Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Prevalence of psychological morbidities among general population, healthcare workers and COVID-19 patients amidst the COVID-19 pandemic: A systematic review and meta-analysis

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ABSTRACT

This review was done to synthesize the existing evidence on the prevalence of various psychological morbidities among general public, healthcare workers and COVID-19 patients amidst this pandemic situation. Systematic searches were conducted in various databases and search engines such as Medline, Chinese national knowledge infrastructure, Cochrane library, ScienceDirect, and Google Scholar from inception until 22 April 2020. Newcastle Ottawa scale was used to assess the quality of included studies. We carried out a meta-analysis with random-effects model and reported pooled prevalence with 95% confidence intervals (CIs).A total of 50 studies were included in the review. Only seven studies (14%) had low risk of bias. Pooled prevalence rate of psychological morbidities includes poor sleep quality (40%), stress (34%), psychological distress (34%), insomnia (30%), post-traumatic stress symptoms (27%), anxiety (26%), depression (26%). Pooled prevalence rate of psychological morbidities with respect to impact of event due to COVID-19 pandemic was 44% (95%CI-42% to 47%). The burden of these psychological morbidities was highest among the COVID-19 patients followed by healthcare workers and general population.

1. Introduction

Currently, the COVID-19 pandemic is in progress. Corona virus disease 2019 or COVID-19, is caused by SARS-COV2, a virus strain belonging to corona virus family (Rothan and Byrareddy, 2020). As on 25th April 2020, globally there were reported 2.7 million cases and 2 lakh deaths (Johns Hopkins Coronavirus Resource Centre, 2020). The cases of COVID-19 were initially identified in China (World Health Organization, 2020a). It was reported by Chinese Center for disease control (CCDC) on January 7th 2020 as a novel corona virus strain (Li et al., 2020). As there was rapid spread of disease to other countries from China, World Health Organization (WHO) identified COVID-19 as Public Health Emergency of International Concern (PHEIC) on 30 January 2020 (World Health Organization, 2020b). With further increase in number of cases, number of deaths and the number of countries which affected globally, WHO announced COVID-19 as pandemic on 11 March 2020 (World Health Organization, 2020c).

In case of any pandemic situation, prevalence of psychological morbidities tends to be higher compared to normal situations (Rajkumar, 2020). The present circumstances because of COVID-19 pandemic have generated increased worry, stress and fear among population subgroups across the countries. Among general population, there is widespread panic due to lack of knowledge on the situation leading to misconception, misinterpretation, stigma and rumours (IASC Reference Group, 2020). With increased spread of COVID-19, almost all the affected countries have issued partial or complete lockdown with the aim to adopt social distancing method and break the chain of transmission. Hence, in addition to the disease, the measures taken by the respective countries to fight against this pandemic has also affected the livelihood of the people and this also may directly or indirectly result in increase of psychological morbidities (IASC Reference Group).

Whereas frontline health workers face problems due to increased work load, intense working schedule and increased chance of getting exposed to positive cases (Li et al., 2020). The most important subgroup, i.e. the victims of the infection, face the fear of dying from the disease, isolation from family, losing their job, facing discrimination and getting stigmatized by the society (IASC Reference Group). All these problems have in turn increased the fear of social isolation, loneliness, fear of getting the disease and dying, staying away from

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family, anxiety, depression, stress, insomnia, sleep disturbances and psychological distress. Thus, it is important to address the needs and gaps in mental and psychological aspect of health in all sub-groups of population (general public, health care workers and COVID-19 patients) (Li et al., 2020).

In order to understand the psychological needs and gaps, it is important to do a situational analysis of the current scenario by collecting currently available evidence from various countries. Hence, we conducted this review to quantify the prevalence of various psychological morbidities among general population, healthcare workers and COVID-19 patients amidst the COVID-19 pandemic.

2. Methods

2.1. Design and registration

We conducted a systematic review and meta-analysis of observational studies. The review protocol was registered on the international prospective register of systematic review (PROSPERO) with registration Number CRD42020182084. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist for reporting systematic reviews incorporating meta-analyses for reporting our review (Supplementary Appendix 1) (Moher et al., 2009).

2.2. Inclusion criteria for studies considered for the review

2.2.1. Type of studies

We included research studies reporting the prevalence of various psychological morbidities for the current review. There was no restriction related to study design or age groups. We included studies irrespective of the setting in which the study was conducted or mode of interview (online/offline). Full-text articles, abstracts and preprints were included, while case reports, case series, review articles and unpublished data were excluded.

2.2.2. Type of participants

We included research studies conducted among general population, healthcare workers (doctors, nurses or other paramedical staffs) or patients suffering from COVID-19.

2.2.3. Type of outcome measure

Research studies reporting the following outcome measure were included: stress, depression, anxiety, psychological distress, post-traumatic stress symptoms (PTSS), poor sleep quality, insomnia and impact of event. Studies reporting any of the above outcomes were included irrespective of the scale used for assessment.

2.3. Search strategy

Extensive electronic search was done in the following databases and search engines: MEDLINE, Chinese National Knowledge Infrastructure (CNKI), Cochrane library, ScienceDirect and Google Scholar. Combination of medical subject heading (Mesh) and free text terms were used for carrying out literature search. Complete details on the terms used in the search engines along with the search results obtained were provided in Supplementary Appendix 2. Search was conducted in all the databases from inception to 22 April 2020 with no language restriction for publication. The reference list of primary retrieved articles was checked to gather any relevant articles for inclusion in the review and analysis.

2.4. Selection of studies

Two independent investigators (YK and RN) performed the literature search and screened the title, abstract and keywords. Full text article was obtained for relevant studies. Further screening of full-text of the retrieved articles was done independently by two investigators (YK and RN) to select the studies satisfying the inclusion criteria. Any disagreements during this selection process were resolved either through consensus or consultation with third investigator (GKS). Quality of the selection process was also monitored by the third investigator (GKS).

2.5. Data extraction and management

Primary investigator (YK) extracted the following study characteristics required for the current review:

1.General Information: Author, study title, publication year, country

2.In Methods section: study design, study period, study setting, study participants, sample size, sampling technique, diagnostic tool, mode of interview, outcome assessment and statistical tests employed

3.In Outcome section: mean age, non-response rate and characteristics, prevalence of stress, anxiety, depression, psychological distress, PTSS, sleep quality, insomnia or impact of event

Primary investigator (YK) transferred these data into the software STATA version 14. Data entry was double checked for correct entry by the second investigator (RN) through comparison of data presented in review and the primary articles.

2.6. Risk of bias assessment in included studies

Two independent authors (YK and RN) assessed the quality of all the included studies using the Newcastle-Ottawa (NO) scale adapted for cross sectional studies (Peterson et al., 2011). Two criteria (selection and outcome) were used to assess the risk of bias. Following domains were used for assessing the risk of bias under selection criteria: representativeness of the sample, justification of sample size, rate of non-respondents and their characteristics and use of validated measurement tool. Under Outcome criteria, assessment of outcome through independent blind assessment or record linkage was used to assess the risk of bias. Each of these outcomes were rated as high (1 point) or low (0 points) based on the quality of evidence and availability of information. Studies scoring more than or equal to 3 points were considered to have high risk of bias.

2.7. Statistical analysis

Meta-analysis was performed using the software STATA 14.2 (StataCorp, College Station, TX, USA). For each of the studies, standard error was calculated using the reported number of outcomes and the sample size. The function *"Metaprop"* was used for performing the pooled analysis (Nyaga et al., 2014). To minimize the effect of extremely small or large prevalence on the overall estimate, Freeman Tukey double arcsine transformation was done to stabilize the variance (Nyaga et al., 2014). Final pooling of data was done with random effects model and reported as proportion with 95% confidence interval (CI).

Evidence of between-study variability was assessed through following methods: Chi-square test for heterogeneity and I^2 statistic to quantify the inconsistency. $I^2 < 25\%$ was mild, 25–75% moderate and $>75\%$ was considered substantial heterogeneity (Higgins and Green, 2011). Since there was significant heterogeneity with respect to all the outcomes included in our analysis ($p<0.05$), additional subgroup analysis and meta-regression was performed to explore the potential sources of this heterogeneity. Subgroup analysis was performed based on the study participants (general population/healthcare workers/COVID-19 patients). For meta-regression, the potential covariates were country, diagnostic tool, study participants, sample size, and quality of included studies. Multivariable meta-regression analysis was performed by including the study-level factors with p value less than 0.2 in the univariable model.

Forest plot was used to graphically represent the study specific and pooled prevalence estimates for overall and subgroup analysis.

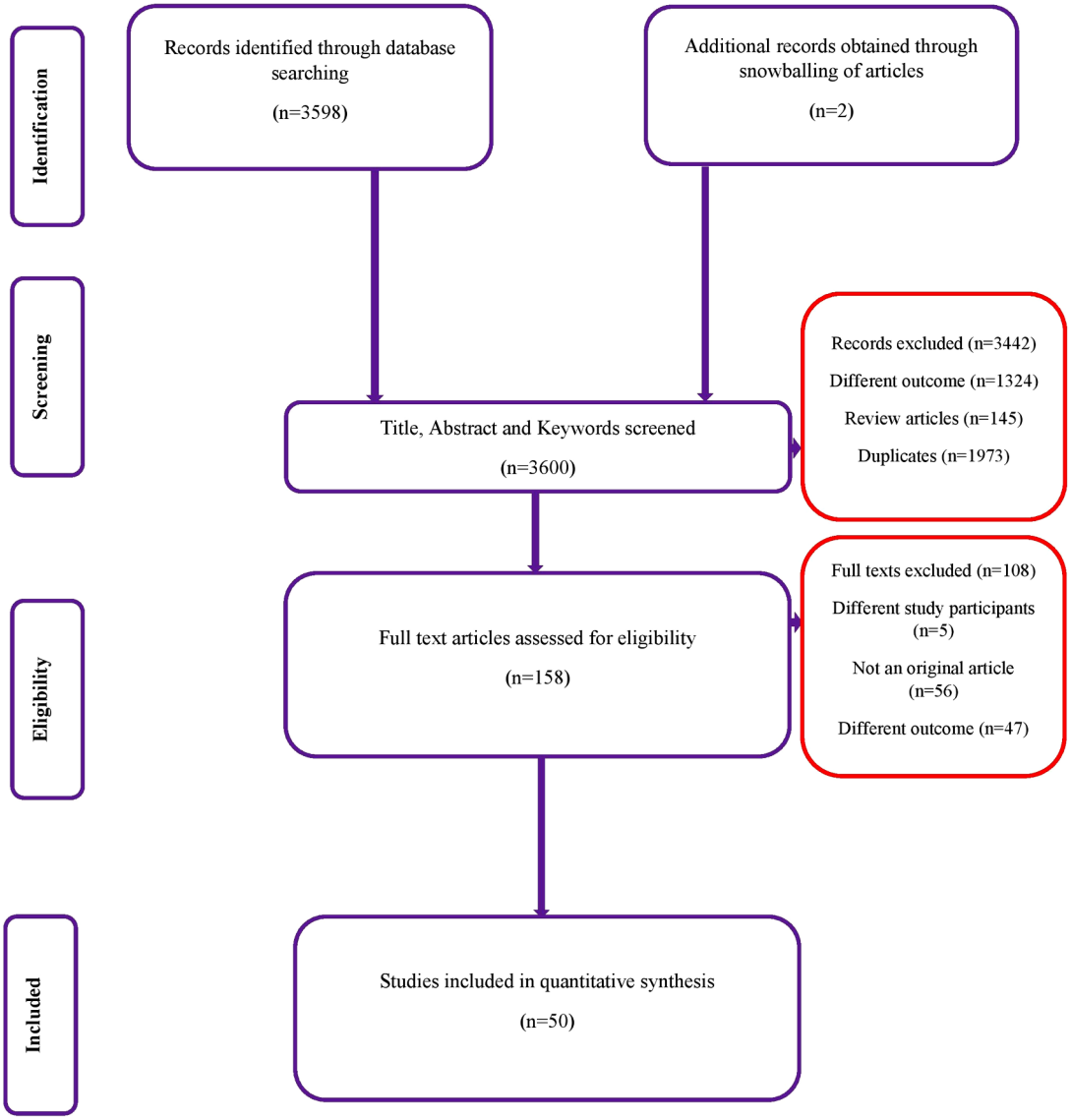

Fig. 1. Flow chart Showing the search strategy and selections of studies.

Publication bias was checked and graphically represented by funnel plot and asymmetry of the plot was tested using Egger's test-value less than 0.10 was considered as statistically significant publication bias (Egger et al., 1997).

3. Results

3.1. Study selection

In total, 3,598 records were screened for their title, abstract and keywords. After removal of duplicates, we reviewed 158 articles' full texts against our eligibility criteria for the possible inclusion in the review. At the same, we reviewed the bibliographies of the retrieved articles and found two more relevant studies. Finally, we analysed data from 50 studies with 171,571 participants satisfying the inclusion criteria (Fig. 1) (Bo et al., 2020; Cao et al., 2020; Cao et al., 2020; Chen et al., 2020; Chung and Yeung, 2020; Dai et al., 2020; Du et al., 2020; Du et al., 2020; Gao et al., 2020; Guo et al., 2020; Hu et al., 2020; Huang and Zhao, 2020; Jiang et al., 2020; Jing et al., 2020; Jizheng et al., 2020; Kong et al., 2020; Lai et al., 2020; Liu et al., 2020b; Liu et al., 2020c; Liu et al., 2020; Liu et al., 2020d; Lu et al., 2020; Lu et al., 2020; Lu et al., 2020; Manqin et al., 2020; Mo et al., 2020; Naeim et al., 2020; Nguyen et al., 2020; Qi et al., 2020; Qian et al., 2020; Qiu et al., 2020; Rossi et al., 2020; Sun et al., 2020; Tan et al., 2020; Tian et al., 2020; Wang et al., 2020a; Wang et al., 2020a; Xu et al., 2020; Yi et al., 2020; Yuan et al., 2020; Yuanhui et al., 2020; Yuhong et al., 2020; Zhang et al., 2020a; Zhang et al., 2020b; Zhang et al., 2020c; Zhang & Ma 2020; Zhao et al., 2020; Zheng et al. 2020; Zhu et al., 2020; Zhu et al., 2020).

3.2. Characteristics of the studies included

Table 1 lists the characteristics of the studies analysed. Majority of the studies (46 out of 50) were conducted in China and one study each in Vietnam, Italy, Singapore and Iran. All the studies were cross-sectional in nature and conducted during the period of COVID-19 pandemic. Most of the studies were conducted among general population and healthcare workers (23 each in each group) and 4 studies among COVID-19 patients. The mean age of study participants ranged from 30.6 to 49.9 years. The sample sizes in the studies varied from 37 to 52,730. Amongst the outcomes, majority of the studies reported anxiety (31 studies) followed by depression (28 studies).

3.3. Methodological quality of the included studies

We performed assessments of risk of bias for all the included studies using NO scale and reported in Table 2. All the 50 studies had high risk of bias related to representativeness of the sample as none of the studies performed random sampling. Only 7 (14%) studies provided proper justification for sample size, 13 (26%) studies reported the non-response rate or their characteristics. All the studies reported use of validated measurement tool. Under the outcome domain, only five studies reported independent assessment of the outcome as majority of studies were conducted as an online survey and self-reported by the participants. Only seven studies (14%) of the included studies had low risk of bias.

3.4. Prevalence of psychological morbidities amidst the COVID-19 pandemic

Table 3 shows the prevalence of psychological morbidities across various subgroups during the COVID-19 pandemic. The overall prevalence of stress amidst the COVID-19 pandemic was 34% (95%CI: 20%−50%). Subgroup analysis showed that this burden was higher among the general population (36%; 95%CI: 5%−75%) compared to healthcare workers (33%; 95%CI: 19%−50%).No studies have reported stress among COVID-19 patients (Appendix 3.1& 3.2).

The pooled prevalence of depression was 26% (95%CI: 20%−33%).COVID-19 patients had the highest burden of depression (42%; 95%CI: 28%−57%) followed by healthcare workers (25%; 95%CI: 19%−32%) and general population (24%; 95%CI: 14%−36%) (Appendix 3.3 & 3.4). The pooled prevalence of anxiety disorder amidst the COVID-19 pandemic was 26% (95%CI: 21%−31%).Here also, the burden was highest among COVID-19 patients (37%; 95%CI: 19%−57%) followed by general population (26%; 95%CI: 20%−32%) and healthcare workers (24%; 95%CI: 16%−32%) (Appendix 3.5& 3.6).

The overall burden of psychological distress was 34% (95%CI: 27%−42%), and it was more common among healthcare workers (41%; 95%CI: 19%−65%) compared to general population (26%; 95%CI: 21%−32%) (Appendix 3.7 & 3.8). The pooled prevalence of PTSS was 27% (95%CI: 12%−45%) with maximum burden in COVID-19 patients (96%; 95%CI: 95%−97%) followed by general population (15%; 95%CI: 4%−31%) and healthcare workers (13%; 95%CI: 11%−16%) (Appendix 3.9 & 3.10). Poor sleep quality was prevalent among 40% (95%CI: 25%−57%) of the population. Maximum burden of poor sleep quality was among COVID-19 patients (82%; 95%CI: 66%−92%) followed by healthcare workers (43%; 95%CI: 28%−59%) and general population (34%; 95%CI: 12%−60%) (Appendix 3.11 & 3.12). The pooled prevalence of insomnia was 30% (95%CI: 12%−52%) with maximum impact among healthcare workers (37%; 95%CI: 32%−42%) followed by general population (7%; 95%CI: 7%−8%) (Appendix 3.13& 3.14). The impact of the COVID-19 pandemic affected the mental health of 44% (95%CI: 42%−47%) of the general population (Appendix 3.15).

3.5. Additional subgroup analysis

Apart from the study population, subgroup analysis was also performed for online/offline version of study and country in which the studies were conducted. However, it could be performed only for anxiety and depression as other outcomes did not have enough number of studies to perform this analysis.

First, based on online/offline version of studies, there was no significant difference in the pooled prevalence of anxiety as the studies conducted through online survey had pooled prevalence of 25% while offline studies had prevalence of 28% (Appendix 3.16). However, the pooled prevalence of depression differed significantly as the online version of studies reported high prevalence of 28% and offline version

Table 1
Characteristics of the studies included (N = 50).

S.N.	First author and year	Country	Study design	Mode of interview (online/offline)	Study participants	Outcomes reported	Age group (in years)	Sample size	Diagnostic tool
1.1	Bo 2020	China	Cross Sectional Study	Online	COVID-19 Patients	PTSS	NA	714	PCL-C
2.	Cao et al., 2020a	China	Cross Sectional Study	Offline	Healthcare Worker	Depression	NA	37	PHQ-9
3.2	Cao et al., 2020a	China	Cross Sectional Study	Online	General Population	Anxiety	NA	7143	GAD-7
4.	Chen 2020	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety, Depression	>18 Years	612	SDS, SAS
type = 'Other''5.	Chung 2020	China	Cross Sectional Study	Online	Healthcare Worker	Depression	NA	69	PHQ-9
6.4	Dai 2020	China	Cross Sectional Study	Online	Healthcare Worker	Psychological Distress	20–81 Years	4357	GHQ 12
7.	Du 2020	China	Cross Sectional Study	Online	Healthcare Worker	Stress, Anxiety, Depression, Sleep	NA	134	PSS, Beck Depression Inventory, Beck Anxiety Inventory, Self-Rated Likert Scale
8.	Gao 2020	China	Cross Sectional Study	Online	General Population	Anxiety, Depression	18–85 Years	4827	WHO-5 Well Being Index, GAD-7
9.	Guo 2020	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety, Depression	NA	11,118	SDS, SAS
10.	Hu 2020	China	Cross Sectional Study	Online	General Population	Anxiety	11–77years	992	SAS
11.	Huang 2020	China	Cross Sectional Study	Online	Healthcare Worker, General Population	Anxiety, Depression, Sleep	NA	7236	CES-D, GAD-7, PQSI

(continued on next page)

Table 1 (*continued*)

S.N.	First author and year	Country	Study design	Mode of interview (online/offline)	Study participants	Outcomes reported	Age group (in years)	Sample size	Diagnostic tool
12.	Jiang 2020	China	Cross Sectional Study	Online	General Population	PTSS	NA	6049	PCL-5
13.	Jing 2020	China	Cross Sectional Study	Online	COVID-19 Patients	Anxiety, Depression	NA	148	SDS, SAS
14.	Jizheng 2020	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety, PTSS	NA	230	SAS, PTSD-SS
15.	KONG 2020	China	Cross Sectional Study	Online	COVID-19 Patients	Anxiety, Depression	15–87 Years	144	HADS
16.	Lai 2020	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety, Depression, Insomnia, Distress	NA	1257	PHQ-9, GAD-7, IES-R, ISI
17.	Li 2020	China	Cross Sectional Study	Online	General Population	Anxiety, Depression	NA	3001	PHQ-9, GAD-7
18.	Liu et al., 2020a	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety	NA	512	SAS
19.	Liu et al., 2020a	China	Cross Sectional Study	Online	General Population	Sleep, PTSS	NA	285	PQSI
20.	Liu et al., 2020a	China	Cross Sectional Study	Online	General Population	Anxiety, Depression, Distress	NA	14,592	PHQ-9, GAD-7, SRQ-20
21.	Liu et al., 2020a	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety, Depression, Distress	NA	4679	SDS, SAS, SRQ-20
22.	Lu 2020	China	Cross Sectional Study	Online	General Population	Anxiety, Depression	16–65 Years	1849	CES-D
23.	Lu 2020	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety, Depression, Sleep	NA	2150	PHQ-9, GAD-7
24.	Lu 2020	China	Cross Sectional Study	Online	General Population, Healthcare Worker	Anxiety, Depression	NA	2299	HAMD, HAMA
25.	Manqin 2020	China	Cross Sectional Study	Online	General Population	Anxiety	NA	3111	GAD-7
26.	Mo 2020	China	Cross Sectional Study	Online	Healthcare Worker	Stress	NA	180	SOS
27.	Naeim 2020	Iran	Cross Sectional Study	Offline	General Population	Anxiety	NA	807	GAD-7
28.	Nguyen et al., 2020	Vietnam	Cross Sectional Study	Offline	General Population	Depression	18–85 Years	3947	PHQ
29.	Qi 2020	China	Cross Sectional Study	Online	Healthcare Worker	Sleep, Insomnia	NA	1306	PSQI, AIS
30.	Qian 2020	China	Cross Sectional Study	Offline	General Population	Anxiety	NA	1011	GAD-7
31.	Qiu 2020	China	Cross Sectional Study	Online	General Population	Distress	NA	52,730	CPDI
32.	Rossi 2020	Italy	Cross Sectional Study	Online	General Population	Stress, Depression, Anxiety, Insomnia, PTSS	>18 Years	18,147	PSS, PHQ-9, GAD-7, ISI, GPS
33.	Sun 2020	China	Cross Sectional Study	Online	General Population	PTSS	NA	2091	PCL-5
34.	Tan 2020	Singapore	Cross Sectional Study	Online	Healthcare Worker	Anxiety, Depression, Stress, PTSS	NA	470	DASS 21, IES-R
35.	Tian 2020	China	Cross Sectional Study	Online	General Population	Distress	13–76 Years	1060	GSI
36.	Wang et al., 2020b	China	Cross Sectional Study	Offline	General Population	Anxiety, Depression, Stress, Impact	12–59years	1210	DASS 21, IES-R
37.	Wang et al., 2020b	China	Cross Sectional Study	Online	General Population	Anxiety, Depression	18–72 Years	600	SDS, SAS
38.	Xu et al., 2020	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety, Depression	NA	60	Depression Index, Anxiety Index

(*continued on next page*)

Table 1 (*continued*)

S.N.	First author and year	Country	Study design	Mode of interview (online/offline)	Study participants	Outcomes reported	Age group (in years)	Sample size	Diagnostic tool
39.	Yi 2020	China	Cross Sectional Study	Online	Healthcare Worker	Stress, Anxiety, Depression	NA	171	PSS, PHQ-9, GAD-7
40.	Yuan 2020	China	Prospective Study	Online	General Population	Sleep	NA	939	PSQI
41.	Yuanhai 2020	China	Cross Sectional Study	Online	Healthcare Worker	Distress	NA	216	Psychological Distress Management Screening Tool
42.	Yuhong 2020	China	Cross Sectional Study	Online	General Population, COVID-19 Patients, Healthcare Worker	Sleep	NA	362	PSQI
43.	Zhang et al., 2020a	China	Cross Sectional Study	Online	Healthcare Worker	Insomnia	NA	1563	ISI
44.	Zhang et al., 2020b	China	Cross Sectional Study	Online	Healthcare Worker	Insomnia, Anxiety, Depression	NA	2182	PHQ 2, GAD-2, ISI
45.	Zhang et al., 2020c	China	Cross Sectional Study	Online	General Population	Impact of event	>18 years	263	IES-R
46.	Zhang et al., 2020a	China	Cross Sectional Study	Online	General Population	Stress	NA	1383	PSS
47.	Zhao 2020	China	Cross Sectional Study	Online	COVID-19 Patients	Depression, Anxiety	NA	106	PHQ-9, GAD-7
48.	Zheng 2020	China	Cross Sectional Study	Online	General Population	Depression	NA	86	SDS
49.	Zhu 2020	China	Cross Sectional Study	Online	Healthcare Worker	Stress, Anxiety, Depression	NA	5062	IES-R, PHQ-9, GAD-7
50.	Zhu 2020	China	Cross Sectional Study	Online	Healthcare Worker	Anxiety, Depression	NA	165	SDS, SAS

NA: Not Available.
PTSS: Post Traumatic Stress Syndrome.
PCL-C: PTSD CheckList – Civilian Version.
GAD: General Anxiety Disorder.
PHQ: Patient Health Questionnaire.
SDS: Zung Self- Rating Depression scale.
SAS: Zung Self Rating Anxiety Scale.
GHQ: General Health Questionnaire.
PSS: Perceived Stress Scale.
WHO: World Health Organization.
CES-D: Center for Epidemiologic Studies Depression Scale.
PSQI: Pittsburgh Sleep Quality Index.
PTSD-SS: Self-Assessment Scale for Posttraumatic Stress Disorder.
HADS: Hospital Anxiety and Depression Scale.
IES-R: Impact of Event Scale - Revised.
ISI: Insomnia Severity Index.
SRQ: Self- Reporting Questionnaire.
HAMD: Hamilton Depression rating scale.
HAMA: Hamilton Anxiety Rating Scale.
SOS: Stress Overload scale.
AIS: Athens Insomnia Scale.
CPDI: COVID-19 Peritraumatic Distress Index.
GPS: Global Psychotrauma Screen; DASS: Depression Anxiety Stress Scale; GSI: Global Severity Index.

Table 2
Risk of bias assessment for the included studies, $N = 50$.

S.N.	First author and year	Representativeness	Sample size justification	Non-response	Validated Measurement tool	Assessment of outcome
1.1	Bo 2020	High	High	High	Low	High
2.	Cao et al., 2020a	High	High	High	Low	High
3.	Cao et al., 2020a	High	High	Low	Low	Low
4.	Chen 2020	High	High	High	Low	High
5.	Chung 2020	High	High	High	Low	High
6.	Dai 2020	High	High	High	Low	High
7.	Du 2020	High	High	Low	Low	High
8.	Gao 2020	High	High	Low	Low	High
9.	Guo 2020	High	High	High	Low	High
10.	Hu 2020	High	High	High	Low	High
11.	Huang 2020	High	High	High	Low	High
12.	Jiang 2020	High	High	High	Low	High
13.	Jing 2020	High	High	High	Low	High
14.	Jizheng 2020	High	Low	Low	Low	High
15.	KONG 2020	High	Low	Low	Low	High
16.	Lai 2020	High	Low	High	Low	High
17.	Li 2020	High	High	High	Low	High
18.	Liu et al., 2020a	High	High	High	Low	High
19.	Liu et al., 2020a	High	High	High	Low	High
20.	Liu et al., 2020a	High	High	High	Low	High
21.	Liu et al., 2020a	High	High	High	Low	High
22.	Lu 2020	High	High	Low	Low	High
23.	Lu 2020	High	Low	High	Low	High
24.	Lu 2020	High	High	Low	Low	High
25.	Manqin 2020	High	High	High	Low	High
26.	Mo 2020	High	High	Low	Low	High
27.	Naeim 2020	High	Low	Low	Low	Low
28.	Nguyen et al., 2020	High	High	Low	Low	Low
29.	Qi 2020	High	High	High	Low	High
30.	Qian 2020	High	Low	Low	Low	Low
31.	Qiu 2020	High	High	High	Low	High
32.	Rossi 2020	High	High	High	Low	High
33.	Sun 2020	High	High	High	Low	High
34.	Tan 2020	High	High	Low	Low	High
35.	Tian 2020	High	High	High	Low	High
36.	Wang et al., 2020b	High	Low	High	Low	Low
37.	Wang et al., 2020b	High	High	High	Low	High
38.	Xu et al., 2020	High	High	High	High	High
39.	YUAN 2020	High	High	High	Low	High
40.	Yi 2020	High	High	High	Low	High
41.	Yuanhai 2020	High	High	High	Low	High
42.	Yuhong 2020	High	High	High	Low	High
43.	Zhang 2020	High	High	High	Low	High
44.	Zhang 2020	High	High	High	Low	High
45.	Zhang 2020	High	High	Low	Low	High
46.	Zhang 2020	High	High	High	Low	High
47.	Zhao 2020	High	High	High	Low	High
48.	Zheng 2020	High	High	High	Low	High
49.	Zhu 2020	High	High	High	Low	High
50.	Zhu 2020	High	High	High	Low	High

only 13% (Appendix 3.17). However, for both the outcomes, only 3 studies were available in offline version and more such studies required to comment on this difference in outcome.

Based on the country also, anxiety did not show significant difference in pooled estimate (China = 26%; Other countries = 21%), while pooled prevalence of depression was significantly higher among studies conducted in China (29%) compared to other countries (11%) (Appendix 3.18& 3.19).

3.6. Meta-regression

Meta-regression was performed for only two outcomes such as anxiety and depression as the other outcomes did not have sufficient number of studies. First, for anxiety, we conducted univariable meta-regression with individual study level factors such as country, diagnostic tool, study participants, sample size, and quality of evidence. Multivariable meta-regression was performed with factors having p value less than 0.2 which included country, diagnostic tool, study participants and sample size. The adjusted model was able to explain 26.4% of the between-study variability and the model was statistically significant ($p = 0.02$).

Second, for depression, univariable regression was performed with the above-mentioned factors and only country, study participants and diagnostic tool satisfied the criteria for multivariable meta-regression. Here also, the adjusted model was significant and able to explain 20.5% of the between-study variability ($p = 0.03$).

3.7. Publication bias

Publication bias was also assessed for only two outcomes (anxiety and depression) as the other outcomes did not have sufficient number of studies. There were no small study effects with non-significant coefficient value for both anxiety ($p = 0.83$) and depression ($p = 0.89$). This shows that there is a possibility of absence of publication bias. Graphical representation of the test of publication bias was depicted through funnel plot in Appendix 3.20 & 3.21. Funnel plot also showed symmetric plot indicating the absence of publication bias.

Table 3
Summary of findings among studies reporting psychological morbidities amidst the COVID-19 pandemic.

Outcome	Number of studies pooled	Pooled ES[#] (95% CI)	I^2	Figure
Stress				
General population	3	36% (5% – 75%)	NA	Appendix 3.1
Healthcare workers	5	33% (19% – 50%)	98.4%	Appendix 3.1
Overall	8	34% (20% – 50%)	99.7%	Appendix 3.2
Depression				
General population	12	24% (14% – 36%)	99.9%	Appendix 3.3
Healthcare workers	16	25% (19% – 32%)	99.4%	Appendix 3.3
COVID-19 patients	3	42% (28% – 57%)	NA	Appendix 3.3
Overall	28	26% (20% – 33%)	99.8%	Appendix 3.4
Anxiety				
General population	15	26% (20% – 32%)	99.7%	Appendix 3.5
Healthcare workers	16	24% (16% – 32%)	99.6%	Appendix 3.5
COVID-19 patients	3	37% (19% – 57%)	NA	Appendix 3.5
Overall	31	26% (21% – 31%)	99.7%	Appendix 3.6
Psychological distress				
General population	3	26% (21% – 32%)	NA	Appendix 3.7
Healthcare workers	4	41% (19% – 65%)	99.8%	Appendix 3.7
Overall	7	34% (27% – 42%)	99.7%	Appendix 3.8
PTSS				
General population	4	15% (4% – 31%)	99.8%	Appendix 3.9
Healthcare workers	2	13% (11% – 16%)	NA	Appendix 3.9
COVID-19 patients	1	96% (95% – 97%)	NA	Appendix 3.9
Overall	7	27% (12% – 45%)	99.8%	Appendix 3.10
Poor sleep quality				
General population	4	34% (12% – 60%)	99.5%	Appendix 3.11
Healthcare workers	5	43% (28% – 59%)	99.2%	Appendix 3.11
COVID-19 patients	1	82% (66% – 92%)	NA	Appendix 3.11
Overall	7	40% (25% – 57%)	99.6%	Appendix 3.12
Insomnia				
General population	1	7% (7% – 8%)	NA	Appendix 3.13
Healthcare workers	4	37% (32% – 42%)	92.6%	Appendix 3.13
Overall	5	30% (12% – 52%)	99.9%	Appendix 3.14
Impact of event				
Overall	2	44% (42% – 47%)	NA	Appendix 3.15

NA-Not applicable.
[#] Effect Size.

4. Discussion

This study found that globally the burden of mental and psychological problems is an important health issue and more common amidst this COVID-19 pandemic. Nearly half of the general public have reported that there was a significant psychological impact due to COVID-19 pandemic. Poor sleep quality (40%) was the most common problem faced by the people followed by stress (34%) and psychological distress (34%). The burden of psychological morbidity was highest among the COVID-19 patients followed by healthcare workers and general population.

In case of a pandemic situation, due to widespread occurrence of disease and increased number of cases and deaths, it is common to observe higher psychological morbidities in the population sub-groups, but it has to be quantified. Similar situations with higher psychological morbidities were also found in the past during the outbreaks of severe acute respiratory syndrome (SARS), H1N1 influenza, Ebola virus, middle east respiratory syndrome (MERS) (Brooks et al., 2020). There was an alarming rise in the prevalence of psychological morbidity among the patients compared to healthcare workers or general public similar to previous outbreaks (Lee et al., 2007). More than half of the patients affected with SARS, MERS or Ebola had at least one of the many psychological morbidities such as depression, anxiety, stress or sleep problems (Chua et al., 2004; Keita et al., 2017; Jeong et al., 2016). Major factors responsible for such high burden among the patients are the perception of threat, mortality level, food insecurity, stigma and discrimination. In addition, as the COVID-19 has no definitive therapeutic agent or vaccine, there is always an uncertainty on the outcome among the patients which can further worsen their mental status. This shows that the mental health needs to be an integral part of rehabilitation of patients following the outbreak. There is also a pressing need to enhance the preparedness and competence of health care workers (including non-psychiatrists) to detect these problems early. Further research is required to study long term mental health sequelae amongst the survivors.

After patients, highest burden of psychological morbidity was found among healthcare workers compared to general public. Previous surveys during epidemics have also reported that healthcare workers have significantly higher prevalence of psychological problems compared to general population (Ji et al., 2017; Lee et al., 2018; Lin et al., 2007; Styra et al., 2008). World Health Organization has informed that there is severe shortage of personal protective equipment (PPE) around the world, as a result of rising demand, misuse, panic buying and hoarding (World Health Organization, 2020d). Therefore, healthcare workers mental status depends on PPE availability to prevent them from getting infected and infecting others. Without this, they will be at risk, and this situation severely impacts their physical and mental health. Even in settings with adequate PPE and intensive training before handling any patients, still there is a possibility of getting disease. Apart from the concerns related to personal protection, safety of their loved ones, death of their own colleagues, excess working hours, worrying about the domestic supplies, ethical concerns about rationing of ventilators for the sick might exert a negative impact on their psychological status (Menon and Padhy, 2020).

Apart from patients and healthcare workers, even the general public have higher prevalence of psychological morbidities during this pandemic period compared to normal times. This was similar to the findings in previous epidemics (Brooks et al., 2020; Liu et al., 2012). Stress (36%) is the most common psychological problem among general public followed by poor sleep quality (34%), psychological distress

(34%), anxiety (26%) and depression (24%). Possible reason for such high burden during pandemic period is the prolonged duration of quarantine. Quarantine is an unpleasant experience among those who undergo it. There is loss of freedom, separation from families and friends, boredom, and uncertainty over their disease status. There can also stressors related to finances, employment, fear and stigma attached to the condition. Previous review on psychological impact of quarantine during previous outbreaks have shown that there is significantly higher prevalence among those general public who are under quarantine (Brooks et al., 2020). The prevalence increased with increase in duration of quarantine. Hence, the potential benefit of introducing a large-scale quarantine should be assessed along with possible psychological consequences attached with it.

The major strength of the study is that we have tried to provide the first comprehensive review on burden of psychological morbidities during the COVID-19 pandemic. We also provided estimates stratified based on the general public, healthcare workers and COVID-19 patients. Test for publication bias have found that there was no significant bias in the current review. However, it could not be assessed for all the outcomes owing to limitation of number of studies.

Our review has certain limitations. Summarizing and concluding the prevalence of psychological morbidities with a single point estimate is difficult because of the inherent heterogeneity. We have tried to overcome this limitation by conducting subgroup analysis and meta-regression based on study-level factors and thus, examined potential sources of heterogeneity. There was lack of representation of studies in countries other than China. Almost 90% of the studies included in our review had high risk of bias mainly because of online mode of recruitment and data collection. All the included studies have used validated screening tool to identify the psychological morbidity. None of the studies used confirmation tool such as diagnostic and statistical manual of psychiatric disorders – 5 (DSM-5) to confirm the diagnosis. However, in such pandemic situation, it is the feasible way to conduct studies as the direct contact and confirmation may not be always possible with all the participants.

In spite of these limitations, this review provides important baseline information of various psychological morbidities suffered by the general public, healthcare workers and COVID-19 patients amidst this pandemic period. This will act as a tool for policymakers to develop and provide guidance to the public. Rapid and effective risk communication should be provided to the public, so that the negative effects of public health measures taken during this pandemic gets neutralized. Both general and medical supplies should be ensured. People under lockdown should be advised about stress management and coping strategies.

Healthcare workers deserves a special attention as the evidences suggest that they can be negatively influenced by the stigmatizing attitudes from the general public. All the frontline workers should work together to enact effective strategies to promote their psychological well-being. During such outbreaks, support from the organization has been proven to be effective in protecting their mental health. Hence, the organization should make sure that they are adequately supported by their staff members and colleagues. They should have a proper plan, policy, and standard operating procedure in place for their workers. Employer institution can arrange for quarantine facilities or accommodation for their staffs. They can also make a support cell, which will provide a platform for workers to exchange and address their concerns, normalize their feelings related to the stressful environment, share helpful stress coping strategies, and discuss about the maladaptive responses.

COVID-19 patients face the maximum mental health trauma during and after the course of their illness. Survivors of COVID-19 patients can have a long-term impact on their mental health. Once the situation improves in any particular region, survivors should be followed up and evaluated for a longer period of time so that the negative psychological consequences are kept in check. Comprehensive strategic plan to ensure good mental health should be developed. This should address behavioural, social and psychological issues related to COVID-19. Hence, in addition to the medical facilities, psychological services for patients, family members, healthcare workers should be developed, implemented and sustained.

Suicidal ideation can be a pressing concern with the growing pandemic across all the subgroups (Eddleston and Gunnell, 2020). Mental healthcare services need a clear assessment and care pathways for people with suicidal ideation, and training of staffs to support newer ways of working. Digital training materials enables the staffs who have not previously worked with people having suicidal ideation to take effective role in helplines and mental healthcare services. Evidence based online applications and interventions should be developed and provided to support the people who are suicidal risk.

Ethical approval

Not required

Author contribution statement

YK and RN was involved in the conception and design of the study; YK, RN, GKS and VM involved in the data acquisition and analysis of the study; YK, GKS and VM involved in the interpretation of the data of work; YK, RN, GKS and VM involved in the drafting of the manuscript; GKS and VM involved in revising it critically for important intellectual content; All the authors are involved in the final approval of the version of manuscript to be published.

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References

Bo, H.-X., Li, W., Yang, Y., Wang, Y., Zhang, Q., Cheung, T., et al., 2020. Posttraumatic stress symptoms and attitude toward crisis mental health services among clinically stable patients with COVID-19 in China. Psychol. Med. 1–7.

Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., et al., 2020. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet. https://doi.org/10.1016/S0140-6736(20)30460-8.

Cao, J., Wei, J., Zhu, H., Duan, Y., Geng, W., Hong, X., et al., 2020a. A Study of Basic Needs and Psychological Wellbeing of Medical Workers in the Fever Clinic of a Tertiary General Hospital in Beijing during the COVID-19 Outbreak. Psychother. Psychosom. 1–3.

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., et al., 2020b. The psychological impact of the COVID-19 epidemic on college students in China. Psychiatry Res., 112934.

ChenC., NingX., YuF., HuangQ., LiX., LuoY. 2020. The mental health of neurological doctors and nurses in Hunan Province, China, during the COVID-19 outbreak. [*preprint*]. doi:10.21203/rs..1.rs-22061/v1; Available from: https://www.researchsquare.com/article/rs-22061/v1.

Chua, S.E., Cheung, V., McAlonan, G.M., Cheung, C., Wong, J.W., Cheung, E.P., et al., 2004. Stress and psychological impact on SARS patients during the outbreak. Can. J. Psychiatry 49, 385–390.

Chung, J.P., Yeung, W., 2020. Staff Mental Health Self-Assessment During the COVID-19 Outbreak. East Asian Archiv. Psychiatry 30 34–34.

Dai, Y., Hu, G., Xiong, H., Qiu, H., Yuan, X, 2020. Psychological impact of the coronavirus

disease 2019 (COVID-19) outbreak on healthcare workers in China. medRxiv.
Du, C., Li, S., Ye, Z., Wei, Q., He, C. 2020. The residents' mental health status and community's role during COVID-19 epidemic: a community-based cross-sectional study in China. doi:10.21203/rs.1.rs-20269/v1.
Du, J., Dong, L., Wang, T., Yuan, C., Fu, R., Zhang, L., et al., 2020b. Psychological Symptoms Among Frontline Healthcare Workers During COVID-19 Outbreak in Wuhan. General Hospital Psychiatry.
Eddleston, M., Gunnell, D., 2020. Preventing suicide through pesticide regulation. Lancet Psychiatry 7, 9–11. https://doi.org/10.1016/S2215-0366(19)30478-X.
Egger, M., Davey Smith, G., Schneider, M., 1997. Bias in meta-analysis detected by a simple, graphical test. BMJ 315, 629–634.
Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., et al., 2020. Mental health problems and social media exposure during COVID-19 outbreak. PLoS ONE 15, e0231924.
Guo, J., Liao, L., Wang, B., Li, X., Guo, L., Tong, Z., et al., 2020. Psychological Effects of COVID-19 on Hospital Staff: a National Cross-Sectional Survey of China Mainland. Available at SSRN 3550050.
Higgins, J.P., Green, S., 2011. Cochrane Handbook for Systematic Reviews of Interventions. John Wiley & Sons.
Hu, W., Su, L., Qiao, J., Zhu, J., Zhou, Y. 2020. Countrywide quarantine only mildly increased anxiety level during COVID-19 outbreak in China. medRxiv.
Huang, Y., Zhao, N., 2020. Mental health burden for the public affected by the COVID-19 outbreak in China: who will be the high-risk group? Psychol. Health Med. 1–12.
IASC Reference Group on Mental Health and Psychosocial Support in Emergency Settings, 2020. Addressing mental health and psychosocial aspects of covid-19 outbreak. In: pp. 2.
Jeong, H., Yim, H.W., Song, Y.J., Ki, M., Min, J.A., Cho, J., et al., 2016. Mental health status of people isolated due to Middle East Respiratory Syndrome. Epidemiol. Health 38, e2016048. https://doi.org/10.4178/epih.e2016048.
Ji, D., Ji, Y.J., Duan, X.Z., Li, W.G., Sun, Z.Q., Song, X.A., et al., 2017. Prevalence of psychological symptoms among Ebola survivors and healthcare workers during the 2014-2015 Ebola outbreak in Sierra Leone: a cross-sectional study. Oncotarget 8, 12784–12791. https://doi.org/10.18632/oncotarget.14498.
Jiang, Hj, Nan, J., Zy, Lv, Yang, J, 2020. Psychological impacts of the COVID-19 epidemic on Chinese people: exposure, posttraumatic stress symptom, and emotion regulation. Asian Pac. J. Trop. Med Epub ahead of print.
Jing, C., Min, W., Yirong, S., Youchun, W., Qing, H, 2020. Investigation on anxiety, depression and influencing factors of patients with new coronavirus pneumonia. J. Nursing.
Jizheng, H., Mingfeng, H., Rotunda, Ake R, Xiaoping, Z, 2020. A survey of mental health of medical staff in new-type coronavirus pneumonia hospitals. Chinese J. Occupational Health Occupational Dis.
Johns Hopkins Coronavirus Resource Centre. 2020. COVID-19 Map. [online] Available at: <https://coronavirus.jhu.edu/map.html> [Accessed 25 April 2020].
Keita, M.M., Taverne, B., Sy Savané, S., March, L., Doukoure, M., Sow, M.S., et al., 2017. Depressive symptoms among survivors of Ebola virus disease in Conakry (Guinea): preliminary results of the PostEboGui cohort. BMC Psychiatry 17, 127. https://doi.org/10.1186/s12888-017-1280-8.
Kong, X., Zheng, K., Tang, M., Kong, F., Zhou, J., Diao, L., et al., 2020. Prevalence and Factors Associated with Depression and Anxiety of Hospitalized Patients with COVID-19. medRxiv.
Lai, J., Ma, S., Wang, Y., Cai, Z., Hu, J., Wei, N., et al., 2020. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. JAMA Network Open 3, e203976.
Lee, A.M., Wong, J.G., McAlonan, G.M., Cheung, V., Cheung, C., Sham, P.C., et al., 2007. Stress and psychological distress among SARS survivors 1 year after the outbreak. Can. J. Psychiatry 52, 233–240. https://doi.org/10.1177/070674370705200405.
Lee, S.M., Kang, W.S., Cho, A.R., Kim, T., Park, J.K, 2018. Psychological impact of the 2015 MERS outbreak on hospital workers and quarantined hemodialysis patients. Compr. Psychiatry 87, 123–127.
Li, W., Yang, Y., Liu, Z., Zhao, Y., Zhang, Q., Zhang, L., et al., 2020. Progression of Mental Health Services during the COVID-19 Outbreak in China. Int. J. Biol. Sci. 16, 1732–1738.
Lin, C.Y., Peng, Y.C., Wu, Y.H., Chang, J., Chan, C.H., Yang, D.Y, 2007. The psychological effect of severe acute respiratory syndrome on emergency department staff. Emerg. Med. J. 24, 12–17. https://doi.org/10.1136/emj.2006.035089.
Liu, C.Y., Yang, Y.Z., Zhang, X.M., Xu, X., Dou, Q.L., Zhang, W.W. 2020. The prevalence and influencing factors for anxiety in medical workers fighting COVID-19 in China: a cross-sectional survey. Available at SSRN 3548781.
Liu, D., Ren, Y., Yan, F., Li, Y., Xu, X., Yu, X., et al., 2020. Psychological Impact and Predisposing Factors of the Coronavirus Disease 2019 (COVID-19) Pandemic on General Public in China. Available at SSRN: https://ssrn.com/abstract=3551415 or 10.2139/ssrn.3551415.
Liu, N., Zhang, F., Wei, C., Jia, Y., Shang, Z., Sun, L., et al., 2020c. Prevalence and predictors of PTSS during COVID-19 Outbreak in China Hardest-hit Areas: gender differences matter. Psychiatry Res. https://doi.org/10.1016/j.psychres.2020.112921.
Liu, Z., Han, B., Jiang, R., Huang, Y., Ma, C., Wen, J., et al., 2020. Mental health status of doctors and nurses during COVID-19 epidemic in China. Available at SSRN 3551329. 2020.
Liu, X., Kakade, M., Fuller, C.J., Fan, B., Fang, Y., Kong, J., et al., 2012. Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. Compr. Psychiatry 53, 15–23. https://doi.org/10.1016/j.comppsych.2013.02.003.Epub. 2011 Apr 12.
Lu, H., Nie, P., Qian, L, 2020a. Do Quarantine Experiences and Attitudes Towards COVID-19 Affect the Distribution of Psychological Outcomes in China? A Quantile Regression Analysis GLO Discussion Paper, No.512, Global Labor Organization (GLO), Essen.2020.
Lu, W., Li-ping, S., Jing, C, 2020b. Psychological status of primary care workers during the COVID-19 epidemic in Shangai. J. Tongji Univ. 41, 2.
Lu, W., Wang, H., Lin, Y., Li, L, 2020c. Psychological status of medical workforce during the COVID-19 pandemic: a cross-sectional study. Psychiatry Res. 288, 112936.
Manqin, S., Shanshan, L., Hongyu, Y., Xiang, L., Wei, L., Shifen, X., 2020. Analysis on Anxiety Status of Chinese Netizens under the Outbreak of the Coronavirus Disease 2019 (COVID-19) and Its Influencing Factors. Modernization of Traditional Chinese Medicine and Materia Medica-World Science and Technology.
Menon, V., Padhy, S.K., 2020. Ethical dilemmas faced by healthcare workers during COVID-19 pandemic: issues, implications and suggestions. Asian J. Psychiatry. http://doi.org/10.1016/j.ajp.2020.102116.
Mo, Y., Deng, L., Zhang, L., Lang, Q., Liao, C., Wang, N., et al., 2020. Work stress among Chinese nurses to support Wuhan for fighting against the COVID-19 epidemic. J. Nursing Manag.
Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G, 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Annals Int. Med. 151, 264–269.
Naeim, M., Rezaeisharif, A., Naeim, R., Seifi, Z, 2020. Psychological responses, behavioral changes and public perceptions in the early phase of the COVID-19 outbreak in Iran. Arch. Med. Sci. 16, 1.
Nguyen, H.C., Nguyen, M.H., Do, B.N., Tran, C.Q., Nguyen, T.T.P., Pham, K.M., et al., 2020. People with Suspected COVID-19 Symptoms Were More Likely Depressed and Had Lower Health-Related Quality of Life: the Potential Benefit of Health Literacy. J. Clin. Med. 9, 965.
Nyaga, V.N., Arbyn, M., Aerts, M, 2014. Metaprop: a Stata command to perform meta-analysis of binomial data. Arch. Public Health 72, 39.
Peterson, J., Welch, V., Losos, M., Tugwell, P, 2011. The Newcastle-Ottawa scale (NOS) for Assessing the Quality of Nonrandomised Studies in Meta-Analyses. Ottawa Hospital Research Institute, Ottawa.
Qi, J., Xu, J., Li, B., Huang, J., Yang, Y., Zhang, Z., et al., 2020. The Evaluation of Sleep Disturbances for Chinese Frontline Medical Workers under the Outbreak of COVID-19. medRxiv.
Qian, M., Wu, Q., Wu, P., Hou, Z., Liang, Y., Cowling, B.J., et al., 2020. Psychological responses, behavioral changes and public perceptions during the early phase of the COVID-19 outbreak in China: a population based cross-sectional survey. medRxiv.
Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., Xu, Y, 2020. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. Gen. Psychiatry.
Rajkumar, R., 2020. COVID-19 and mental health: a review of the existing literature. Asian J. Psych. 52, 102066.
Rossi, R., Socci, V., Talevi, D., Mensi, S., Niolu, C., Pacitti, F., et al., 2020. COVID-19 pandemic and lockdown measures impact on mental health among the general population in Italy.An N= 18147 web-based survey. medRxiv.
Rothan, H.A., Byrareddy, S.N., 2020. The Epidemiology and Pathogenesis of Coronavirus Disease (COVID-19) Outbreak. J. Autoimmun. 109, 102431.
Styra, R., Hawryluck, L., Robinson, S., Kasapinovic, S., Fones, C., Gold, W.L, 2008. Impact on health care workers employed in high-risk areas during the Toronto SARS outbreak. J. Psychosom. Res. 64, 177–183. https://doi.org/10.1016/j.jpsychores.2007.07.015.
Sun, L., Sun, Z., Wu, L., Zhu, Z., Zhang, F., Shang, Z., et al., 2020. Prevalence and Risk Factors of Acute Posttraumatic Stress Symptoms during the COVID-19 Outbreak in Wuhan, China. medRxiv.
Tan, B.Y.Q., Chew, N.W.S., Lee, G.K.H., Jing, M., Goh, Y., Yeo, L.L.L., et al., 2020. Psychological Impact of the COVID-19 Pandemic on Health Care Workers in Singapore. Ann. Internal Med.
Tian, F., Li, H., Tian, S., Yang, J., Shao, J., Tian, C, 2020. Psychological symptoms of ordinary Chinese citizens based on SCL-90 during the level I emergency response to COVID-19. Psychiatry Res. 288, 112992.
Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C.S., et al., 2020a. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. Int. J. Environ. Res. Public Health 17, 1729.
Wang, Y., Di, Y., Ye, J., Wei, W, 2020b. Study on the public psychological states and its related factors during the outbreak of coronavirus disease 2019 (COVID-19) in some regions of China. Psychol. Health Med 1-0.
World Health Organization, 2020a. Situation Report-94. Coronavirus disease (COVID-2019) Situation Reports. World Health Organization, Geneva, pp. 2. [online] Available at: <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200423-sitrep-94-covid-19.pdf?sfvrsn=b8304bf0_4>. [Accessed 24 April 2020].
World Health Organization, 2020b. Statement On The Second Meeting Of The International Health Regulations (2005) Emergency Committee Regarding The Outbreak Of Novel Coronavirus (2019-Ncov). [online] Available at: <https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)> [Accessed 24 April 2020].
World Health Organization. 2020c. Shortage of personal protective equipment endangering health workers worldwide. [Internet] [cited 27 Apr 2020]. Available from: https://www.who.int/news-room/detail/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide.
World Health Organization, 2020d. WHO Director-General's Opening Remarks At The Media Briefing On COVID-19 - 11 March 2020. [online] Available at: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020. [Accessed 24 April 2020].
Xu, J., Xu, Q., Wang, C., Wang, J, 2020. Psychological status of surgical staff during the

COVID-19 outbreak. Psychiatry Res. 288, 112955.
Yi, L., Chan, Y., Zhang, D., Deng, S., Zhou, L., Mai, W, 2020. Investigation of mental health status of frontline medical staff in COVID-19 treatment hospital in Guangdong province. Guangdong Med. J.
Yuan, S., Liao, Z., Huang, H., Jiang, B., Zhang, X., Wang, Y., 2020. . Comparison of the Indicators of Psychological Stress in the Population of Hubei Province and Non-Endemic Provinces in China During Two Weeks During the Coronavirus Disease 2019 (COVID-19) Outbreak in February 2020. Med. Sci. Monitor.
Yuanhui, Z., Tang, L., Jiang, Q., Zhou, C., Lin, W., Wei, Y., et al., 2020. Psychological distress among nurses who are from other provinces and engaged in assisting to combat the recent outbreak of COVID-19. J. Nursing Sci.
Yuhong, H.E., Yao, W., Jinsong, W., Jiabao, H., Xing, W, 2020. Impact of COVID-19 outbreak on sleep quality of medical staff in Wuhan. Med. J. Wuhan Univ 10.14188/j.1671 - 8852.2020.0098.[Epubaheadofprint.
Zhang, C., Yang, L., Liu, S., Ma, S., Wang, Y., Cai, Z., et al., 2020a. Survey of Insomnia and Related Social Psychological Factors Among Medical Staff Involved in the 2019 Novel Coronavirus Disease Outbreak. Front. Psychiatry 11, 306.
Zhang, W., Wang, K., Yin, L., Zhao, W., Xue, Q., Peng, M., et al., 2020b. Mental Health and Psychosocial Problems of Medical Health Workers during the COVID-19 Epidemic in China. Psychother. Psychosom.
Zhang, W.R., Wang, K., Yin, L., Zhao, W.F., Xue, Q., Peng, M., et al., 2020c. Mental health and psychosocial problems of medical health workers during the COVID-19 epidemic in China. Psychother. Psychosom. 1–9.
Zhang, Y., Ma, Z.F., 2020. Impact of the COVID-19 Pandemic on Mental Health and Quality of Life among Local Residents in Liaoning Province, China: a Cross-Sectional Study. Int. J. Environ. Res. Public Health 17, 2381.
Zhao, Q., Caihong, H., Renjie, F., Yuan, Y, 2020. Investigation of the mental health of patients with novel coronavirus pneumonia. Chinese J. Neurol. 53 E003-E003.
Zheng, X., Tao, G., Huang, P., He, F., Shao, X., Xu, Y., et al., 2020. Self-Reported Depression of Cancer Patients Under 2019 Novel Coronavirus Pandemic. Available at SSRN 3555252.
Zhu, J., Sun, L., Zhang, L., Wang, H., Fan, A., Yang, B., et al., 2020. Prevalence and Influencing Factors of Anxiety and Depression Symptoms in the First-Line Medical Staff Fighting Against the COVID-19 in Gansu. Available at SSRN 3550054.
Zhu, Z., Xu, S., Wang, H., Liu, Z., Wu, J., Li, G., et al., 2020. COVID-19 in Wuhan: immediate Psychological Impact on 5062 Health Workers. medRxiv.