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Review article

Prevalence of stress, depression, anxiety and sleep disturbance among nurses during the COVID-19 pandemic: A systematic review and meta-analysis

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ABSTRACT

Background: The new coronavirus disease's (COVID-19) high risk of infection can increase the workload of healthcare workers, especially nurses, as they are most of the healthcare workforce. These problems can lead to psychological problems. Therefore, the aim of this systematic review and meta-analysis to ascertain the present impact of the COVID-19 outbreak on the prevalence of stress, anxiety, depression and sleep disturbance among nurses.

Methods: A systematic review and meta-analysis were conducted. The following databases were searched: PubMed, CHINAL, MEDLINE, EMBASE, PsycINFO, MedRxiv and Google Scholar, from January 2020 up to 26th October 2020. Prevalence rates were pooled with meta-analysis using a random-effects model. Heterogeneity was tested using I-squared (I^2) statistics.

Results: A total of 93 studies (n = 93,112), published between January 2020 and September 2020, met the inclusion criteria. The overall prevalence of stress was assessed in 40 studies which accounted for 43% (95% CI 37–49). The pooled prevalence of anxiety was 37% (95% CI 32–41) in 73 studies. Depression was assessed in 62 studies, with a pooled prevalence of 35% (95% CI 31–39). Finally, 18 studies assessed sleep disturbance and the pooled prevalence was 43% (95% CI 36–50).

Conclusion: This meta-analysis found that approximately one third of nurses working during the COVID-19 epidemic were suffering from psychological symptoms. This highlights the importance of providing comprehensive support strategies to reduce the psychological impact of the COVID-19 outbreak among nurses under pandemic conditions. Further longitudinal study is needed to distinguish of psychological symptoms during and after the infectious disease outbreaks.

1. Introduction

At the end of December 2019, the new coronavirus disease (COVID-19) emerged in Wuhan City, Hubei province, China, and subsequently spread worldwide [1]. COVID-19 has seriously threatened human health. As of 30th January 2020, the World Health Organization (WHO) declared a public health emergency and considered COVID-19 a pandemic [2]. Globally, the WHO reported 65.6 million confirmed cases worldwide, with nearly 1.5 million deaths up until 6th December 2020 [3]. This increasing number of confirmed cases can overwhelm healthcare systems with thousands of patients needing urgent care.

This high risk of infection from COVID-19 increases the workload of healthcare workers who are involved directly in diagnoses, treatment and care of patients with COVID-19. This is particularly true of nurses, as they are most of the healthcare workforce, and they are in the closest proximity to patients with COVID-19. In June 2020, the International Council of Nurses (ICN) estimated that more than 600 nurses have died from COVID-19 worldwide [4]. In battling the sudden emergency by working at high risk of infection from patients, this can lead to mental health problems such as stress, anxiety and depression.

Previous research on the Severe Acute Respiratory Syndrome (SARS) or Middle East Respiratory Syndrome (MERS) epidemics indicates that nurses working at these times were under extraordinary amounts of pressure [5,6]. A systematic thematic review of 22 studies was

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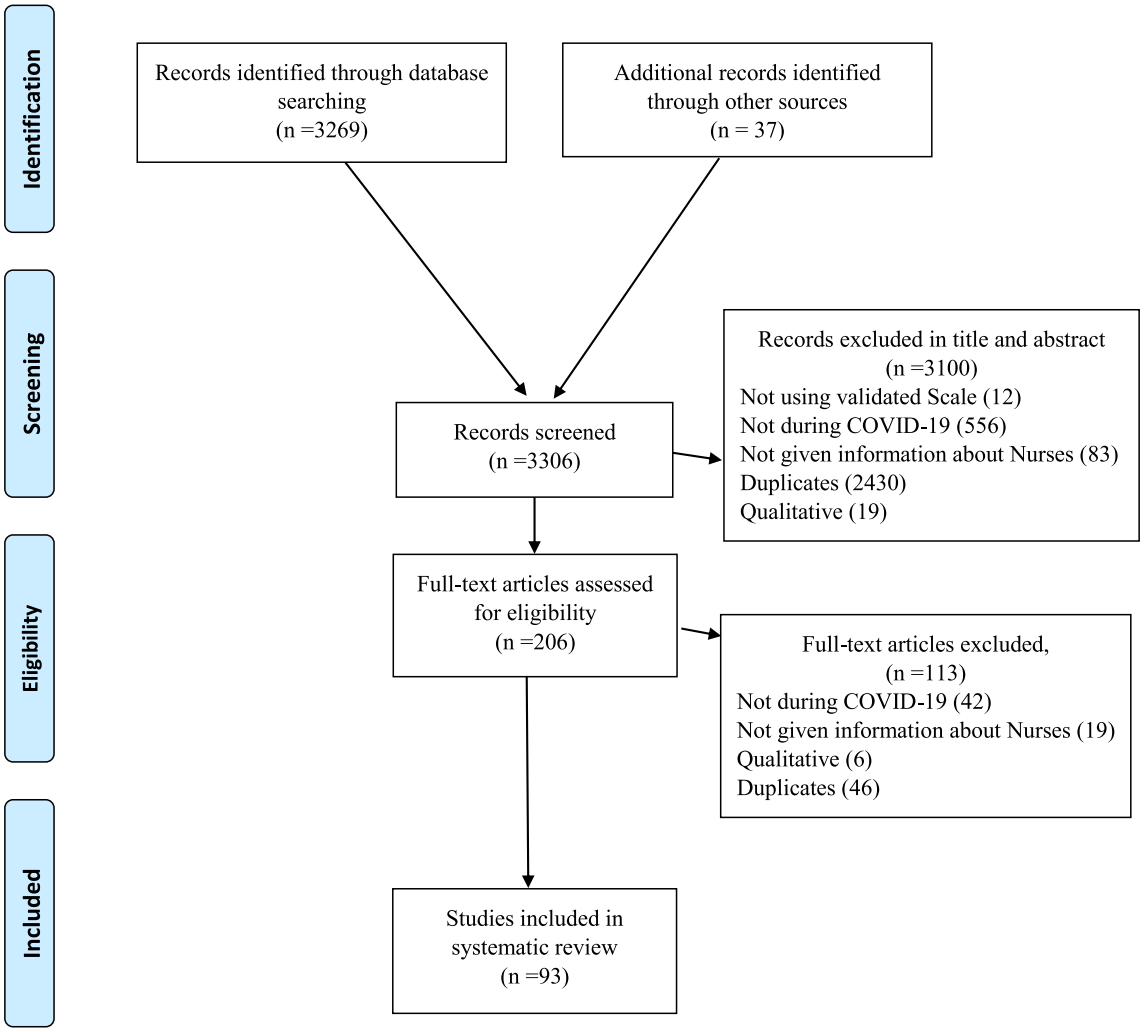

Fig. 1. PRISMA diagram.

conducted by Brooks et al. [7] to identify the social and occupational factors associated with the psychological wellbeing of healthcare workers during the SARS outbreak. The review found that specialized training and preparedness, working at high risk of infection, quarantine, job stress, perceived risk, poor organizational support and stigmatization all impacted on nurses' personal or professional life.

Two previous systematic reviews have been published which explore the prevalence of psychological outcomes among healthcare workers during infectious disease outbreaks [8,9]. However, to date, the psychological impact of the COVID-19 outbreak on nurses has not yet been systematically reported. Therefore, the aim of this study is to conduct a rapid systematic review and meta-analysis to ascertain the present impact of the COVID-19 outbreak on the prevalence of stress, anxiety, depression and sleep disturbance among nurses.

2. Methods

This systematic review and meta-analysis were undertaken according to the PRISMA standards. The review protocol was registered at PROSPERO (No. CRD42020193300).

2.1. Search strategy

A systematic literature search, between January 2020 and 26th October 2020, was conducted using the following databases: PubMed, CHINAL, MEDLINE, EMBASE, PsycINFO, MedRxiv and Google Scholar. Search terms used both free text words and medical subject headings, i.e. MeSH terms, to search papers in the review (Supplementary Appendix 1). In addition, reference lists were screened of the retrieved studies to identify any further studies.

2.2. Study selection

Two investigators (A.M; A.J) performed the search, scrutinizing all titles and abstracts for eligibility against the inclusion and exclusion criteria. Any disagreements were resolved through discussion with a third investigator (A. B). Studies were included in the review according to the following inclusion criteria: (1) reported prevalence of stress or anxiety or depression or sleep disturbance among nurses during COVID-19 outbreaks; (2) all types of setting; and (3), cross-sectional or cohort survey (only the baseline data were extracted). The exclusion criteria were: (1) protocol papers and conference abstracts; (2) if stress or anxiety or depression or sleep disturbance was assessed via an unvalidated scale; and (3), study did not report prevalence among nurses. For any additional information the study authors were contacted.

2.3. Quality assessment

Upon retrieval of the applicable studies, the quality assessment was completed using the Newcastle-Ottawa Scale (NOS) [10]. This scale consists of eight items that evaluate the non-randomized studies, which covered three criteria: the selection of the participants, comparability of

Table 1
Characteristics of the included studies ($n = 93$):

	Study	Preprint	Setting	Frontline	Country	Month	Measure	Events	Total Sample	Instrument	Cut Off	NOS
1	Cai et al., (2020)	No	NG	NG	China	February	Stress	72	546	SCL-90	≥160	Moderate
2	Z. Zhu et al., (2020)	No	Hospital	Frontline	China	February	Stress	1130	3417	IES-R	˃33	Low
							Anxiety	863	3417	GAD-7	≥8	
							Depression	489	3417	PHQ-9	≥10	
3	Choudhury et al., (2020)	No	NG	Mixed	UK	April	Stress	7	23	PSS-4	NG	Moderate
							Anxiety	7	23	GAD-7	≥10	
							Depression	6	23	PHQ-9	≥10	
4	Lai et al., (2020)	No	Hospital	Mixed	China	January	Stress	569	764	IES-R	≥26	Low
							Anxiety	360	764	GAD-7	≥10	
							Depression	409	764	PHQ-9	≥10	
							Insomnia	292	764	ISI	≥15	
5	Liu et al., (2020)	Yes	Hospital	Mixed	China	February	Stress	432	2826	SRQ-20	≥7	Low
							Anxiety	497	2826	SAS	≥50	
							Depression	1108	2826	SDS	≥50	
6	Yin et al., (2020)	No	NG	NG	China	February	Stress	110	246	PCL-5	≥33	Moderate
7	J. Zhu et al., (2020)	No	Hospital	Frontline	China	February	Anxiety	24	86	SAS	≥50	Moderate
							Depression	37	86	SDS	≥50	
8	Guo et al., (2020)	Yes	Hospital	Mixed	China	February	Anxiety	1100	5900	SAS	≥50	Low
							Depression	2006	5900	SDS	≥50	
9	Xiao et al., (2020)	No	Hospital	Mixed	China	January	Anxiety	210	359	HADS	≥8	Low
							Depression	224	359	HADS	≥8	
10	Wang et al., (2020)	No	Hospital	Mixed	China	February	Stress	34	202	PCL-5	≥50	Low
11	Wang et al., (2020)	No	Hospital	Mixed	China	February	Anxiety	29	75	SAS	≥50	Moderate
							Depression	10	75	SDS	≥50	
							Sleep disturbance	18	75	PSQI	˃7	
12	Zhang et al., (2020)	No	Hospital	Frontline	China	February	Anxiety	473	984	GAD-7	≥10	Moderate
							Depression	526	984	PHQ-9	≥10	
							Insomnia	395	984	ISI	≥8	
13	Mo et al., (2020)	No	Hospital	Frontline	China	February	Stress	59	180	SOS	NG	Moderate
							Anxiety	72	180	SAS	≥50	
14	Huang et al., (2020)	No	Hospital	Frontline	China	February	Stress	46	160	PTSD	≥50	Moderate
							Anxiety	43	160	SAS	≥50	
15	García-Fernández et al., (2020)	No	NG	NG	Spain	March	Stress	105	233	ASDI	NG	Moderate
							Anxiety	213	233	HAM-A	≥6	
							Depression	207	233	BDI	≥ 14	
16	Szepietowski et al., (2020)	No	Hospital	NG	Poland	NG	Anxiety	13	62	GAD-7	≥5	Moderate
							Depression	29	62	PHQ-9	≥10	
17	Cui et al., (2020)	Yes	Hospital	Frontline	China	February	Stress	146	481	PSS	˃25	Moderate
							Anxiety	200	481	SAS	≥50	
18	Du et al., (2020)	No	Hospital	Frontline	China	January	Stress	30	55	PSS	≥ 14	Moderate
							Anxiety	21	55	BAI	≥ 8	
							Depression	8	55	BDI-II	≥ 14	
19	Zhou et al., (2020)	No	Hospital	Frontline	China	February	Sleep disturbance	314	1614	PSQI	˃7	Moderate
20	Jiang et al., (2020)	No	Hospital	Mixed	China	February	Anxiety	319	1569	SAS	≥50	Moderate
							Depression	514	1569	SDS	≥53	
21	R. Zhang et al., (2020)	No	Hospital	Mixed	China	February	Stress	29	203	IES-R	≥33	Moderate
							Anxiety	29	203	GAD-7	≥8	
							Depression	21	203	PHQ-9	≥10	
							Sleep disturbance	71	203	PSQI	˃7	
22	S. X. Zhang et al., (2020)	No	NG	NG	Peru, Ecuador, and Bolivia	April	Anxiety	43	175	GAD-7	≥10	Moderate
23	Wan et al., (2020)	Yes	Hospital	Mixed	China	February	Anxiety	775	885	STAI	≥31	Moderate
24	Taghizadeh et al., (2020)	Yes	NG	NG	Iran	April	Anxiety	72	105	HADS-S	≥8	Moderate
							Depression	54	105	HADS-D	≥8	
25	S. X. Zhang et al., (2020a)	No	NG	NG	Iran	February	Anxiety	20	63	GAD-7	≥10	Moderate
							Depression	18	63	PHQ-9	≥10	
26	Salman et al., (2020)	Yes	Hospital	Mixed	Pakistan	February	Anxiety	35	133	GAD-7	≥10	Moderate
							Depression	33	133	PHQ-9	≥10	
27	Zhpu et al., (2020)	Yes	NG	NG	China	January	Anxiety	133	147	GAD-7	≥10	Moderate
							Depression	114	147	PHQ-9	≥10	
							Sleep Disturbance	94	147	SRSS	≥ 23	
28	Pan et al., (2020)	No	Hospital	Frontline	China	February	Anxiety	44	148	GAD-7	≥5	Moderate
							Depression	57	148	PHQ-9	≥5	

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Table 1 (*continued*)

	Study	Preprint	Setting	Frontline	Country	Month	Measure	Events	Total Sample	Instrument	Cut Off	NOS
							Insomnia	129	148	PHQ-15	≥10	
29	Ning et al., (2020)	No	Hospital	Mixed	China	February	Anxiety	60	295	SAS	≥50	Low
							Depression	89	295	SDS	≥53	
30	Y. Liu et al., (2020)	Yes	Hospital	Mixed	China	February	Stress	297	577	PSS	≥14	Moderate
							Anxiety	65	577	GAD-7	≥10	
							Depression	73	577	PHQ-9	≥10	
31	Otgonbaatar et al., (2020)	No	Hospital	Mixed	Mongolian	February	Stress	309	473	WSP	≥111	Moderate
32	Li et al., (2020)	No	Hospital	Mixed	China	February	Stress	1127	3381	IES-R	≥33	Moderate
							Anxiety	864	3381	GAD-7	≥8	
							Depression	485	3381	PHQ-9	≥10	
33	Lv et al., (2020)	Yes	Hospital	Mixed	China	February	Anxiety	1280	3378	GAD-7	≥5	Low
							Depression	1297	3378	PHQ-9	≥5	
							Insomnia	1253	3378	ISI	≥8	
34	Hu et al., (2020)	No	Hospital	Frontline	China	January	Anxiety	833	2014	SAS	≥50	Low
							Depression	878	2014	SDS	≥53	
35	B. Wang et al., (2020)	Yes	Hospital	Mixed	China	January	Stress	59	313	PDSS	≥11	Moderate
							Depression	100	313	PHQ-9	≥10	
36	W. Zhang et al., (2020)	No	Hospital	Mixed	China	February	Anxiety	39	197	PHQ-4	≥3	Moderate
							Depression	39	197	PHQ-4	≥3	
							Insomnia	102	197	ISI	˚8	
37	Weilenmann et al., (2020)	Yes	Hospital	Mixed	Switzerland	April	Anxiety	161	553	GAD-7	≥10	Moderate
							Depression	138	553	PHQ-9	≥10	
38	Sahin et al., (2020)	No	Hospital	Mixed	Turkey	April	Anxiety	226	301	BAI	≥16	Moderate
39	Rossi et al., (2020)	No	Hospital	Mixed	Italy	March	Stress	105	474	PSS	≥3	Low
							Anxiety	104	474	GAD-7	≥15	
							Depression	152	474	PHQ-9	≥15	
							Insomnia	55	474	ISI	˚22	
40	Kaveh et al., (2020)	No	Hospital	Mixed	Iran	March	Anxiety	213	513	BAI	≥16	Moderate
41	Guixia and Hui, (2020)	No	Hospital	Mixed	China	February	Anxiety	38	92	SAS	≥50	Moderate
							Depression	53	92	SDS	≥53	
42	Al Amer et al., (2020)	Yes	Hospital	Mixed	Jordan	March	Stress	202	405	DASS	≥19	Moderate
							Anxiety	208	405	DASS	≥10	
							Depression	234	405	DASS	≥14	
43	Shechter et al., (2020)	No	Hospital	Mixed	USA	April	Stress	200	313	PTSD	≥3	Low
							Anxiety	125	313	GAD-2	≥3	
							Depression	166	313	PHQ-2	≥3	
44	Naser et al., (2020)	No	Mixed	NG	Jordan	March	Anxiety	61	151	GAD-7	≥15	Moderate
							Depression	70	151	PHQ-9	≥15	
45	Que et al., (2020)	No	Mixed	Mixed	China	February	Anxiety	107	208	GAD-7	≥10	Moderate
							Depression	96	208	PHQ-9	≥10	
							Insomnia	70	208	ISI	≥15	
46	Jahrami et al., (2020)	No	Mixed	Mixed	Bahrain	April	Stress	95	119	PSS	≥14	Moderate
							Sleep disturbance	87	119	PSQI	≥5	
47	Koksal et al., (2020)	No	Mixed	Mixed	Turkey	April	Anxiety	197	339	HADS	≥10	Moderate
							Depression	130	339	HADS	≥7	
48	Tu et al., (2020)	No	Hospital	Frontline	China	February	Anxiety	40	100	GAD-7	≥4	Low
							Depression	46	100	PHQ-9	≥10	
							Sleep disturbance	60	100	PSQI	≥7	
49	Yang et al., (2020)	Yes	Hospital	Mixed	China	March	Anxiety	193	1017	SAS	≥50	Moderate
							Depression	335	1017	SDS	≥50	
50	Chekole et al., (2020)	No	Mixed	Mixed	Ethiopia	April	Stress	68	100	PSS	>20	Moderate
51	Fang et al., (2020)	Yes	NG	NG	China	NG	Depression	117	293	SDS	≥40	Moderate
52	Jia et al., (2020)	No	Hospital	Mixed	China	January	Anxiety	156	867	SAS	≥50	Moderate
53	Zerbini et al., (2020)	No	Hospital	Mixed	Germany	April	Stress	34	75	PHQ-9	≥ 5	Moderate
							Anxiety	12	75	GAD-7	≥ 10	
							Depression	22	75	PHQ-9	≥ 10	
54	Pouralizadeh et al., (2020)	No	Hospital	Mixed	Iran	April	Anxiety	171	441	GAD-7	≥10	Moderate
							Depression	165	441	PHQ-9	≥10	
55	Gallopeni et al., (2020)	No	Hospital	Mixed	Kosovo	April	Anxiety	137	304	HADS	≥11	Moderate
							Depression	106	304	HADS	≥11	
56	Li et al., (2020a)	No	Hospital	Frontline	China	February	Anxiety	136	176	HAM-A	≥14	Moderate
57		Yes	Mixed	Mixed	Malawi	September	Anxiety	26	102	CAS	≥9	Moderate

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Table 1 (*continued*)

	Study	Preprint	Setting	Frontline	Country	Month	Measure	Events	Total Sample	Instrument	Cut Off	NOS
	Chorwe-Sungani, (2020)											
58	Saricam, (2020)	No	Hospital	Frontline	Turkey	April	Anxiety	57	123	STAI	≥57	Moderate
59	Arafa et al., (2020)	No	Hospital	Frontline	KSA & Egypt	April	Stress	55	103	DASS	≥10	Moderate
							Anxiety	61	103	DASS	≥8	
							Depression	65	103	DASS	≥8	
60	Silwal et al., (2020)	No	Hospital	Frontline	Nepal	April	Stress	24	152	DASS	≥19	Moderate
							Anxiety	64	152	DASS	≥10	
							Depression	30	152	DASS	≥14	
61	Li et al., (2020b)	No	Hospital	Frontline	China	March	Stress	220	356	PCL-5	≥33	Low
62	Hong et al., (2020)	No	Hospital	Frontline	China	February	Anxiety	379	4692	GAD-7	≥10	Low
							Depression	442	4692	PHQ-9	≥10	
63	Hoedl et al., (2020)	Yes	Mixed	Mixed	Austrian	July	Stress	1751	2602	PSS	≥14	Moderate
64	Xiaozheng et al., (2020)	No	Hospital	Frontline	China	March	Insomnia	24	97	AIS	≥6	Moderate
65	Zhan et al., (2020a)	No	Hospital	Frontline	China	March	Stress	789	1794	PSS	≥25	Low
							Insomnia	948	1794	AIS	≥6	
66	AlAteeq et al., (2020)	No	Hospital	Mixed	KSA	March	Anxiety	44	132	GAD-7	≥10	Moderate
							Depression	50	132	PHQ-9	≥10	
67	Khanal et al., (2020)	No	Hospital	Frontline	Nepal	May	Anxiety	94	167	HADS	≥7	Moderate
							Depression	78	167	HADS	≥7	
							Insomnia	50	167	ISI	≥10	
68	Bachilo et al., (2020)	Yes	Mixed	Mixed	Russia	May	Anxiety	55	139	GAD-7	≥5	Moderate
							Depression	68	139	PHQ-9	≥5	
69	Wanigasooriya et al., (2020)	Yes	Hospital	Frontline	UK	July	Stress	226	775	IES-R	˚33	Moderate
							Anxiety	276	775	PHQ-4	≥3	
							Depression	255	775	PHQ-4	≥3	
70	Leng et al., (2020)	No	Hospital	Frontline	China	February	Stress	20	90	PSS	˚25	Moderate
71	Aksoy and Koçak, (2020)	No	Mixed	Mixed	Turkey	April	Anxiety	264	726	STAI	≥35	Moderate
72	Hendy et al., (2020)	No	Hospital	Frontline	Egypt	April	Stress	293	374	NSS	≥40	Moderate
73	Zhan et al., (2020b)	No	Hospital	Frontline	China	March	Stress	1298	2667	PSS	≥25	Low
							Anxiety	1062	2667	GAD-7	≥10	
							Depression	1458	2667	PHQ-9	≥10	
74	Skoda et al., (2020)	No	Mixed	Mixed	Germany	March	Anxiety	172	1511	GAD-7	≥10	Moderate
75	Nie et al., (2020)	No	Hospital	Frontline	China	February	Stress	194	263	IES-R	˚33	Moderate
76	Zhu et al., (2020)	No	Mixed	Mixed	China	January	Anxiety	1502	6107	SAS	≥50	Low
							Depression	2908	6107	SDS	≥50	
77	Chen et al., (2020)	No	Mixed	Mixed	China	February	Anxiety	45	311	GAD-7	≥10	Moderate
							Depression	53	311	PHQ-9	≥10	
78	Tselebis et al., (2020)	Yes	Hospital	Frontline	Greece	May	Stress	75	150	PSS	≥14	Moderate
							Insomnia	74	150	AIS	≥6	
79	Prasad et al., (2020)	No	Mixed	Mixed	USA	April	Stress	208	248	IES-R	˚26	Moderate
							Anxiety	85	248	GAD-7	≥10	
							Depression	54	248	PHQ-2	≥3	
80	Lee et al., (2020)	No	Hospital	Frontline	Singapore	June	Anxiety	52	155	HADS	≥11	Moderate
							Depression	49	155	HADS	≥11	
81	Azoulay et al., (2020)	No	Hospital	Frontline	France	May	Anxiety	249	498	HADS	≥11	Moderate
							Depression	158	498	HADS	≥11	
82	Xiong et al., (2020)	No	Hospital	Mixed	China	February	Anxiety	94	231	GAD-7	≥10	Moderate
							Depression	61	231	PHQ-9	≥10	
83	Sampaio et al., (2020)	No	Mixed	Mixed	Portugal	April	Stress	210	767	DASS	≥10	Moderate
							Anxiety	250	767	DASS	≥6	
							Depression	166	767	DASS	≥7	
84	Buselli et al., (2020)	No	Hospital	Frontline	Italy	May	Anxiety	20	133	GAD-7	≥10	Moderate
							Depression	27	133	PHQ-9	≥10	
85	Salopek-Žiha et al., (2020)	No	Mixed	Mixed	Croatia	April	Stress	10	97	DASS	≥10	Moderate
							Anxiety	12	97	DASS	≥6	
							Depression	14	97	DASS	≥7	
86	Wasim et al., (2020)	No	Hospital	Frontline	Pakistan	June	Insomnia	46	78	ISI	≥8	Moderate
87	Ahn et al., (2020)	Yes	Hospital	Frontline	Korea	April	Anxiety	345	967	GAD-7	≥5	Moderate
							Depression	172	967	PHQ-9	≥10	
88	Zheng et al., (2020)	No	Mixed	Mixed	China	February	Anxiety	2643	3228	SAS	≥50	Low
							Depression	2121	3228	SDS	≥50	
89	Gorini et al., (2020)	No	Hospital	Frontline	Italy	May	Stress	125	214	IES-R	˚26	Moderate
							Anxiety	78	214	GAD-7	≥10	
							Depression	66	214	PHQ-2	≥3	
90	An et al., (2020)	No	Hospital	Frontline	China	March	Depression	481	1103	PHQ-9	≥10	Moderate
91	Zhang et al., (2020)	No	Mixed	Mixed	China	April	Stress	111	468	PCL	≥50	Moderate

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Table 1 (*continued*)

	Study	Preprint	Setting	Frontline	Country	Month	Measure	Events	Total Sample	Instrument	Cut Off	NOS
92	Ruiz-Fernández et al., (2020)	No	Hospital	Frontline	Spain	April	Stress	265	348	PSS	≥25	Moderate
93	Han et al., (2020)	No	Hospital	Mixed	China	February	Anxiety Depression	4539 6324	22,034 22,034	SAS SDS	≥50 ≥50	Low

AIS = Athens Insomnia Scale; ASDI = Acute Stress Disorder Inventory; BAI=Beck Anxiety Inventory; BDI=Beck Depression Inventory; CAS = Coronavirus Anxiety Scale; DASS=Depression, Anxiety, and Stress Scale; GAD = Generalized Anxiety Disorder; HADS=Hospital Anxiety and Depression Scale; HAM-A = Hamilton Anxiety Rating Scale; IES-R = Impact of Event Scale-Revised; ISI=Insomnia Severity Index; NG = Not Given; NSS=Nursing Stress Scale; PCL-5 = PTSD Checklist for DSM-5; PDSS=Panic Disorder Severity Scale; PHQ = Patient Health Questionnaire; PSQI=Pittsburgh Sleep Quality Index; PSS=Perceived Stress Scale; PTSD=Post-Traumatic Stress Disorder; SAS = Zung Self-rating Anxiety Scale; SCL-90 = Symptom Check-List-90; SDS = Zung Self-rating Depression Scale; SOS=Stress Overload Scale; SRQ = Self-Reporting Questionnaire; SRSS=Sleep Self-Assessment Scale; STAI=State-Trait Anxiety Inventory; WSP=Work Stress Profile.

study groups and outcome assessment. The NOS uses a score system with the lowest possible score of zero and the highest possible score of nine. The total points awarded indicate the overall quality of the study. A study was determined to be of low risk of bias when the score was 7–9, of moderate risk of bias if the score was 5–6, and high risk of bias if the score was 0–4 [11].

2.4. Data analyses

To estimate the pooled prevalence, odds ratios (ORs) with 95% Confidence Interval (CI) were calculated as the effect size by using a random-effects model. Heterogeneity was tested using I-squared (I^2) statistics. A value of I^2 was considered to be low with 0–25%, 25–50% as moderate and 50–75% considered as high heterogeneity [12]. In addition, subgroup analyses to test the significant differences in the prevalence of stress, anxiety, depression and sleep disturbance between different groups (setting, frontline or second line; data collection month, NOS,) were performed when there were at least four studies per subgroup. A sensitivity analysis was performed by removing one study at a time to evaluate the impact of pooled prevalence of remining studies [13].

Funnel plots were found to be an inaccurate method for assessing publication bias in meta-analyses of proportion studies [14,15]. Therefore, publication bias was estimated using Egger's liner regression test and funnel plot [16]. A p value of less than 0.05 was considered as statistically significant. Meta-analysis was conducted using Comprehensive Meta-Analysis software, version 2.2 (Englewood, New Jersey, USA). Forest plots were constructed using a Microsoft Excel spreadsheet constructed by Neyeloff et al. [17].

3. Results

The database search identified 3306 papers; of these, 3100 papers were excluded during title and abstract screening for the following reasons: 556 papers were not conducted during the COVID-19 period; 83 did not give information about nurses; 2430 were duplicated papers. A further, 113 papers were excluded during full text review. As such, 93 studies were identified as eligible for meta-analysis (Fig. 1 shows the PRISMA flow chart).

3.1. General characteristics

Ninety-three studies, involving 93,112 nurses, were included in this meta-analysis. All studies were conducted between January 2020 and September 2020: eight in January, 36 in February, 13 in March, 13 in April, six in May, two in June, two in July and one in September. Twenty preprint studies [18–37] were included in the analyses. All studies included in this meta-analysis were of cross sectional design. The vast majority ($n = 67$ studies) were conducted in hospital settings; seventeen were mixed setting and only nine studies did not provide setting information. Thirty-four studies involved nurses who worked on the frontline in the fight against the COVID-19 epidemic; however, 49 studies involved mixed nurses, i.e. those working in the frontline and second line, whereas ten studies did not give this information. Forty-nine studies originated from China, four from each Turkey and Iran, three from Italy, two each from Germany, Jordan, Nepal, Pakistan, Spain, the USA and the UK, and one from each of the following: Austrian, Bahrain, Croatia, Egypt, Ethiopia, France, Greece, Korea, Kosovo, KSA, Malawi, Mongolian, Poland, Portugal, Russia, Singapore and Switzerland. Two study was conducted in more than one country [38,39]. (See Table 1 for a general characteristics of studies).

3.2. Quality assessment

The studies were assessed using the NOS checklist. Nineteen studies were classified as having a low risk of bias and seventy-four as moderate. The detailed results of the quality assessment of the studies included in this meta-analysis are listed in Table 2.

3.3. Prevalence of stress

Stress was estimated in 40 studies [18,20,25,27,29,33,35,36,39–70]. The overall pooled point estimates of prevalence for stress varied between 10% and 84% (Fig. 2: forest plots). All meta-analyses of prevalence estimates of stress reported by the 40 studies yielded a summary prevalence of 43% (11,139/27,034 participants, 95% CI 37–49). Sensitivity analysis by excluding one study each time demonstrated that no differences in the overall estimation by more or less than 1%. There was significant heterogeneity between studies to estimate the prevalence ($p < 0.000$, $I^2 = 98$).

The pooled prevalence according to the month of data collected was as follows: February: 32% ($n = 14$; 95% CI 25–41; I2 = 98), March: 45% (n = 6; 95% CI 37–53; I2 = 96) and April: 50% ($n = 13$; 95% CI 35–66; I2 = 98). Seventeen studies [20,35,36,39,43,44,46,54,57–63,67,69] involving nurses who were working on the frontline showed stress prevalence at 46% (95% CI = 39–54; $I^2 = 97$), whereas 20 studies including mixed nurses working in the frontline and second line showed the stress prevalence was 42% (95% CI = 31–53, $I^2 = 99$). Thirteen studies that used the Perceived Stress Scale (PSS) showed a pooled prevalence of stress at 50% (95% CI = 41–59, $I^2 = 98$), whereas eight studies [35,45,54–56,63,64,67] using the Impact of Event Scale-Revised (IES-R) had a pooled prevalence of 50% (95% CI = 37–63, $I^2 = 99$). The other studies used different scales. In the subgroup analyses using the NOS, the pooled prevalence in studies ($n = 9$) with low risk of bias accounted for 41% (95% CI = 29–54, $I^2 = 99$), whereas those with a moderate risk of bias ($n = 31$) accounted for 43% (95% CI = 36–52, $I^2 = 98$).

3.4. Prevalence of anxiety

The overall pooled point estimates of prevalence for anxiety varied between 8% and 91%, which was reported

Table 2
Quality assessment result of observational studies (n = 93) using the Newcastle-Ottawa Scale:

	Study	Representativeness of the sample (One Point)	Sample Size (One Point)	Non-Respondents (One Point)	Ascertainment of the exposure (One Point)	Study controls for other variable (Two Point)	Assessment of Outcome (One Point)	Statistical Test (One Point)	Adequate Follow up time (One Point)	Score	
1	Cai et al., (2020)	1	1	1	0	0	0	1	1	5	Moderate
2	Z. Zhu et al., (2020)	1	1	1	1	1	1	1	0	7	Low
3	Choudhury et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
4	Lai et al., (2020)	1	1	1	1	2	1	1	0	8	Low
5	Liu et al., (2020)	1	1	1	1	1	1	1	0	7	Low
6	Yin et al., (2020)	1	1	0	1	1	1	1	0	6	Moderate
7	J. Zhu et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
8	Guo et al., (2020)	1	1	1	1	2	1	1	0	8	Low
9	Xiao et al., (2020)	1	1	1	1	1	1	1	0	7	Low
10	Wang et al., (2020)	0	1	1	1	1	1	1	0	6	Low
11	Wang et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
12	Zhang et al., (2020)	1	1	1	1	1	0	1	0	6	Moderate
13	Mo et al., (2020)	0	1	1	1	1	0	1	1	6	Moderate
14	Huang et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
15	García-Fernández et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
16	Szepietowski et al., (2020)	0	1	1	0	1	1	1	0	5	Moderate
17	Cui et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
18	Du et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
19	Zhou et al., (2020)	0	1	1	1	1	0	1	1	6	Moderate
20	Jiang et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
21	R. Zhang et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
22	S. X. Zhang et al., (2020)	0	1	1	0	1	1	1	0	5	Moderate
23	Wan et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
24	Taghizadeh et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
25	S. X. Zhang et al.,(2020a)	0	1	1	1	1	0	1	1	6	Moderate
26	Salman et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
27	Zhpu et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
28	Pan et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
29	Ning et al., (2020)	1	1	1	1	1	1	1	0	7	Low
30	Y. Liu et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
31	Otgonbaatar et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
32	Li et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
33	Lv et al., (2020)	1	1	1	1	2	1	1	0	8	Low
34	Hu et al., (2020)	1	1	1	1	2	1	1	0	8	Low
35	B. Wang et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate

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Table 2 (*continued*)

	Study	Representativeness of the sample (One Point)	Sample Size (One Point)	Non-Respondents (One Point)	Ascertainment of the exposure (One Point)	Study controls for other variable (Two Point)	Assessment of Outcome (One Point)	Statistical Test (One Point)	Adequate Follow up time (One Point)	Score	
36	W. Zhang et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
37	Weilenmann et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
38	Sahin et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
39	Rossi et al., (2020)	1	1	1	1	2	1	1	0	8	Low
40	Kaveh et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
41	Guixia and Hui, (2020)	0	1	1	1	1	0	1	0	5	Moderate
42	Al Amer et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
43	Shechter et al., (2020)	1	1	1	1	2	1	1	0	8	Low
44	Naser et al., (2020)	1	1	0	1	1	1	1	0	6	Moderate
45	Que et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
46	Jahrami et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
47	Koksal et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
48	Tu et al., (2020)	1	1	1	1	1	1	1	0	7	Low
49	Yang et al., (2020)	1	1	0	1	1	1	1	0	6	Moderate
50	Chekole et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
51	Fang et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
52	Jia et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
53	Zerbini et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
54	Pouralizadeh et al., (2020)	0	1	1	1	1	0	1	1	6	Moderate
55	Gallopeni et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
56	Li et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
57	Chorwe-Sungani, (2020)	0	1	1	1	1	0	1	0	5	Moderate
58	Saricam, (2020)	0	1	1	1	1	0	1	0	5	Moderate
59	Arafa et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
60	Silwal et al., (2020)	1	1	1	0	0	0	1	1	5	Moderate
61	Li et al., (2020)	1	1	1	1	1	1	1	0	7	Low
62	Hong et al., (2020)	1	1	1	1	2	1	1	0	8	Low
63	Hoedl et al., (2020)	0	1	1	1	1	0	1	1	6	Moderate
64	Xiaozheng et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
65	Zhan et al., (2020)	1	1	1	1	1	1	1	0	7	Low
66	AlAteeq et al., (2020)	0	1	1	1	1	0	1	1	6	Moderate
67	Khanal et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
68	Bachilo et al., (2020)	0	1	1	0	1	1	1	0	5	Moderate
69	Wanigasooriya et al., (2020)	1	1	1	0	0	0	1	1	5	Moderate
70	Leng et al., (2020)	0	1	1	1	1	0	1	1	6	Moderate
71	Aksoy and Koçak, (2020)	0	1	1	0	1	1	1	0	5	Moderate
72	Hendy et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
73		1	1	1	1	2	1	1	0	8	Low

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Table 2 (*continued*)

	Study	Representativeness of the sample (One Point)	Sample Size (One Point)	Non-Respondents (One Point)	Ascertainment of the exposure (One Point)	Study controls for other variable (Two Point)	Assessment of Outcome (One Point)	Statistical Test (One Point)	Adequate Follow up time (One Point)	Score	
	Zhan et al., (2020b)										
74	Skoda et al., (2020)	0	1	1	1	1	0	1	1	6	Moderate
75	Nie et al., (2020)	1	1	1	0	0	0	1	1	5	Moderate
76	Zhu et al., (2020)	1	1	1	1	1	1	1	0	7	Low
77	Chen et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
78	Tselebis et al., 2020)	0	1	1	0	1	1	1	0	5	Moderate
79	Prasad et al., 2020)	0	1	1	1	1	0	1	1	6	Moderate
80	Lee et al., 2020)	0	1	1	1	1	0	1	0	5	Moderate
81	Azoulay et al., (2020)	0	1	1	0	1	1	1	0	5	Moderate
82	Xiong et al., (2020)	0	1	1	0	1	1	1	0	5	Moderate
83	Sampaio et al., (2020)	0	1	1	1	1	0	1	1	6	Moderate
84	Buselli et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
85	Salopek-Žiha et al., (2020)	0	1	1	0	1	1	1	0	5	Moderate
86	Wasim et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
87	Ahn et al., (2020)	0	1	1	1	1	0	1	0	5	Moderate
88	Zheng et al., (2020)	1	1	1	1	2	1	1	0	8	Low
89	Gorini et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
90	An et al., (2020)	0	1	0	1	2	1	1	0	6	Moderate
91	Zhang et al., (2020)	0	1	1	1	1	1	1	0	6	Moderate
92	Ruiz-Fernández et al., (2020)	0	1	1	0	1	1	1	0	5	Moderate
93	Han et al., (2020)	1	1	1	1	2	1	1	0	8	Low

by 73 studies [18–26,28–30,32,34,35,37–39,42–46,48,49,51,53–57,62,64–67,71–106] (Fig. 3: forest plots). All meta-analyses of prevalence estimates of anxiety yielded a summary prevalence of 37% (23,535/81,561 participants, 95% CI 32–41). The pooled prevalence did not change in sensitivity analysis by excluding one study each time by less than 2%. There was significant heterogeneity between studies to estimate the prevalence ($p < 0.000$, $I^2 = 99$).

The prevalence of anxiety among nurses who worked on the frontline ($n = 24$) was high at 39% (95% CI = 32–46, $I^2 = 98$) compared to mixed studies ($n = 42$), which was 32% (95% CI = 27–38, $I^2 = 99\%$). In the subgroup analyses by month, according to when the study was conducted, the pooled prevalence of anxiety was 45% ($n = 7$; 95% CI = 33–58, $I^2 = 99$), 32% ($n = 29$; 95% CI = 25–40, $I^2 = 99$), 38% (n = 9; 95% CI = 26–52, $I^2 = 98$), 40% ($n = 18$; 95% CI = 34–46.2, $I^2 = 95$) and 39% ($n = 5$; 95% CI = 28–51, $I^2 = 93$) for January, February, March, April and May, respectively. Thirty-two studies used the Generalized Anxiety Disorder-7 (GAD-7) scale, which showed the highest anxiety prevalence at 30% (95% CI = 25–35, $I^2 = 98$), whereas studies ($n = 16$) using the Zung Self-Rating Anxiety Scale (SAS) reported anxiety prevalence at 30% (95% CI = 22–39, $I^2 = 99$). The prevalence of anxiety in the low risk of bias studies (n = 16) was 32% (95% CI = 24–41, $I^2 = 99$); in studies ($n = 57$) with a moderate risk of bias, the pooled prevalence was 38% (95% CI = 33–43, $I^2 = 97$).

3.5. Prevalence of depression

The overall pooled point estimates of depression reported by the 62 studies [19,22–31,34,35,37,39,42,43,45,48,49,51,53–57,62,64–67,71–74,77–88,90,91,94–96,99–103,105–108] varied between 9% and 89% (Fig. 4: forest plots). The pooled point prevalence of depression was 35% (25,769/76,992 participants, 95% CI 31–39). In sensitivity analysis, no study had an implication for the pooled prevalence by more or less than 1%. There was significant heterogeneity between studies to estimate the prevalence ($p < 0.000$, $I^2 = 99$). The pooled prevalence according to the month of data collected was as follows: January: 49% (n = 7; 95% CI 42–56; $I^2 = 95$), February: 29% (n = 24; 95% CI 24–35; $I^2 = 99$), March: 50% ($n = 8$; 95% CI 27–45; $I^2 = 97$), April: 31% (n = 14; 95% CI 25–39; $I^2 = 95$) and May: 35.1% (n = 5; 95% CI 27–45; $I^2 = 89$). Nineteen studies involving nurses who were working on the frontline showed the depression prevalence at 33% (95% CI = 24–43, $I^2 = 99$), whereas 36 studies including nurses working on the frontline and second line showed the depression prevalence was 33% (95% CI = 29–37, $I^2 = 98$).

Twenty-nine studies used the Patient Health Questionare-9 (PHQ-9) scale had a pooled prevalence of 32% (95% CI = 25–40, $I^2 = 99$), whereas thirteen studies used the Zung Self-Rating Depression Scale (SDS) had a pooled prevalence of 39% (95% CI = 32–46, $I^2 = 99$). The

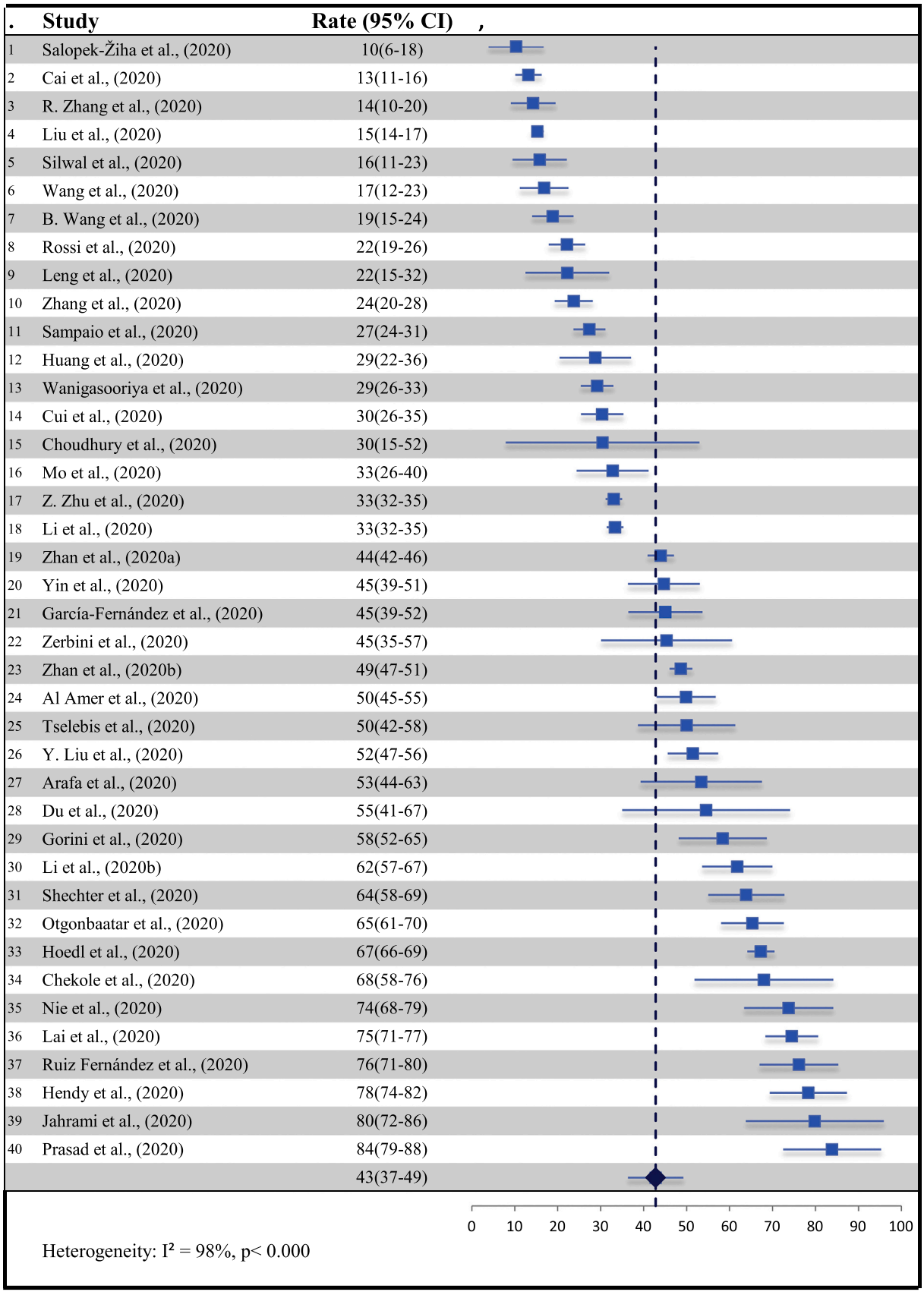

Fig. 2. Forest Plot of the Prevalence of Stress ($N = 40$).

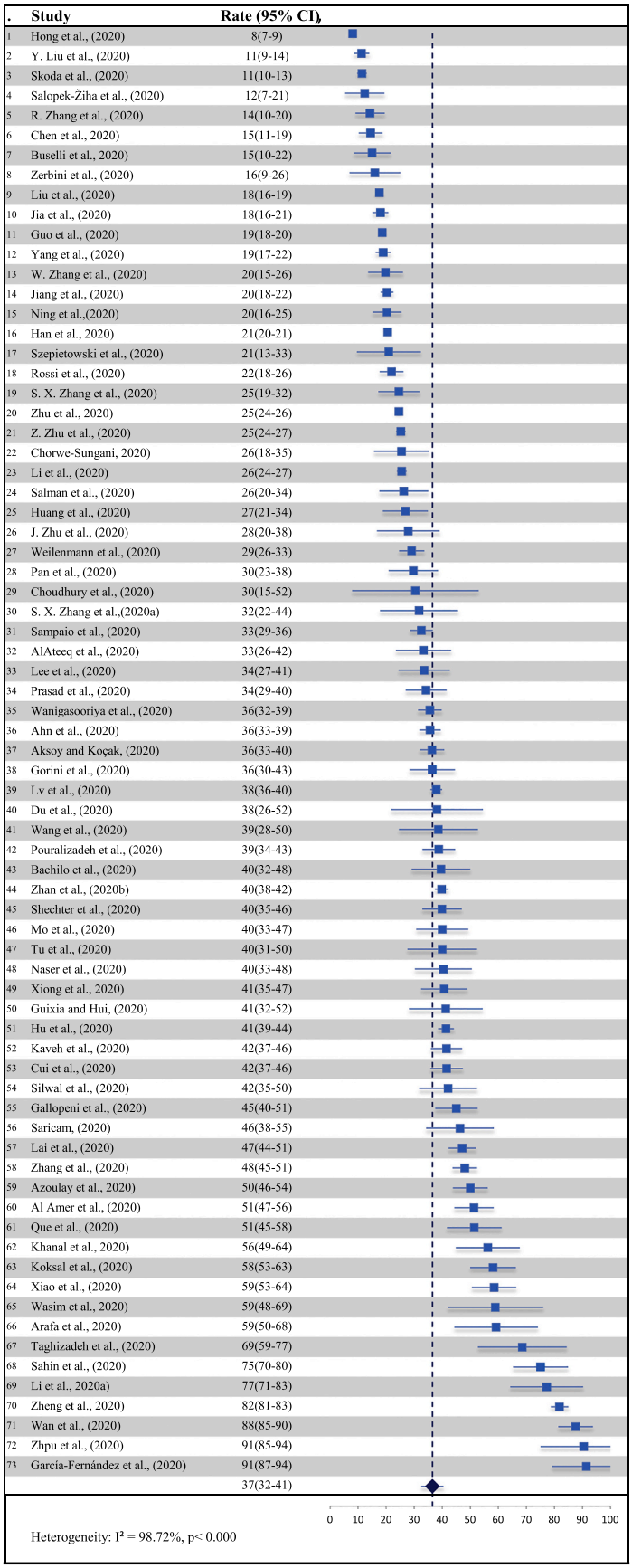

Fig. 3. Forest Plot of the Prevalence of Anxiety ($N = 73$).

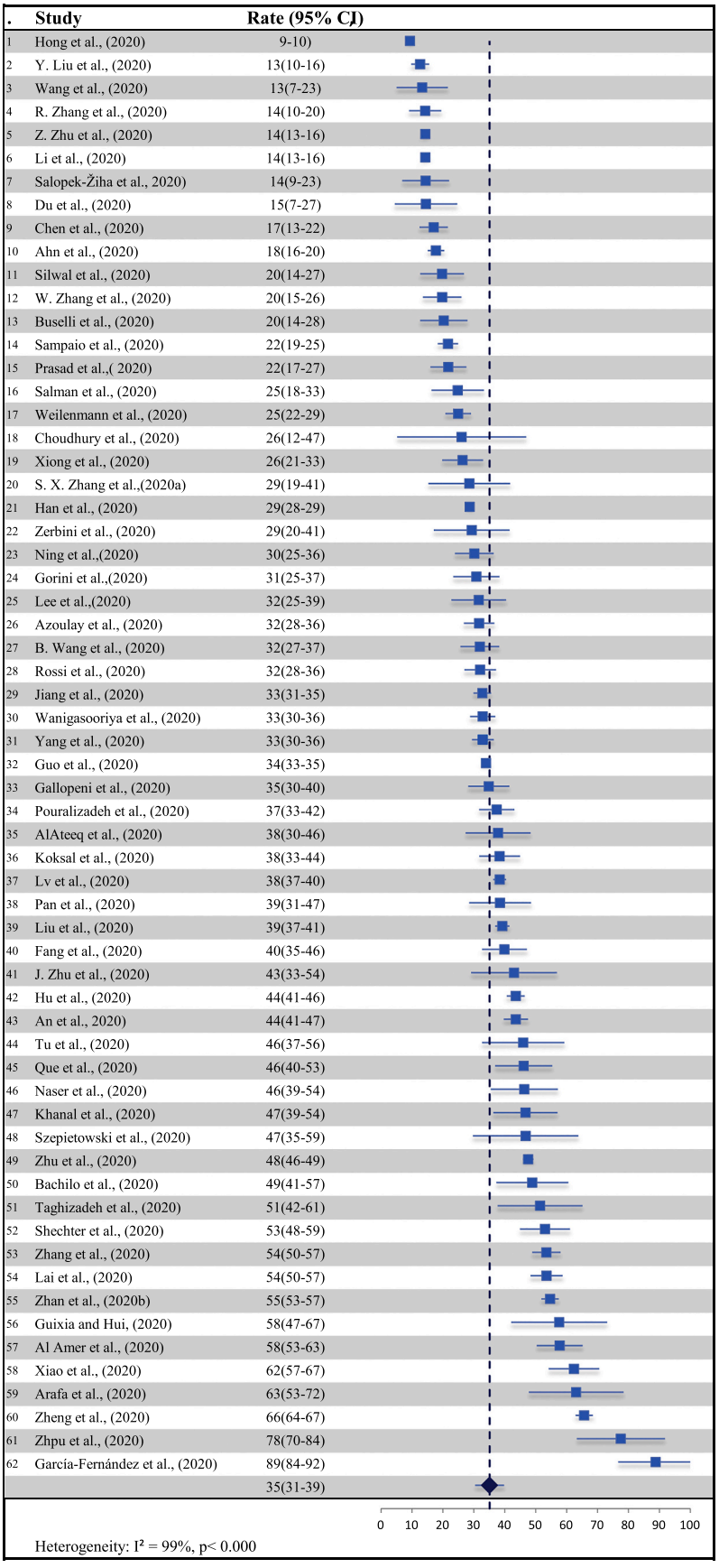

Fig. 4. Forest Plot of the Prevalence of Depression ($N = 62$).

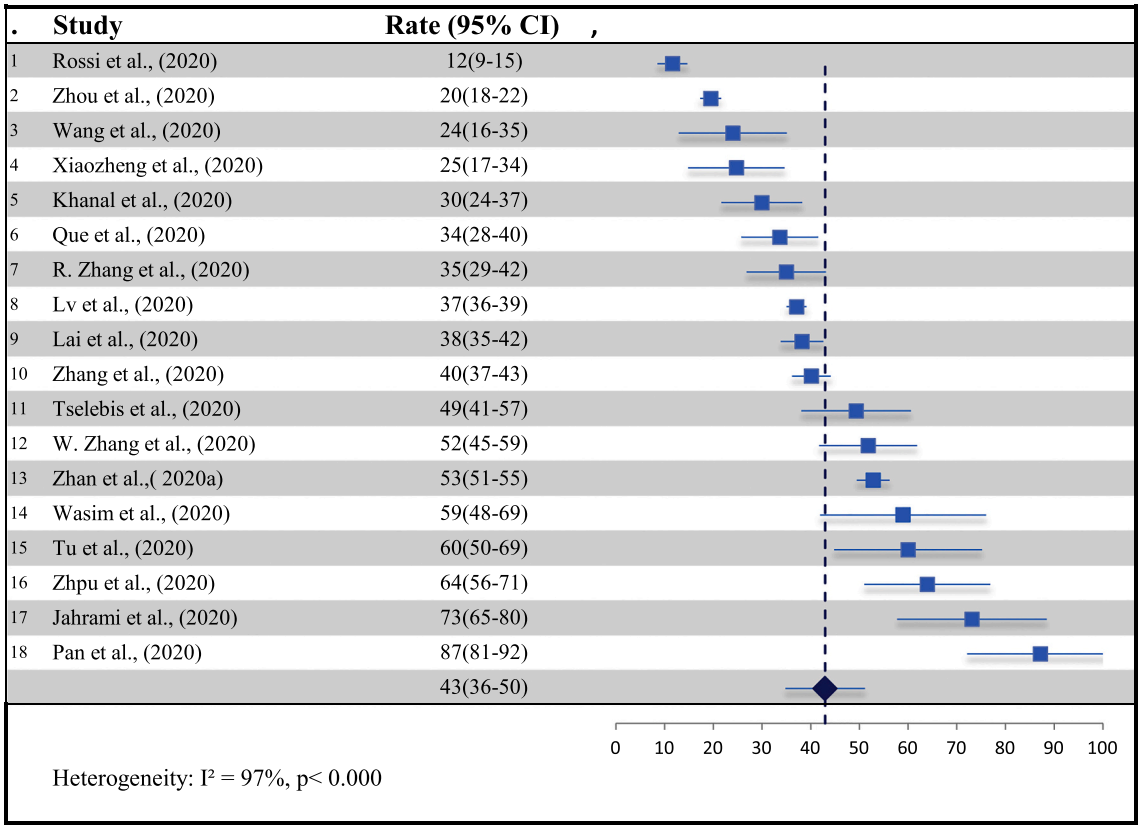

Fig. 5. Forest Plot of the Prevalence of Sleep Disturbance ($N = 18$).

other studies used different scales. In the subgroup analyses using the NOS, the pooled prevalence in studies (n = 16) with low risk of bias was 39% (95% CI = 32–47, $I^2 = 99$), whereas the moderate risk of bias studies ($n = 46$) accounted for 34% (95% CI = 29–39, $I^2 = 97$).

3.6. Prevalence of sleep disturbance

The prevalence rate of sleep disturbance in 18 studies [24,26,36,48,52,55,56,59,72,79,82,84,86,88,96,104,109,110] ranged from 12% to 87% (Fig. 5: Forest plots) with pooled prevalence estimates of 43% (4082/10,697 participants, 95% CI 36–50). In sensitivity analysis, no study had an implication for the pooled prevalence by more or less than 2%. There was significant heterogeneity between studies to estimate the prevalence ($p < 0.000$, $I^2 = 97$). The studies (n = 9) including frontline nurses reported the prevalence of sleep disturbance at 47% (95% CI = 34–60.1, $I^2 = 98$), whereas the studies (n = 8) including mixed nurses reported the prevalence at 37% (95% CI = 28–46, $I^2 = 96$).

Eight studies used the Insomnia Severity Index (ISI) scale with a pooled prevalence of 36% (95% CI = 30–43, $I^2 = 95$), whereas five studies used the Pittsburgh Sleep Quality Index (PSQI) with a pooled prevalence of 41% (95% CI = 22–64, $I^2 = 98$). The other studies used different scales. In the subgroup analyses using the NOS, the pooled prevalence in studies (n = 5) with low risk of bias was 38% (95% CI = 27–50, $I^2 = 98$), whereas the moderate risk of bias studies (n = 13) accounted for 45% (95% CI = 35–57, $I^2 = 97$).

3.7. Publication bias

Funnel plots indicated evidence of publication bias using visual inspection (Fig. 6). However, Egger's regression test in stress ($n = 40$) ($p = 0.42$), anxiety ($n = 73$) ($p = 0.29$), depression ($n = 38$) ($p = 0.35$) and sleep disturbance (n = 18) ($p = 0.38$) did not show presence of publication bias.

4. Discussion

The psychological health of nurses during the COVID-19 pandemic is important, as this can impact their performance and reduce the quality of care provided. Sadly, there have been several reports of suicides among healthcare professionals due to psychological pressures and the possible fear of dying [111,112].

This meta-analysis is the first to estimate the aggregate prevalence of stress, anxiety, depression and sleep disturbance among nurses during the COVID-19 pandemic. The review included 93 cross-sectional studies of a total of 93,112 nurses showing high proportions of those symptoms. The aggregate prevalence of stress, anxiety, depression and sleep disturbance (43%, 37%, 35% and 43%, respectively) among nurses during the COVID-19 outbreak suggests that at least one third of nurses have experienced stress, anxiety, depression and sleep disturbance. These results are higher than those reported in the general population during the same period. Shi et al. [113] reported that in the general population, 24% of people had stress, 32% had anxiety, 28% had depression and 29% had insomnia. This was because the nurses were more exposed to patients with COVID-19.

The results of current review are even higher when compared with the reported prevalence during the MERS and SARS epidemics among nurses: 11% for stress [114], 20% for depression [115], 30% for anxiety [116] and 10% for sleep disturbance [117]. This may be because COVID-19 is rapidly spread, is human-to-human transmissible [1], and is potentially fatal. These factors are exacerbated by the shortage of personal protective equipment, increased working hours and new or unfamiliar clinical guidelines for the management of COVID-19 patients [118]. Altogether, these factors can increase nurses' experience of stress,

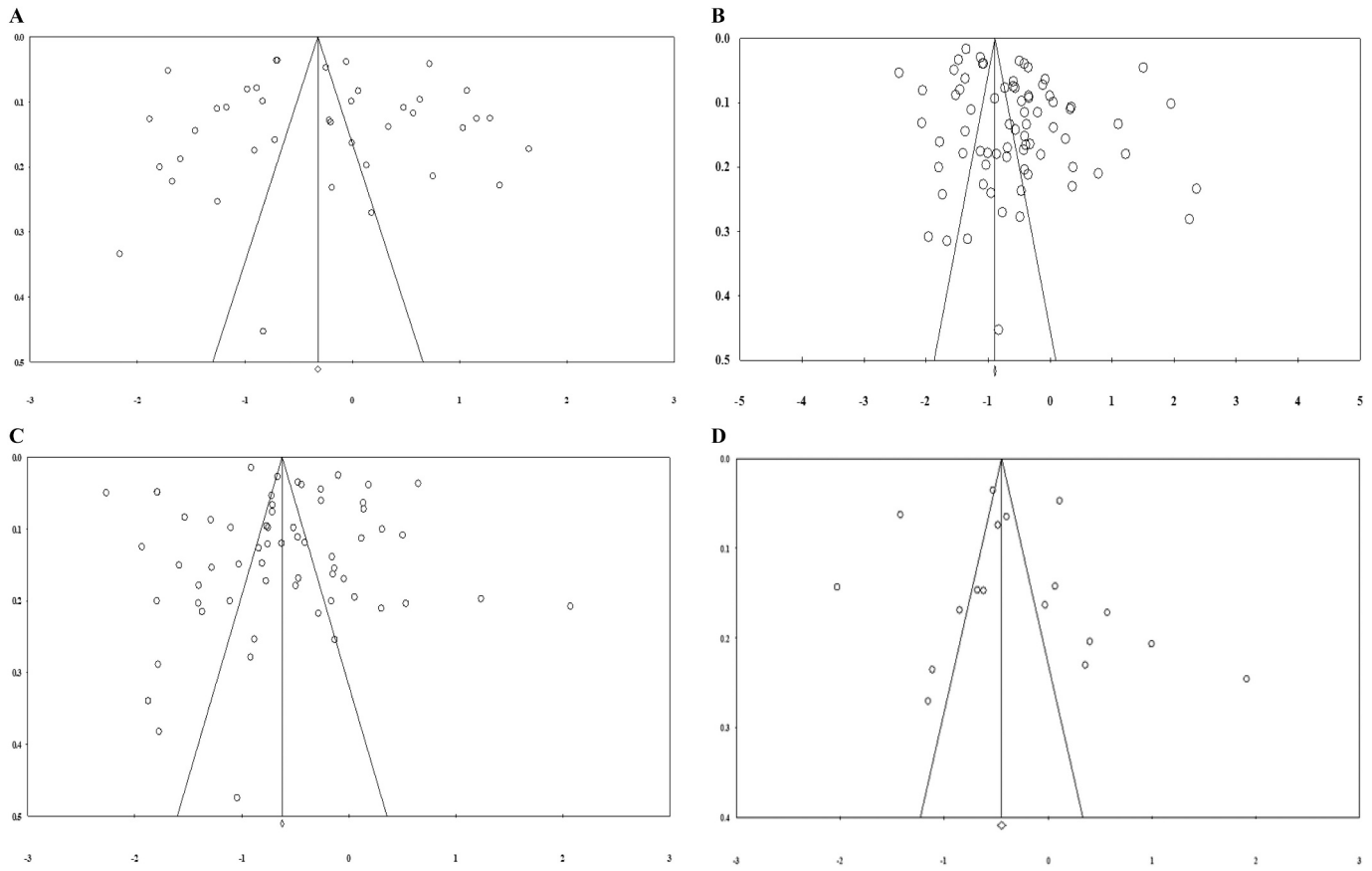

Fig. 6. Funnel plots test publication bias as following **A**:Stress (n = 40 studies); **B**: Anixity (n = 73 studies) **C:** Depression (*n* = 62); and **D**: Sleep Disterbance (n = 18).

anxiety, depression and sleep disturbance.

This meta-analysis found that the pooled prevalence varied between studies; for example, ranging between 10% [66] - 84% [52,64] for stress, 8% [94] - 91% [51] for anxiety, 9% [94] - 89% [51] for depression and 12% [48] - 87% [72] for sleep disturbance. This could be explained by the diversity of the assessment scale, healthcare system, population characteristics and lifestyles. Another possible reasons of differences in prevalence the variation in cut-offs scores of elevated symptoms for same instrument. For example; as shown in Table 1, the cut-off score of IES-R scale in Zhu et al. [54] was ˃33, whereas Lai et al. [55] used ≥26. The GAD-7 cut off score was ≥8 in Zhang et al. [56] and ≥ 10 by Zhpu et al. [24]. In depression, Lv et al. [26] used ≥5, while Li et al. [45] used ≥10 as cut off score of PHQ-9. The ISI cut off score was ≥15 in Que. et al. [82], whereas ˃8 in Zhang et al. [88].

The studies' quality was assessed using the NOS; all studies fell into the medium-quality and low-quality categories. The bias mainly involved the selection and size of samples, and follow-up time. Therefore, the amount of heterogeneity between the studies in terms of pooled prevalence and moderate analyses were low. Most importantly the Egger's test showed an absence of a publication bias.

The major strength of this meta-analysis is the large sample size of over 93,112 articles drawn from 93 studies, which estimated the psychological impacts on nurses during the COVID-19 outbreak. However, there are several potential limitations to this this meta-analysis. First, this review searched medRxiv's preprint studies, which are still not peer reviewed, which may introduce publication bias. Second, the majority of the studies (*n* = 69) were conducted in Asia, the generalization of the finding may be limited. Third, there is a possibility that some studies were not included in this meta-analysis, although this analysis used different MeSH terms and several databases. In addition, only studies published, unpublished or translated into English were included in this analysis. Fourth, stress, anxiety, depression and sleep disturbance were assessed using various scales and measures; this led to variability between studies and could increase the errors of prevalence estimates. Fifth, there were insufficient data available on the demographic and clinical characteristics, so not all information could be eliminated thoroughly. Finally, all findings were derived from cross-sectional design, which can reduce the ability to draw conclusions about changes in the psychological symptoms and associated factor [119]. It is important for further research to conduct a longitudinal study to identify the prevalence of symptoms during and after the infectious disease outbreaks.

Altogether, stress, anxiety, depression and sleep disturbance are significant problems for nurses worldwide during an infection disease outbreaks. The results of this meta-analysis have a number of potential implications for interventions to improve the psychological wellbeing of nurses during crises. For example, organizations should provide counselling support services or online workshops and training material to enable them to come over any psychological problems [120].

In addition, they should improve the working conditions of nurses by increasing manpower and resource allocation. Nurse managers play a crucial role through effective communication, rotating nurses, implementing flexible schedules and encouraging nurses to use psychosocial and psychological support service [121].

5. Conclusions

This is the first systematic review and meta-analysis reporting pooled prevalence estimates for stress, anxiety, depression and sleep disturbance among nurses during the COVID-19 outbreak. The findings show

that over one third of nurses have experienced stress, anxiety, depression and sleep disturbance during the COVID-19 outbreak, which is higher than the previous MERS and SARS epidemics. Furthermore, these results highlight the need for appropriate interventions that can reduce psychological impacts on nurses.

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Contributions

A.M and A.J and A.B designed the protocol, literature search, data synthesis interpreted the results, and wrote the manuscript and contributed to the conceptualization and design and the manuscript preparation.

Declaration of Competing Interest

The authors certify that there is no actual or potential conflict of interest in relation to this article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychores.2020.110343.

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