PLOS ONE

RESEARCH ARTICLE

Stress, anxiety, depression and sleep disturbance among healthcare professional during the COVID-19 pandemic: An umbrella review of 72 meta-analyses

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OPEN ACCESS

Citation: Al Maqbali M, Alsayed A, Hughes C, Hacker E, Dickens GL (2024) Stress, anxiety, depression and sleep disturbance among healthcare professional during the COVID-19 pandemic: An umbrella review of 72 meta-analyses. PLoS ONE 19(5): e0302597. https://doi.org/10.1371/journal.pone.0302597

Editor: Fadwa Alhalaiqa, Qatar University College of Nursing, QATAR

Received: January 21, 2024

Accepted: April 8, 2024

Published: May 9, 2024

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: https://doi.org/10.1371/journal.pone.0302597

Data Availability Statement: All data are in the paper and/or supporting information files.

Abstract

The outbreak of SARS-CoV-2, which causes COVID-19, has significantly impacted the psychological and physical health of a wide range of individuals, including healthcare professionals (HCPs). This umbrella review aims provide a quantitative summary of meta-analyses that have investigated the prevalence of stress, anxiety, depression, and sleep disturbance among HCPs during the COVID-19 pandemic. An umbrella review of systematic reviews and meta-analyses reviews was conducted. The search was performed using the EMBASE, PubMed, CINAHL, MEDLINE, PsycINFO, and Google Scholar databases from 01st January 2020 to 15th January 2024. A random-effects model was then used to estimate prevalence with a 95% confidence interval. Subgroup analysis and sensitivity analyses were then conducted to explore the heterogeneity of the sample. Seventy-two meta-analyses involved 2,308 primary studies were included after a full-text review. The umbrella review revealed that the pooled prevalence of stress, anxiety, depression, and sleep disturbance among HCPs during the COVID-19 pandemic was 37% (95% CI 32.87–41.22), 31.8% (95% CI 29.2–34.61) 29.4% (95% CI 27.13–31.84) 36.9% (95% CI 33.78–40.05) respectively. In subgroup analyses the prevalence of anxiety and depression was higher among nurses than among physicians. Evidence from this umbrella review suggested that a significant proportion of HCPs experienced stress, anxiety, depression, and sleep disturbance during the COVID-19 pandemic. This information will support authorities when implementing specific interventions that address mental health problems among HCPs during future pandemics or any other health crises. Such interventions may include the provision of mental health support services, such as counseling and peer support programs, as well as the implementation of organizational strategies to reduce workplace stressors.

Funding: The author(s) received no specific funding for this work.

Competing interests: The authors have declared that no competing interests exist.

1. Introduction

In December 2019, the coronavirus disease 2019 (COVID-19) pandemic emerged in Wuhan, China. The disease quickly spread worldwide, and the WHO declared a global health emergency in March 2020 [1]. Due to the COVID-19 pandemic, many countries implemented various measures to prevent the spread of the disease. These included implementing a partial or complete lockdown and social distancing strategies of varying intensity. The measures taken by these countries also affected the livelihood of individuals, an occurrence which might directly or indirectly also increase psychological morbidities. Undoubtedly, pandemics have a long history of impacting physical and mental health for different population groups, and HCPs are typically the most affected group in terms of bearing the burden of these illnesses [2]. In addition, several researchers have shown that work-related psychological disorders, including stress, anxiety, depression, and burnout, had already negatively affected the healthcare system before the COVID-19 pandemic, leading to low-quality care and high malpractice litigation [3–5].

As a result of the pandemic, HCPs experienced various changes in their personal and professional lives. For some, these included being given more responsibility, having to re-learn how to effectively control the infection, and dealing with the emotional impact of caring for infected and dying COVID-19 patients [6]. The alteration in their work environment, as well as the likelihood that they might acquire the infection themselves, can also affect their personal mental health. It is almost inevitable that the experiences of HCPs went through during the pandemic put them at heightened risk of stress, anxiety, depression, and sleep disturbance [7,8]. It is important to understand the effects of the pandemic on the mental health and well-being of HCPs in order to help plan strategies to prevent these individuals from experiencing detrimental effects, and to ensure that they can continue to deliver healthcare services.

During previous viral outbreaks including the Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS) epidemics, HCPs were placed under extraordinary amounts of pressure [9,10]. Indeed, evidence suggested that HCPs suffered from high levels of stress, anxiety, depression and sleep disturbance during these outbreaks [11,12]. A high prevalence of mental health problems can adversely impact the quality of life of HCPs, increase disability, turnover, absenteeism, and errors, and can deleteriously affect patient outcomes which may lead to low patient satisfaction [13]. Further, it might increase suicidal ideation or self-harming among HCPs [14].

In the present review, four phenomena were addressed. Sleep disturbance refers to a range of sleep-related problems, including disruptions in the body's natural sleep-wake cycle, insufficient or poor-quality sleep, and sleep disorders [15]. The anxiety symptoms were defined as a state of excessive fear that translates to behavioural disturbances [16]. Major depressive disorder is a set of symptoms that includes depressed mood, loss of pleasure or interest, fatigue, changes in sleep and activity levels, and other symptoms, with a minimum duration of two weeks and at least five or more symptoms present according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [16]. Cohen et al., [17] define stress as "the degree to which individuals appraise situations in their lives as stressful". In this umbrella review, stress, anxiety, depression, and sleep disturbance symptoms were defined based on the validated scales/questionnaires that assess each phenomenon in the original studies.

Several primary studies and, subsequently, systematic reviews and meta-analyses have been carried out to identify the prevalence of mental health problems among HCPs during the COVID-19 pandemic. Additionally, three umbrella reviews of meta-analyses [18–20] have been published previously, but the number of meta-analyses included in both cases did not exceed twenty. Since their publication, further meta-analyses have estimated the prevalence of

stress, anxiety, depression, and sleep disturbance during the COVID-19 pandemic. The advantages of umbrella reviews include their ability to provide a comprehensive analysis of the literature, in this case about the prevalence of various mental disorders in HCPs during the COVID-19 pandemic. In addition, the results can then be used to make policy-level decisions to improve the quality of clinical care in terms of making clinical risk predictions and can inform future research priorities. Therefore, the aim of this umbrella review is to quantify meta-analytic findings aimed at estimating the prevalence symptoms of stress, anxiety, depression, and sleep disturbance among HCPs during the COVID-19 pandemic.

2. Methods

The umbrella review and meta-analysis were carried out according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines [21]. The review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) database and can be accessed online (CRD42022364721).

2.1 Search strategy

A systematic search was conducted to identify relevant meta-analyses in various electronic databases published between 1st January 2020 and 15th January 2024. The databases searched were PubMed, CINAHL, MEDLINE, EMBASE, PsycINFO, and Google Scholar. The search terms strategy used Medical Subject Headings (MeSH) and free text words with Boolean operators and truncations (AND/OR/NOT). The key search terms included (MH "Coronavirus Infections+") OR "COVID-19" OR "COVID" OR "coronavir* OR "Coronavirus" OR "SARS-COV2" AND "Health care provider" OR "health care professional" OR "healthcare provider*" OR (MH "Nurses+") OR (MH "Medical Staff") OR (MH "Physician") OR (MH "Medical Doctor") OR (MH "Staff Nurses") OR "nursing staff" OR "health personnel or health professional or nurse" OR "health personnel or health professional or nurse" AND "Stress" OR "post-traumatic stress disorder" OR "panic disorder" OR "obsessive compulsive disorder OR "anxi*" OR (MH "Anxiety Disorders+") OR (MH "Anxiety+") OR (MH "Depression+") OR "depress*" OR (MH "Affective Symptoms+") OR (MH "Affective Disorders+") OR (MH "Bipolar Disorder+") OR "affective" OR "mood" OR "mental" OR (MH "Mental Disorders+") OR (MH "Mental OR "psycho*" OR (MH "Insomnia+") OR (MH "Circadian Rhythm+") OR (MH "Sleep Disorders+") OR (MH "Insomnia+") OR (MH "Sleep +") AND "Systematic Review" OR "Meta-Analysis" OR "Meta-Analytic". Additionally, the reference lists were searched to find any other studies.

2.2 Study selection

Two reviewers (A.M.; A.A.) independently extracted the data from the search, scrutinizing all titles and abstracts for eligibility against the inclusion and exclusion criteria. A third reviewer (G.D.) was available to resolve any disagreements through discussion. Systematic reviews incorporating meta-analyses were included according to the following criteria. The studies: (1) examined the prevalence of stress or anxiety or depression or sleep disturbance symptoms; (2) presented results for HCPs as a group or separately (e.g., nurses or physicians only); further, studies involving non-HCPs must have presented results for HCPs separately and not pooled with non-HCPs.; (3) were conducted during the COVID-19 pandemic; (4) were published in English; (5) involved a systematic review with meta-analysis. Studies were excluded if (1) these consisted of a systematic review without meta-analysis; (2) consisted of a literature review or a narrative review (3) the participants were general population or non-HCPs.

2.3 Quality assessment

The methodological quality assessment of each meta-analysis was blindly rated by two reviewers using the Assessment of Multiple Systematic Reviews (AMSTAR-2) tool [22]. This scale consists of 16 items that evaluate the risk of bias of a systematic review. Items 1, 3, 5, 6, 10, 13, 14, and 16 are evaluated with either a "Yes" or "No" response. Items 2, 4, 7, 8, and 9 are evaluated with "Yes," "Partial Yes," or "No" responses. Items 11, 12, and 15 are evaluated with "Yes," "No," or "No meta-analysis conducted" responses. The overall rating can be rated as "High," "Moderate," "Low," or "Critically low."

2.4 Credibility of evidence

The credibility of the evidence of each association provided was evaluated by the Fusar-Poli and Radua [23] classification criteria. The level of evidence as convincing (class I) when specific criteria were met, including more than 1000 cases, $p<10^{-6}$, I^2 higher than 50%, 95% prediction intervals excluding the null, no small-study effects, and no publication bias. If the number of cases exceeded 1000, $p<10^{-6}$, the largest study showed a statistically significant effect, but not all class I criteria were satisfied; the evidence level was considered highly suggestive (class II). When there were over 1000 cases, $p<10^{-3}$, but no other class I or II criteria were met, the evidence level was termed suggestive (class III). If no class I-III criteria were met, the evidence level was classified as weak (class IV). The fourth level, termed weak evidence (class IV), included associations with a $p \leq 0.05$, but these associations did not meet the criteria for class I, class II, or class III. The fifth level, denoted as non-significant (NS), comprised associations with a $p > 0.05$.

2.5 Data analyses

There are two methods exist for deriving effect size estimates from existing meta-analyses. The first approach involves conducting a meta-analysis on the effect size estimates taken from individual studies included in multiple prior meta-analyses [24]. However, this method demands significant time and resources. Furthermore, it contradicts the primary purpose of an umbrella review because it requires return to the original studies.

The second approach employs a statistical technique to efficiently summarize data from previous meta-analyses without the need to go back to the individual studies. This method relies solely on the summary effect sizes and their associated variances provided in the original meta-analyses [25]. It calculates an overall effect size for the combined meta-analyses by computing a weighted average of the summary effect sizes, with the weights determined by the inverse of the variances [26]. This approach is similar to the methods used in meta-analyses of primary studies. Although the second approach (combining summary effect sizes) may not achieve the same level of precision as the first method (combining all individual studies), empirical tests have confirmed its ability to generate a statistically valid estimate for the overall effect size [27,28]. In this umbrella review, we employed the second approach, which entailed the utilization of aggregate data derived from the meta-analyses.

The analyses were conducted using R software, version 4.3.1 (R Foundation for Statistical Computing), with packages used 'meta' [29], 'metafore' [30] and 'metaumbrella'[31]. Pooled estimates prevalence with 95% Confidence Intervals (CIs) was conducted using random effect models, and the results were reported on a forest plot. In addition, the I-squared (I^2) test was used to assess the statistical heterogeneity of the included meta-analyses. A value of $I^2 < 25\%$ was considered low, 25–50% moderate, and $> 50\%$ high [32]. Subgroup analyses were performed when there were at least four meta-analyses per subgroup.

Publication bias was assessed using Egger's test with a $p < 0.10$ indicates a statistically significant small-study effect [33]. Statistical significance was set at $p<0.05$. If publication bias was identified, trim and fill methods were used to adjust the publication bias [34]. A sensitivity analysis was conducted in which individual meta-analyses were systematically removed one at a time to assess how they affected the overall combined prevalence of the remaining meta-analyses [35], with the aim of clarifying the stability and reliability of the finding [36].

3. Result

A total of 1,987 papers were identified through the database search. Out of these, 1,843 were excluded at the abstract and title screening stage for the following reasons: 786 were duplicates, 443 did not include a meta-analysis, 392 lacked information about prevalence, 139 lacked information about HCP status, and 83 were not conducted during the period of the COVID-19 pandemic. A further 72 papers were excluded during the full text review process. As a result, 72 meta-analyses were eligible for umbrella review (Fig 1).

3.1 General characteristics of the studies included

The included 72 meta-analyses [37–108]. Fifty-four of the meta-analyses dealt with HCPs in general, whereas two meta-analyses reported the situation only with regard to physicians or nurses [44,59], three meta-analyses dealt with nurses [49,79,91], and one dealt with physicians [88], while 17 meta-analyses included a mixed population (General and HCPs),(Only data specifically related to healthcare professionals were included in the umbrella review analysis). The most commonly used statistical software was STATA (n = 32), R (n = 17) and comprehensive meta-analysis (n = 11). Twenty-four meta-analyses used the Newcastle–Ottawa scale to assess the quality of the studies. Forty-six meta-analyses included mixed studies from different countries, twenty-five meta-analyses were conducted in specifical geographical areas: 10 for China, five for India, four for Asia two for Bangladesh and Ethiopia and one for each of the following: Egypt, South Asia, and Vietnam. The detailed characteristics of the studies including meta-analyses are shown in Table 1.

3.2 Quality appraisal

Each meta-analysis was assessed using the AMSTAR-2 tool. Twenty- nine meta-analyses were classified as moderate quality and thirty-seven as low quality. Only six meta-analyses were classified as critically low quality [37,44,45,76,97,101].

3.3 Prevalence of stress

Stress was reported in 42 meta-analyses among HCPs. The estimation of prevalence for stress varied between 11% [72] and 66.6% [58] (Fig 2: Forest Plots). The pooled prevalence of stress from was 37% (292,245/854,852 participants, 95% CI 32.87–41.22) with 95% PI: 14.86–66.3. There was significant heterogeneity between meta-analyses when it came to estimating the prevalence of stress ($p< 0.0001$, $I^2 = 99.9\%$). In the subgroup analysis, the prevalence of anxiety among nurses was determined to be 42.6% (n = 5; 95% CI = 30.49–55.27, $I^2 = 99\%$), as shown in Fig 3: Forest Plots. However, the analysis for physicians was not conducted due to an insufficient number of available meta-analyses. In sensitivity analysis, none of the meta-analyses resulted in changes to the pooled prevalence estimates greater than a 2%. The prevalence rate estimates for stress were considered to be suggestive evidence (class III) (Seen Table 2).

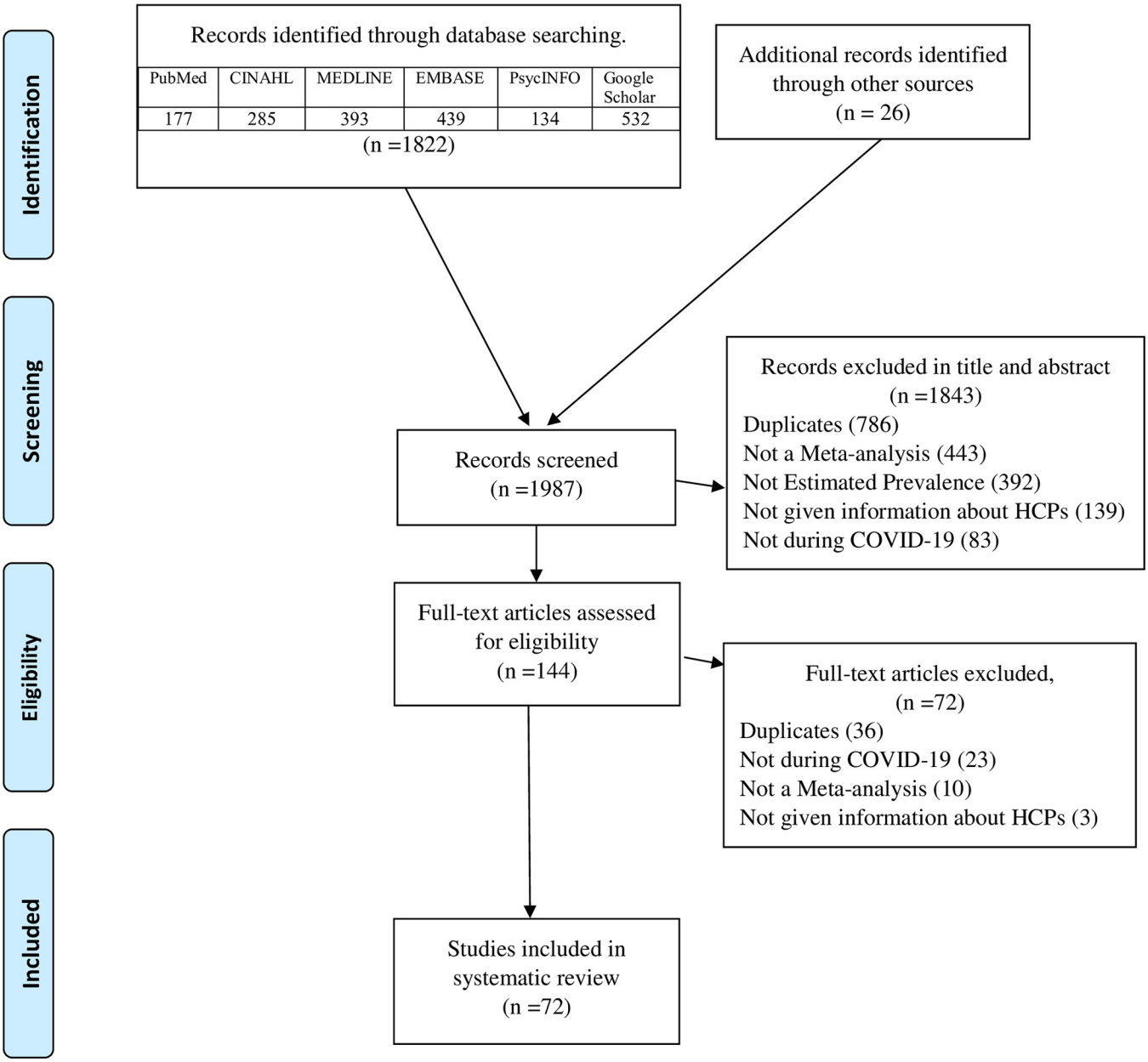

Fig 1. PRISMA diagram.

https://doi.org/10.1371/journal.pone.0302597.g001

3.4 Prevalence of anxiety

Fifty-five meta-analyses estimated the prevalence of anxiety among HCPs, and ranged from 11.4% [40] to 71.9% [58]. The pooled prevalence of anxiety was 31.8% (734,036/2,310,774 participants, 95% CI 29.2–34.61) with 95% PI: 15.24–54.83 (Fig 4: Forest Plots) among all HCPs and there was considerable heterogeneity ($p< 0.0001$, $I^2 = 99.9\%$). In the subgroup analyses, in terms of professional status, the pooled prevalence of anxiety was 31.6% (n = 12; 95% CI = 28.33–35.14, $I^2 = 99\%$) and 26.3% (n = 9; 95% CI = 22.89–30.10, $I^2 = 99\%$) for nurses, and physicians respectively (Figs 5 and 6: Forest Plots). A sensitivity analysis, specifically a leave-

Table 1. Characteristics of the included meta-analyses (N = 72).

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
1	(Batra et al. 2020) [38]	65	Stress	All	17	40.3	31.4–50.0	99.1	6543	16235	CMA	REM	NIH	Moderate	HCPs
			Anxiety	All	46	34.4	29.5–39.7	99.1	17749	51596					
				Nurses	8	39.3	27.5–52.5	98.9	8606	21899					
				Physicians	8	32.5	21.9–45.2	99.0	7117	21899					
			Depression	All	46	31.8	26.8–37.2	99.2	16906	53164					
				Nurses	9	42.4	30.4–5.4	99.0	9301	21936					
				Physicians	9	39.1	27.3–52.2	98.4	8577	21936					
2	(Krishnamoorthy et al. 2020) [39]	23	Stress	All	5	33	19–50	98.4	1986	6017	STATA	REM	NOS	Moderate	Mixed
			Anxiety	All	16	24	16–32	99.6	9201	38337					
			Depression	All	16	25	19–32	99.4	9425	37701					
			Sleep Disturbance	All	5	43	28–59	99.2	2010	4675					
3	(Pappa et al. 2020) [41]	13	Anxiety	All	12	23.2	17.8–29.1	99	7367	31756	MetaXL	REM	NOS	Moderate	HCPs
				Nurses	6	25.8	19.2–33.0	98	5160	19999					
				Physicians	6	21.7	15.3–29	97	4340	19999					
			Depression	All	10	22.8	15.1–31.5	99.6	7071	31014					
				Nurses	5	30.3	18.2–43.8	99.5	5679	18742					
				Physicians	5	25.4	16.6–35.2	98	4760	18742					
			Sleep Disturbance	All	5	34.3	27.5–41.5	98	2935	8558					
4	(Qiu et al. 2020) [42]	52	Sleep Disturbance	All	52	39.2	36.0–427	98.3	12446	31749	R	REM	Loney	Low	HCPs/ China
				Nurses	41	39.4	35.7–43.5	98.4	9878	25070					
				Physicians	3	34.2	12.6–55.8	99.2	720	2104					
5	(Salari et al. 2020a) [44]	7	Sleep Disturbance	Nurses	6	34.8	24.8–46.4	97.4	2526	7259	CMA	REM	STROBE	Critically Low	HCPs

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
				Physicians	5	41.6	27.7–57	97.3	2286	5496					
6	(Salari et al. 2020b) [45]	29	Stress	All	8	36.4	18.3–59.5	99	1293	3551	CMA	REM	STROBE	Critically Low	HCPs /Frontline
			Anxiety	All	17	27	20.1–35.3	95.5	2987	11062					
			Depression	All	15	20.6	13.1–30.9	99.1	2196	10658					
7	(Allan et al. 2020) [37]	9	Stress	All	9	23.4	16.3–31.2	96	970	4147	R	REM	NIH	Critically Low	HCPs
8	(Salazar de Pablo et al. 2020) [46]	15	Stress	All	3	29.9	8.9–65.2	99.7	2030	6789	CMA	REM	MMAT	Moderate	Mixed
			Anxiety	All	4	22.2	12.7–35.8	99	1713	7716					
			Depression	All	4	17.9	6.7–40.1	99.6	1381	7716					
			Sleep Disturbance	All	3	44.5	38.2–50.9	93	1553	3490					
9	(Ren et al. 2020) [43]	5	Anxiety	All	4	27	12–43	99.4	1308	4843	STATA	REM	AHRQ	Low	Mixed
			Depression	All	3	25	4–45	99.7	1166	4663					
10	(Pan et al. 2020) [40]	7	Anxiety	All	7	11.4	7.1–15.8	99	848	7441	STATA	REM	STROBE	Low	Mixed
11	(Zhang et al. 2021) [82]	26	Stress	All	8	42.1	26.0–60.0	99.5	3866	9183	R	REM	NIH	Moderate	HCPs/ China
			Anxiety	All	23	27.0	21.0–34.0	99.0	5791	21447					
			Depression	All	18	26.2	21.0–33.0	98.6	4930	18818					
			Sleep Disturbance	All	8	35.5	28.0–42.0	98.3	4174	11758					
12	(Adibi et al. 2021) [48]	19	Anxiety	All	19	30.5	25.6–35.4	98.4	6669	21866	STATA	REM	NG	Low	HCPs
13	(Al Maqbali et al. 2021) [49]	93	Stress	Nurses	40	43	37–49	98	11625	27034	CMA	REM	NOS	Moderate	Nurses
			Anxiety	Nurses	73	37	32–41	99	30178	81561					
			Depression	Nurses	62	35	31–39	99	26947	76992					
			Sleep Disturbance	Nurses	18	43	36–50	96	4600	10697					
14	(Alimoradi et al. 2021) [50]	62	Sleep Disturbance	All	62	43	39–47	99.3	25521	59350	STATA	REM	NOS	Low	Mixed
15	(Bareeqa et al. 2021) [51]	8	Depression	All	8	31.5	20.7–43.5	99.3	3234	10267	OMA	REM	NOS	Low	Mixed/ China

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
16	(Cénat et al. 2021) [52]	27	Stress	All	4	21.0	9.0–43.0	99.7	1444	6878	R	REM	JBI	Moderate	Mixed
			Anxiety	All	23	15.9	12.2–20.3	99	5895	37076					
			Depression	All	18	14	11.0–17.0	95.3	4781	34151					
			Sleep Disturbance	All	6	16	8.0–30.0	99.8	993	6209					
17	(Ching et al. 2021) [53]	148	Stress	All	40	36.4	23.2	49.7	12380	34010	OMA	REM	STROBE	Low	HCPs/Asia
			Anxiety	All	117	39.7	34.3–45.1	99.8	39557	99639					
			Depression	All	98	37.5	33.8–41.3	99.5	38861	103628					
18	(Dutta et al. 2021) [57]	33	Stress	All	17	37.7	24.0–52.3	100	10269	27238	MetaXL	REM	NOS	Low	HCPs
			Anxiety	All	31	32.5	26.4–39	99	7628	23472					
			Depression	All	30	32.4	25.6–39.3	99	12200	37655					
			Sleep Disturbance	All	11	36.6	36.6–48.3	99	3810	10411					
19	(Hao et al. 2021) [60]	20	Stress	All	5	25.6	11.8–39.4	99	790	3085	R	REM	AHRQ	Low	HCPs
			Anxiety	All	16	28.6	22.4–36.4	99	2864	10015					
				Nurses	7	23.5	15.8–35	99	1437	6113					
			Depression	All	14	24.1	16.2–32.1	99	1915	7948					
				Nurses	5	25	12.7–37.4	96	423	1692					
			Sleep Disturbance	All	5	44.1	31.3–57	98	1607	3643					
20	(Yan et al. 2021) [81]	35	Stress	All	4	56	32–79	97	428	765	R	REM	STROBE	Low	HCPs /China
			Anxiety	All	29	41	35–47	98	6439	15704					
			Depression	All	20	27	20–32	94	5680	21038					
			Sleep Disturbance	All	8	41	33–50	98	3065	7476					
21	(Liu et al. 2021) [65]	33	Stress	All	5	30.6	9.1–65.9	98	979	3200	CMA	REM	NOS	Low	Mixed

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
			Anxiety	All	31	32.7	29.9–38.2	98	12340	37736					
			Depression	All	23	25.8	20.4–31.0	98	9347	36230					
			Sleep Disturbance	All	8	37.3	32.1–42.8	98	3649	9784					
22	(Mahmud et al. 2021) [66]	69	Stress	All	41	44.9	37–31.1	99.8	37170	82783	STATA	REM	STROBE	Low	HCPs
			Anxiety	All	75	41.4	36.2–46.7	99.8	61038	147435					
			Depression	All	69	37.1	31.8–42.4	99.8	53665	144649					
			Sleep Disturbance	All	21	43.8	35.8–51.7	99.4	14616	33370					
23	(Marvaldi et al. 2021) [67]	70	Stress	All	9	31.4	17.5–47.3	99.8	7979	25412	OMA	REM	AHRQ	Moderate	HCPs
			Anxiety	All	22	30	24.2–37	99.6	15583	51942					
			Depression	All	25	31.1	25.7–36.8	996	21157	68030					
			Sleep Disturbance	All	10	44	24.6–64.5	99.8	5468	12428					
24	(Phiri et al. 2021) [70]	83	Stress	All	19	23.2	10.5–35.9	99.8	10666	45976	STATA	REM	NOS	Moderate	Mixed
			Anxiety	All	67	21.9	18.7–25	99.7	24296	110940					
			Depression	All	67	23.4	20.6–26.3	99.5	28699	122644					
			Sleep Disturbance	All	17	24	16.4–31.6	99.5	9626	40110					
25	(Santabárbara et al. 2021) [73]	71	Anxiety	All	71	25	21–29	99.1	14641	58565	STATA	REM	JBI	Low	HCPs
				Nurses	17	27	20–34	97.8	1856	6875					
				Physicians	13	17	12–22	95.6	880	5177					
26	(Saragih et al. 2021) [77]	38	Stress	All	14	37	25–50	99.8	5695	15391	STATA	REM	JBI	Low	HCPs
			Anxiety	All	33	40	29–52	99.8	12453	31132					
			Depression	All	30	37	29–45	99.7	16738	45238					
27	(Singh et al. 2021) [76]	6	Stress	All	6	65.1	48.2–80.3	98.6	1577	2423	STATA	REM	NIH	Critically Low	Mixed/ India
			Anxiety	All	5	35.3	26.3–44.9	92.3	658	1863					

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
			Depression	All	6	35.4	25.1–46.4	97.6	1534	4333					
28	(Sun et al. 2021) [77]	47	Anxiety	All	44	37	31–42	99.9	23828	64401	STATA	REM	NOS	Low	HCPs
				Nurses	9	34	26–41	99	9310	27382					
				Physicians	9	28	19–38	99.1	7667	27382					
			Depression	All	39	39	31–41	99.6	30395	77936					
				Nurses	8	38	30–46	99	10339	27209					
				Physicians	8	33	26–40	97.9	8979	27209					
			Sleep Disturbance	All	9	32	23–42	99.5	4040	12626					
29	(Varghese et al. 2021) [79]	26	Stress	Nurses	10	40.6	25.6–56.8	98.6	1707	4204	OMA	REM	Loney	Low	Nurses
			Anxiety	Nurses	21	33	24–43	99.4	4502	13641					
			Depression	Nurses	17	32	21–44	99.4	3934	12294					
30	(Wu et al. 2021) [95]	29	Stress	All	5	41.2	19.8–64.5	99.8	4188	10165	STATA	REM	STROBE	Moderate	Mixed
			Anxiety	All	23	29	23.6–34.7	99.4	14541	50143					
			Depression	All	23	31	24.7–37.5	99.5	12986	41889					
			Sleep Disturbance	All	7	47.3	38.8–55.8	98.7	6326	13375					
31	(Xia et al. 2021) [80]	17	Sleep Disturbance	All	15	45.1	37.2–53.1	98.7	5530	12261	STATA	REM	Loney	Moderate	HCPs /China
32	(Deng et al. 2021) [55]	34	Anxiety	All	22	40	33–46	99	4560	11401	R	REM	AHRQ	Low	HCPs /China
			Depression	All	20	31	25–37	98.4	3546	11438					
33	(Dong et al. 2021) [56]	22	Stress	All	9	29.1	24.3–33.8	96.9	4258	14631	STATA	REM	AHRQ	Moderate	HCPs /China
			Anxiety	All	22	34.4	29.5–39.4	98.8	10338	30052					
			Depression	All	18	31.1	24.5–37.7	99.2	6827	21953					
34	(Serrano-Ripoll et al. 2021) [75]	13	Sleep Disturbance	All	13	38	37–39	99	5349	14075	STATA	REM	MU	Moderate	HCPs
35	(Hossain et al. 2021) [62]	17	Anxiety	All	15	43.6	33.1–54.5	99.2	6557	15038	STATA	REM	NOS	Low	Mixed/ South Asia
			Depression	All	14	29.9	23.9–36.6	98.1	4984	16670					
36	(Li et al. 2021) [64]	65	Stress	All	9	21.5	10.5–34.9	99.7	5254	24439	STATA	REM	MU	Low	HCPs

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
			Anxiety	All	57	22.1	18.2–26.3	99.4	16416	74280					
			Depression	All	55	21.7	18.3–25.2	99.3	18373	84666					
37	(El-Qushayri et al. 2021) [58]	10	Stress	All	6	66.6	47.6–81.3	98	1273	1911	CMA	REM	NIH	Moderate	HCPs/Egypt
			Anxiety	All	4	71.9	49.4–86.9	98	966	1344					
			Depression	All	5	65.5	46.9–80.3	98	1090	1664					
38	(Jahrami et al. 2021) [63]	11	Sleep Disturbance	All	11	36	21.1–54.2	99	1747	4854	R	REM	NOS	Moderate	Mixed
39	(Olaya et al. 2021) [69]	57	Depression	All	46	24	20–25	99.3	12846	53527	STATA	REM	JBI	Low	HCPs
				Nurses	14	25	18–33	97.7	1471	5883					
				Physicians	10	24	16–31	96.9	1024	4266					
40	(Raoofi et al. 2021) [71]	46	Anxiety	All	46	26.1	19–34.6	99	16065	61551	R	REM	NOS	Low	HCPs
				Nurses	31	24.7	17.6–33.5	99	3074	12447					
				Physicians	17	24	12.6–40.9	99	1239	5162					
41	(Salehi et al. 2021) [72]	4	Stress	All	4	11	5–16	95	217	1977	STATA	REM	STROBE	Moderate	Mixed
42	(Abdulla et al. 2021) [47]	23	Stress	All	12	58.1	44.8–71.3	99	2445	4209	Rev	REM	27-itmes	Moderate	HCPs /India
			Anxiety	All	10	42.9	30.3–55.5	98	1312	3059					
			Depression	All	5	41.9	29.2–54.6	99	2429	5796					
43	(Crocamo et al. 2021) [54]	14	Depression	All	14	23.8	16.2–32.2	99	3373	14173	STATA	REM	NOS	Low	HCPs
44	(Halemani et al. 2021) [59]	13	Stress	Nurses	4	37	8–66	99.6	720	1946	STATA	REM	NOS	Low	HCPs
				Physicians	3	37	6–68	99	343	928					
			Anxiety	Nurses	13	42	33–50	97	1750	4167					
				Physicians	12	34	26–42	95	1127	3315					
			Depression	Nurses	13	42	32–50	97	1750	4167					
				Physicians	12	34	23–45	97	1127	3315					
			Sleep Disturbance	Nurses	4	44	35–53	91	637	1447					
				Physicians	4	35	26–43	91	500	1428					

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
45	(Hosen et al. 2021) [61]	4	Anxiety	All	4	52	32–71	96	883	1699	STATA	REM	JBI	Low	Mixed/ Bangladesh
			Depression	All	4	41	35–46	62.1	697	1699					
46	(Norhayati et al. 2021) [68]	80	Stress	All	20	31.7	21.3–42.2	98	4017	12673	Rev	REM	JBI	Low	HCPs/Asia
			Anxiety	All	68	34.8	30.1–38.8	100	43474	124925					
				Nurses	18	36.1	23.8–48.4	100	4178	11574					
				Physicians	18	30.1	20.6–39.6	99	2191	7279					
			Depression	All	60	34.6	30.9–38.4	100	45779	132308					
				Nurses	19	36.6	27.1–46.2	99	3718	10159					
				Physicians	19	28.3	18.9–37.8	99	1937	6845					
			Sleep Disturbance	All	12	37.9	25.4–50.4	100	5638	14877					
47	(Zhao et al. 2021) [83]		Stress	All	5	28	9.5–59	99	1212	4327	CMA	REM	Loney	Low	Mixed
			Anxiety	All	14	23.	17.1–30.8	98	2995	13020					
			Depression	All	11	23.9	15–35.9	99	2849	11922					
48	(Thakur and Pathak 2021) [78]	20	Stress	All	3	55.6	36–110	99	1356	2438		REM	NOS	Low	HCPs /Frontline
			Anxiety	All	10	27.2	18.1–36.3	98	3229	11873					
			Depression	All	9	32	18–46	99	3604	11262					
			Sleep Disturbance	All	3	34.4	32.5–36.3	99	1296	3768					
49	(Aymerich et al. 2022) [84]	239	Stress	All	57	40	32–47	99.87	19217	48042	STATA	REM	NOS	Low	HCPs
			Anxiety	All	176	42	35–48	99.94	86735	206513					
			Depression	All	160	33	28–38	99.95	69551	210762					
			Sleep Disturbance	All	55	42	36–48	99.57	15569	37068					
50	(Hu et al. 2022) [86]	71	Anxiety	All	60	26.7	19.6–34.6	100	20558	76998	R	REM	JBI	Low	HCPs/China
			Depression	All	56	28.7	19.6–34.6	100	25655	89390					

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
			Sleep Disturbance	All	25	40.4	33.8–47.2	99	10883	26937					
51	(Johns et al. 2022) [88]	55	Anxiety	Physicians	30	25.8	20.4–31.5	99.2	8586	33281	R	REM	JBI	Low	Physicians
			Depression	Physicians	26	20.5	16–25.3	98.9	6447	31447					
52	(Li et al. 2022) [89]	48	Sleep Disturbance	All	48	46.4	40.3–52.5	99.5	15322	33021	STATA	REM	AHRQ	Low	Mixed/ China
53	(Rezaei et al. 2022) [90]	24	Depression	All	24	26	18–35		10923	42010	R	REM	NOS	Low	HCPs
54	(Xiong et al. 2022) [93]	44	Stress	All	7	27	16–38	99.8	7330	27148	STATA	REM	AHRQ	Low	HCPs /China
			Anxiety	All	18	17	13–21	99.5	5915	34793					
			Depression	All	15	15	13–16	94.3	7293	48621					
			Sleep Disturbance	All	5	15	7–23	99	857	5711					
55	(Zhang et al. 2022) [94]	88	Anxiety	All	88	33.6	29.7–37.6	99.2	25222	75066	STATA	REM	STROBE	Low	HCPs
56	(Ślusarska et al. 2022) [91]	23	Anxiety	Nurses	22	29	18–40	99.9	12488	43062	R	REM	AHRQ	Low	HCPs
			Depression	Nurses	18	22	15–30	99.7	8675	39430					
57	(Blasco-Belled et al. 2022) [85]	74	Stress	All	24	32	23–42	100	8122	25382	MetaXL	REM	JBI	Moderate	Mixed
			Anxiety	All	66	31	27–36	99	22309	71966					
			Depression	All	60	31	26–35	99	26269	84740					
58	(Huang et al. 2022) [87]	17	Stress	All	3	17	4–34	85	45	265	CMA	REM	Hoy's	Low	HCPs/ Frontline
			Anxiety	All	16	32	20–44	98	2494	7795					
			Depression	All	14	31	21–41	97	2326	7504					
59	(Tran et al. 2022) [92]	7	Depression	All	7	17.3	9.2–27.3	100	1555	8987	CMA	REM	JBI	Low	HCPs /Vietnam
60	(Tong et al. 2022) [105]	19	Stress	All	10	53	41.1–64.9	78.3	3167	5976	R	REM	NOS	Moderate	HCPs
			Anxiety	All	19	43	33.8–52.3	99	7316	17013					
			Depression	All	19	44.6	36.1–53.1	99	7588	17013					
			Sleep Disturbance	All	16	42.9	33.9–51.9	99	6612	15413					
61	(Andhavarapu et al. 2022) [96]	119	Stress	All	119	34	30–39	90	39829	117143	CMA	REM	NOS	Moderate	HCPs
62	(Mamun et al. 2022) [103]	4	Sleep Disturbance	All	4	51	23–79	98	575	1127	STATA	REM	JBI	Moderate	HCPs/ Bangladesh

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
63	(Cheung et al. 2022) [98]	6	Anxiety	All	6	37.8	28.7–46.9	96	1230	3253	STATA	REM	JBI	Moderate	HCPs/Asia
			Depression	All	6	39.8	29–50.5	97	1295	3253					
64	(Hasen et al. 2023b) [100]	8	Depression	All	7	40	23–57	99	1101	2752	STATA	REM	NOS	Moderate	HCPs/ Ethiopia
			Sleep Disturbance	All	3	37	13–58	98	334	904					
65	(Athe et al. 2023) [97]	11	Stress	All	6	50.4	22.6–78.2	99	585	1161	RevMan	REM		Critically Low	HCPs/India
			Anxiety	All	10	42.9	30.3–55.5	98	1302	3036					
			Depression	All	8	35.4	24.5–46.3	97	1114	3147					
66	(Sialakis et al. 2023) [107]	14	Anxiety	All	14	41.4	30.3–52.9	99	3221	7780	MedCalc	REM	JBI	Moderate	HCPs
			Depression	All	14	33.8	24.7–43.6	98	2630	7780					
67	(Gheshlagh et al. 2023) [99]	12	Anxiety	All	12	23	18–27	98	6891	29960	STATA	REM	NOS	Moderate	HCPs/ Asia
			Depression	All	11	20	14–27	99	5890	29448					
68	(Wang et al. 2023) [106]	14	Stress	Nurses	14	65.4	55.9–79.9	99	13902	21257	STATA	REM	NOS	Moderate	HCPs
69	(Khobragade and Agrawal 2023) [101]	39	Stress	All	23	43	30–56	99	3494	8125	R	REM	NOS	Critically Low	HCPs/India
			Sleep Disturbance	All	16	35	28–44	97	1741	4974					
70	(Lee et al. 2023) [102]		Stress	All	107	25.5	22.5–28.6	100	47070	184588	R	REM	JBI	Moderate	HCPs
				Nurses	42	27.4	22.5–32.5	99	10016	36554					
				Physicians	42	22.4	16.4–29.1	99	5635	25155					
			Anxiety	All	272	28.7	26.5–31	99	84831	295578					
				Nurses	85	31.5	26.9–36.3	99	22899	72695					
				Physicians	81	26.9	23–31	98	10072	37443					
			Depression	All	274	28.5	26.5–30.7	99	94019	329891					
				Nurses	98	28	24.5–31.7	99	24327	86881					

(*Continued*)

Table 1. (Continued)

	Study	Total Study Included	Outcome	Population	Study Included	Prevalence	95% CI	I^2	Events	Sample size	Analysis Software	Model	Appraisal Tool	AMSTAR-2 Quality	Remarks
				Physicians	89	25.3	21.8–29	99	10417	41175					
			Sleep Disturbance	All	54	24.4	19.4–29.9	99	7536	30886					
				Nurses	14	26	16–37.3	99	1644	6324					
				Physicians	15	16	10.2–22.7	95	632	3948					
71	(Sharma et al. 2023) [104]		Stress	All	22	36	23.7–48.2	99	2875	7985	R	OMA	JBI	Moderate	HCPs/India
			Anxiety	All	20	25	18.4–31.6	98	1953	7811					
			Depression	All	21	20.1	15.6–24.6	97	2055	10222					
			Sleep Disturbance	All	6	18.9	9.9–28	95	296	1565					
72	(Hasen et al. 2023a) [108]	13	Stress	All	9	51	41–62	98	1929	3815	STATA	REM	NOS	Moderate	HCPs/ Ethiopia
			Anxiety	All	8	46	30–61	99	1802	3703					

National Institutes of Health: NIH; Joanna Briggs Institute (JBI); OMA: Open Meta Analyst;GRADE: Grading of Recommendations Assessment, Development and Evaluations; NOS: Newcastle–Ottawa Scale; AHRQ: Agency for Healthcare Research and Quality; MMAT: Mixed Methods Appraisal Tool; MU: McMaster University; SAQOR: Systematic Assessment of Quality in Observation Research; CMA: Comprehensive Meta-Analysis software; HCPs: Healthcare Professionals.

https://doi.org/10.1371/journal.pone.0302597.t001

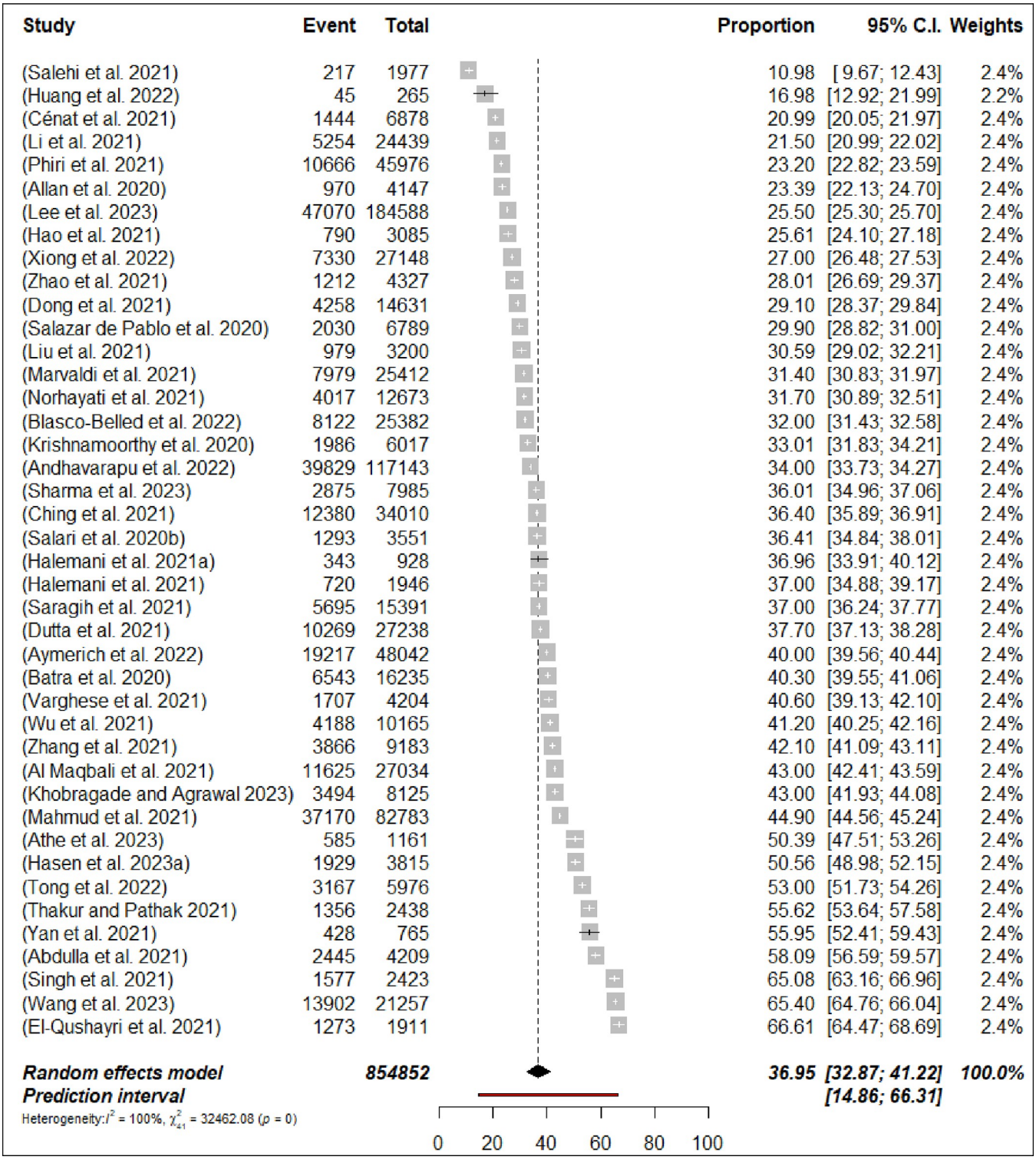

Fig 2. Forest plot of the prevalence of stress among HCPs stress (N = 42).

https://doi.org/10.1371/journal.pone.0302597.g002

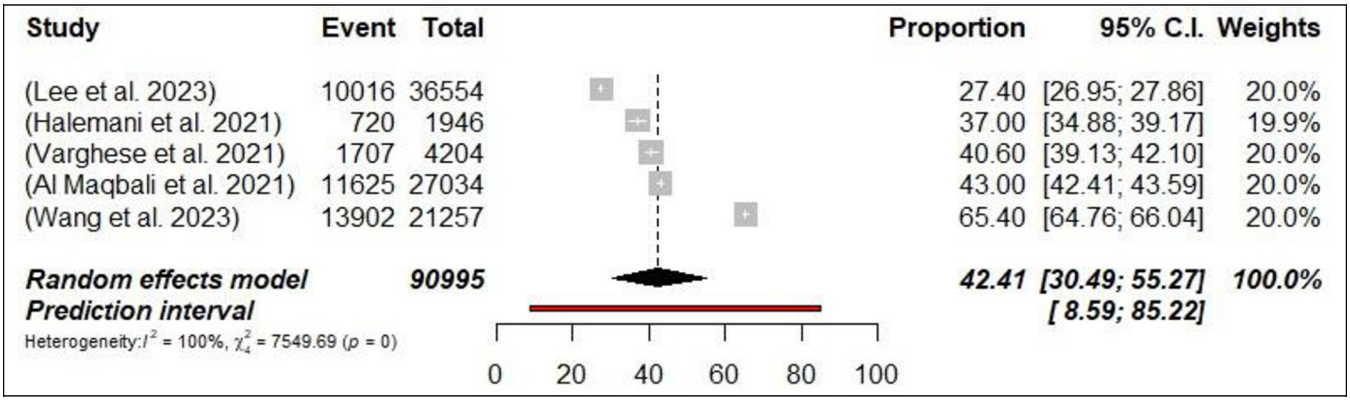

Fig 3. Forest plot of the prevalence of stress among nurses (N = 5).

https://doi.org/10.1371/journal.pone.0302597.g003

one-out analysis, revealed that none of the meta-analyses had an impact on the global prevalence estimate of anxiety symptoms greater than 1%. Suggestive evidence (class III) was found for the estimated prevalence of anxiety in the case of HCPs, nurses and physicians.

3.5 Prevalence of depression

A total of 54 meta-analyses examined the prevalence of depression among HCPs during the COVID-19 pandemic and results ranged from 14% [52] to 65.6% [58]. The pooled prevalence was 29.4% (698,808/2,349,613 participants, 95% CI 27.13–31.84) with 95% PI: 15.01–49.62 (Fig 7: Forest Plots) and there was a significant result in terms of the study heterogeneity ($p<$ 0.0001, I^2 = 99.9%). In subgroups analyses, the prevalence of depression was higher among nurses 32% (n = 11; 95% CI = 28–36.35, I^2 = 99%) compared with physicians 28.4% (n = 8; 95% CI = 24.32–32.78, I^2 = 99%) (Figs 8 and 9: Forest Plots). In the sensitivity analysis, the pooled prevalence remained stable when one meta-analysis was excluded at a time, with

Table 2. Level of evidence for the prevalence of symptoms among HCPs.

	No	Total	Event	Prevalence %	Random effects (95% CI)	Random effects p-value	95% Prediction Interval	I^2, %	Egger Test	Begg	Class of Evidence	Sensitivity Analysis
Stress												
HCPs	42	854852	292245	37	32.87–41.22	<0.0001	14.86–66.3	99.9	0.19	0.79	III	± 2%
Nurses	5	90995	37970	42.4	30.49–55.27	<0.0001	8.59–85.22	99.9	0.87	1	III	± 3%
Anxiety												
HCPs	55	2310774	734036	31.8	29.2–34.61	<0.0001	15.24–54.83	99.9	0.23	0.53	III	± 1%
Nurses	12	321415	105438	31.6	28.33–35.14	<0.0001	19.54–46.86	99.6	0.31	0.58	III	± 1%
Physician	9	160937	43219	26.3	22.89–30.10	<0.0001	14.98–42.05	99.2	0.65	1	III	± 1%
Depression												
HCPs	54	2349613	698808	29.4	27.13–31.84	<0.0001	15.01–49.62	99.9	0.16	0.84	III	± 0.5%
Nurses	11	305385	96564	32	28–36.35	<0.0001	17.98–50.34	99.8	0.82	0.94	III	± 1%
Physician	8	154935	43268	28.4	24.32–32.78	<0.0001	15.37–46.32	99.8	0.98	0.62	III	± 1%
Sleep												
HCPs	36	502780	191673	36.9	33.78–40.05	<0.0001	19.99–57.70	99.7	0.24	0.04	III	± 1%
Nurses	5	50797	19285	37.1	30.71–44.1	<0.0001	30.71–44.06	99.3	0.33	0.61	III	± 2%
Physician	4	12976	4138	30.6	20.04–43.77	<0.0001	2.68-87-62	99.5	0.48	1	III	± 3%

https://doi.org/10.1371/journal.pone.0302597.t002

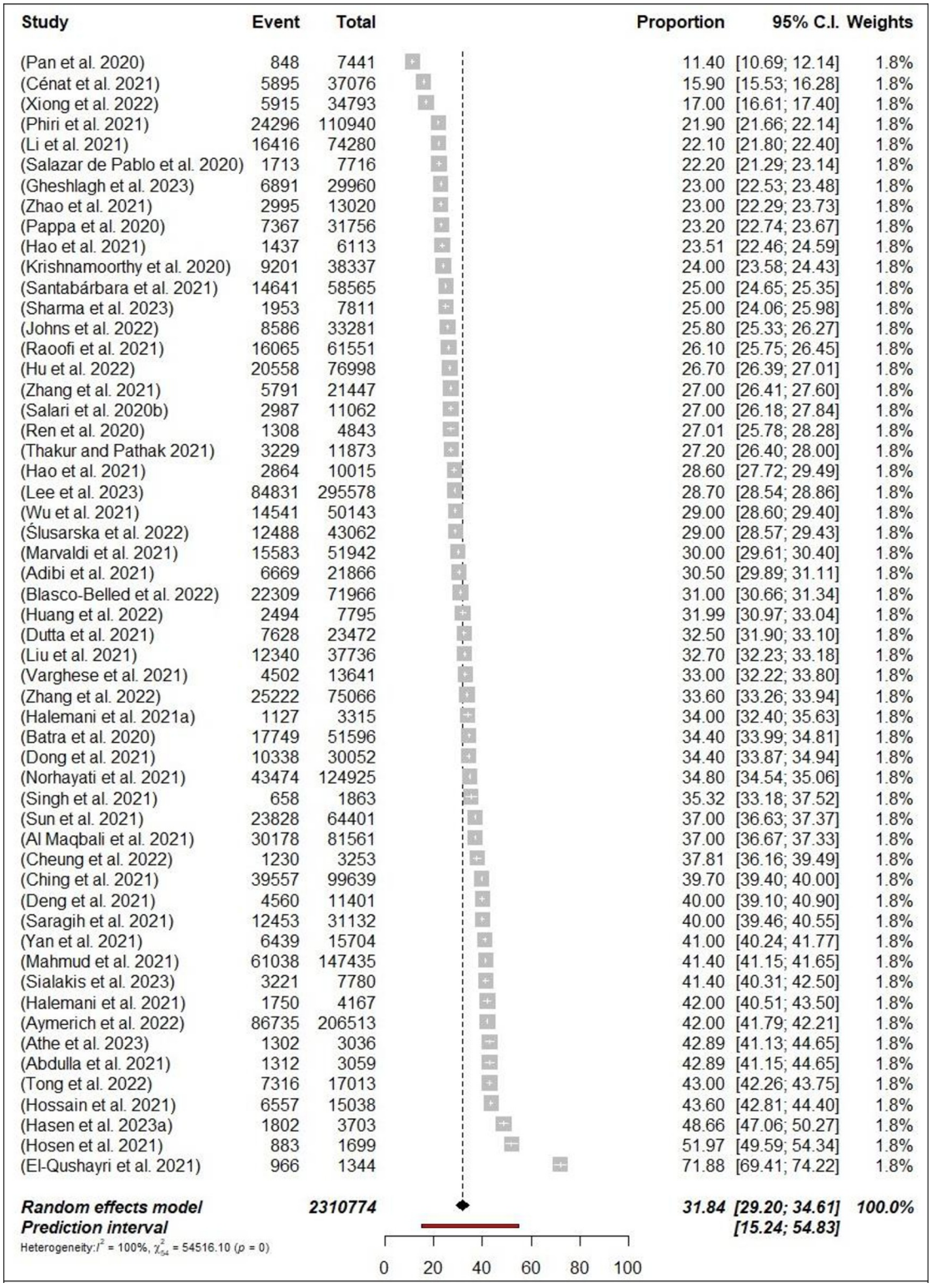

Fig 4. Forest plot of the prevalence of anxiety among HCPs (N = 55).

https://doi.org/10.1371/journal.pone.0302597.g004

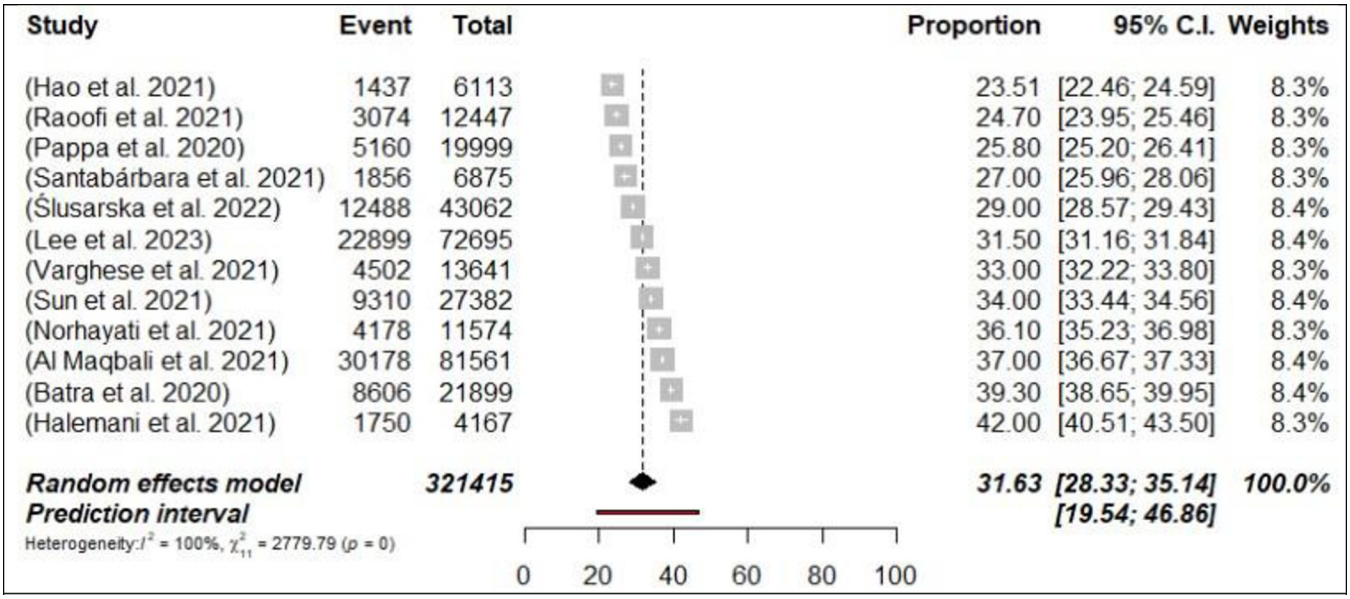

Fig 5. Forest plot of the prevalence of anxiety among nurses (N = 12).

https://doi.org/10.1371/journal.pone.0302597.g005

variations of less than 1%. Class III evidence revealed suggestive findings regarding the estimated prevalence of depression among HCPs, nurses, and physicians.

3.6 Prevalence of sleep disturbance

Sleep disturbance was assessed in 36 meta-analyses, with a calculated pooled prevalence of 36.9% (191,673/502,780 participants, 95% CI 33.78–40.05) with 95% PI: 19.99–57.70 (Fig 10: Forest Plots) with significant differences in terms of the meta-analyses heterogeneity presented ($p < 0.0001$, $I^2 = 99.7\%$). The prevalence of sleep disturbance ranged from 15.01% [93] to 47.3% [95]. In subgroup analyses, the prevalence of sleep disturbance was found to be higher among nurses at 37.1% (n = 5; 95% CI = 30.71–44.1, $I^2 = 99\%$) compared to physicians, where

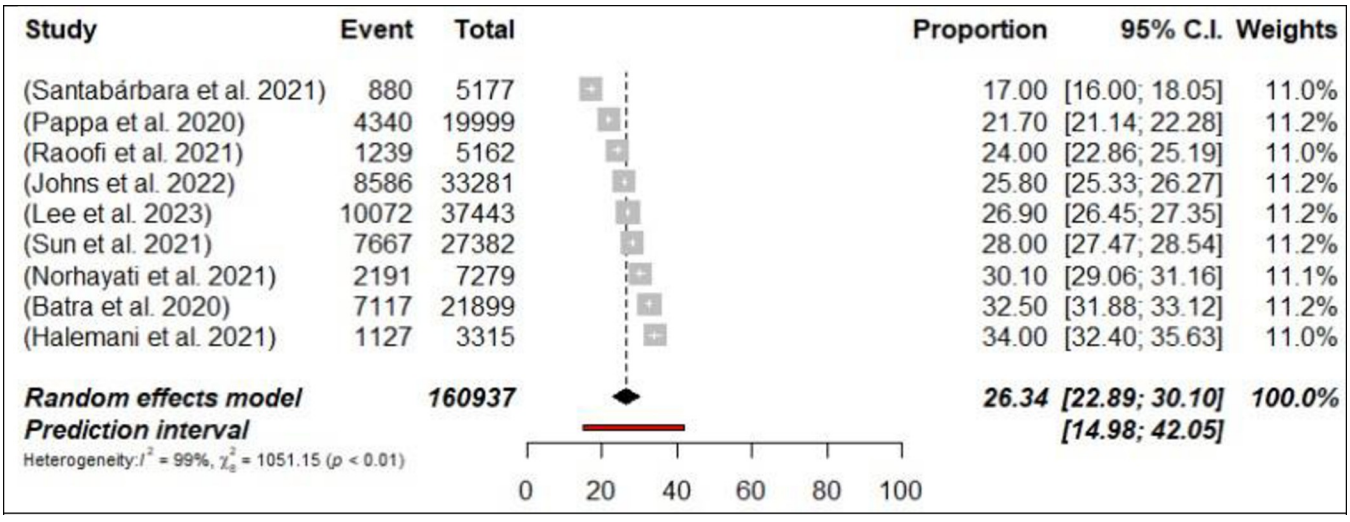

Fig 6. Forest plot of the prevalence of anxiety among physicians (N = 9).

https://doi.org/10.1371/journal.pone.0302597.g006

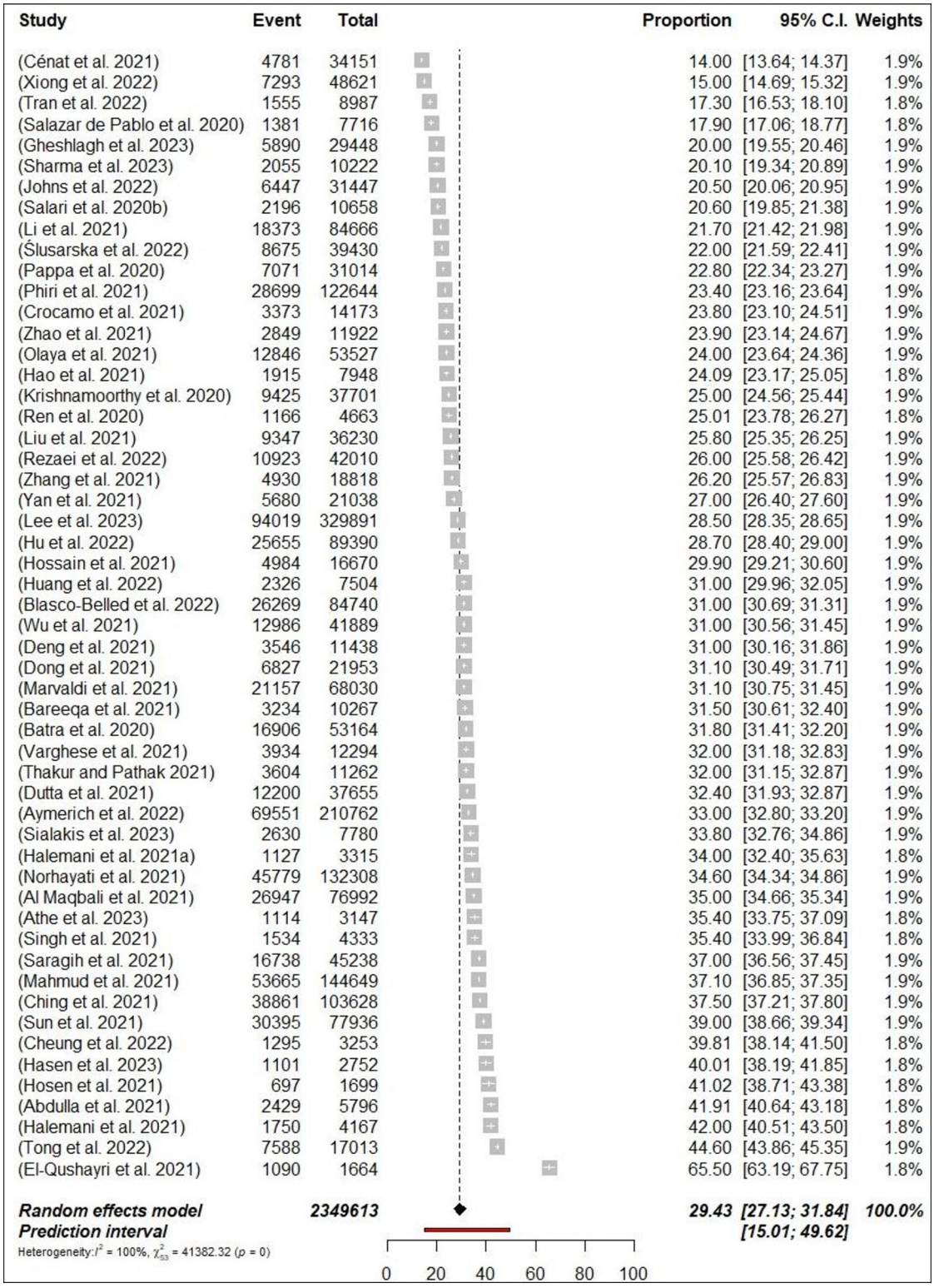

Fig 7. Forest plot of the prevalence of depression among HCPs (N = 54).

https://doi.org/10.1371/journal.pone.0302597.g007

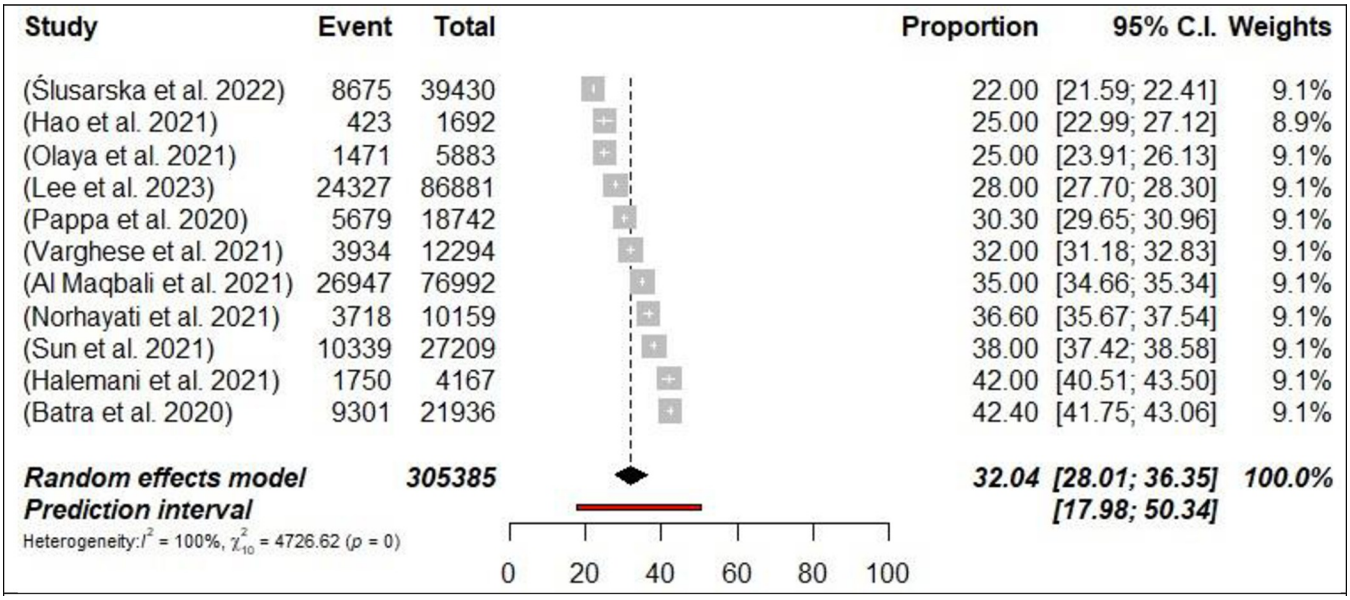

Fig 8. Forest plot of the prevalence of depression among nurses (N = 11).

https://doi.org/10.1371/journal.pone.0302597.g008

it was 30.6% (n = 4; 95% CI = 20.04–43.77, I^2 = 99%) (Figs 11 and 12: Forest Plots). The estimated prevalence rate of sleep disturbance was deemed to be suggestive evidence (Class III). The pooled prevalence did not change in sensitivity analysis by excluding one meta-analyses each time by less than 3%.

3.7 Publication bias

The result of Egger's regression test for all pooled prevalence indicates that publication bias was insignificant, showing no evidence of publication bias Table 2.

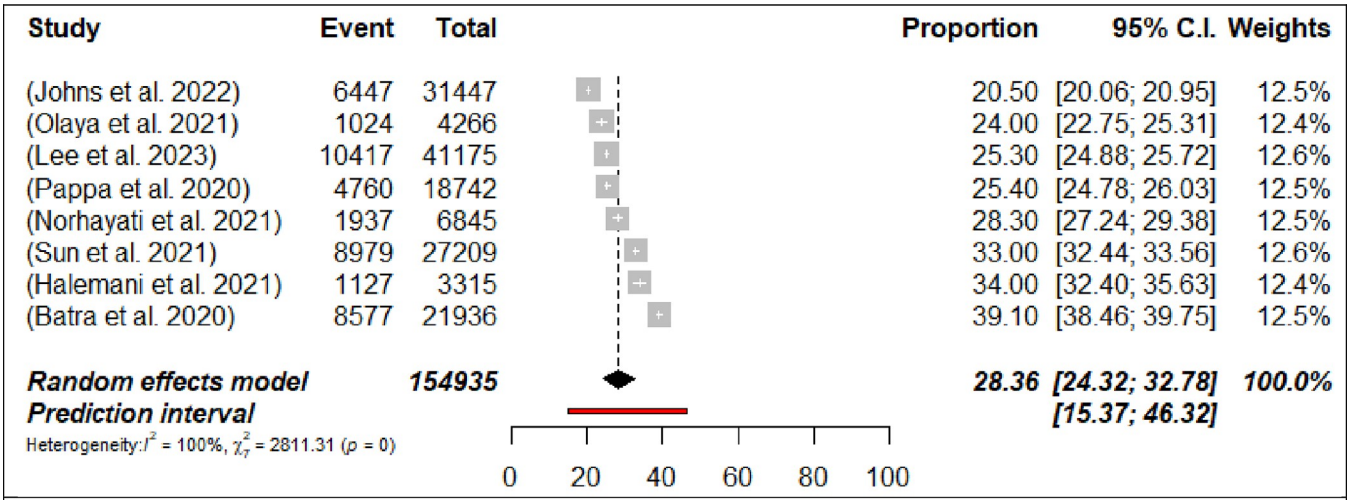

Fig 9. Forest plot of the prevalence of depression among physicians (N = 8).

https://doi.org/10.1371/journal.pone.0302597.g009

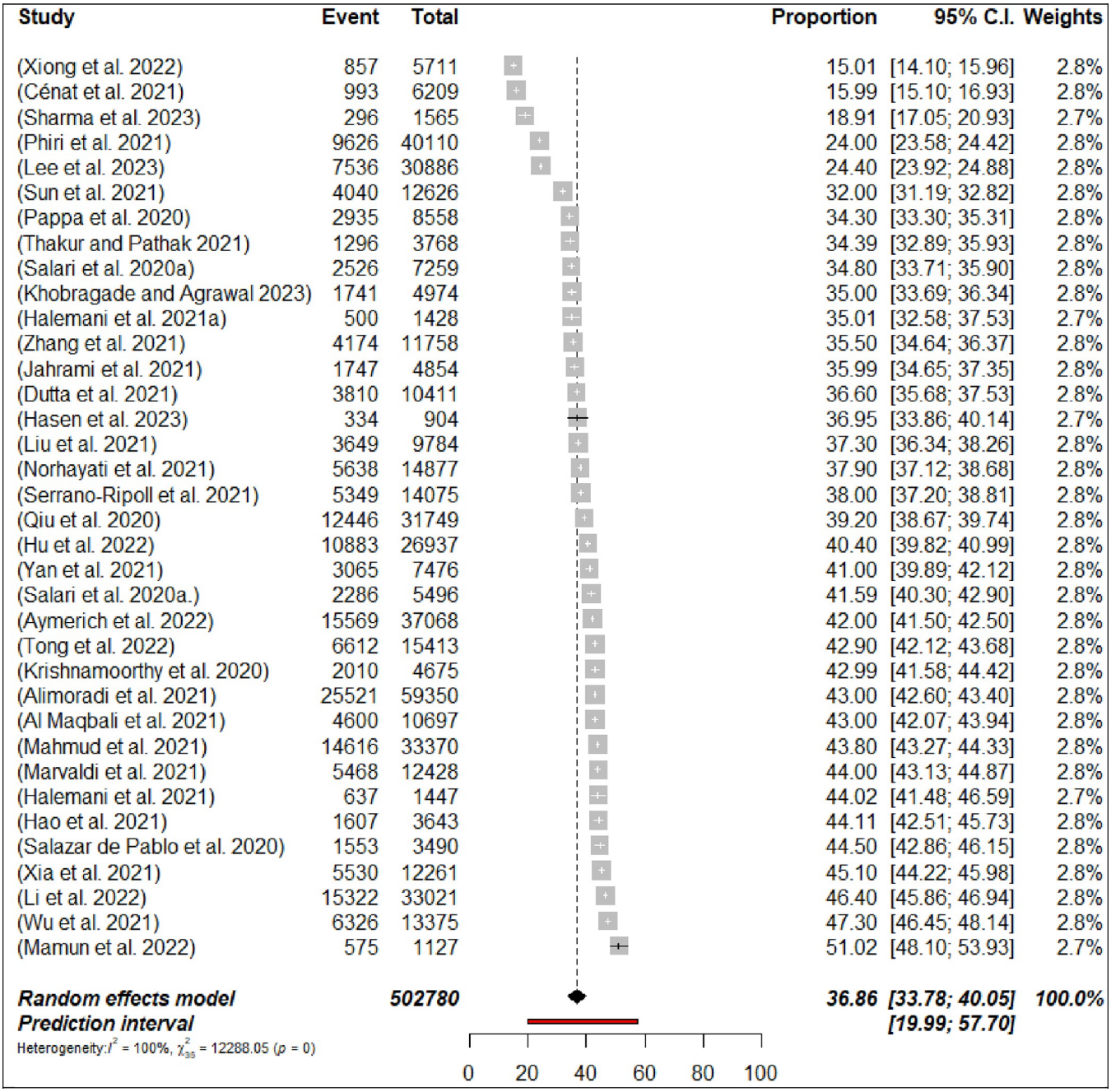

Fig 10. Forest plot of the prevalence of sleep disturbance among HCPs (N = 36).

https://doi.org/10.1371/journal.pone.0302597.g010

4. Discussion

To the best of our knowledge, this is the first umbrella review to provide a comprehensive synthesis of the estimate of the aggregate data prevalence symptoms of stress, anxiety, depression, and sleep disturbance among HCPs, physicians, and nurses during the entire COVID-19 pandemic.

In the present umbrella review, which utilizes aggregate data from 71 meta-analyses, the most prevalent problems among healthcare professionals (HCPs) were found to be stress

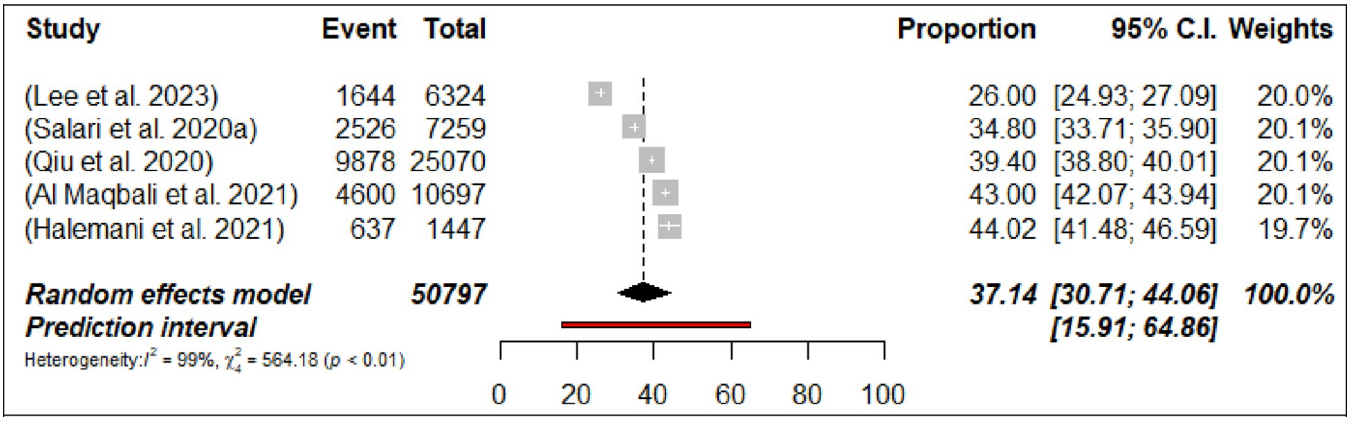

Fig 11. Forest plot of the prevalence of sleep disturbance among nurses (N = 5).

https://doi.org/10.1371/journal.pone.0302597.g011

(37%), followed by sleep disturbance (36.9%), anxiety (31.8%), and depression (29.4%). The findings among HCPs are slightly higher than the prevalence estimates from the general population (prevalence estimates of 27% for sleep disturbance; 36% for stress; 26% for anxiety and 28% for depression) during the COVID-19 pandemic [109]. In addition, a report by the World Health Organization prior to the COVID-19 pandemic estimated that the global prevalence of anxiety and depression was 4.4% and 3.6% respectively [110]. While some of this disparity may result from different methodological approaches used, the prevalence of depression and anxiety during the COVID-19 pandemic appears to have been higher than before the outbreak. The rise in mental health problems among HCPs may have been triggered by the uncertainty surrounding the pandemic, increased workload, and the fear of family transmission, any, or all of which may also contribute to the higher prevalence of these conditions.

The results of this umbrella review revealed higher prevalence rates compared with two previous reviews of meta-analyses [18,20]. These include 10 meta-analyses which reported prevalence rates during COVID-19 among HCPs: 25% for anxiety and 24% for depression [18]. Another umbrella review involving 18 meta-analyses found stress in 36% of the sample, depression in 26%, anxiety in 27% and sleep disturbance in 32% among HCPs during the COVID-19 pandemic [20]. It is important to highlight that the previous reviews included meta-analyses published before March 2021, while this current review included studies published until January 2024. As a result, the current umbrella review includes more meta-analyses

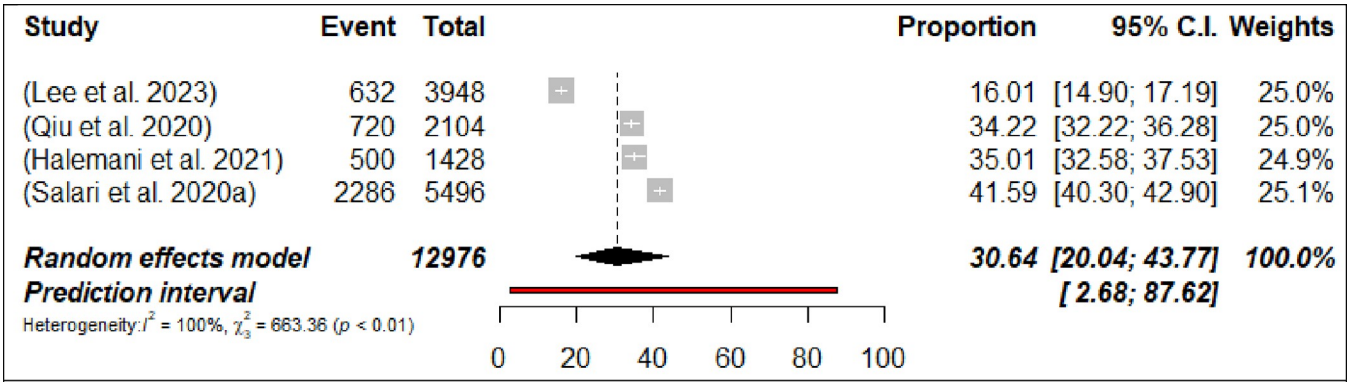

Fig 12. Forest plot of the prevalence of sleep disturbance among physicians (N = 4).

https://doi.org/10.1371/journal.pone.0302597.g012

compared to the two previous umbrella reviews [18,20]. This umbrella review therefore extends the scientific knowledge of the impact of COVID on mental health of HCPs.

The results of our study suggest that the psychological trauma experienced by HCPs during the SARS and MERS epidemics was lower than that experienced during the COVID-19 pandemic [111–114]. However, the difference between COVID-19 and previous pandemics could be explained by the high mortality rate and infectious potential of the COVID-19 pandemic. The results of this study suggest that the COVID-19 pandemic has had a significant negative effect on the psychological health of HCPs. One important lesson that should be learned is that early detection and treatment are carried out to prevent these types of psychological issues developing into more complex ones.

The result of this analysis demonstrates a higher level of anxiety, depression and sleep disturbance among nurses compared to physicians. One explanation for this may be that nurses are involved in more prolonged and closer contact to COVID-19 patients than physicians [115–117]. Another possible reason might be due to the higher number of nurses included in original studies.

The current review found that the overall pooled prevalence varied between the meta-analyses, for example ranging between 1% [72] and 66.6% [58] for stress, 11.% [40] and 71.9% [58] for anxiety, 14% [52] and 65.6% [58] for depression, and 15% [93] and 47.3% [95] for sleep disturbance. This could be linked to the varying COVID-19 infection and mortality rates in the countries in which the studies were conducted. Other possible reasons might relate to the healthcare system, cultural norms of HCPs, and their perceptions of stress, anxiety, depression, and sleep disturbance which in turn might be influenced by their working conditions, exposure to pandemics, intensity of lockdown and social distancing strategies, and perceived support. For instance, the result of the meta-analysis by El-Qushayri [58] showed the highest prevalent rate in terms of stress, anxiety and depression. This may be because this meta-analysis included only HCPs from Egypt, which in turn might indicate that the Egyptian healthcare system was severely affected by COVID-19 compared to other countries [118].

The finding of this umbrella review highlights significant negative effect that the COVID-19 pandemic has had on the psychological health of HCPs, further emphasizing the need for regular mental health assessment and management in this population. Due to the increasing number of complex traumas that HCPs are experiencing, special attention should be paid to the development of positive traumatic growth. The higher prevalence of stress, anxiety, depression, and sleep disturbance among HCPs have important implications for both the policies and practices of the healthcare system under consideration. It is important to identify effective interventions for HCPs such as the behavioural and educational interventions that have been suggested, including the development of a sense of coherence, positive thinking, and social support [119–121]. Currently there is a lack of evidence about the effectiveness of some psychological interventions that were adapted for use during COVID-19 pandemic specifically for healthcare workers [122,123].

Heterogeneity was significant in the majority of the analyses; several reasons can be attributed to this prominence. Firstly, the individual studies within each meta-analysis might differ substantially in terms of their design, sample sizes, interventions or exposures, and outcome measures. These variations can lead to differing effect sizes or conclusions, making the integration of results into a cohesive summary more complex. Furthermore, heterogeneity can arise from variations in the quality of these studies. While some research might have been meticulously conducted with strict inclusion criteria and rigorous methodologies, other studies on healthcare workers may have inherent biases or confounding factors due to the rapidly changing nature of the pandemic, the pressures of lockdowns, and their effects.

The unique characteristics and experiences of healthcare workers during the COVID-19 crisis, compounded by the challenges of lockdown measures, have the potential to further amplify this variability. Factors such as age, gender, ethnicity, and underlying health conditions, when combined with the stress, increased workload, and challenges of the pandemic and lockdown situations, can significantly influence study outcomes. Additionally, methodological differences in individual studies, like the use of a wide variety of questionnaires to measure symptoms, varied cut-off points, and severity thresholds, as well as the absence of a consistent 'gold standard' for diagnostic interviews, can contribute to increased heterogeneity. In the context of the umbrella review, synthesizing findings from such a diverse collection of meta-analyses, particularly those focused on healthcare workers during this unparalleled period marked by fluctuating lockdown measures, poses a formidable challenge. Such complexity may constrain the robustness and precision of the conclusions drawn.

One of the most critical factors that policymakers need to consider when it comes to implementing effective interventions is the availability of organizational support. This can be done through various work-based interventions such as implementing shorter working hours and having buddy systems [124]. In addition, other measures such as providing mental health consultants and tele counselling can also help reduce the impact of the outbreak of disease on the well-being of staff members [125,126].

4.1 Limitations

Several limitations must be taken into consideration when interpreting the results of this umbrella review even though one strength of this methodology is that it provides comprehensive evidence regarding the mental health problems that were faced by HCPs during the COVID-19 pandemic, First, there is a possibility of selection bias. For example, non-English language meta-analyses were not included in this umbrella review, and this may introduce a selection bias. Second, it may be the case that some meta-analyses may have included the same primary studies and that there is consequently a significant study overlap between the meta-analyses included in this review. However, since the results of the studies were then combined with other studies, and a new result was presented, these were regarded as being new studies [25]. Further, several researchers address overlapping by removing some of the reviews with higher rates of overlapping [26,127]. Although removing the overlapping meta-analyses solves the problem of dependent effects, it might introduce a bias of its own. Excluding one of two overlapping meta-analyses from an umbrella review will bias the overall estimate [128,129]. In addition, Hennessy and Johnson [127] clearly mention that the overlap of primary studies included in a meta-review is not necessarily a bias but often can be a benefit.

Third, the various methodologies of the primary studies that were included in the meta-analyses, in terms of sampling methods, assessment tools, operational definitions of the symptoms and study length, might have affected the sensitivity and specificity with regard to detecting the prevalence estimations of stress, anxiety, depression, and sleep disturbance [130]. Finally, it should be noted that stress, anxiety, depression, and sleep disturbance varied between the HCPs studied. Therefore, future research should focus on the difference contexts of estimation prevalence between HCPs and should report the prevalence in each group.

5. Conclusion

In summary, this umbrella review systematically analyses the currently available evidence on the prevalence of stress, anxiety, depression, and sleep disturbance among HCPs in relation to COVID-19. It revealed that the incidence of these symptoms is high in the HCP population. However, there is wide variation in the degree of these conditions among this HCP population.

This may be due to the varying experiences of COVID-19 and the cultural differences in the countries where the studies have been carried out. It is clear from the current evidence that strategies involving multi-level interventions are required to develop effective interventions that can help improve the mental health and well-being of HCPs and foster post-traumatic growth. Further research needs to address the limitations of the existing literature, in order to enable the authorities, providers, and patients to improve the quality of mental health on the part of HCPs.

Supporting information

S1 Checklist. PRISMA 2020 checklist.
(DOCX)

S1 Table. Quality assessment result of meta analysis using the AMSTAR-2 (N = 72).
(DOCX)

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Visualization: Mohammed Al Maqbali, Geoffrey L. Dickens.

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Writing – review & editing: Mohammed Al Maqbali, Ahmad Alsayed, Ciara Hughes, Eileen Hacker, Geoffrey L. Dickens.

References

1. WHO. International Health Regulations Emergency Committee on novel coronavirus in China. 2020 [cited 12 Sep 2020]. Available: https://www.who.int/news-room/events/detail/2020/01/30/default-calendar/international-health-regulations-emergency-committee-on-novel-coronavirus-in-china.
2. Hill JE, Harris C, Danielle L C, Boland P, Doherty AJ, Benedetto V, 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: 1551–1573. https://doi.org/10.1111/jan.15175 PMID: 35150151
3. Chirico F, Ferrari G, Nucera G, Szarpak L, Crescenzo P, Ilesanmi O. Prevalence of anxiety, depression, burnout syndrome, and mental health disorders among healthcare workers during the COVID-19 pandemic: A rapid umbrella review of systematic reviews. 2021; 6: 209–220. https://doi.org/10.19204/2021/prvl7
4. Chirico F, Crescenzo P, Sacco A, Ricco M, Ripa S, Nucera G, et al. Prevalence of burnout syndrome among Italian volunteers of the Red Cross: a cross-sectional study. Industrial health. 2021; 59: 117–127. https://doi.org/10.2486/indhealth.2020-0246 PMID: 33473066
5. Magnavita N, Chirico F, Sacco A. COVID-19: from hospitals to courts. The Lancet. 2021; 397: 1542. https://doi.org/10.1016/S0140-6736(21)00472-4 PMID: 33894829
6. Smallwood N, Harrex W, Rees M, Willis K, Bennett CM. COVID-19 infection and the broader impacts of the pandemic on healthcare workers. Respirology. 2022; 27: 411–426. https://doi.org/10.1111/resp.14208 PMID: 35048469
7. Chen J, Zhang SX, Yin A, Yáñez JA. Mental health symptoms during the COVID-19 pandemic in developing countries: A systematic review and meta-analysis. J Glob Health. 2022; 12: 05011. https://doi.org/10.7189/jogh.12.05011 PMID: 35604881
8. Zhang SX, Chen RZ, Xu W, Yin A, Dong RK, Chen BZ, et al. A Systematic Review and Meta-Analysis of Symptoms of Anxiety, Depression, and Insomnia in Spain in the COVID-19 Crisis. Int J Environ Res Public Health. 2022; 19: 1018. https://doi.org/10.3390/ijerph19021018 PMID: 35055841
9. Gm M, Am L, V C, C C, Kw T, Pc S, et al. Immediate and sustained psychological impact of an emerging infectious disease outbreak on health care workers. Canadian journal of psychiatry Revue canadienne de psychiatrie. 2007; 52. https://doi.org/10.1177/070674370705200406 PMID: 17500305
10. Lee SM, Kang WS, Cho A-R, Kim T, Park JK. Psychological impact of the 2015 MERS outbreak on hospital workers and quarantined hemodialysis patients. Comprehensive Psychiatry. 2018; 87: 123–127. https://doi.org/10.1016/j.comppsych.2018.10.003 PMID: 30343247
11. Liu X, Kakade M, Fuller CJ, Fan B, Fang Y, Kong J, et al. Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. Comprehensive Psychiatry. 2012; 53: 15–23. https://doi.org/10.1016/j.comppsych.2011.02.003 PMID: 21489421
12. Liu Y, Gayle AA, Wilder-Smith A, Rocklöv J. The reproductive number of COVID-19 is higher compared to SARS coronavirus. J Travel Med. 2020; 27: taaa021. https://doi.org/10.1093/jtm/taaa021 PMID: 32052846
13. Søvold LE, Naslund JA, Kousoulis AA, Saxena S, Qoronfleh MW, Grobler C, et al. Prioritizing the Mental Health and Well-Being of Healthcare Workers: An Urgent Global Public Health Priority. Frontiers in Public Health. 2021; 9. Available: https://www.frontiersin.org/articles/10.3389/fpubh.2021.679397. https://doi.org/10.3389/fpubh.2021.679397 PMID: 34026720
14. Bismark M, Smallwood N, Jain R, Willis K. Thoughts of suicide or self-harm among healthcare workers during the COVID-19 pandemic: qualitative analysis of open-ended survey responses. BJPsych Open. 2022; 8: e113. https://doi.org/10.1192/bjo.2022.509 PMID: 35699151
15. National Institutes of Health. National institutes of health sleep disorders research plan. Maryland, USA: National Institutes of Health; 2011 pp. 1–34. Available: https://www.nhlbi.nih.gov/files/docs/ncsdr/201101011NationalSleepDisordersResearchPlanDHHSPublication11-7820.pdf.
16. Association American Psychiatric. Diagnostic and Statistical Manual of Mental Disorders, 5th Edition: DSM-5. 5th edition. Washington, D.C: American Psychiatric Publishing; 2013.
17. Cohen S, Kamarck T, Mermelstein R. A Global Measure of Perceived Stress. Journal of Health and Social Behavior. 1983; 24: 385–396. https://doi.org/10.2307/2136404 PMID: 6668417
18. Fernandez R, Sikhosana N, Green H, Halcomb EJ, Middleton R, Alananzeh I, et al. Anxiety and depression among healthcare workers during the COVID-19 pandemic: a systematic umbrella review of the global evidence. BMJ Open. 2021; 11: e054528. https://doi.org/10.1136/bmjopen-2021-054528 PMID: 34548373
19. Sahebi A, Abdi K, Moayedi S, Torres M, Golitaleb M. The prevalence of insomnia among health care workers amid the COVID-19 pandemic: An umbrella review of meta-analyses. J Psychosom Res. 2021; 149: 110597. https://doi.org/10.1016/j.jpsychores.2021.110597 PMID: 34388380

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

21. Page MJ, Moher D, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. BMJ. 2021; 372: n160. https://doi.org/10.1136/bmj.n160 PMID: 33781993

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

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

24. Belbasis L, Brooker RD, Zavalis E, Pezzullo AM, Axfors C, Ioannidis JP. Mapping and systematic appraisal of umbrella reviews in epidemiological research: a protocol for a meta-epidemiological study. Systematic Reviews. 2023; 12: 123. https://doi.org/10.1186/s13643-023-02265-7 PMID: 37452309

25. Pollock M, Fernandes RM, Becker LA, Pieper D, Butler LD. Chapter V: Overviews of Reviews. 2nd ed. In: Higgins JP, Thomas J, Chandel J, Cumpston M, Li T, Page M, et al., editors. Cochrane Handbook for Systematic Reviews of Interventions 63. 2nd ed. Chichester (UK): John Wiley & Sons; 2022. Available: www.training.cochrane.org/handbook.

26. Lunny C, Pieper D, Thabet P, Kanji S. Managing overlap of primary study results across systematic reviews: practical considerations for authors of overviews of reviews. BMC Medical Research Methodology. 2021; 21: 140. https://doi.org/10.1186/s12874-021-01269-y PMID: 34233615

27. Tang LL, Caudy M, Taxman F. A Statistical Method for Synthesizing Meta-Analyses. Computational and Mathematical Methods in Medicine. 2013; 2013: e732989. https://doi.org/10.1155/2013/732989 PMID: 24194787

28. Makowski D, Catarino R, Chen M, Bosco S, Montero-Castaño A, Pérez-Soba M, et al. Synthesising results of meta-analyses to inform policy: a comparison of fast-track methods. Environmental Evidence. 2023; 12: 16. https://doi.org/10.1186/s13750-023-00309-y

29. Schwarzer G, Carpenter JR, Rücker G. Meta-Analysis with R. Cham: Springer International Publishing; 2015. https://doi.org/10.1007/978-3-319-21416-0

30. Viechtbauer W. Conducting Meta-Analyses in R with the metafor Package. Journal of Statistical Software. 2010; 36: 1–48. https://doi.org/10.18637/jss.v036.i03

31. Gosling CJ, Solanes A, Fusar-Poli P, Radua J. metaumbrella: the first comprehensive suite to perform data analysis in umbrella reviews with stratification of the evidence. BMJ Ment Health. 2023; 26. https://doi.org/10.1136/bmjment-2022-300534 PMID: 36792173

32. Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003; 327: 557–560. https://doi.org/10.1136/bmj.327.7414.557 PMID: 12958120

33. Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997; 315: 629–634. https://doi.org/10.1136/bmj.315.7109.629 PMID: 9310563

34. Duval S, Tweedie R. Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. Biometrics. 2000; 56: 455–463. https://doi.org/10.1111/j.0006-341x.2000.00455.x PMID: 10877304

35. Patsopoulos NA, Evangelou E, Ioannidis JPA. Sensitivity of between-study heterogeneity in meta-analysis: proposed metrics and empirical evaluation. Int J Epidemiol. 2008; 37: 1148–1157. https://doi.org/10.1093/ije/dyn065 PMID: 18424475

36. Mathur MB, VanderWeele TJ. Sensitivity analysis for publication bias in meta-analyses. J R Stat Soc Ser C Appl Stat. 2020; 69: 1091–1119. https://doi.org/10.1111/rssc.12440 PMID: 33132447

37. Allan SM, Bealey R, Birch J, Cushing T, Parke S, Sergi G, et al. The prevalence of common and stress-related mental health disorders in healthcare workers based in pandemic-affected hospitals: a rapid systematic review and meta-analysis. Eur J Psychotraumatol. 2020; 11: 1810903. https://doi.org/10.1080/20008198.2020.1810903 PMID: 33244359

38. Batra K, Singh TP, Sharma M, Batra R, Schvaneveldt N. Investigating the Psychological Impact of COVID-19 among Healthcare Workers: A Meta-Analysis. Int J Environ Res Public Health. 2020; 17: E9096. https://doi.org/10.3390/ijerph17239096 PMID: 33291511

39. Krishnamoorthy Y, Nagarajan R, Saya GK, Menon V. Prevalence of psychological morbidities among general population, healthcare workers and COVID-19 patients amidst the COVID-19 pandemic: A systematic review and meta-analysis. Psychiatry Res. 2020; 293: 113382. https://doi.org/10.1016/j.psychres.2020.113382 PMID: 32829073

40. Pan R, Zhang L, Pan J. The Anxiety Status of Chinese Medical Workers During the Epidemic of COVID-19: A Meta-Analysis. Psychiatry Investig. 2020; 17: 475–480. https://doi.org/10.30773/pi.2020.0127 PMID: 32403209

41. Pappa S, Ntella V, Giannakas T, Giannakoulis VG, Papoutsi E, Katsaounou P. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. Brain Behav Immun. 2020; 88: 901–907. https://doi.org/10.1016/j.bbi.2020.05.026 PMID: 32437915

42. Qiu D, Yu Y, Li R-Q, Li Y-L, Xiao S-Y. Prevalence of sleep disturbances in Chinese healthcare professionals: a systematic review and meta-analysis. Sleep Medicine. 2020; 67: 258–266. https://doi.org/10.1016/j.sleep.2019.01.047 PMID: 31040078

43. Ren X, Huang W, Pan H, Huang T, Wang X, Ma Y. Mental Health During the Covid-19 Outbreak in China: a Meta-Analysis. Psychiatr Q. 2020; 91: 1033–1045. https://doi.org/10.1007/s11126-020-09796-5 PMID: 32642822

44. Salari N, Khazaie H, Hosseinian-Far A, Ghasemi H, Mohammadi M, Shohaimi S, et al. The prevalence of sleep disturbances among physicians and nurses facing the COVID-19 patients: a systematic review and meta-analysis. Global Health. 2020; 16: 92. https://doi.org/10.1186/s12992-020-00620-0 PMID: 32993696

45. Salari N, Khazaie H, Hosseinian-Far A, Khaledi-Paveh B, Kazeminia M, Mohammadi M, et al. The prevalence of stress, anxiety and depression within front-line healthcare workers caring for COVID-19 patients: a systematic review and meta-regression. Hum Resour Health. 2020; 18: 100. https://doi.org/10.1186/s12960-020-00544-1 PMID: 33334335

46. Salazar de Pablo G, Vaquerizo-Serrano J, Catalan A, Arango C, Moreno C, Ferre F, et al. Impact of coronavirus syndromes on physical and mental health of health care workers: Systematic review and meta-analysis. J Affect Disord. 2020; 275: 48–57. https://doi.org/10.1016/j.jad.2020.06.022 PMID: 32658823

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

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

49. Al Maqbali M, Al Sinani M, Al-Lenjawi B. Prevalence of stress, depression, anxiety and sleep disturbance among nurses during the COVID-19 pandemic: A systematic review and meta-analysis. J Psychosom Res. 2021; 141: 110343. https://doi.org/10.1016/j.jpsychores.2020.110343 PMID: 33360329

50. Alimoradi Z, Broström A, Tsang HWH, Griffiths MD, Haghayegh S, Ohayon MM, et al. Sleep problems during COVID-19 pandemic and its' association to psychological distress: A systematic review and meta-analysis. EClinicalMedicine. 2021; 36: 100916. https://doi.org/10.1016/j.eclinm.2021.100916 PMID: 34131640

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

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

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

54. Crocamo C, Bachi B, Calabrese A, Callovini T, Cavaleri D, Cioni RM, et al. Some of us are most at risk: Systematic review and meta-analysis of correlates of depressive symptoms among healthcare workers during the SARS-CoV-2 outbreak. Neurosci Biobehav Rev. 2021; 131: 912–922. https://doi.org/10.1016/j.neubiorev.2021.10.010 PMID: 34655656

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

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

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

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

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

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

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

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

63. Jahrami H, BaHammam AS, Bragazzi NL, Saif Z, Faris M, Vitiello MV. Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. J Clin Sleep Med. 2021; 17: 299–313. https://doi.org/10.5664/jcsm.8930 PMID: 33108269

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

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

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

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

68. Norhayati MN, Che Yusof R, Azman MY. Prevalence of Psychological Impacts on Healthcare Providers during COVID-19 Pandemic in Asia. International Journal of Environmental Research and Public Health. 2021; 18: 9157. https://doi.org/10.3390/ijerph18179157 PMID: 34501747

69. Olaya B, Pérez-Moreno M, Bueno-Notivol J, Gracia-García P, Lasheras I, Santabárbara J. Prevalence of Depression among Healthcare Workers during the COVID-19 Outbreak: A Systematic Review and Meta-Analysis. J Clin Med. 2021; 10: 3406. https://doi.org/10.3390/jcm10153406 PMID: 34362188

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

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

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

73. Santabárbara J, Lasheras I, Lipnicki DM, Bueno-Notivol J, Pérez-Moreno M, López-Antón R, et al. Prevalence of anxiety in the COVID-19 pandemic: An updated meta-analysis of community-based studies. Progress in Neuro-Psychopharmacology and Biological Psychiatry. 2021; 109: 110207. https://doi.org/10.1016/j.pnpbp.2020.110207 PMID: 33338558

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

75. Serrano-Ripoll MJ, Zamanillo-Campos R, Castro A, Fiol-de Roque MA, Ricci-Cabello I. Insomnia and sleep quality in healthcare workers fighting against COVID-19: a systematic review of the literature and meta-analysis. Actas Esp Psiquiatr. 2021; 49: 155–179. PMID: 34195971

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

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

78. Thakur B, Pathak M. Burden of Predominant Psychological Reactions Among the Healthcare Workers and General Population During COVID-19 Pandemic Phase: A Systematic Review and Meta-Analysis. Indian J Community Med. 2021; 46: 600–605. https://doi.org/10.4103/ijcm.IJCM_1007_20 PMID: 35068717

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

80. Xia L, Chen C, Liu Z, Luo X, Guo C, Liu Z, et al. Prevalence of Sleep Disturbances and Sleep Quality in Chinese Healthcare Workers During the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. Front Psychiatry. 2021; 12: 646342. https://doi.org/10.3389/fpsyt.2021.646342 PMID: 33679493

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

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

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

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

85. Blasco-Belled A, Tejada-Gallardo C, Fatsini-Prats M, Alsinet C. Mental health among the general population and healthcare workers during the COVID-19 pandemic: A meta-analysis of well-being and psychological distress prevalence. Curr Psychol. 2022; 1–12. https://doi.org/10.1007/s12144-022-02913-6 PMID: 35250245

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

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

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

89. Li Y, Chen B, Hong Z, Sun Q, Dai Y, Basta M, et al. Insomnia symptoms during the early and late stages of the COVID-19 pandemic in China: a systematic review and meta-analysis. Sleep Medicine. 2022; 91: 262–272. https://doi.org/10.1016/j.sleep.2021.09.014 PMID: 34732293

90. Rezaei S, Hoseinipalangi Z, Rafiei S, Dolati Y, Hosseinifard H, Asl MT, et al. The global Prevalence of Depression among Health Workers during the COVID-19 pandemic: a Systematic review and Meta-analysis. Journal of Affective Disorders Reports. 2022; 8: 100326. https://doi.org/10.1016/j.jadr.2022.100326 PMID: 35165672

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

92. Tran QD, Vu TQC, Phan NQ. Depression prevalence in Vietnam during the Covid-19 pandemic: A systematic review and meta-analysis. Ethics Med Public Health. 2022; 23: 100806. https://doi.org/10.1016/j.jemep.2022.100806 PMID: 35676918

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

94. Zhang L, Yan M, Takashima K, Guo W, Yamada Y. The effect of the COVID-19 pandemic on health care workers' anxiety levels: a meta-analysis. PeerJ. 2022; 10: e13225. https://doi.org/10.7717/peerj.13225 PMID: 35433133

95. Wu T, Jia X, Shi H, Niu J, Yin X, Xie J, et al. Prevalence of mental health problems during the COVID-19 pandemic: A systematic review and meta-analysis. J Affect Disord. 2021; 281: 91–98. https://doi.org/10.1016/j.jad.2020.11.117 PMID: 33310451

96. Andhavarapu S, Yardi I, Bzhilyanskaya V, Lurie T, Bhinder M, Patel P, et al. Post-traumatic stress in healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. Psychiatry Res. 2022; 317: 114890. https://doi.org/10.1016/j.psychres.2022.114890 PMID: 36260970

97. Athe R, Dwivedi R, Singh K, Babusab Hulmani S, Karadi N, Boraiah C, et al. Impact of COVID-19 on the Mental Health of Healthcare Workers and Job Loss From a Gender Perspective in India: A Systematic Review and Meta-Analysis. Cureus. 2023; 15: e48219. https://doi.org/10.7759/cureus.48219 PMID: 38050506

98. Cheung T, Cheng CPW, Fong TKH, Sharew NT, Anders RL, Xiang YT, et al. Psychological impact on healthcare workers, general population and affected individuals of SARS and COVID-19: A systematic review and meta-analysis. Frontiers in Public Health. 2022; 10. Available: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1004558. https://doi.org/10.3389/fpubh.2022.1004558 PMID: 36407973

99. Gheshlagh RG, Hassanpour-Dehkordi A, Moradi Y, Zahednezhad H, Mazaheri E, Kurdi A. Prevalence of Psychological Disorders among Health Workers During the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. Int J Prev Med. 2023; 25–25. https://doi.org/10.4103/ijpvm.ijpvm_212_21 PMID: 37033279

100. Hasen AA, Seid AA, Mohammed AA. Depression and insomnia among healthcare professionals during COVID-19 pandemic in Ethiopia: a systematic review and meta-analysis. PeerJ. 2023; 11: e15039. https://doi.org/10.7717/peerj.15039 PMID: 36967998

101. Khobragade AW, Agrawal N. Prevalence of Stress and Insomnia among Health Care Workers in India during COVID-19 Pandemic: A Systematic Review and Meta-analysis. Indian J Community Med. 2023; 48: 525–532. https://doi.org/10.4103/ijcm.ijcm_482_22 PMID: 37662125

102. Lee BEC, Ling M, Boyd L, Olsson C, Sheen J. The prevalence of probable mental health disorders among hospital healthcare workers during COVID-19: A systematic review and meta-analysis. J Affect Disord. 2023; 330: 329–345. https://doi.org/10.1016/j.jad.2023.03.012 PMID: 36931567

103. Mamun MA, Al-Mamun F, Hosen I, Kaggwa MM, Sikder MT, Muhit M, et al. Prevalence and risk factors of sleep problems in Bangladesh during the COVID-19 pandemic: a systematic review and meta-analysis. Sleep Epidemiol. 2022; 2: 100045. https://doi.org/10.1016/j.sleepe.2022.100045 PMID: 36250199

104. Sharma SK, Joseph J, Dhandapani M, Varghese A, Radha K, Das K, et al. The Psychological Morbidity among Health Care Workers During the Early Phase of Covid-19 Pandemic in India: A Systematic Review and Meta-Analysis. Indian J Community Med. 2023; 48: 12–23. https://doi.org/10.4103/ijcm.ijcm_159_22 PMID: 37082389

105. Tong J, Zhang J, Zhu N, Pei Y, Liu W, Yu W, et al. Effects of COVID-19 pandemic on mental health among frontline healthcare workers: A systematic review and meta-analysis. Front Psychol. 2022; 13: 1096857. https://doi.org/10.3389/fpsyg.2022.1096857 PMID: 36778177

106. Wang J, Luo Z, Liao X, Zeng Y, Zhou J, Liu M, et al. The levels and related factors of posttraumatic growth among nurses: A systematic review and meta-analysis. J Psychiatr Ment Health Nurs. 2023. https://doi.org/10.1111/jpm.12975 PMID: 37724379

107. Sialakis C, Sialaki PA, Frantzana A, Iliadis C, Ouzounakis P, Kourkouta L. Prevalence of anxiety and depression of health care workers during COVID-19 –a systematic review and meta-analysis. Med Pharm Rep. 2023; 96: 246–253. https://doi.org/10.15386/mpr-2579 PMID: 37577023

108. Hasen AA, Seid AA, Mohammed AA. Anxiety and stress among healthcare professionals during COVID-19 in Ethiopia: systematic review and meta-analysis. BMJ Open. 2023; 13: e070367. https://doi.org/10.1136/bmjopen-2022-070367 PMID: 36750289

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

110. WHO. World Health Organization: Depression and Other Common Global Health Estimates. Geneva. Swizerland: World Health Organization; 2017 pp. 1–24. Available: https://scholar.google.com/scholar_lookup?title=Depression%20and%20Other%20Common%20Mental%20Disorders%3A%20Global%20Health%20Estimates&publication_year=2017.

111. Bai Y, Lin C-C, Lin C-Y, Chen J-Y, Chue C-M, Chou P. Survey of stress reactions among health care workers involved with the SARS outbreak. Psychiatr Serv. 2004; 55: 1055–1057. https://doi.org/10.1176/appi.ps.55.9.1055 PMID: 15345768

112. Chen C-S, Wu H-Y, Yang P, Yen C-F. Psychological distress of nurses in Taiwan who worked during the outbreak of SARS. Psychiatr Serv. 2005; 56: 76–79. https://doi.org/10.1176/appi.ps.56.1.76 PMID: 15637196

113. Lancee WJ, Maunder RG, Goldbloom DS, Coauthors for the Impact of SARS Study. Prevalence of psychiatric disorders among Toronto hospital workers one to two years after the SARS outbreak. Psychiatr Serv. 2008; 59: 91–95. https://doi.org/10.1176/ps.2008.59.1.91 PMID: 18182545

114. Tham K, Tan Y, Loh O, Tan W, Ong M, Tang H. Psychological Morbidity among Emergency Department Doctors and Nurses after the SARS Outbreak. Hong Kong Journal of Emergency Medicine. 2005; 12: 215–223. https://doi.org/10.1177/102490790501200404

115. Martin P, Tian E, Kumar S, Lizarondo L. A rapid review of the impact of COVID-19 on clinical supervision practices of healthcare workers and students in healthcare settings. Journal of Advanced Nursing. 2022; 78: 3531–3539. https://doi.org/10.1111/jan.15360 PMID: 35841328

116. Palmer J, Ku M, Wang H, Crosse K, Bennett A, Lee E, et al. Public health emergency and psychological distress among healthcare workers: a scoping review. BMC Public Health. 2022; 22: 1396. https://doi.org/10.1186/s12889-022-13761-1 PMID: 35858867

117. Sheikhbardsiri H, Doustmohammadi MM, Afshar PJ, Heidarijamebozorgi M, Khankeh H, Beyramijam M. Anxiety, stress and depression levels among nurses of educational hospitals in Iran: Time of performing nursing care for suspected and confirmed COVID-19 patients. J Educ Health Promot. 2021; 10: 447. https://doi.org/10.4103/jehp.jehp_1319_20 PMID: 35233394

118. Abd El Ghaffar MM, Salem MR, Al Soda MF, Abd El Razik MS, Tahoon MH, Tahoon MF, et al. COVID-19 Pandemic Preparedness in Egypt's Teaching Hospitals: A Needs Assessment Study. Frontiers in Public Health. 2022; 9. Available: https://www.frontiersin.org/articles/10.3389/fpubh.2021.748666. https://doi.org/10.3389/fpubh.2021.748666 PMID: 35111710

119. Hooper JJ, Saulsman L, Hall T, Waters F. Addressing the psychological impact of COVID-19 on healthcare workers: learning from a systematic review of early interventions for frontline responders. BMJ Open. 2021; 11: e044134. https://doi.org/10.1136/bmjopen-2020-044134 PMID: 34020974

120. Labrague LJ. Psychological resilience, coping behaviours and social support among health care workers during the COVID-19 pandemic: A systematic review of quantitative studies. Journal of Nursing Management. 2021; 29: 1893–1905. https://doi.org/10.1111/jonm.13336 PMID: 33843087

121. Rykkje L, Søvik MB, Ross L, McSherry W, Cone P, Giske T. Educational interventions and strategies for spiritual care in nursing and healthcare students and staff: A scoping review. Journal of Clinical Nursing. 2022; 31: 1440–1464. https://doi.org/10.1111/jocn.16067 PMID: 34611922

122. Schoultz M, McGrogan C, Beattie M, Macaden L, Carolan C, Polson R, et al. Psychological first aid for workers in care and nursing homes: systematic review. BMC Nurs. 2022; 21: 1–6. https://doi.org/10.1186/s12912-021-00740-x PMID: 34983509

123. Chirico F, Nowrouzi-Kia B. Post-COVID-19 syndrome and new challenges posed by climate change require an interdisciplinary approach: the role of occupational health services. J Health Soc Sci. 2022; 2: 132–6.

124. Goldberg SB, Lam SU, Simonsson O, Torous J, Sun S. Mobile phone-based interventions for mental health: A systematic meta-review of 14 meta-analyses of randomized controlled trials. PLOS Digital Health. 2022; 1: e0000002. https://doi.org/10.1371/journal.pdig.0000002 PMID: 35224559

125. Gupta S, Kumar M, Rozatkar AR, Basera D, Purwar S, Gautam D, et al. Feasibility and Effectiveness of Telecounseling on the Psychological Problems of Frontline Healthcare Workers Amidst COVID-19:

A Randomized Controlled Trial from Central India. Indian Journal of Psychological Medicine. 2021; 43: 343–350. https://doi.org/10.1177/02537176211024537 PMID: 34385729

126. Singh S, Sagar R. Tele mental health helplines during the COVID-19 pandemic: Do we need guidelines? Asian J Psychiatr. 2022; 67: 102916. https://doi.org/10.1016/j.ajp.2021.102916 PMID: 34781242

127. Hennessy EA, Johnson BT. Examining Overlap of Included Studies in Meta-Reviews: Guidance for using the Corrected Covered Area Index. Res Synth Methods. 2020; 11: 134–145. https://doi.org/10.1002/jrsm.1390 PMID: 31823513

128. Cooper H, Koenka AC. The overview of reviews: unique challenges and opportunities when research syntheses are the principal elements of new integrative scholarship. Am Psychol. 2012; 67: 446–462. https://doi.org/10.1037/a0027119 PMID: 22352742

129. Munder T, Brütsch O, Leonhart R, Gerger H, Barth J. Researcher allegiance in psychotherapy outcome research: An overview of reviews. Clinical Psychology Review. 2013; 33: 501–511. https://doi.org/10.1016/j.cpr.2013.02.002 PMID: 23500154

130. Chirico F, Magnavita N. Burnout Syndrome and Meta-Analyses: Need for Evidence-Based Research in Occupational Health. Comments on Prevalence of Burnout in Medical and Surgical Residents: A Meta-Analysis. Int. J. Environ. Res. Public. Health. 2019, 16, https://doi.org/10.3390/ijerph16091479. International Journal of Environmental Research and Public Health. 2020; 17: 741. https://doi.org/10.3390/ijerph17030741 PMID: 31979315