[46] In addition, studies have shown a correlation between burnout and anxiety/depression. To better respond to large-scale infectious public event, it is crucial to focus on the burnout and mental health of medical staff and to provide timely and effective support. Effective support usually occurs in the context of trusted professional and institutional relationships, and so the prepandemic period is a critical time for building this relationship, especially for preventing burnout.[47]

Apart from burnout, medical staff reported a high prevalence of anxiety (37.1%, 95% CI 34.7% to 39.7%), depression (37.6%, 95% CI 35.0% to 40.4%), insomnia (43.7%, 95% CI 39.1% to 48.5%), stress (41.3%, 95% CI 35.1% to 47.9%), PTSD symptoms (30.6%, 95% CI 23.6% to 38.5%) and somatic symptoms (25.0%, 95% CI 16.7% to 35.6%). As with the previous coronavirus epidemic, medical staff experienced severe psychological distress.[48] This is not surprising given the mental and physical stressors faced by medical staff in their daily work during the epidemic. Among these psychopathological outcomes, anxiety and depression reactions were the most extensively investigated. Based on available evidence, we found that the prevalence of anxiety and depression among medical staff during COVID-19 was higher in comparison to MERS and SARS.[49] The protracted COVID-19 pandemic and the unfavourable conditions in which medical staff operate for a long time favour the emergence of chronic effects of stress, such as anxiety and depression, which have been confirmed in experience.[42] Sleep problems seemed to be the most prominent mental health problem in previous studies, which was corroborated by this study.[50] Various psychosocial factors during COVID-19, including stress, anxiety, depression, workload and uncertainty of effective disease control, significantly affect sleep quality. Research indicates that stress involves increased psychological and physical activation in response to demand, and the activated hypothalamus-pituitary-adrenal system is incompatible with normal sleep, which may lead to sleep disorders.[51] Among the mental health problems of this study, the prevalence of stress was second only to insomnia. We found that some sociodemographic and occupational factors increase medical staff's psychological problems during COVID-19. Frontline medical team working in high-risk environments where they had direct contact with suspected and confirmed cases of COVID-19 reported a higher likelihood of anxiety, depression and insomnia than non-frontline medical staff working in low-risk environments, consistent with previous studies,[48 50 52] perhaps due to increased fear of infection, stigmatisation and isolation.[53] However, we did not find that stress, PTSD symptoms and somatic symptoms were associated with work environment risks. In previous studies, high-risk environments were often more robust predictors of these outcomes.[48 54–56] In the subgroup analysis of the profession and gender, we found almost no differences, except that anxiety reported a higher prevalence in women than in men. Papers on the gender and occupation of medical staff suffering from psychological distress symptoms did not show complete accordance. Most studies believe that nurses provide direct care to patients and have closer contact with patients than other medical personnel, and they are more susceptible to related negative emotions.[57–59] Similarly, female identity is often supposed a risk factor. Generally, women were considered to be more sensitive and had a weaker psychological endurance, especially in the face of emergency situations.[50 60] Most nurses in our study were female. It is worth noting that these differences may decrease or even disappear when specific professional training has been performed.[61 62] Therefore, it is necessary to provide adequate training and practical support in the predisease stage.

In this meta-analysis, the subgroup analysis reported differences in the prevalence of mild, moderate and severe cases. It is not surprising to find that mild cases are the most common except for stress. In most studies, psychological crises are associated with the unknown nature of sudden infectious diseases, inadequate preparedness, frequent policy changes and other ambiguous situations.[59] For most medical staff, this psychological distress may be temporary and can be alleviated by leaving the environment or receiving adequate psychosocial support. Furthermore, some studies have also pointed out that mild psychological reactions during emergencies are beneficial. Kang *et al*[63] noted that people with mild mental health disorders might be more likely

to take action than those with more severe disturbances. They are more motivated to learn the necessary skills and adapt to diverse challenges in productive ways, which is beneficial for healthcare teams. Positive coping also has been seen to increase immune function, leading to a better response state.[64] However, if these symptoms are not adequately acknowledged and managed, they may worsen over time due to overload.

Strengths and limitations

There were several strengths of this study. First, it extensively searched international and Chinese databases, as well as reflections from preprint databases. Second, compared with previous reviews and meta-analyses, this meta-analysis provides broader and more comprehensive evidence. The analysis contained a large sample from 46 countries and focused on burnout and various mental health problems. Finally, based on sufficient data, we conducted a subgroup analysis of multiple factors that affect burnout and mental health issues.

Several limitations of this study must be considered. First, the majority of studies included in this meta-analysis were cross-sectional, which only provided a snapshot of the existing situation. In the future, more evidence from longitudinal studies can be integrated to explore the long-term impact of COVID-19 on burnout and mental health of medical staff. Second, the majority of the studies recruited participants on a voluntarily basis and used online self-report questionnaires, without reporting on the control of confounding factors. Therefore, there may be certain biases, such as selection bias and confounding bias, that might have influenced the results and, in turn, also the findings of our study. Previous studies have also mentioned the possibility of these biases during epidemics of infectious diseases.[48 65] Third, the included studies were heterogeneous in many aspects, such as high I^2 statistics. As previous studies pointed out,[40 66 67] differences in measurement tools can be a source of heterogeneity. In our research, there were statistical differences in the prevalence of anxiety, depression and insomnia reported by different measurement tools. Considering the diversity of tools for measuring burnout and secondary outcomes, inconsistent cut-off values and limited data, this study did not conduct a statistical analysis of their measurement tools. Differences in definitions and cut-off values may affect the interpretation of the pooled prevalence. In the future, consistent definitions and standardised measurement tools can be developed to provide a more robust understanding of the pooled prevalence, especially for burnout. Working environments and sampling methods are sources of heterogeneity, although not for all results. In addition, populations, data collection time and different epidemic situations in other countries and regions may also be sources of heterogeneity; further analysis based on sufficient data is needed. Fourth, although this meta-analysis was carried out nearly one and a half years after the occurrence of COVID-19, we may have missed some crucial papers published after 17 May 2021. Finally, the stress, PTSD and somatic symptoms in this meta-analysis have not been studied comprehensively, which may limit our analyses of these symptoms.

CONCLUSIONS

This meta-analysis provides more comprehensive information on the burnout and mental health of medical staff during COVID-19. Medical staff were faced a high prevalence of burnout and common mental health problems, such as anxiety, depression and insomnia, with mild symptoms accounting for the most significant proportion. Subgroup analysis found that frontline medical workers were more prone to mental health problems. Identifying risks and adopting preventive interventions is a priority for policymakers and medical staff to avoid long-term occupational, health and social impacts. Although this study noted stress, PTSD symptoms and somatisation symptoms, it did not conduct a more comprehensive analysis, and more evidence could be synthesised in the future, including other mental health issues such as suicidal ideation. In addition, this meta-analysis was mainly cross-sectional surveys, limiting our analysis of whether these results are persistent. In the future, evidence from more longitudinal studies can be integrated to explore the long-term impact of COVID-19 on the burnout and mental health of healthcare professionals.

Contributors HJZ conducted the systematic review and wrote the manuscript under the supervision of SQX and JRZ. HJZ conducted the literature search, selected and classified the appropriate articles, created the tables/figures and wrote the manuscript. XYY assisted in the search strategy, literature searches and methodological procedure of the systematic review. All authors contributed directly by consistently giving comments and feedback to the review write-up. All authors read and approved the final manuscript. JRZ assumes full responsibility for the research work as guarantor, has access to data, and controls the decision to publish.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

ORCID iDs
Shiqi Xie http://orcid.org/0000-0002-4100-1267
Jianrong Zhou http://orcid.org/0000-0002-3612-1264

REFERENCES

1 WHO. Statement on the second meeting of the International health regulations (2005) emergency committee regarding the outbreak of novel Coronavirus (2019-nCoV). 2020. Available: https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)
2 WHO. WHO Coronavirus (COVID-19) dashboard. Available: https://covid19.who.int [Accessed 19 Feb 2023].
3 McAlonan GM, Lee AM, Cheung V, *et al*. Immediate and sustained psychological impact of an emerging infectious disease outbreak on health care workers. *Can J Psychiatry* 2007;52:241–7.
4 Lam MH-B, Wing Y-K, Yu MW-M, *et al*. Mental morbidities and chronic fatigue in severe acute respiratory syndrome survivors: long-term follow-up. *Arch Intern Med* 2009;169:2142–7.
5 Lehmann M, Bruenahl CA, Löwe B, *et al*. Ebola and psychological stress of health care professionals. *Emerg Infect Dis* 2015;21:913–4.
6 Matua GA, Wal D der. Living under the constant threat of ebola: a phenomenological study of survivors and family caregivers during an ebola outbreak. *J Nurs Res* 2015;23:217–24.
7 Song W, Huang D, Yu J. How does centralized isolation treatment strategy affect the medical staff's mental health during the COVID-19 pandemic? *Front Public Health* 2022;10.
8 Ran M-S, Gao R, Lin J-X, *et al*. The impacts of COVID-19 outbreak on mental health in general population in different areas in China. *Psychol Med* 2022;52:2651–60.
9 El Omrani O, Carmen VA, Bionat JF, *et al*. COVID-19, mental health, and young people's engagement. *J Adolesc Health* 2023;72:S18–9.
10 Wilder-Smith A, Freedman DO. Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel Coronavirus (2019-nCoV) outbreak. *J Travel Med* 2020;27.
11 Butler N, Quigg Z, Pearson I, *et al*. The impact of COVID-19 and associated measures on health, police, and non-government organisation service utilisation related to violence against women and children. *BMC Public Health* 2022;22:288.
12 Wang C, Pan R, Wan X, *et al*. Immediate psychological responses and associated factors during the initial stage of the 2019 Coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health* 2020;17.
13 Lai J, Ma S, Wang Y, *et al*. Factors associated with mental health outcomes among health care workers exposed to Coronavirus disease 2019. *JAMA Netw Open* 2020;3.
14 Oteir AO, Nazzal MS, Jaber AF, *et al*. Depression, anxiety and insomnia among frontline Healthcare workers amid the Coronavirus pandemic (COVID-19) in Jordan: a cross-sectional study. *BMJ Open* 2022;12.
15 Lu M-Y, Ahorsu DK, Kukreti S, *et al*. The prevalence of post-traumatic stress disorder symptoms, sleep problems, and psychological distress among COVID-19 frontline Healthcare workers in Taiwan. *Front Psychiatry* 2021;12.
16 Burns ES, Pathmarajah P, Muralidharan V. Physical and psychological impacts of Handwashing and personal protective equipment usage in the COVID-19 pandemic: a UK based cross-sectional analysis of Healthcare workers. *Dermatol Ther* 2021;34.
17 Barello S, Palamenghi L, Graffigna G. Burnout and somatic symptoms among frontline Healthcare professionals at the peak of the Italian COVID-19 pandemic. *Psychiatry Res* 2020;290.
18 Chew NWS, Lee GKH, Tan BYQ, *et al*. A multinational, Multicentre study on the psychological outcomes and associated physical symptoms amongst Healthcare workers during COVID-19 outbreak. *Brain Behav Immun* 2020h;88:559–65.
19 Qureshi I, Gogoi M, Wobi F, *et al*. Healthcare workers from diverse ethnicities and their perceptions of risk and experiences of risk management during the COVID-19 pandemic: qualitative insights from the United Kingdom-reach study. *Front Med (Lausanne)* 2022;9.
20 Sahebi A, Hasheminejad N, Shohani M, *et al*. Personal protective equipment-associated headaches in health care workers during COVID-19: a systematic review and meta-analysis. *Front Public Health* 2022;10:942046.
21 Grailey K, Lound A, Brett S. Lived experiences of Healthcare workers on the front line during the COVID-19 pandemic: a qualitative interview study. *BMJ Open* 2021;11.
22 Roslan NS, Yusoff MSB, Razak AA, *et al*. Burnout prevalence and its associated factors among Malaysian Healthcare workers during COVID-19 pandemic: an embedded mixed-method study. *Healthcare (Basel)* 2021;9:90.
23 Kakemam E, Chegini Z, Rouhi A, *et al*. Burnout and its relationship to self-reported quality of patient care and adverse events during COVID-19: a cross-sectional online survey among nurses. *J Nurs Manag* 2021;29:1974–82.
24 Alrawashdeh HM, Al-Tammemi AB, Alzawahreh MK, *et al*. Occupational burnout and job satisfaction among physicians in times of COVID-19 crisis: a CONVERGENT parallel mixed-method study. *BMC Public Health* 2021;21.
25 Koutsimani P, Montgomery A, Georganta K. The relationship between burnout, depression, and anxiety: a systematic review and meta-analysis. *Front Psychol* 2019;10:284.
26 Salvagioni DAJ, Melanda FN, Mesas AE, *et al*. Physical, psychological and occupational consequences of job burnout: a systematic review of prospective studies. *PLoS One* 2017;12.
27 Sun J, Sarfraz M, Ivascu L, *et al*. How did work-related depression, anxiety, and stress hamper Healthcare employee performance during COVID-19? the mediating role of job burnout and mental health. *Int J Environ Res Public Health* 2022;19.
28 Sklar M, Ehrhart MG, Aarons GA. COVID-related work changes, burnout, and turnover intentions in mental health providers: a moderated mediation analysis. *Psychiatr Rehabil J* 2021;44:219–28.
29 Kelly D, Schroeder S, Leighton K. Anxiety, depression, stress, burnout, and professional quality of life among the hospital workforce during a global health pandemic. *J Rural Health* 2022;38:795–804.
30 Hao Q, Wang D, Xie M, *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 Psychiatry* 2021;12.
31 Saragih ID, Tonapa SI, Saragih IS, *et al*. Global prevalence of mental health problems among Healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Int J Nurs Stud* 2021;121.
32 Aymerich C, Pedruzo B, Pérez JL, *et al*. COVID-19 pandemic effects on health worker's mental health: systematic review and meta-analysis. *Eur Psychiatry* 2022;65.
33 Hill JE, Harris C, Danielle L C, *et al*. The prevalence of mental health conditions in Healthcare workers during and after a pandemic: systematic review and meta-analysis. *J Adv Nurs* 2022;78:1551–73.
34 Rapisarda F, Vallarino M, Cavallini E, *et al*. The early impact of the COVID-19 emergency on mental health workers: a survey in Lombardy, Italy. *Int J Environ Res Public Health* 2020;17.
35 Matsuo T, Kobayashi D, Taki F, *et al*. Prevalence of health care worker burnout during the Coronavirus disease 2019 (COVID-19) pandemic in Japan. *JAMA Netw Open* 2020;3.
36 FUCfE-b N. The Joanna Briggs Institute critical appraisal tools. Available: http://ebn.nursing.fudan.edu.cn/school/quality [Accessed 17 Aug 2021].
37 Higgins JPT, Thompson SG, Deeks JJ, *et al*. Measuring inconsistency in meta-analyses. *BMJ* 2003;327:557–60.
38 DerSimonian R, Laird N. Meta-analysis in clinical trials revisited. *Contemp Clin Trials* 2015;45:139–45.
39 Egger M, Davey Smith G, Schneider M, *et al*. Bias in meta-analysis detected by a simple, graphical test. *BMJ* 1997;315:629–34.
40 Busch IM, Moretti F, Mazzi M, *et al*. What we have learned from two decades of epidemics and Pandemics: a systematic review and meta-analysis of the psychological burden of frontline healthcare workers. *Psychother Psychosom* 2021;90:178–90.
41 Chen Y, Zhang L, Qi H, *et al*. Relationship between negative emotions and job burnout in medical staff during the prevention and control of the COVID-19 epidemic: the mediating role of psychological resilience. *Front Psychiatry* 2022;13.
42 Magnavita N, Chirico F, Garbarino S, *et al*. SARS/MERS/SARS-Cov-2 outbreaks and burnout syndrome among Healthcare workers. an umbrella systematic review. *Int J Environ Res Public Health* 2021;18:4361.
43 Martínez-Cuazitl A, Martínez-Salazar IN, Maza-De La Torre G, *et al*. Burnout syndrome in a military tertiary hospital staff during the COVID-19 contingency. *Int J Environ Res Public Health* 2022;19.
44 Huo L, Zhou Y, Li S, *et al*. Burnout and its relationship with depressive symptoms in medical staff during the COVID-19 epidemic in China. *Front Psychol* 2021;12:616369.: .
45 Jalili M, Niroomand M, Hadavand F, *et al*. Burnout among Healthcare professionals during COVID-19 pandemic: a cross-sectional study. *Int Arch Occup Environ Health* 2021;94:1345–52.
46 Abdelhafiz AS, Ali A, Ziady HH, *et al*. Prevalence, associated factors, and consequences of burnout among Egyptian physicians during COVID-19 pandemic. *Front Public Health* 2020;8:590190.

47 Maunder RG, Lancee WJ, Balderson KE, *et al*. Long-term psychological and occupational effects of providing hospital healthcare during SARS outbreak. *Emerg Infect Dis* 2006;12:1924–32.
48 Chigwedere OC, Sadath A, Kabir Z, *et al*. The impact of epidemics and pandemics on the mental health of healthcare workers: a systematic review. *Int J Environ Res Public Health* 2021;18: .
49 Delanerolle G, Zeng Y, Shi J-Q, *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;12:739–65.
50 Hu N, Deng H, Yang H, *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;303:323–30.
51 Akerstedt T. Psychosocial stress and impaired sleep. *Scand J Work Environ Health* 2006;32:493–501.
52 Alshekaili M, Hassan W, Al Said N, *et al*. Factors associated with mental health outcomes across Healthcare settings in Oman during COVID-19: frontline versus non-frontline Healthcare workers. *BMJ Open* 2020;10.
53 Chersich MF, Gray G, Fairlie L, *et al*. COVID-19 in Africa: care and protection for frontline Healthcare workers. *Global Health* 2020;16.
54 Kisely S, Warren N, McMahon L, *et al*. Occurrence, prevention, and management of the psychological effects of emerging virus outbreaks on Healthcare workers: rapid review and meta-analysis. *BMJ* 2020;369.
55 Qi G, Yuan P, Qi M, *et al*. Influencing factors of high PTSD among medical staff during COVID-19: evidences from both meta-analysis and subgroup analysis. *Saf Health Work* 2022;13:269–78.
56 Nguyen C, Young FG, McElroy D, *et al*. Personal protective equipment and adverse dermatological reactions among Healthcare workers: survey observations from the COVID-19 pandemic. *Medicine (Baltimore)* 2022;101.
57 Robert R, Kentish-Barnes N, Boyer A, *et al*. Ethical dilemmas due to the COVID-19 pandemic. *Ann Intensive Care* 2020;10.
58 Williamson V, Murphy D, Greenberg N. COVID-19 and experiences of moral injury in front-line key workers. *Occup Med (Lond)* 2020;70:317–9.
59 Zhang C, Yang L, Liu S, *et al*. Survey of insomnia and related social psychological factors among medical staff involved in the 2019 novel Coronavirus disease outbreak. *Front Psychiatry* 2020;11.
60 Christiansen DM, Berke ET. Gender- and sex-based contributors to sex differences in PTSD. *Curr Psychiatry Rep* 2020;22.
61 Mealer M, Conrad D, Evans J, *et al*. Feasibility and acceptability of a resilience training program for intensive care unit nurses. *Am J Crit Care* 2014;23:e97–105.
62 Carmassi C, Gesi C, Corsi M, *et al*. Exploring PTSD in emergency operators of a major University hospital in Italy: a preliminary report on the role of gender, age, and education. *Ann Gen Psychiatry* 2018;17:17.
63 Kang L, Ma S, Chen M, *et al*. Impact on mental health and perceptions of psychological care among medical and nursing staff in Wuhan during the 2019 novel Coronavirus disease outbreak: a cross-sectional study. *Brain Behav Immun* 2020;87:11–7.
64 Sakami S, Maeda M, Maruoka T, *et al*. Positive coping Up- and down-regulates in vitro cytokine productions from T cells dependent on stress levels. *Psychother Psychosom* 2004;73:243–51.
65 Wright KB. Researching Internet-based populations: advantages and disadvantages of online survey research, online questionnaire Authoring software packages, and web survey services. *J Comput Mediat Commun* 2017;10.
66 Wu P, Fang Y, Guan Z, *et al*. The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk. *Can J Psychiatry* 2009;54:302–11.
67 D'Ettorre G, Pellicani V, Ceccarelli G. Post-traumatic stress disorder symptoms in Healthcare workers: a ten-year systematic review. *Acta Biomed* 2020;91.
68 Zung WW. A rating instrument for anxiety disorders. *Psychosomatics* 1971;12:371–9.
69 Spitzer RL, Kroenke K, Williams JBW, *et al*. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med* 2006;166:1092–7.
70 ZUNG WW. A self-rating depression scale. *Arch Gen Psychiatry* 1965;12:63–70.
71 Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001;16:606–13.
72 Lovibond S, Lovibond P, Lovibond S, *et al*. Manual for the depression anxiety stress scales2nd ed. Psychology Foundation of Australia, 1995.
73 Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand* 1983;67:361–70.
74 Soldatos CR, Dikeos DG, Paparrigopoulos TJ. The diagnostic validity of the athens insomnia scale. *J Psychosom Res* 2003;55:263–7.
75 Bastien CH, Vallières A, Morin CM. Validation of the insomnia severity index as an outcome measure for insomnia research. *Sleep Med* 2001;2:297–307.
76 Zhou Y, Zhou Y, Song Y, *et al*. Tackling the mental health burden of frontline healthcare staff in the COVID-19 pandemic: China's experiences. *Psychol Med* 2021;51:1955–6.