

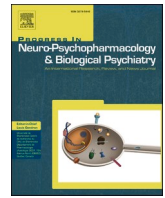


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## Prevalence of anxiety in health care professionals during the COVID-19 pandemic: A rapid systematic review (on published articles in Medline) with meta-analysis

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### ABSTRACT

During the COVID-19, healthcare workers are exposed to a higher risk of mental health problems, especially anxiety symptoms. The current work aims at contributing to an update of anxiety prevalence in this population by conducting a rapid systematic review and meta-analysis. Medline and Pubmed were searched for studies on the prevalence of anxiety in health care workers published from December 1, 2019 to September 15, 2020. In total, 71 studies were included in this study. The pooled prevalence of anxiety in healthcare workers was 25% (95% CI: 21%–29%), 27% in nurses (95% CI: 20%–34%), 17% in medical doctors (95% CI: 12%–22%) and 43% in frontline healthcare workers (95% CI: 25%–62%). Our results suggest that healthcare workers are experiencing significant levels of anxiety during the COVID-19 pandemic, especially those on the frontline and nurses. However, international longitudinal studies are needed to fully understand the impact of the pandemic on healthcare workers' mental health, especially those working at the frontline.

### 1. Introduction

The COVID-19 outbreak has led to an increment of psychological distress levels in the general population. Some contributing risk factors for this increment are the unpredictable nature of the disease, home isolation and confinement, a lack of clarity from leaders regarding the seriousness of the risk, or the emotional contagion between individuals (Huremović, 2019). The psychological impact has been reported to be especially high in healthcare workers (HCW), who face additional group-specific stressors (Cheng and Li Ping Wah Pun Sin, 2020; C. Zhang et al., 2020b). Very intense work-related stressors include long working

hours, strict instructions and safety measures, a permanent need for concentration and vigilance, reduced social contact, and the performance of tasks which they may not have been prepared for (Vieta et al., 2020).

This emotional distress experienced by HCW during the COVID-19 pandemic has been significantly associated with depression, stress and anxiety (Elbay et al., 2020; Lai et al., 2020), with anxiety being frequently observed in HCW (Garcia-Iglesias et al., 2020). Recent studies have shown that frontline HCW may be experiencing the highest levels of anxiety (Buselli et al., 2020), because they are usually responsible for the care of patients with COVID-19, and more mentally overwhelmed by

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the lack of specific treatment guidelines or adequate support (Liu et al., 2020b). A previous study reported that nurses with a higher level of stress were more likely to develop anxiety (Mo et al., 2020) and HCW women seem also to be at higher risk for anxiety (Babore et al., 2020).

Three systematic reviews and meta-analyses have reported prevalence rates of anxiety among HCW during the COVID-19 pandemic. The first, based on 13 cross-sectional studies, reported an overall prevalence of 23.2% (Pappa et al., 2020). The second meta-analysis included seven studies from China and reported an increased risk of anxiety among HCW (OR=1.32, 95%CI=1.09–1.6) compared with other professionals (da Silva and Neto, 2021). The third study found that the prevalence of anxiety and depression was similar among HCW and the general population (33%), but higher among patients with pre-existing conditions and COVID-19 infection (55%) (Luo et al., 2020). These systematic reviews and meta-analyses were conducted in April/May 2020. Since then, there has been a growing number of studies analyzing the prevalence of anxiety in HCW during the COVID-19 pandemic. Thus, the current meta-analysis aims to update the evidence on the prevalence of anxiety in HCW during the COVID-19 pandemic. Furthermore, and due to the evidence that suggests that the psychological impact of the COVID-19 pandemic might differ across different professional categories, we also investigated the prevalence of anxiety separately for professional groups (i.e., medical doctors, nurses, and frontline HCW).

## 2. Materials and methods

This study was conducted in accordance with the PRISMA guidelines for reporting systematic reviews and meta-analysis (Moher et al., 2009) (Table S1).

### 2.1. Search strategy

Two researchers (JBN and MPM) searched for cross-sectional studies reporting the prevalence of anxiety published from December 1, 2019 through September 15, 2020, using MEDLINE via PubMed. The search strategy was: (covid OR covid-19 OR coronavirus OR "corona virus" OR SARS-CoV-2 OR "Coronavirus"[Mesh] OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR "COVID-19"[Supplementary Concept] OR "Coronavirus Infections/epidemiology"[Mesh] OR "Coronavirus Infections/prevention and control"[Mesh] OR "Coronavirus Infections/psychology"[Mesh] OR "Coronavirus Infections/statistics and numerical data"[Mesh]) AND (anxiety OR anxiety symptoms OR anxiety disorders OR anxious OR "Trauma and Stressor Related Disorders"[Mesh] OR "Anxiety"[Mesh] OR "Anxiety Disorders"[Mesh] OR "Anxiety/epidemiology"[Mesh] OR "Anxiety/statistics and numerical data"[Mesh] OR depression OR depressive OR "Depression"[Mesh] OR "Depressive Disorder"[Mesh] OR "Depression/statistics and numerical data"[Mesh]) AND ("health care workers" OR "medical staff" OR "health care professionals" OR "health care workers" OR "health workers" OR "health professionals" OR "health personnel" OR "Health Personnel"[Mesh]). No language restriction was made. References from selected articles were inspected to detect additional potential studies. Any disagreement was resolved by consensus among two more reviewers (JS and BO).

### 2.2. Selection criteria

Studies were included if they: (1) reported cross-sectional data on the prevalence of anxiety during the COVID-19 pandemic; (2) were focused on samples of HCW; and (3) described the methods used to assess or diagnose anxiety. We excluded abstracts without the full text available and review articles.

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

### 2.3. Methodological quality assessment

Articles were assessed by two independent reviewers (JBN and MPM) for methodological validity before inclusion in the review using the Joanna Briggs Institute (JBI) standardized critical appraisal instrument for prevalence studies (Moola et al., 2017). Quality was evaluated with a score of zero or one for each of nine criteria: 1) Was the sample frame appropriate to address the target population?; 2) Were study participants recruited in an appropriate way?; 3) Was the sample size adequate?; 4) Were the study subjects and setting described in detail?; 5) Was data analysis conducted with sufficient coverage of the identified sample?; 6) Were valid methods used for the identification of the condition?; 7) Was the condition measured in a standard, reliable way for all participants?; 8) Was there appropriate statistical analysis?; 9) Was the response rate adequate, and if not, was the low response rate managed appropriately?

Disagreements between the reviewers were resolved through discussions, or by consulting two more reviewers (JS and BO).

### 2.4. Data extraction and statistical analysis

A generic inverse variance method with a random effect model was used to estimate the pooled prevalence (DerSimonian and Laird, 1986). Random-effects model attempts to generalize findings beyond the included studies by assuming that the selected studies are random samples from a larger population (Cheung et al., 2012).

The Hedges Q statistic was reported to check heterogeneity across studies, with statistical significance set at  $p < 0.10$ . The  $I^2$  statistic and 95% confidence interval was also used to quantify heterogeneity (von Hippel, 2015).  $I^2$  values between 25% and 50% are considered as low, 50%–75% as moderate, and 75% or more as high (Higgins et al., 2003). Heterogeneity of effects between studies occurs when differences in results for the same exposure-disease association cannot be fully explained by sampling variation. Sources of heterogeneity can include differences in study design or demographic characteristics. We performed meta-regression and subgroup analyses (Thompson and Higgins, 2002) to explore sources of heterogeneity expected in meta-analyses of observational studies (Egger et al., 1998). We also conducted a sensitivity analysis to determine the influence of each individual study on the overall result by omitting studies one by one. Publication bias was determined through visual inspection of a funnel plot and also with the Egger's test (Egger et al., 1997) ( $p$  value  $< 0.05$  indicates publication bias) since funnel plots were found to be an inaccurate method for assessing publication bias in meta-analyses of proportion studies (Hunter et al., 2014).

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

## 3. Results

### 3.1. Identification and selection of articles

Figure 1 shows the flowchart of the literature search strategy and study selection process. Initially, 354 potential records were identified, from which 1 duplicate was removed, 168 were excluded after screening the titles and abstracts for not meeting the inclusion criteria and 2 of them were then excluded because full text was not available. After reading the remaining 184 articles in full, we finally included 71 in our meta-analysis (Almater et al., 2020; Apisarnthanarak et al., 2020; Ayhan Başer et al., 2020; Badahdah et al., 2020; Cai et al., 2020; Chen et al., 2020b–d; Cheng et al., 2020b; Chew et al., 2020; Civantos et al., 2020; Consolo et al., 2020; Dal' Bosco et al., 2020; Di Tella et al., 2020; Dosil Santamaría et al., 2020; Elbay et al., 2020; Elhadi et al., 2020; Gallopeni et al., 2020; Giusti et al., 2020; Gupta et al., 2020a; Gupta et al., 2020b; Huang et al., 2020a; Huang et al., 2020b; Huang and Zhao, 2020;

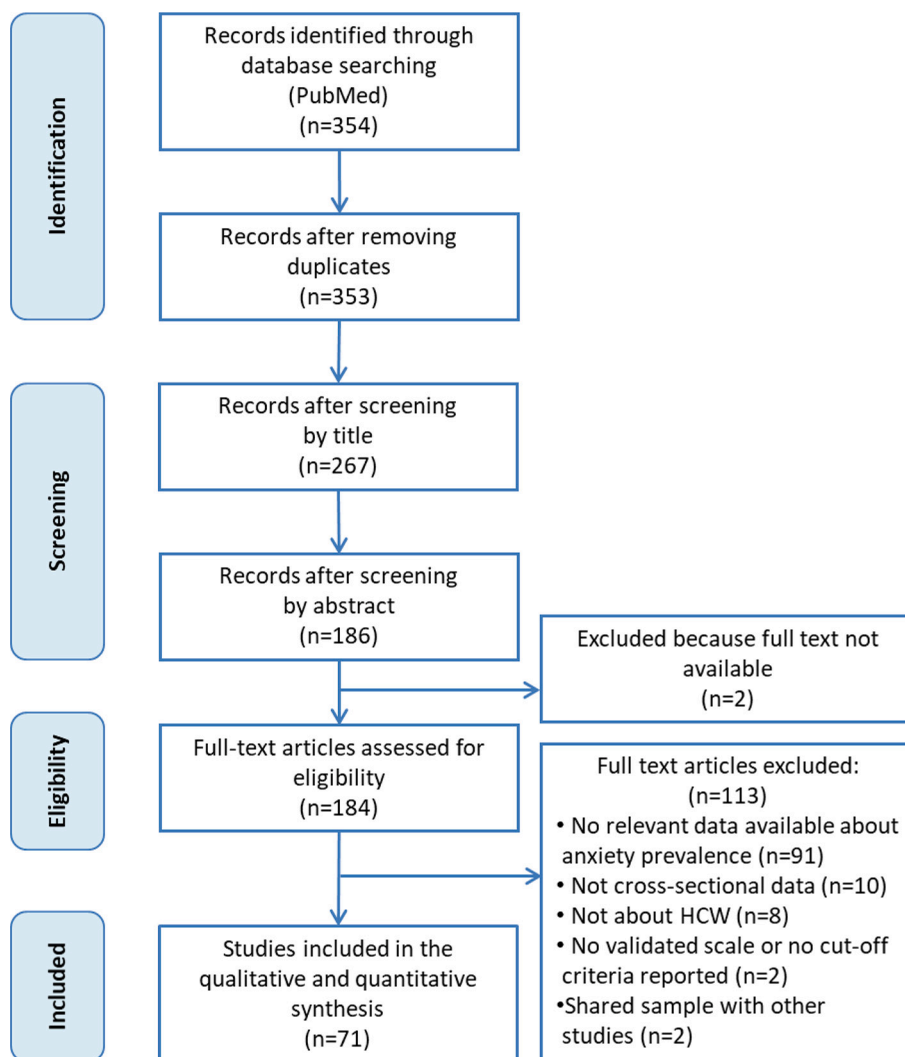


Figure 1. Flowchart of the study selection.

Kannampallil et al., 2020; Keubo et al., 2020; Koksai et al., 2020; Lai et al., 2020; Li et al., 2020b; Li et al., 2020b; Liang et al., 2020; Lin et al., 2020; Liu et al., 2020a, 2020b; Lu et al., 2020; Luceño-Moreno et al., 2020; Magnavita et al., 2020; Mahendran et al., 2020; Naser et al., 2020; Ning et al., 2020; Pouralizadeh et al., 2020; Prasad et al., 2020; Que et al., 2020; Şahin et al., 2020; Salopek-Žiĥa et al., 2020; Sandesh et al., 2020; Si et al., 2020; Skoda et al., 2020; Stojanov et al., 2020; Suryavanshi et al., 2020; Temsah et al., 2020; Teng et al., 2020; Teo et al., 2020; Tu et al., 2020; Vanni et al., 2020; Wang et al., 2020a, 2020b, 2020c, 2020d; Wańkiewicz et al., 2020; Xiao et al., 2020; Xiaoming et al., 2020; Xiong et al., 2020b; Yang et al., 2020a, 2020b; Yáñez et al., 2020; Zhang et al., 2020b; Zhang et al., 2020b; Zhou et al., 2020; Zhu et al., 2020a, 2020b).

### 3.2. Characteristics of the included studies

Table 1 shows the characteristics of those studies (n = 59) that reported prevalence rates of anxiety in HCW (without distinction of the type of workers); Table 2 displays characteristics of studies reporting data from nurses (n = 17); Table 3 for medical doctors (n = 13), and Table 4 for frontline HCW (n = 13).

The sample size of the studies ranged from 46 to 8817 participants. Only 30 studies reported the mean age of participants, which ranged from 29 to 47 years. All but two studies included men and women, with women outnumbering men in most of the studies that included this data

(58/65). Fifty studies included general samples of HCWs, with 13 of these also including data on specific subgroups: nurses and doctors (7 studies), frontline HCWs (4 studies), and nurses, doctors and workers assisting COVID-19 patients (Frontline HCW). Four studies included samples of pediatric HCWs, with data specifically on nurses and doctors in only one of these. Five studies only included frontline HCW, with one providing data on subsamples of frontline nurses and doctors. Three studies focused only on nurses, and another two on frontline nurses, while two studies only included doctors. The remaining 5 studies focused on professional groups considered to be HCW: dental workers, laboratory HCW, physiotherapists, and non-physician HCW (with a subpopulation of nurses). A total of 33 studies were conducted in China, 5 studies in Italy, 4 studies were from Turkey, 3 studies from each of India and USA, 2 studies from Ecuador, Peru, Saudi Arabia, Singapore, Spain, and a single study from each of Bolivia, Brazil, Cameroon, Croatia, Germany, Iran, Jordan, Kosovo, Libya, Nepal, Oman, Pakistan, Poland, Serbia, South Korea and Thailand. All studies were performed using online questionnaires, and of those that reported sampling methodology, all but four used non-random approaches. The response rate was reported by 38 studies and ranged from 18.5% to 100%. All studies measured anxiety by means of standardized scales, most commonly the Generalized Anxiety Disorder scale (GAD, 35 studies), the Zung Self-rating Anxiety Scale (SAS, 10 studies), the Hospital Anxiety and Depression Scale (HADS, 10 studies), and the Depression, Anxiety, and Stress Scale (DASS, 9 studies).

**Table 1**  
 Characteristics of the studies included in the meta-analysis based on samples of healthcare workers.

Author (Publication year)	Population	Country	Mean age (SD)	% Females (n)	Sample size (n)	Response rate (%)	Sampling method	Anxiety assessment	Diagnostic Criteria	Prevalence		Quality assessment
										%	n	
Apisarntharak et al. (2020)	HCW	Thailand	32 (23-62)	59.00% (95)	160	NR	NR	GAD-7	≥10	19.38%	31	6
Ayhan Başer et al. (2020)	HCW	Turkey	NR	NR	426	98%	NR	BAI	≥16	24.41%	104	7
Badahdah et al. (2020)	HCW	Oman	37.67 (7.68)	80.30% (407)	509	NR	NR	GAD-7	≥10	25.93%	132	7
Chen et al. (2020b)	HCW	China	36.54 (8.57)	68.63% (619)	902	NR	Convenience	GAD-7	≥10	16.63%	150	7
Chen et al. (2020c)	HCW	Ecuador	NR	34.52% (87)	252	62.84%	Convenience	GAD-7	≥10	28.17%	71	7
Chen et al., (2020d)	Pediatric HCW	China	32.6 (6.5)	90.48% (95)	105	84.68%	NR	SAS	≥50	18.10%	19	7
Cheng et al. (2020b)	Pediatric HCW	China	NR	82.4% (440)	534	NR	Convenience	SAS	≥50	14.00%	75	7
Chew et al. (2020)	HCW	India, Singapore	29 (NR)	64.3% (583)	906	90.60%	NR	DASS-21	≥10	8.72%	79	8
Consolo et al. (2020)	Dental Workers	Italy	NR	39.6% (141)	356	40.00%	Convenience	GAD-7	≥10	23.88%	85	7
Di Tella et al. (2020)	HCW	Italy	42.9 (11.2)	72.4% (105)	145	NR	Convenience	STAI-S	≥41	71.03%	103	6
Dosil Santamaria et al. (2020)	HCW	Spain	42.8 (10.2)	80.29% (338)	421	NR	Snowball	DASS-21	≥10	28.74%	121	7
Elbay et al. (2020)	HCW	Turkey	36.05 (8.69)	56.8% (251)	442	NR	Convenience	DASS-21	≥10	35.29%	156	7
Elhadi et al. (2020)	HCW	Libya	33.3 (7.4)	51.94% (387)	745	93.13%	Convenience	HADS	>10	46.71%	348	8
Gallopeni et al. (2020)	HCW	Kosovo	39 (10.37)	61.32% (363)	592	NR	NR	HADS	>10	44.59%	264	7
Giusti et al. (2020)	HCW	Italy	44.6 (13.5)	62.42% (206)	330	41.25%	Convenience	STAI-S	≥40	71.20%	235	7
Gupta et al. (2020a)	HCW	Nepal	29.5 (6.1)	52.67% (79)	150	NR	Snowball	GAD-7	≥10	10.00%	15	6
Gupta et al. (2020b)	HCW	India	NR	36.12% (406)	1124	79.45%	Quota	HADS	>7	37.19%	418	8
Huang and Zhao (2020)	HCW	China	NR	NR	2250	85.30%	Convenience	GAD-7	≥9	35.64%	802	7
Huang et al. (2020a)	HCW	China	NR	81.30% (187)	230	93.50%	Cluster	SAS	≥50	23.04%	53	8
Huang et al. (2020b)	HCW	China	NR	58.79% (214)	364	96.55%	Cluster	SAS	≥50	23.35%	85	9
Kannampallil et al. (2020)	HCW	USA	NR	54.96% (216)	393	28.58%	NR	DASS-21	≥8	18.58%	73	6
Keubo et al. (2020)	HCW	Cameroon	NR	54.45% (159)	292	NR	Snowball	HADS	>10	42.12%	123	6
Koksal et al. (2020)	HCW	Turkey	35.6 (8.5)	70.1% (492)	702	NR	NR	HADS	>10	57.55%	404	7
Lai et al. (2020)	HCW	China	NR	76.69% (964)	1257	68.69%	Convenience	GAD-7	≥10	12.25%	154	8
Li et al. (2020a)	HCW	China	NR	100% (4369)	4369	82.17%	Convenience	GAD-7	≥8	25.20%	1101	8
Liang et al. (2020)	HCW	China	NR	81.31% (731)	899	NR	Convenience	GAD-7	≥10	14.24%	128	7
Lin et al. (2020)	HCW	China	NR	NR	2316	NR	Convenience	GAD-7	>5	41.11%	952	6
Liu et al. (2020b)	HCW	China	NR	84.57% (433)	512	85.33%	Convenience	SAS	≥50	12.50%	64	8
Liu et al. (2020a)	Pediatric HCW	China	NR	85.52% (1737)	2031	NR	Convenience	DASS-21	≥10	12.21%	248	7
Lu et al. (2020)	HCW	China	NR	77.64% (1785)	2299	94.88%	NR	HAMA	≥7	24.75%	569	8
Magnavita et al. (2020)	HCW	Italy	NR	70.10% (417)	595	73.46%	Convenience	GADS	≥5	16.64%	99	8
Mahendran et al. (2020)	Dental Workers	China	NR	72.5% (87)	120	96.00%	Convenience	GAD-7	≥10	32.50%	39	7
Naser et al. (2020)	HCW	Jordan	NR	56.1% (653)	1163	NR	Convenience	GAD-7	≥10	32.76%	381	7
Ning et al. (2020)	HCW	China	NR	72.88% (446)	612	NR	Snowball	SAS	≥50	16.34%	100	7
Prasad et al. (2020)	Nonphysician HCW	USA	NR	90.8% (315)	347	NR	Convenience	GAD-7	≥10	31.70%	110	7
Que et al. (2020)	HCW	China	31.06 (6.99)	69.06% (1578)	2285	NR	Convenience	GAD-7	≥10	11.60%	265	7
Şahin et al. (2020)	HCW	Turkey	NR	66.03% (620)	939	NR	Convenience	GAD-7	≥10	18.96%	178	7
Salopek-Ziha et al. (2020)	HCW	Croatia	NR	NR	124	NR	Convenience	DASS-21	≥10	16.94%	21	5
Si et al. (2020)	HCW	China	NR	70.68% (610)	863	76.00%	Convenience	DASS-21	≥10	7.88%	68	8
Skoda et al. (2020)	HCW	Germany	NR	75.99% (1690)	2224	NR	Convenience	GAD-7	≥10	9.49%	211	6

(continued on next page)

Table 1 (continued)

Author (Publication year)	Population	Country	Mean age (SD)	% Females (n)	Sample size (n)	Response rate (%)	Sampling method	Anxiety assessment	Diagnostic Criteria	Prevalence		Quality assessment
										%	n	
Stojanov et al. (2020)	HCW	Serbia	40.5 (8.37)	66.17% (133)	201	NR	NR	GAD-7	≥10	25.37%	51	6
Suryavanshi et al. (2020)	HCW	India	NR	51.27% (101)	197	20.40%	Snowball	GAD-7	≥9	28.43%	56	6
Temsah et al. (2020)	HCW	Saudi Arabia	NR	75.09% (437)	582	71.76%	Convenience	GAD-7	≥10	31.79%	185	8
Teng et al. (2020)	HCW	China	NR	NR	338	NR	Snowball	SAS	≥50	13.31%	45	6
Teo et al. (2020)	Laboratory HCW	Singapore	34 (NR)	73.77% (90/122)	103	84.43%	NR	GAD-7	≥10	24.27%	25	7
Vanni et al. (2020)	HCW	Italy	47 (10.37)	65.22% (30)	46	90.20%	Convenience	DASS-21	≥10	28.26%	13	7
Wang et al. (2020a)	HCW	China	NR	85.84% (897)	1045	73.18%	Convenience	HADS	>10	20.00%	209	7
Wang et al. (2020d)	HCW	China	37 (NR)	77.37% (212)	274	NR	Convenience	GAD-7	≥10	13.87%	38	6
Wang et al. (2020c)	Pediatric HCW	China	33.75 (8.41)	90.24% (111)	123	52.44%	Convenience	SAS	≥50	7.32%	9	7
Wang et al. (2020b)	HCW	China	33.5 (8.89)	64.52% (1291)	2001	72.06%	Convenience	HADS	>7	22.59%	452	8
Wańkiewicz et al. (2020)	HCW	Poland	40.25 (5.25)	52.15% (230)	441	NR	NR	GAD-7	>5	64.40%	284	7
Xiao et al. (2020)	HCW	China	NR	67.22% (644)	958	NR	Convenience	HADS	>7	54.07%	518	6
Xiaoming et al. (2020)	HCW	China	33.25 (8.26)	77.93% (6874)	8817	90.62%	Convenience	GAD-7	≥10	5.09%	449	8
Yang et al. (2020a)	Physical Therapists	South Korea	NR	47.69% (31)	65	89.04%	Convenience	GAD-7	>5	32.31%	21	7
Yang et al. (2020b)	HCW	China	NR	NR	449	91.08%	Convenience	SAS	≥40 (raw)	29.18%	131	7
Yáñez et al. (2020)	HCW	Peru	NR	64.03% (194)	303	75.75%	NR	GAD-7	≥10	21.78%	66	7
Zhang et al. (2020a)	HCW	China	NR	82.73% (1293)	1563	80.32%	Convenience	GAD-7	≥10	12.92%	202	8
Zhang et al. (2020b)	HCW	Bolivia, Ecuador, Peru	38.9 (10.1)	67.98% (484)	712	59.2%	Cluster	GAD-7	≥10	23.03%	164	9
Zhu et al. (2020b)	HCW	China	NR	85.03% (4304)	5062	77.07%	Convenience	GAD-7	≥8	24.06%	1218	8

Note. \*Quality score based on the Joanna Briggs Institute (JBI) standardized critical appraisal instrument for prevalence studies (Moola et al., 2017; see Table S2). HCW = Healthcare workers; NR =not reported; BAI = Beck Anxiety Inventory; DASS-21 = Depression, Anxiety and Stress scales; GAD-7 = General Anxiety Disorder-7; HADS = Hospital Anxiety and Depression Scale; HAMA = Hamilton Anxiety Rating Scale; SAS = Zung Self-Rating Scale; STAI-S = State-trait Anxiety Scale.

**Table 2**  
Characteristics of the studies included in the meta-analysis based on samples of nurses.

Author (Publication year)	Population	Country	Mean age (SD)	% Females (n)	Sample size (n)	Response rate (%)	Sampling method	Anxiety assessment	Diagnostic Criteria	Prevalence		Quality assessment
										%	n	
Dal' Bosco et al. (2020)	Nurses	Brazil	NR	79% (89.8)	88	18.49%	Convenience	HADS	>7	48.90%	43	6
Gupta et al. (2020b)	Nurses	India	NR	NR	207	79.45%	Quota	HADS	>7	49.76%	103	6
Huang et al. (2020a)	Nurses	China	NR	NR	160	93.50%	Cluster	SAS	≥50	26.88%	43	7
Keubo et al. (2020)	Nurses	Cameroon	NR	NR	168	NR	Snowball	HADS	>10	44.64%	75	5
Lai et al. (2020)	Nurses	China	NR	90.84% (694)	764	68.69%	Convenience	GAD-7	≥10	12.70%	97	8
Li et al. (2020b)	Frontline Nurses	China	NR	77.27% (136)	176	NR	Convenience	HAMA	≥7	77.27%	136	6
Liu et al. (2020a)	Nurses	China	NR	NR	1173	NR	Convenience	DASS-21	≥10	12.87%	151	6
Ning et al. (2020)	Nurses	China	NR	97.97% (289)	295	NR	Snowball	SAS	≥50	20.34%	60	6
Pouralizadeh et al. (2020)	Nurses	Iran	36.34 (8.74)	95.2% (420)	441	NR	NR	GAD-7	≥10	38.78%	171	7
Prasad et al. (2020)	Nurses	USA	NR	93.1% (231)	248	NR	Convenience	GAD-7	≥10	34.27%	85	6
Que et al. (2020)	Nurses	China	35.94 (8.17)	97.75% (195)	208	NR	Convenience	GAD-7	≥10	14.90%	31	6
Şahin et al. (2020)	Nurses	Turkey	NR	NR	254	NR	Convenience	GAD-7	≥10	21.65%	55	5
Skoda et al. (2020)	Nurses	Germany	NR	86.83% (1511)	1511	NR	Convenience	GAD-7	≥10	11.38%	172	6
Tu et al. (2020)	Frontline Nurses	China	34.44 (5.85)	100% (100)	100	100%	Cluster	GAD-7	≥10	7.00%	7	8
Wang et al. (2020a)	Nurses	China	NR	NR	773	73.18%	Convenience	HADS	>10	20.70%	160	7
Xiong et al. (2020a)	Nurses	China	NR	97.31 (217)	223	61.80%	Convenience	GAD-7	≥10	12.11%	27	7
Zhu et al. (2020a)	Frontline Nurses	China	NR	NR	86	NR	Convenience	SAS	≥50	27.91%	24	5

Note. \*Quality score based on the Joanna Briggs Institute (JBI) standardized critical appraisal instrument for prevalence studies (Moola et al., 2017; see Table S2). NR = not reported; DASS-21 = Depression, Anxiety and Stress scales; GAD-7 = General Anxiety Disorder-7; HADS = Hospital Anxiety and Depression Scale; HAMA = Hamilton Anxiety Rating Scale; SAS = Zung Self-Rating Scale.

### 3.3. Quality assessment

The risk of bias scores ranged from 5 to 9, with a mean score of 7.01 (Table S2). The most common sources of bias were: (a) recruitment of inappropriate participants (67 studies), (b) response rate not reported or large number of non-responders (39 studies), and (c) sample size too small to ensure good precision of the final estimate (24 studies).

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

The estimated overall prevalence of anxiety was 25% in overall samples of HCW (95% CI: 21%–29%) (Fig. 2), 27% in nurses (95% CI: 20%–34%) (Fig. 3), 17% in medical doctors (95% CI: 12%–22%) (Fig. 4), and 43% in Frontline HCW (95% CI: 25%–62%) (Fig. 5), with significant heterogeneity between studies ( $Q$  test:  $p < 0.001$ ) in HCW overall, nurses, doctors and frontline HCW.

### 3.5. Meta-regression and subgroup analysis

Potential sources of heterogeneity were investigated across the studies. Our subgroup analysis showed that the prevalence of anxiety was lower for studies using the DASS-21, a convenience sampling method, with high methodological quality, or studies conducted in China (Table 5).

### 3.6. Sensitive analysis

Excluding each study one-by-one from the analysis did not

substantially change the pooled prevalence of anxiety. This indicated that no single study had a disproportional impact on the overall prevalence (data not shown).

### 3.7. Risk of publication bias

Visual inspection of the funnel plot (Fig. 6) suggested a small publication bias for the estimation of the pooled prevalence in HCW, nurses and medical doctors, confirmed by significant Egger's test results ( $p < 0.05$ ). In contrast, no publication bias was identified in the estimation of the pooled prevalence in frontline HCW (Egger's test:  $p = 0.804$ ).

## 4. Discussion

### 4.1. Summary of main findings

The COVID-19 pandemic is having an unprecedented impact on HCW, with anxiety being one of most commonly reported mental condition. The present study provides an up-to-date meta-analysis of studies reporting the prevalence of anxiety in HCW during the COVID-19 pandemic. Our meta-analysis is based on 71 studies, and to the best of our knowledge, we are the first to report overall prevalence rates of anxiety in different occupational categories of HCW (i.e., nurses, medical doctors and frontline HCW). Our findings show that HCW, nurses and doctors report high anxiety levels (25%, 27% and 17%, respectively), and up to 43% of the frontline HCW display high levels of anxiety symptoms. The prevalence found in HCW is similar to the one reported by Pappa et al. (23.2%) (Pappa et al., 2020) but lower than the

**Table 3**  
Characteristics of the studies included in the meta-analysis based on samples of medical doctors.

Author (Publication year)	Population	Country	Mean age (SD)	% Females (n)	Sample size (n)	Response rate (%)	Sampling method	Anxiety assessment	Diagnostic Criteria	Prevalence		Quality assessment
										%	n	
Almater et al. (2020)	MD	Saudi Arabia	32.9 (9.6)	43.9% (47)	107	30.60%	Convenience sampling	GAD-7	≥10	21.50%	23	6
Civantos et al. (2020)	MD	USA	NR	39.26% (137)	349	NR	Convenience sampling	GAD-7	≥10	18.91%	66	7
Gupta et al. (2020b)	MD	India	NR	NR	749	79.45%	Quota sampling	HADS	>7	35.25%	264	7
Huang et al. (2020a)	MD	China	NR	NR	70	93.50%	Cluster Sampling	SAS	≥50	14.29%	10	7
Keubo et al. (2020)	MD	Cameroon	NR	NR	74	NR	Snowball sampling	HADS	>10	36.49%	27	5
Lai et al. (2020)	MD	China	NR	54.77% (270)	493	68.69%	Convenience sampling	GAD-7	≥10	11.56%	57	8
Liu et al. (2020a)	MD	China	NR	NR	858	NR	Convenience sampling	DASS-21	≥10	11.31%	97	6
Ning et al. (2020)	MD	China	NR	49.53% (157)	317	NR	Snowball sampling	SAS	≥50	12.62%	40	6
Que et al. (2020)	MD	China	33.69 (7.44)	63.49% (546)	860	NR	Convenience sampling	GAD-7	≥10	11.98%	103	7
Şahin et al. (2020)	MD	Turkey	NR	NR	580	NR	Convenience sampling	GAD-7	≥10	18.62%	108	6
Skoda et al. (2020)	MD	Germany	NR	65.65% (323)	492	NR	Convenience sampling	GAD-7	≥10	5.89%	29	7
Wang et al. (2020a)	MD	China	NR	NR	149	73.18%	Convenience sampling	HADS	>10	20.13%	30	6
Zhu et al. (2020a)	Frontline MD	China	NR	64.56% (51)	79	NR	Convenience sampling	SAS	≥50	11.39%	9	6

Note. \*Quality score based on the Joanna Briggs Institute (JBI) standardized critical appraisal instrument for prevalence studies (Moola et al., 2017; see Table S2). MD = Medical doctor; NR = not reported; DASS-21 = Depression, Anxiety and Stress scales; GAD-7 = General Anxiety Disorder-7; HADS = Hospital Anxiety and Depression Scale; SAS = Zung Self-Rating Scale.

**Table 4**  
Characteristics of the studies included in the meta-analysis based on samples of frontline healthcare workers.

Author (Publication year)	Population	Country	Mean age (SD)	% Females (n)	Sample size (n)	Response rate (%)	Sampling method	Anxiety assessment	Diagnostic Criteria	Prevalence		Quality assessment
										%	n	
Cai et al. (2020)	Frontline HCW	China	30.6 (8.8)	68.82% (819)	1173	NR	Non-probabilistic sampling	BAI	≥16	15.69%	184	7
Kannampallil et al. (2020)	Frontline HCW	USA	NR	51.38% (112)	218	15.85%	NR	DASS-21	≥8	21.56%	47	5
Lai et al. (2020)	Frontline HCW	China	NR	NR	522	68.69%	Convenience sampling	GAD-7	≥10	16.09%	84	7
Li et al. (2020b)	Frontline Nurses	China	NR	77.27% (136)	176	NR	Convenience sampling	HAMA	≥7	77.27%	136	6
Luceño-Moreno et al. (2020)	Frontline HCW	Spain	43.88 (10.82)	86.40% (1228)	1422	92.40%	Non probabilistic sampling	HADS	≥7	79.32%	1128	8
Sandesh et al. (2020)	Frontline HCW	Pakistan	NR	42.86% (48)	112	NR	Convenience sampling	DASS-21	≥10	85.71%	96	5
Stojanov et al. (2020)	Frontline HCW	Serbia	39.1 (7.3)	65.25% (77)	118	NR	NR	GAD-7	≥10	31.36%	37	6
Tu et al. (2020)	Frontline Nurses	China	34.44 (5.85)	100% (100)	100	100%	Cluster Sampling	GAD-7	≥10	7.00%	7	8
Wang et al. (2020a)	Frontline HCW	China	NR	NR	401	73.18%	Convenience sampling	HADS	>10	24.69%	99	7
Wang et al. (2020b)	Frontline HCW	China	NR	59.46% (393)	661	72.06%	Convenience sampling	HADS	>7	28.74%	190	8
Wańkiewicz et al. (2020)	Frontline HCW	Poland	40.47 (4.93)	56.31% (116)	206	NR	NR	GAD-7	>5	99.03%	204	6
Zhou et al. (2020)	Frontline HCW	China	35.77 (8.13)	81.19% (492)	606	NR	NR	GAD-7	>5	45.38%	275	7
Zhu et al. (2020a)	Frontline HCW	China	34.16 (8.06)	83.03% (137)	165	NR	Convenience sampling	SAS	≥50	20.00%	33	6

Note. \*Quality score based on the Joanna Briggs Institute (JBI) standardized critical appraisal instrument for prevalence studies (Moola et al., 2017; see Table S2). HCW = healthcare workers; NR = not reported; BAI = Beck Anxiety Inventory; DASS-21 = Depression, Anxiety and Stress scales; GAD-7 = General Anxiety Disorder-7; HADS = Hospital Anxiety and Depression Scale; HAMA = Hamilton Anxiety Rating Scale; SAS = Zung Self-Rating Scale.



## Prevalence of Anxiety in Health Care Workers

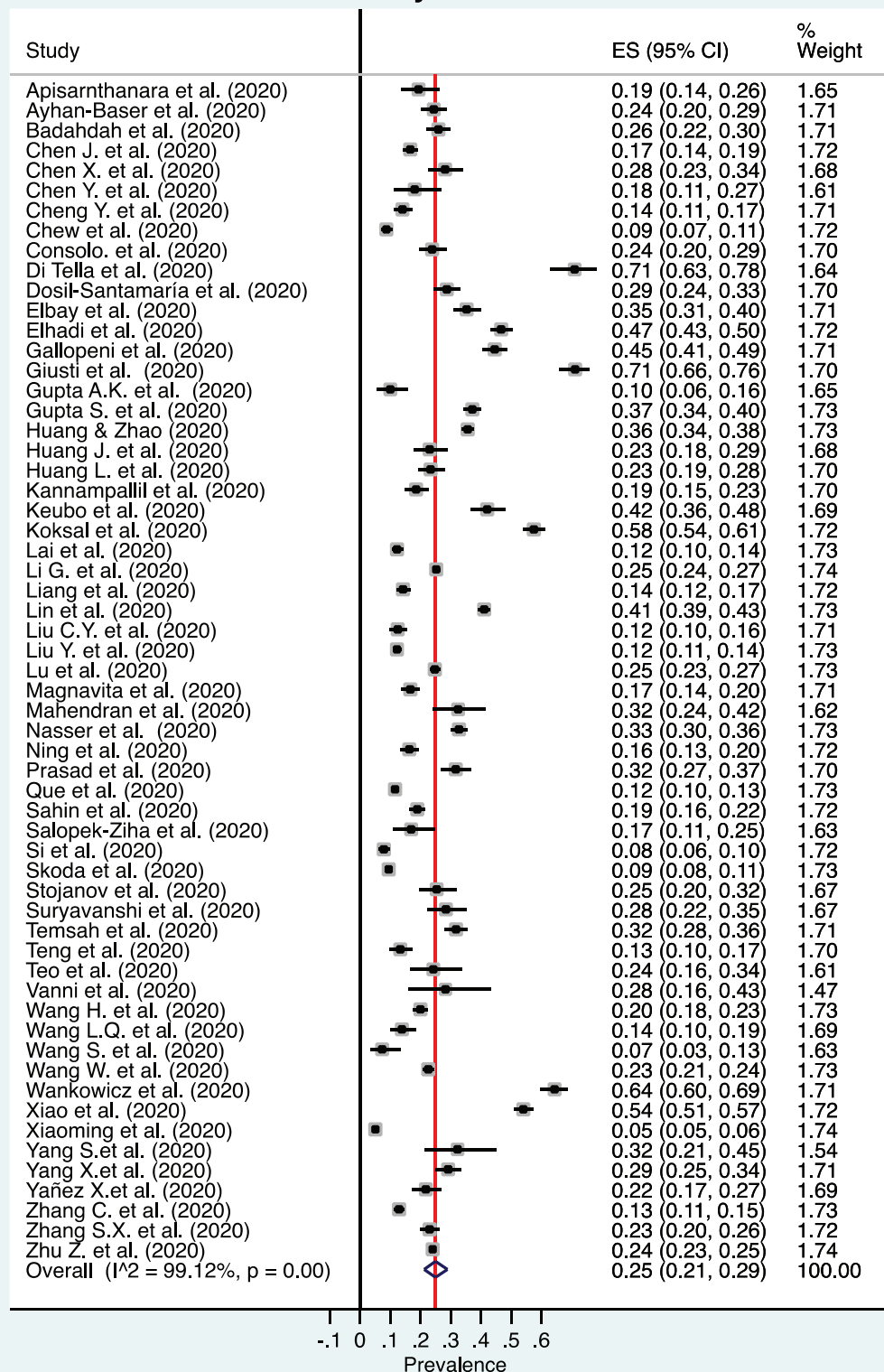


Figure 2. Forest plot for the prevalence of anxiety among healthcare workers

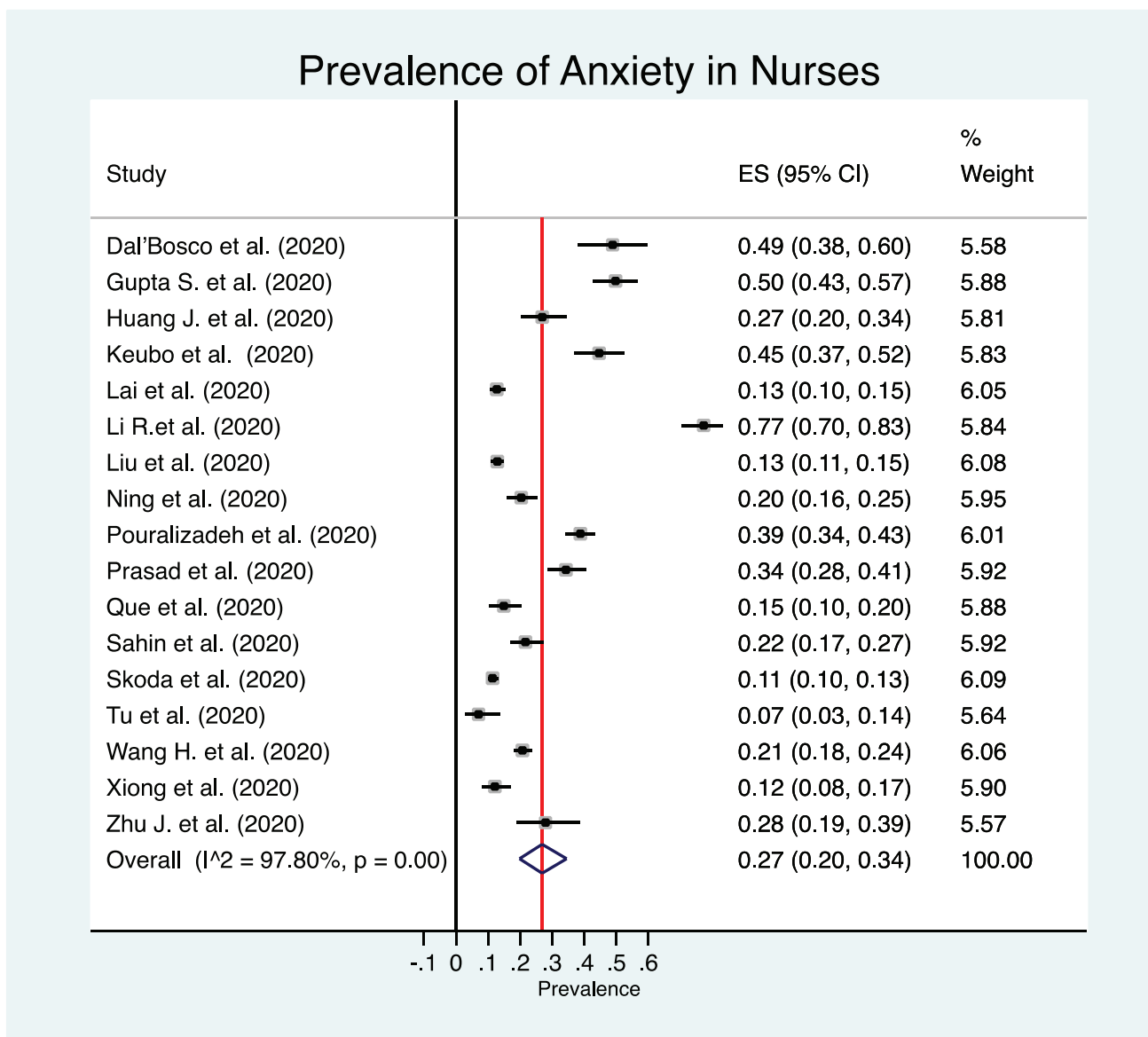


Figure 3. Forest plot for the prevalence of anxiety among nurses.

one reported by Luo et al. (33%) (Luo et al., 2020). These discrepancies might be explained in light of the different number of studies included or the origin of the samples (i.e., China).

Some previous systematic reviews and meta-analyses have been conducted to report the prevalence of anxiety in the general population. A recent meta-analysis conducted from December 2019 to August 2020 and based on 43 population-based studies reported an overall prevalence of anxiety of 25% (Santabárbara et al., 2021). Similarly, a recent systematic review (Xiong et al., 2020a) found that the prevalence of anxiety symptoms ranged from 6.3% to 50.9% in the general population during the COVID-19 outbreak (based on 11 population-based studies). The present study reports similar prevalence rates of anxiety in HCW to that reported in the general population, although the proportion of anxiety in frontline HCW appears to be higher (43%).

The finding of frontline HCW as the workers with the highest levels of anxiety is consistent with previous literature (Alshekaili et al., 2020; Buselli et al., 2020; Cabarkapa et al., 2020). Frontline HCW are directly responsible for caring for patients with COVID-19, and are exposed to several risk factors for anxiety such as burnout, lack of treatment guidelines, and feeling inadequately supported (Lai et al., 2020;

Rajkumar, 2020). The exposure to critical medical situation and death and trauma make frontline HCW especially vulnerable to post-traumatic stress disorder (PTSD) (Carmassi et al., 2020). Despite the fact that the present meta-analysis is based on studies that evaluated anxiety symptoms with standardized questionnaire, they correspond to overall anxiety, but do not specifically assess the presence of PTSD. However, symptoms of PTSD might be also indirectly captured by these instruments.

The relatively high anxiety levels observed in nurses (27%) is also consistent with some previous reports showing that nurses are particularly affected by severe emotional distress (Dennison Himmelfarb and Baptiste, 2020). Nurses have direct contact with patients and therefore have more direct emotional contact. Recent systematic reviews have shown that being a nurse in the COVID-19 pandemic is a risk factor for anxiety (Cabarkapa et al., 2020; Sanghera et al., 2020). Factors promoting anxiety include fear of being infected or infecting others (Mo et al., 2020), lack of personal protective equipment, lack of access to COVID-19 testing, and lack of accurate information about the disease (Shanafelt et al., 2020).

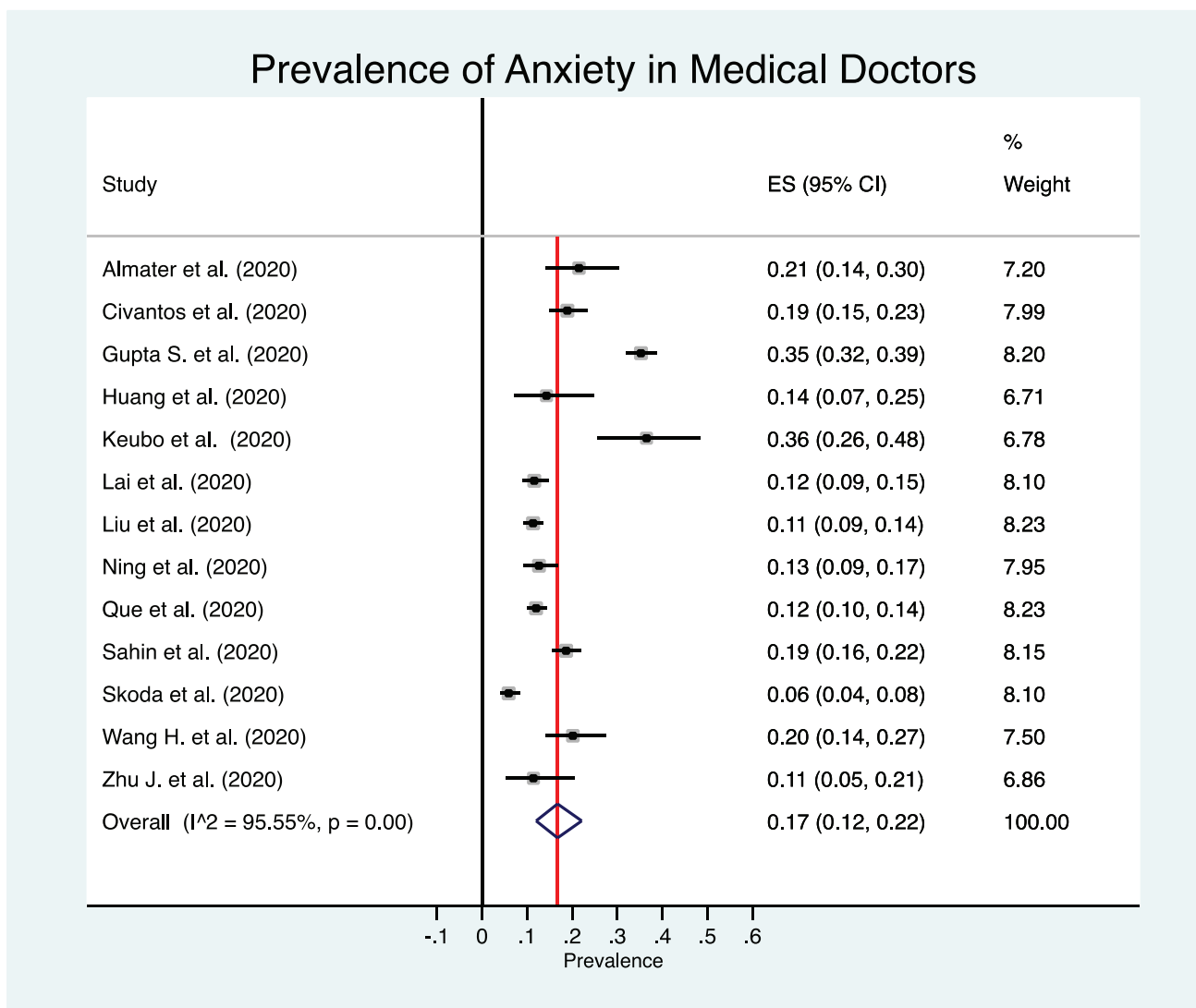


Figure 4. Forest plot for the prevalence of anxiety among medical doctors.

#### 4.2. Strengths and limitations

Some strengths of our meta-analysis are the inclusion of a large body of literature and the use of a rigorous approach to identify publication bias (i.e., Egger’s test). These results show that there is a small bias in the estimation of the pooled prevalence of anxiety for HCW, nurses and medical doctors but null for frontline HCW.

However, some limitations should be considered when interpreting our results. First, the majority of the studies included were based on cross-sectional data and non-probabilistic samples. The epidemiological status of COVID-19 is constantly changing worldwide, and thus longitudinal studies are necessary to determine whether the elevated levels anxiety are sustained, reduced or increased over time (Pierce et al., 2020). Second, the studies used a variety of self-report anxiety scales, and the use of some tests was associated with significantly higher prevalence of anxiety than others. Ideally, studies should use the same measure of anxiety, and if possible, include a diagnosis based on clinical interviews. However, this is not always possible, and the use of brief, self-reported standardized questionnaires appears as a common practice in epidemiological studies. Finally, while we were able to include studies from many countries, the majority of studies were focused on Asian countries, particularly on Chinese samples. Europe and America are both highly affected by the COVID-19 pandemic, thus there is still

need for epidemiological studies in these regions using randomized sampling design, when possible.

#### 5. Conclusions

This meta-analysis confirms the huge mental toll of the COVID-19 pandemic in HCW, especially in frontline HCW and nurses. Therefore, there is an urgent need to prevent and treat common mental health problems in this population. Several strategies have been recommended to support the mental health and well-being of HCW. These include accurate work-related information, regular breaks, adequate rest and sleep, a healthy diet, physical activity, peer support, family support, avoidance of unnecessary coping strategies, limiting the use of social media and professional counselling or psychological services (Pollock et al., 2020). In addition, psychological support based on coping strategies should be provided to control anxiety. Spiritual care programs and other approaches developed for end-of-life and palliative care could also be helpful (Chirico et al., 2020).

Since the beginning of the COVID-19 pandemic, psychological support for health workers has been implemented in different countries. In China, different groups of mental health providers used social networking platforms and telephone aids to implement mental health support by offering guidance and supervision to solve psychological

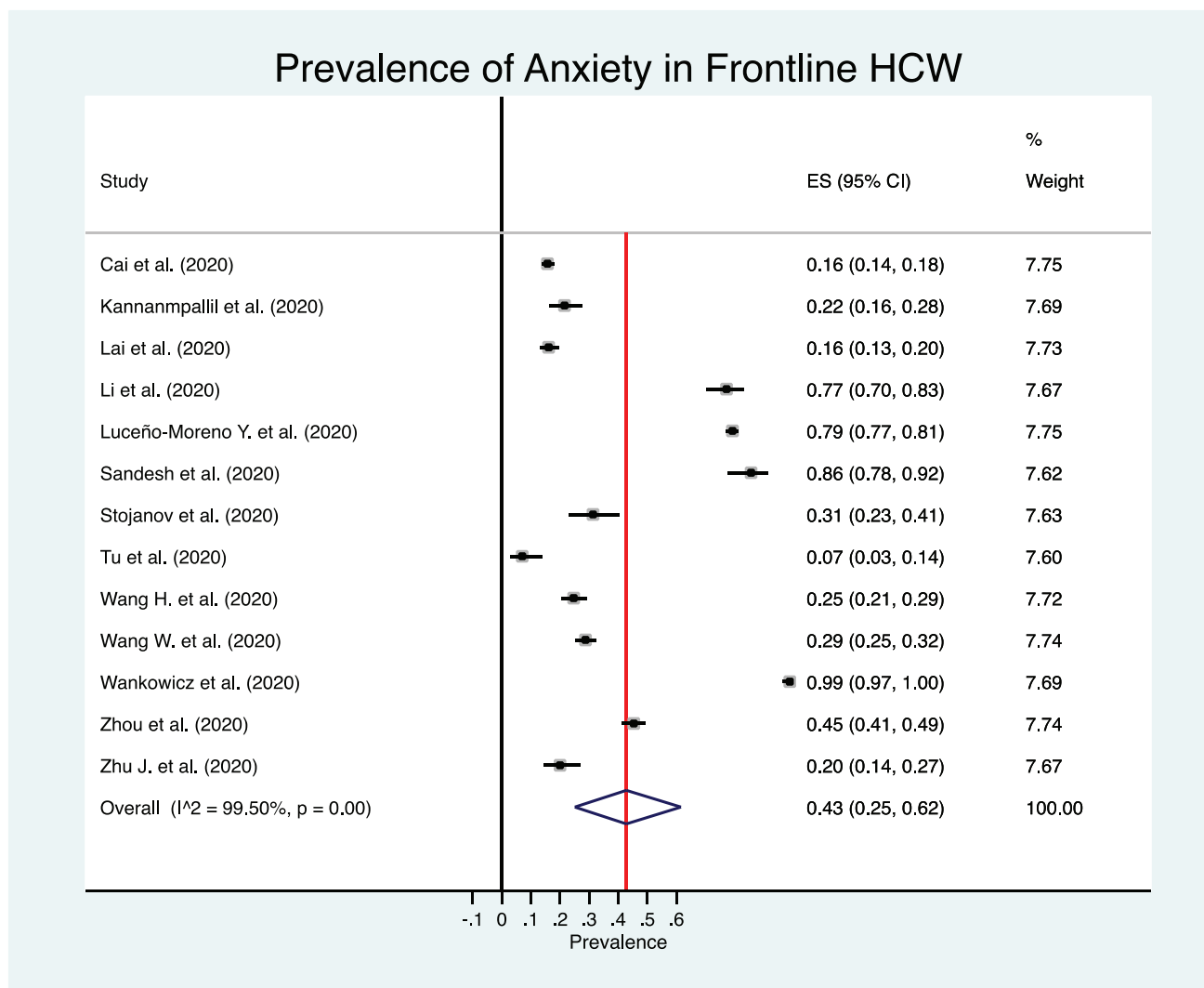


Figure 5. Forest plot for the prevalence of anxiety among frontline healthcare workers.

problems (Chen et al., 2020a; Cheng et al., 2020a). In Iran, consistent measures were taken to prevent, screen and treat mental health disorders among staff serving patients with COVID-19 (Zandifar et al., 2020). In the UK, in the first three weeks of the outbreak, a digital learning package was developed and evaluated. This e-learning package included evidence-based guidance, support and signage related to psychological well-being for all health care workers in the UK (Blake et al., 2020). In Spain, the Ministry of Health and the General Council of Psychologists activated a telephone support line for professionals with direct intervention in the management of the pandemic, such as health frontline care workers (Spanish Government, 2020). Finally, it is worth to mention the use of interventions based on cognitive behavior therapy to mitigate maladaptive coping strategies and change cognitive bias (Ho et al., 2020). These interventions can be delivered through e-health platforms (such as the Internet) and have been widely proved to be cost-effective for treating anxiety disorders (Zhang and Ho, 2017).

These are only examples of the psychological support being given in different countries. We advocate that the psychological support provided should be adapted to specific groups of workers and that further research should be carried out into which measures are most effective in minimizing the psychological impact of the COVID-19 pandemic in HCW.

#### Ethical statement for solid state ionics

Hereby, I Beatriz Olaya consciously assure that for the manuscript “Prevalence of anxiety in health care professionals during the COVID-19 pandemic: A rapid systematic review with meta-analysis” the following is fulfilled:

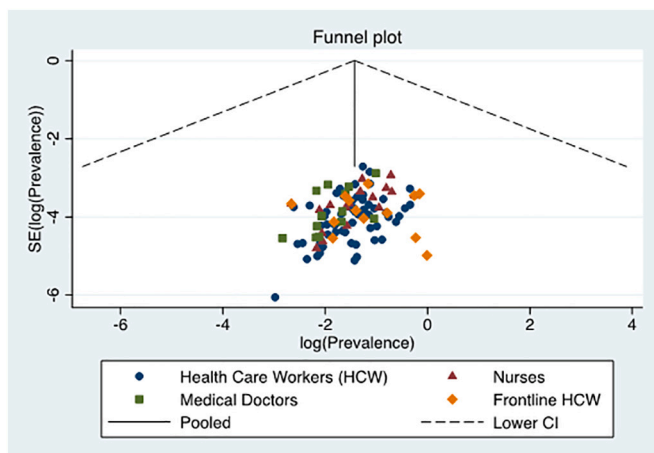
- 1) This material is the authors’ own original work, which has not been previously published elsewhere.
- 2) The paper is not currently being considered for publication elsewhere.
- 3) The paper reflects the authors’ own research and analysis in a truthful and complete manner.
- 4) The paper properly credits the meaningful contributions of co-authors and co-researchers.
- 5) The results are appropriately placed in the context of prior and existing research.
- 6) All sources used are properly disclosed (correct citation). Literally copying of text must be indicated as such by using quotation marks and giving proper reference.
- 7) All authors have been personally and actively involved in substantial work leading to the paper, and will take public responsibility for its content.

**Table 5**  
Overall prevalence rates of anxiety according to study characteristics.

	Healthcare Workers (HCW)			Nurses			Medical Doctors			Frontline HCW		
	No. of studies	Prevalence (%) (95% CI)	<i>p</i> *	No. of studies	Prevalence (%) (95% CI)	<i>p</i> *	No. of studies	Prevalence (%) (95% CI)	<i>p</i> *	No. of studies	Prevalence (%) (95% CI)	<i>p</i> *
<b>Anxiety assessment</b>			0.179			0.919			0.502			0.711
GAD-7	29	23 (18–28)		8	18 (11–26)		7	16 (11–22)		5	41 (11–76)	
HADS	8	40 (30–51)		4	40 (23–59)		2	33 (30–36)		3	44 (10–82)	
DASS-21	8	18 (12–26)		1	13 (11–15)		1	11 (9–14)		2	43 (38–49)	
SAS	9	17 (13–22)		3	24 (19–29)		3	13 (10–16)		1	20 (14–27)	
STAI	2	71 (67–75)		-	-		-	-		-	-	
Other (BAI/ HAMA/GADS/ STAI)	3	23 (21–25)		1	77 (70–83)		-	-		2	22 (20–25)	
<b>Country</b>			0.005			0.190			0.077			0.051
China	26	19 (14–24)		10	22 (14–31)		7	12 (11–14)		8	28 (17–40)	
Other	33	30 (25–36)		7	35 (21–55)		6	21 (12–33)		5	68 (37–92)	
<b>Sampling method</b>			0.857			0.640			0.070			0.747
Convenience	36	24 (19–29)		11	25 (17–34)		9	14 (11–17)		6	42 (23–62)	
Other	14	26 (19–33)		6	30 (19–43)		4	24 (11–39)		3	31 (0–83)	
<b>Quality rating</b>			0.632			0.168			0.721			0.164
Medium (<7)	13	27 (16–38)		11	32 (21–44)		7	18 (13–23)		5	67 (30–95)	
High (≥ 7)	46	25 (21–29)		6	19 (11–28)		6	15 (8–25)		7	30 (11–53)	

Note: 95%CI = 95% Confidence interval; HCW = healthcare workers; NR = not reported; BAI = Beck Anxiety Inventory; DASS-21 = Depression, Anxiety and Stress scales; GAD-7 = General Anxiety Disorder-7; HADS = Hospital Anxiety and Depression Scale; HAMA = Hamilton Anxiety Rating Scale; SAS = Zung Self-Rating Scale; STAI = State-trait Anxiety Scale.

\* *P* value obtained from univariate meta-regression.



**Figure 6.** Funnel plot for the prevalence of anxiety.

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I agree with the above statements and declare that this submission follows the policies of Solid State Ionics as outlined in the Guide for Authors and in the Ethical Statement.

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**Declaration of Competing Interest**

None.

**Appendix A. Supplementary data**

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pnpbp.2021.110244>.

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