



The Prevalence of Psychological Status During the COVID-19 Epidemic in China: A Systemic Review and Meta-Analysis

Wei Li¹, Huijuan Zhang¹, Caidi Zhang¹, Jinjing Luo¹, Hongyan Wang¹, Hui Wu², Yikang Zhu¹, Huiru Cui¹, Jijun Wang^{1,3,4,5}, Hui Li^{6*}, Zhuoying Zhu^{1,5}, Yifeng Xu^{1,5} and Chunbo Li^{1,3,4,5*}†

¹ Shanghai Key Laboratory of Psychotic Disorders, Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China, ² Shanghai General Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, ³ Chinese Academy of Science Center for Excellence in Brain Science and Intelligence Technology, Chinese Academy of Science, Shanghai, China, ⁴ Brain Science and Technology Research Center, Shanghai Jiao Tong University, Shanghai, China, ⁵ Institute of Psychology and Behavioral Science, Shanghai Jiao Tong University, Shanghai, China, ⁶ Shanghai Clinical Research Center for Mental Health, Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China

OPEN ACCESS

Edited by:

Fushun Wang,
Nanjing University of Chinese
Medicine, China

Reviewed by:

Stephen Zhang,
University of Adelaide, Australia
Abida Sultana,
EviSyn Health, Bangladesh

*Correspondence:

Chunbo Li
licb@smhc.org.cn
Hui Li
lihuindyxs@163.com

†These authors have contributed
equally to this work

Specialty section:

This article was submitted to
Psychology for Clinical Settings,
a section of the journal
Frontiers in Psychology

Received: 07 October 2020

Accepted: 24 March 2021

Published: 04 May 2021

Citation:

Li W, Zhang H, Zhang C, Luo J,
Wang H, Wu H, Zhu Y, Cui H, Wang J,
Li H, Zhu Z, Xu Y and Li C (2021) The
Prevalence of Psychological Status
During the COVID-19 Epidemic in
China: A Systemic Review and
Meta-Analysis.
Front. Psychol. 12:614964.
doi: 10.3389/fpsyg.2021.614964

The COVID-19 is creating panic among people around the world and is causing a huge public mental health crisis. Large numbers of observational studies focused on the prevalence of psychological problems during the COVID-19 pandemic were published. It is essential to conduct a meta-analysis of the prevalence of different psychological statuses to insight the psychological reactions of general population during the COVID-19 epidemic in China. Sixty six observational studies about the psychological statuses of people during the COVID-19 were included, searching up to 1 December 2020. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) was used to evaluate the quality of the included studies. OpenMeta[Analyst] was used for the data analysis. High prevalence of acute stress and fear symptoms were observed in the early period of the epidemic. Additionally, anxiety and depression symptoms continued at a high prevalence rate during the epidemic. It should alert the lasting mental health problems and the risk of post-traumatic stress disorder and other mental disorders.

Systematic Review Registration: PROSPERO CRD 42020171485.

Keywords: mental healthcare, COVID-19 pandemic, meta-analysis, psychological problems, PTSD

INTRODUCTION

The coronavirus disease (COVID-19) spread rapidly in China since it first appeared in Wuhan, China, in December 2019 (Liu et al., 2012). The acute respiratory infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has spread globally due to its high transmission rate (The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, 2020). On 11 March 2020, the WHO characterized COVID-19 as a pandemic. By 1 October 2020, the cumulative number of infections worldwide has exceeded 36 million, and the number of deaths has exceeded 1 million (World Health Organization, 2020). The COVID-19 is creating panic among people around the world and is causing a public mental health crisis (Dong and Bouey, 2020; Yao et al., 2020).

Looking back at the SARS outbreak in 2003 and the Ebola outbreak in 2014, not only did the incidence of psychological problems such as anxiety, fear, and stress increase during the epidemic

period, but the psychological problems were also decelerating the recovery of infected patients (Person et al., 2004; Shultz et al., 2016). In addition, long-term follow-up revealed a significant increase in the incidence of mental disorders such as post-traumatic stress disorder and depression, especially among the health care workers (HCW) and survivors of the infection (Mak et al., 2009; Wu et al., 2009; Liu et al., 2012). Fear of illness and death, social isolation, and reduced income all contribute to the high incidence of mental and psychological problems during the emergence of epidemics (Carvalho et al., 2020). Therefore, targeted intervention according to the prevalence of mental and psychological problems during the epidemic has important social effects.

We conducted a meta-analysis of cross-sectional studies published before 6 March 2020 on the prevalence of different psychological states during early stage of COVID-19 epidemic in China (Li W. et al., 2020). The present study updated the literature retrieval date to 1 December 2020 to search more databases through a more comprehensive retrieval strategy. At the same time, the present study focuses on not only the prevalence of different psychological states, but also the difference of the prevalence among different periods of COVID-19 pandemic. Based on the changes in the epidemic situation and the major events related to the psychological status of people, this study provides an evidence-based data for the prevention and control of the epidemic and psychological crisis intervention in the future.

MATERIALS AND METHODS

Search Strategy

We searched the following databases for studies published before 1 December 2020: PubMed, EMBASE, The Cochrane Library, EBSCO, Web of Science, medRxiv, PsycINFO, Chinese National Knowledge Infrastructure (CNKI), Chongqing VIP database for Chinese Technical Periodicals, WANFANG DATA, Chinese Biological Medical Literature Database, and official information release platform (WeChat Official Account or Weibo). The search terms are described in the **Supplementary Material**. The reference lists of included articles were hand-checked for further relevant studies, and experts in the field were asked about the ongoing studies.

Inclusion and Exclusion Criteria

All reports investigating the psychological status during the COVID-19 outbreak were screened using the following inclusion criteria: (a) the survey was carried out by using scales with good reliability and validity, and definite boundary values; (b) information about prevalence, sample size, and time of investigation or time of submission; (c) the survey was conducted after COVID-19 outbreak; (d) the survey was conducted among general population; (e) cross-sectional study; (f) studies published in either English or Chinese. The exclusion criteria were as follows: (a) incomplete outcome data or lack of valid data following contact with the original authors; (b) descriptive studies, qualitative studies, anthropologic studies, review articles, research protocols, case reports, and duplicated reports.

Screening of Articles and Data Extraction

Three researchers (CD.Z., JJ.L., and HY.W.) independently explored previous studies based on search terms. The retrieved records were managed by Endnote X9. After removing the duplicates, all titles and abstracts of the records were screened by the three independent researchers (CD.Z., JJ.L., and HY.W.), and all studies that could possibly meet the inclusion criteria according to one of the researchers were retrieved as full text. The decision to include or exclude a study was also made by the three independent researchers (CD.Z., JJ.L., and HY.W.). The disagreements were discussed and resolved through discussion with a third reviewer (YK. Z.).

The data were then extracted and checked by two independent reviewers (H.L. and W.L.) using a standardized data collection form. The pertinent data extracted included data source, publication date, sample size, investigation time, population, location, and method of investigation, where possible.

Quality Assessment of the Studies

The included studies were assessed using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist (Vandenbroucke et al., 2007), which includes 22 items for evaluating the title and abstract, introduction, methods, results and discussion, while assigning 1 point for each item, with a total of 22 points.

Outcome Measures

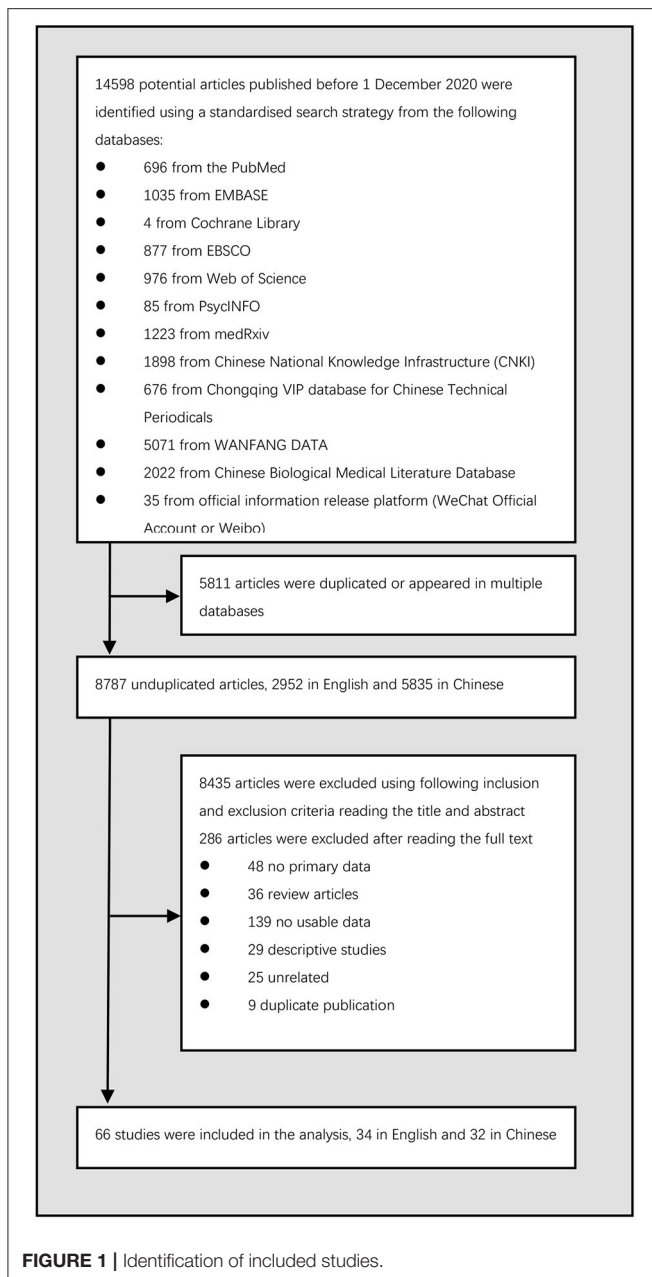
The primary outcome is the prevalence of different psychological statuses during the COVID-19 outbreak. The secondary outcomes are the prevalence of different psychological statuses in Hubei province and other provinces/cities outside the Hubei province.

Categorization of Time Periods

According to the dynamic changes in the situation and the major events related to the psychological status (Pan et al., 2020), we divided the epidemic into three time periods: the first period was from 23 January to 1 February 2020, during which the experts announced that the virus could be passed on, the government enforced lockdown in Wuhan, local traffic control and social isolation, and the hospitals faced serious shortages of medical resources and protective materials. The second period was from 2 February to 17 February, 2020, during which the Chinese government dispatched medical teams to Hubei Province for medical assistance, alleviated the shortage of medical resources and protective materials gradually, and set up psychological assistance hotlines in all provinces and cities throughout the country. The third period was from 18 February to 24 April, 2020. During this period, the number of patients recovered and discharged increased, and many provinces and cities down-regulated the level of emergency response to major public health emergencies and psychological medical teams to assist Wuhan.

Analysis

Meta-analyses were performed using the OpenMeta[Analyst] (Brown University, Rhode Island) (Lau et al., 1992; Viechtbauer,



2010; Wallace et al., 2012). For different psychological statuses, only when no less than five different time points could be extracted from the included studies, a meta-analysis was performed. The studies were listed by the investigation time. The pooled effect size was calculated using the DerSimonian-Laird method for the point at which each new study was chronologically added to the evidence base (Kristian et al., 2011). The forest plots provide a visual representation of the trend of different psychological states with the spread of the epidemic. To present the prevalence of different psychological status during different periods of the COVID-19

epidemic, we performed the subgroup meta-analysis according to different periods.

For each meta-analysis, the heterogeneity was estimated using the inconsistency relative index I^2 , which describes the percentage of variation among studies by heterogeneity and not by chance. Values of I^2 above 25, 50, and 75% were defined as low, moderate, and high heterogeneity, respectively (Higgins et al., 2011). Because the heterogeneity was high ($I^2 > 75\%$), we used the random effects model and the DerSimonian-Laird method to interpolate the prevalence with a 95% confidence interval (CI) (Kristian et al., 2011). To identify the potential impact of small sample size (<500), sensitivity analyses were performed.

RESULTS

Characteristics of the Included Studies

The process of identification of studies included in the analysis was shown in **Figure 1**. We found a total of 14,598 references in the databases. After removing these duplicates and studies that were reported in more than one article, 8,787 unduplicated articles remained. After reading the title and abstract of these unduplicated articles, we identified 8,435 articles that did not meet our inclusion and exclusion criteria, and after reading the full text, we identified an additional 286 articles that did not meet our criteria. This left us with 66 articles. Among these 66 studies, 34 in English and 32 in Chinese, were included in the subsequent analyses.

The characteristics of these 66 studies are shown in **Table 1**.

The respondents of seven studies came from Hubei province (Cao H. et al., 2020; Fu et al., 2020; Huo et al., 2020; Luo F. et al., 2020; Yang T. et al., 2020; Yu et al., 2020; Zhou and Liu, 2020); the respondents of the thirteen studies came from provinces and cities other than Hubei province (Cao H. et al., 2020; Deng and Lei, 2020; Fu et al., 2020; Guo L. et al., 2020; Huo et al., 2020; Lin G. et al., 2020; Liu Z. et al., 2020; Sun Q. et al., 2020; Tan et al., 2020; Yang B. et al., 2020; Yang L. et al., 2020; Yang S. et al., 2020; Zhang J. et al., 2020).

Quality Assessment of the Included Studies

The STROBE evaluation results of the included studies showed that all of studies had scores >11 , the lowest score was 12 (Qiu et al., 2020), and the highest score was 22 (Wang et al., 2020a). The average score was (18.56 ± 1.51) , which is at the relatively good level.

Findings From Meta-Analyses The Prevalence of Different Psychological Statuses During the COVID-19 Epidemic

A total of 53 studies investigated the prevalence of anxiety symptoms from 28 January to 15 April, 2020, and the prevalence was found to be 29.6% (95% CI: 19.7–39.5%). There were respectively 7, 24, and 22 studies to investigate the prevalence of anxiety symptoms during three periods of epidemic. The prevalence were found to be 26.2% (95% CI: 19.3–33.1%) in the

TABLE 1 | Characteristics of the included studies.

No.	Study	Time of investigation	Age (Mean \pm SD)	Sex (M/F)	Location of investigation	Questionnaires	Sample size
1	Cai et al., 2020	1/31–2/4	Unavailable	7404/14898	China	Self-compiled questionnaire	22,302
2	Cao H. et al., 2020	2/6–2/13	Unavailable	478/1022	China	HAMA/HAMD	1,500
3	Cao Y. et al., 2020	5/2–5/10	Unavailable	127/303	Shanghai	IES	430
4	Deng et al., 2020	2/13–2/16	32.48 \pm 9.05	226/254	China	SAS/SDS/SRQ	480
5	Deng and Lei, 2020	3/2–3/9	Unavailable	77/496	Guangdong province	SAS	573
6	Dong et al., 2020	2/16–2/22	34 \pm 9	378/567	China	PHQ-9	945
7	Feng et al., 2020	2/17–3/10	Unavailable	Unavailable	China	SAS/SDS/AIS/PCL-C	53,427
8	Fu et al., 2020	2/18–2/28	Unavailable	376/866	Wuhan	GAD-7/PHQ-9/AIS	1,242
9	Gao et al., 2020	1/31–2/2	32.3 \pm 10.0	1560/3267	China	WHO-5/GAD-7	4,827
10	Guo F. et al., 2020	2/18–2/22	Unavailable	15034/11683	China	CES-D/GAD-2	26,717
11	Guo L. et al., 2020	2/3–2/14	Unavailable	3903/9919	China	SCL-90/SASRQ	13,822
12	Guo Y. et al., 2020	2/26–2/29	34.4 \pm 11.1	1024/1307	China	HADS	2,331
13	He et al., 2020	2/17–2/27	Unavailable	246/876	China	ISI	1,066
14	Huang et al., 2020	2/10–2/15	Unavailable	2676/3585	China	PHQ-9/SAS	6,261
15	Huang and Zhao, 2020	2/3–2/17	35.3 \pm 5.6	3284/3952	China	GAD-7/CES-D/PSQI	7,236
16	Huo et al., 2020	2/9–2/14	Unavailable	434/496	Hubei and Yunnan province	GAD-7/PHQ-9	930
17	Jiang et al., 2020a	1/31–2/2	39.6 \pm 12.1	261/825	China	Self-compiled questionnaire	1,086
18	Jiang et al., 2020b	2/23–2/29	34.66 \pm 12.02	25781/34418	China	SDS/SAI	60,199
19	Li S. et al., 2020	2/16–2/23	Unavailable	833/2168	China	GAD-7/PHQ-9	3,001
20	Li Y. et al., 2020	1/30–2/1	33.2 \pm 8.6	209/768	China	GAD-7/PHQ-9	977
21	Liang et al., 2020	1/30	Unavailable	223/361	China	PCL-C	584
22	Lin G. et al., 2020	1/31–2/8	27.7 \pm 10.9	213/591	Hainan province	Self-compiled questionnaire	804
23	Lin L. et al., 2020	2/5–2/10	Unavailable	Unavailable	China	GAD-7/PHQ-9/ASDS	3,826
24	Lin L.-Y. et al., 2020	2/5–2/27	Unavailable	1685/3956	China	GAD-7 /PHQ-9/ASDS/ISI	5,641
25	Lin Y. et al., 2020	1/24–2/24	Unavailable	733/1713	China	STAI	2,446
26	Liu et al., 2020	1/30–2/3	Unavailable	251/357	China	STAI/SDS/SCL-90	608
27	Liu Y. et al., 2020	2/13–3/4	Unavailable	301/461	China	SCL-90	762
28	Liu Z. et al., 2020	3/11–3/15	Unavailable	224/503	Guangdong province	GAD-7/PHQ-9	727
29	Luo F. et al., 2020	3/14–3/17	45.0 \pm 10.0	122/361	Hubei province	SAS/SDS	483
30	Qi et al., 2020	2/25–3/15	31.8 \pm 8.6	250/395	China	PSS-10	645
31	Qiu et al., 2020	1/31–2/10	Unavailable	Unavailable	China	Self-compiled questionnaire	52,730
32	Ran et al., 2020	2/23–3/2	28.7 \pm 10.64	586/1184	China	GAD-7 /PHQ-9/PHQ-15	1,770
33	Ren Y. et al., 2020	2/14–3/29	Unavailable	360/812	China	GAD-7/PHQ-9/SCL-90/PSS-10/ISI/PCL-5	1,172
34	Ren Z. et al., 2020	2/9–2/20	Unavailable	2030/4100	China	GAD-7/PHQ-9	6,130
35	Shi et al., 2020	2/28–3/11	35.97 \pm 8.22	27149/29530	China	GAD-7/PHQ-9/ISI/ASDS	56,679
36	Song F. et al., 2020	1/28–2/20	Unavailable	553/525	China	SCL-90	1,078
37	Song L. et al., 2020	4/9–4/22	35.35 \pm 6.61	183/526	China	GAD-7/CES-D/ISI	709
38	Sun et al., 2021	1/30–2/3	Unavailable	Unavailable	China	PCL-5	2,091
39	Sun M. et al., 2020	1/28–2/4	Unavailable	323/887	China	GAD-7	3,111
40	Sun Q. et al., 2020	2/5–2/19	Unavailable	1162/1972	Except for Hubei province	GAD-7 /PHQ-9/ISI	3,134
41	Tan et al., 2020	2/24–2/25	30.8 \pm 7.4	501/172	Chongqing	IES-R/DASS-21/ISI	673
42	Tian et al., 2020	1/31–2/2	35.01 \pm 12.8	549/511	China	SCL-90	1,060
43	Wang C. et al., 2020	1/31–2/2	Unavailable	396/814	China	IES-R/DASS	1,210
44	Wang J. et al., 2020	2/4–2/18	Unavailable	2824/3613	China	PSQI	6,437
45	Wang M. et al., 2020	2/1–2/18	Unavailable	576/925	China	GAD-7/PHQ-9/SRQ-20/ISI	1,501
46	Wang et al., 2020a	1/31–2/2	32.32 \pm 9.98	1560/3267	China	GAD-7/WHO-5	4,827
47	Wang et al., 2020b	2/20–2/22	Unavailable	406/623	China	SAS/SDS	1,029
48	Wu M. et al., 2020	2/13–2/29	Unavailable	13304/11485	China	HADS	24,789
49	Xiao et al., 2020	2/1–3/31	25.05 \pm 9.18	1037/2038	China	GAD-7/PHQ-9	3,075
50	Yang B. et al., 2020	2/2–2/3	Unavailable	213/414	Sichuan province	GAD-7/PHQ-9	627

(Continued)

TABLE 1 | Continued

No.	Study	Time of investigation	Age (Mean ± SD)	Sex (M/F)	Location of investigation	Questionnaires	Sample size
51	Yang L. et al., 2020	2/1–2/9	Unavailable	142/379	Fujian province	PQEEPH	521
52	Yang S. et al., 2020	3/5–3/14	Unavailable	1239/1196	Deqing and Taizhou	GAD-7/PHQ-9	2,435
53	Yang T. et al., 2020	2/13–2/15	Unavailable	185/148	Wuhan	GAD-7/PHQ-9	333
54	Yang X. et al., 2020	2/1–2/4	33.84 ± 12.28	542/1096	China	PSS	1,638
55	Yang Y. et al., 2020	2/19–2/21	Unavailable	1548/1611	China	GHQ-20	3,159
56	Yu et al., 2020	2/17–2/27	Unavailable	1180/1847	Enshi	SAS	3,027
57	Zhang J. et al., 2020	2/10–2/15	36.45 ± 2.14	0/300	Changzhi	SCL-90	300
58	Zhang et al., 2020b	2/1–2/5	Unavailable	617/561	Wuhan	ISI	1,178
59	Zhao et al., 2020	2/18–2/25	29.17 ± 10.58	Unavailable	China	PSQI	1,722
60	Zhen and Zhou, 2020	1/27–1/30	Unavailable	361/689	China	Self-compiled questionnaire	1,050
61	Zhong et al., 2020	2/13–2/24	Unavailable	5685/10363	China	SASRQ	16,048
62	Zhou and Liu, 2020	3/2–3/5	33.22 ± 0.61	73/138	Hubei province	PQEEPH	211
63	Zhu et al., 2020b	2/5–2/7	33 ± 9	380/996	China	SAS/SDS	1,376
64	Zhu et al., 2020a	2/19–2/26	Unavailable	424/568	China	SAS	992
65	Zhu X. et al., 2020	1/30–2/13	Unavailable	2176/4219	China	GAD-7/PHQ-9/SRQ-20	63,85
66	Zhu Z. et al., 2020	2/17–3/10	Unavailable	410/512	China	SCL-90	922

HAMA, Hamilton Anxiety Scale; HAMD, Hamilton Depression Scale; IES, Impact of Event Scale; SAS, Self-rating Anxiety Scale; SDS, Self-rating Depression Scale; SRQ, Stress Response Questionnaire; PHQ-9, 9-item Patient Health Questionnaire; AIS, Athens Insomnia Scale; PLC-C, Post-traumatic Stress Disorder Checklist-Civilian Version; GAD-7, 7-item anxiety scale; CES-D, Center for Epidemiological Survey, Depression Scale; GAD-2, 2-item anxiety scale; WHO-5, 5-item World Health Organization Well-Being Index; SCL-90, 90-item Symptom Check List; SASRQ, Stanford Acute Stress Reaction Questionnaire; HADS, Hospital Anxiety and Depression Scale; ISI, Insomnia Severity Index; PSQI, Pittsburgh Sleep Quality Index; SA, State Anxiety Inventory; ASDS, Acute Stress Disorder Scale; STAI, state-trait anxiety inventory; PSS-10, 10-item Perceived Stress Scale; PHQ-15, 15-item Patient Health Questionnaire; IES-R, Impact of Event Scale-Revised; DASS-21, 21-item Depression Anxiety Stress Scale; SRQ-20, 20-item Stress Response Questionnaire; PQEEPH, Psychological Questionnaires for Emergent Events of Public Health; PSS, Perceived Stress Scale; GHQ-20, General Health Questionnaire.

first period, 32.5% (95% CI: 25.7–39.3%) in the second period, and 27.4% (95% CI: 14.6–40.3%) in the third period of epidemic (see in **Figure 2A**).

A total of 45 studies investigated the prevalence of depression symptoms from 31 January to 15 April, 2020, with a prevalence of 32.5% (95% CI: 20.5–44.4%). There were respectively 5, 20 and 20 studies to investigate the prevalence of depression symptoms during three periods of epidemic. The prevalence were found to be 31.4% (95% CI: 16.9–45.9%) in the first period, 32.6% (95% CI: 26.5–38.8%) in the second period, and 32.5% (95% CI: 15.3–49.6%) in the third period of epidemic (see in **Figure 2B**).

A total of 15 studies investigated the prevalence of sleep problems from 3 February to 15 April, 2020, and the overall prevalence was found to be 26.3% (95% CI: 13.0–39.6%). There were respectively seven and eight studies to investigate the prevalence of sleep problems during the second and third period of epidemic. The prevalence were found to be 18.8% (95% CI: 13.9–23.7%) in the second period, and 32.8% (95% CI: 13.6–51.9%) in the third period of epidemic (see in **Figure 2C**).

A total of 11 studies investigated the prevalence of acute stress symptoms from 1 February to 6 May, 2020, with a prevalence of 39.4% (95% CI: 32.5–46.2%). There were respectively 1, 4, and 6 studies to investigate the prevalence of acute stress symptoms during three periods of epidemic. The prevalence were found to be 75.5% (95% CI: 73.1–78.0%) in the first period, 24.1% (95% CI: 15.0–33.3%) in the second period, and 43.5% (95% CI: 35.1–52.0%) in the third period of epidemic (see in **Figure 2D**).

A total of nine studies investigated the prevalence of somatic symptoms from 1 February to 7 March, 2020, with a prevalence of 22.2% (95% CI: 14.0–30.5%). There were respectively 1, 4, and 4 studies to investigate the prevalence of somatic symptoms during three periods of epidemic. The prevalence were found to be 33.6% (95% CI: 30.7–36.4%) in the first period, 22.1% (95% CI: 12.3–32.0%) in the second period, and 19.2% (95% CI: 1.0–37.5%) in the third period of epidemic (see in **Figure 2E**).

A total of seven studies investigated the prevalence of fear symptoms from 1 February to 3 March, 2020, with a total incidence of 41.4% (95% CI: 27.4–55.4%). There were respectively 1, 4, and 2 studies to investigate the prevalence of fear symptoms during three periods of epidemic. The prevalence were found to be 44.8% (95% CI: 41.8–47.8%) in the first period, 53.2% (95% CI: 33.4–73.0%) in the second period, and 16.0% (95% CI: 13.7–18.3%) in the third period of epidemic (see in **Figure 2F**).

A total of five studies investigated the prevalence of obsessive-compulsive symptoms from 1 February to 22 February, 2020, with a total incidence of 39.9% (95% CI: 11.0–68.7%). There were respectively 1, 3, and 1 studies to investigate the prevalence of obsessive-compulsive symptoms during three periods of epidemic. The prevalence were found to be 59.6% (95% CI: 56.7–62.6%) in the first period, 23.0% (95% CI: 3.5–42.6%) in the second period, and 69.9% (95% CI: 66.7–73.2%) in the third period of epidemic (see in **Figure 2G**).

A total of six studies did not classify different psychological statuses, but used some comprehensive mental health

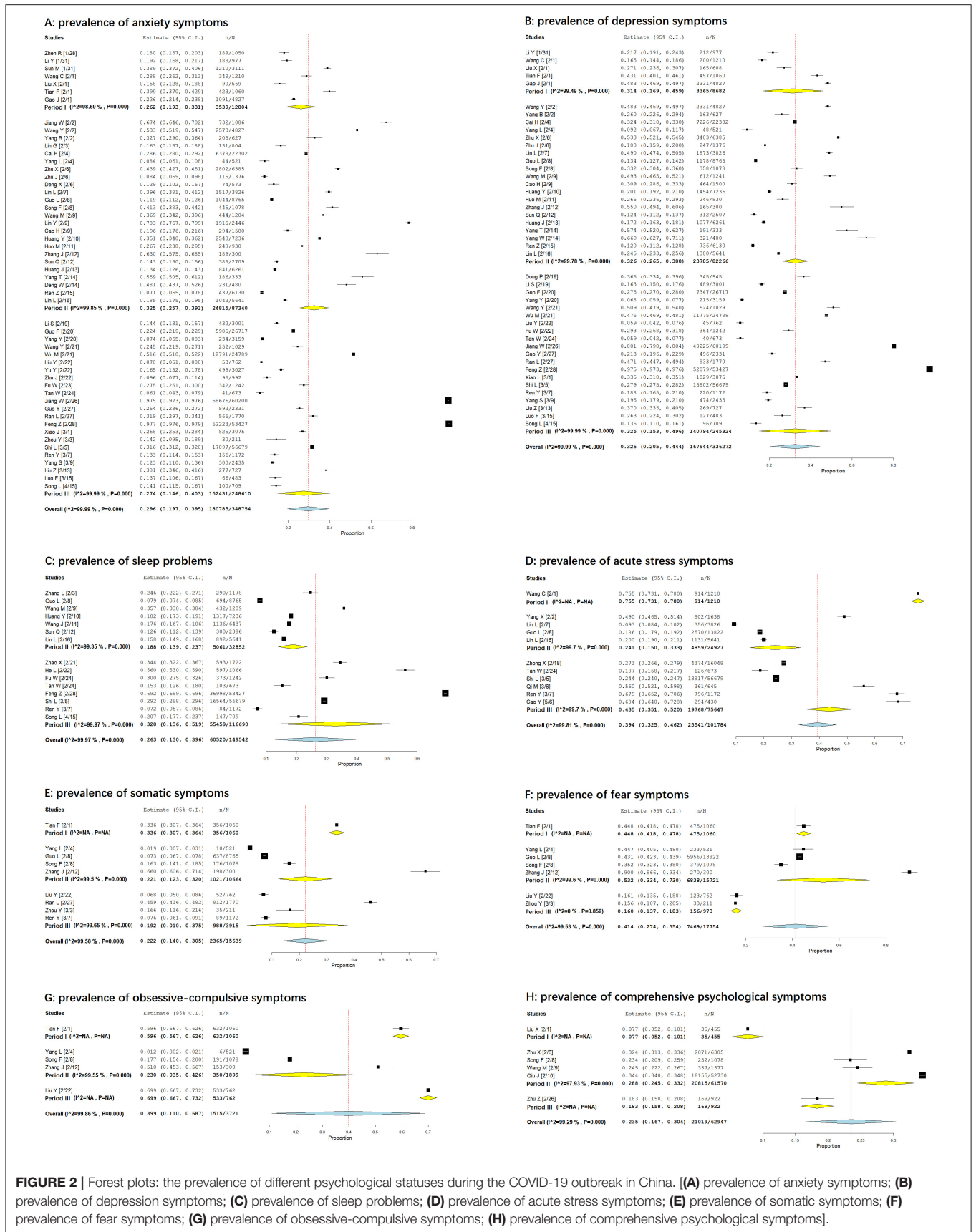


FIGURE 2 | Forest plots: the prevalence of different psychological statuses during the COVID-19 outbreak in China. [(A) prevalence of anxiety symptoms; (B) prevalence of depression symptoms; (C) prevalence of sleep problems; (D) prevalence of acute stress symptoms; (E) prevalence of somatic symptoms; (F) prevalence of fear symptoms; (G) prevalence of obsessive-compulsive symptoms; (H) prevalence of comprehensive psychological symptoms].

questionnaires to investigate it from 1 February to 26 February, 2020. The prevalence of comprehensive psychological symptoms was 23.5% (95% CI: 16.7–30.4%). There were respectively 1, 4 and 1 studies to investigate the prevalence of comprehensive psychological symptoms during three periods of epidemic. The prevalence were found to be 7.7% (95% CI: 5.2–10.1%) in the first period, 28.8% (95% CI: 24.5–33.2%) in the second period, and 18.3% (95% CI: 15.8–20.8%) in the third period of epidemic (see in **Figure 2H**).

The Prevalence of Different Psychological Status in Hubei Province and Other Provinces/Cities Outside Hubei Province

A total of six studies investigated the prevalence of anxiety symptoms in Hubei province from 9 February to 15 March, 2020, with a prevalence of 24.7% (95% CI: 16.4–32.9%). A total of 13 studies investigated the prevalence of anxiety symptoms in provinces and cities other than Hubei province from 2 February to 13 March, 2020, with a prevalence of 21.6% (95%CI: 17.1–26.1%) (See in **Figure 3A**).

A total of five studies investigated the prevalence of depression symptoms in Hubei province. The investigation period was from 9 February to 15 March, 2020, with a prevalence of 34.7% (95% CI: 26.2–43.1%). A total of 10 studies conducted investigations on the prevalence of depression symptoms in provinces and cities other than Hubei province, from 2 February to 13 March, 2020, with a prevalence of 22.5% (95%CI: 17.6–27.5%) (see in **Figure 3B**).

Sensitivity Analyses

The studies with small sample size (sample size < 500) were excluded for sensitivity analysis (Cao Y. et al., 2020; Deng et al., 2020; Luo F. et al., 2020; Yang T. et al., 2020; Zhang J. et al., 2020; Zhou and Liu, 2020). It was found that the results did not change in direction, indicating that the results were relatively stable (**Table 2** and **S2** in **Supplementary Material**).

DISCUSSION

Compared with previous meta-analysis studies focusing on the mental health during the Covid-19 outbreak (Hessami et al., 2020; Luo M. et al., 2020; Ren X. et al., 2020; Wu T. et al., 2020), the present study tried to show psychological statuses during different periods of epidemic through subgroup analysis. By reviewing the psychological conditions at different periods after the occurrence of the stress event of the COVID-19 epidemic, according to the results of our research, more targeted psychological assistance can be arranged at appropriate time point to help people during public emergent events.

An overview of the different psychological statuses during the COVID-19 epidemic in China showed that although the prevalence of acute stress symptoms reached a high level in the early stage of the epidemic, it gradually declined with the progress of the epidemic. However, the prevalence of anxiety and depression symptoms did not improve with the control of the epidemic, but still stayed at a high level, which was significantly higher than the average level of anxiety and depression according to the results from meta-analyses on prevalence of depression and anxiety in Chinese general population before the COVID-19 epidemic (Baxter et al., 2016; Guo et al., 2016; Wang et al., 2017). Previous studies found that anxiety and depression are risk factors for post-traumatic stress disorder (PTSD) (Grekin and O'hara, 2014; Song et al., 2018). Thus, the continued high prevalence of anxiety and depression symptoms during an epidemic may account for the elevated risk of long-term psychological problems (such as PTSD). Timely intervention for anxiety and depression during the epidemic is also helpful in preventing from the incidence of PTSD and related mental disorders.

In the early period of the COVID-19 epidemic, the public's response to the epidemic was not only reflected in the unknown pathogenic capacity and lethality of the virus, but also in the trust in the national public health response capacity and the effectiveness of personal protection measures (Dong and Bouey, 2020). Furthermore, with the promulgation of public health policies, such as the lockdown of the city, the blocking

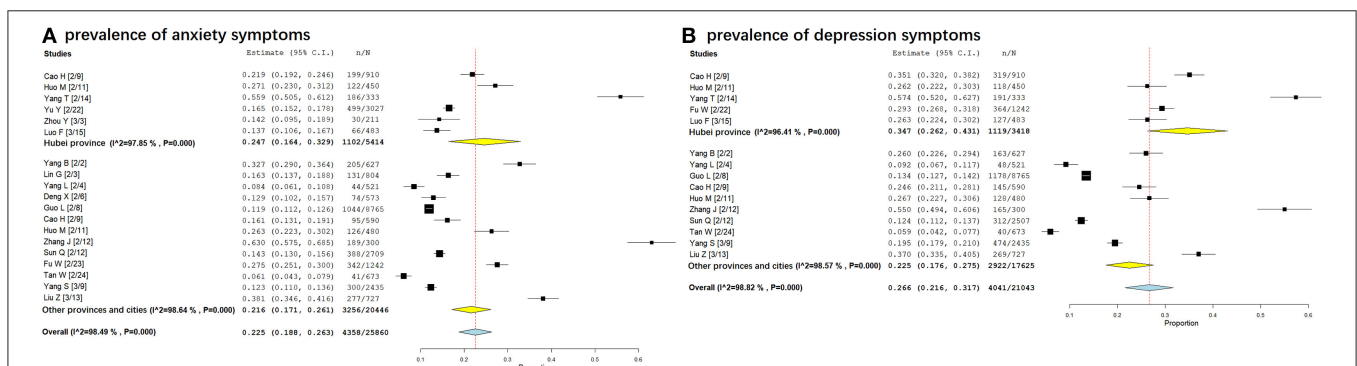


FIGURE 3 | Forest plots: the prevalence of anxiety and depression symptoms in Hubei province and other provinces/cities. [(A) prevalence of anxiety symptoms in Hubei province and other provinces/cities; (B) prevalence of anxiety symptoms in other provinces/cities outside Hubei province and other provinces/cities].

TABLE 2 | Sensitivity analysis: the prevalence of different psychological statuses after removing small-sample study.

	Period 1 (23th Jan–1st Feb)	Period 2 (2nd Feb–17th Feb)	Period 3 (18th Feb–24th Apr)	Overall
Anxiety symptoms	26.2% (95% CI: 19.3–33.1%)	29.3% (95% CI: 22.0–36.5%)	28.8% (95% CI: 15.4–42.2%)	28.6% (95% CI: 18.2–39.0%)
Depression symptoms	31.4% (95% CI: 16.9–45.9%)	28.0% (95% CI: 21.5–34.4%)	32.8% (95% CI: 15.1–50.4%)	30.6% (95% CI: 18.1–43.1%)
Sleep problems	NA	18.8% (95% CI: 13.9–23.7%)	32.8% (95% CI: 13.6–51.9%)	26.3% (95% CI: 13.0–39.6%)
Acute stress symptoms	75.5% (95% CI: 73.1–78.0%)	24.1% (95% CI: 15.0–33.3%)	38.7% (95% CI: 30.4–46.9%)	36.5% (95% CI: 29.6–43.5%)
Somatic symptoms	33.6% (95% CI: 30.7–36.4%)	8.4% (95% CI: 2.8–14.0%)	20.1% (95% CI: –1.9–42.0%)	17.0% (95% CI: 8.7–25.3%)
Fear symptoms	44.8% (95% CI: 41.8–47.8%)	40.9% (95% CI: 35.5–46.4%)	16.1% (95% CI: 13.5–18.8%)	36.8% (95% CI: 26.4–47.1%)
Obsessive-compulsive symptoms	59.6% (95% CI: 56.7–62.6%)	9.4% (95% CI: –6.8–25.6%)	69.9% (95% CI: 66.7–73.2%)	37.1% (95% CI: 4.8–69.4%)
Comprehensive psychological symptoms	NA	28.8% (95% CI: 24.5–33.2%)	18.3% (95% CI: 15.8–20.8%)	26.7% (95% CI: 21.6–31.8%)
Anxiety symptoms				
Hubei province				19.0% (95% CI: 13.8–24.3%)
Other cities/provinces				17.7% (95% CI: 13.8–21.6%)
Depressive symptoms				
Hubei province				32.1% (95% CI: 26.5–37.7%)
Other cities/provinces				18.3% (95% CI: 13.8–22.8%)

NA: There was no study investigated the prevalence of the psychological status during the time period.

of traffic, and social isolation, the public's fear of COVID-19 increased (Wu et al., 2009). Therefore, the prevalence of fear and acute stress symptoms, the two acute psychological reactions to traumatic events, which quickly increased at the early period, and the prevalence was significantly higher than other psychological problems (Prati et al., 2012; Santos-Reyes and Gouzeva, 2020). Under the intervention of epidemic prevention and control at the national level, the prevalence of fear and acute stress symptoms decreased at the late period of epidemic.

Previous studies on the psychological reaction of the public during COVID-19 mentioned the “Psychological Typhoon Eye” effect (Yáñez et al., 2020; Zhang et al., 2020a; Zhang S. X. et al., 2020). At the beginning of the epidemic, the residents in Hubei province did not realize the severity of the epidemic and felt that the virus was far away from them. The Hubei Provincial Government did not take strong measures in time. The information received by people is not symmetrical with the facts, it will cause greater panic later. This sent a false signal to the people: this new disease is not serious and can be prevented and controlled. Thus, the true situation of the epidemic was concealed. Furthermore, the residents outside the Hubei province appeared to be more anxious due to the asymmetry of information, and the media reported that the

epidemic was very serious (Zhang et al., 2020a). This study did not find that the prevalence of anxiety and depression symptoms outside Hubei province were significantly higher than the prevalence inside Hubei province. However, the results of sensitivity analysis showed the prevalence of depression symptoms inside Hubei province is higher than the prevalence outside Hubei province. This may be related to the explosive increase of infected cases in Hubei province at the early stage of the epidemic, but the local government did not take active and effective measures to prevent the epidemic. However, few studies have been carried out on the prevalence of psychological statuses of residents in Hubei Province, which may be one of the reasons for the insignificant typhoon eye effect. Further researches are needed to show the effect in the future.

LIMITATIONS

However, the study had several limitations. Firstly, although we have tried to avoid the influence of noise on the results, some confounding factors may still influence the results. In order to reduce the impact of noise on the results, we used more stringent inclusion criteria. Therefore, the present study

only focused studies conducted in general population, the study population may be more homogeneous, which may partly reduce the influence of possible noise. At the same time, all of the included studies were conducted quality assessment and were at the relatively good level. Additionally, in the sensitivity analysis, when we excluded the studies with small sample size to redo meta-analysis. It was found that the results did not change in direction, indicating that the results were relatively stable. For the longitudinal observation of the dynamic psychological status, the optimal way is to conduct a long-term cross-sectional survey of a specific population through systematic sampling. However, during the epidemic, it was difficult to restrict the population of investigation through an online survey. Additionally, the results of this current study show that there is significant heterogeneity among the studies. The heterogeneity is still large after subgroup analysis, which may be due to the fact that the included studies investigated very different population and settings.

CONCLUSIONS

There are different characteristics of the prevalence of psychological problems/symptoms during the COVID-19 epidemic. The persistently high prevalence of anxiety and depression symptoms during the epidemic could be a risk factor for PTSD and other mental disorders after the outbreak. Therefore, timely implementation of mental health policies is urgently needed for the public mental health crisis during the fight against COVID-19.

REFERENCES

- Baxter, A. J., Charlson, F. J., Cheng, H. G., Shidhaye, R., Ferrari, A. J., and Whiteford, H. A. (2016). Prevalence of mental, neurological, and substance use disorders in China and India: a systematic analysis. *Lancet Psychiatry* 3, 832–841. doi: 10.1016/S2215-0366(16)30139-0
- Cai, H., Zhu, Y., Lei, L., Pan, C., Zhu, L., Li, J., et al. (2020). Novel coronavirus pneumonia epidemic-related knowledge, behaviors and psychology status among college students and their family members and friends: an internet-based cross-sectional survey (in Chinese). *Chin. J. Public Health* 36, 152–155. doi: 10.11847/zgggws1128106
- Cao, H., Zuo, C., Li, G., Huang, Y., Li, L., Huang, S., et al. (2020). A cross-sectional study of psychological status in different epidemic areas in China after the COVID-19 outbreak. *Front. Psychiatry* 11:575705. doi: 10.3389/fpsy.2020.575705
- Cao, Y., Ma, Z. F., Zhang, Y., and Zhang, Y. (2020). Evaluation of lifestyle, attitude and stressful impact amid COVID-19 among adults in Shanghai, China. *Int. J. Environ. Health Res.* doi: 10.1080/09603123.2020.1841887. [Epub ahead of print].
- Carvalho, P. M. D. M., Moreira, M. M., De Oliveira, M. N. A., Landim, J. M. M., and Neto, M. L. R. (2020). The psychiatric impact of the novel coronavirus outbreak. *Psychiatry Res. Neuroimag.* 286:112902. doi: 10.1016/j.psychres.2020.112902
- Deng, W., Liu, Y., and Cheng, S. (2020). Investigation on psychological status of the people under coronavirus disease (in Chinese). *J. North China Univ. Sci. Technol.* 22, 482–488. doi: 10.19539/j.cnki.2095-2694.2020.06.013
- Deng, X., and Lei, L. (2020). A survey of public anxiety and health needs in Guangdong during the COVID-19 period (in Chinese). *J. Med. Aesthetic Cosmetol.* 29, 7–8.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

CL and HL designed the study. WL, HL, and HZ were responsible for drafting the research searching strategy and data extraction. JL, CZ, YZ, and HW conducted the searching and screening of studies. WL drafted the manuscript. HL, HW, HC, JW ZZ, YX, and CL made critical revisions. All authors approved the final version for publication.

FUNDING

This work was funded by Shanghai Jiao Tong University Special Grant for the Prevention and Control of Novel Coronavirus (2020RK61), Shanghai Clinical Research Center for Mental Health (19MC1911100), and National Key R&D Program of China (2018YFC2001605).

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.614964/full#supplementary-material>

- Dong, L., and Bouey, J. (2020). Public mental health crisis during COVID-19 pandemic, China. *Emerg. Infect. Dis.* 26, 1616–1618. doi: 10.3201/eid2607.202407
- Dong, P., Ni, Z., Zhao, K., Sun, G., and Sun, H. (2020). Public depression status during the COVID-19 epidemic (in Chinese). *Chin. Mental Health J.* 34, 710–714. doi: 10.3969/j.issn.1000-6729.2020.8.014
- Feng, Z., Liu, X., and Chen, Z. (2020). Analysis of characteristics of public psychological problems during COVID-19 epidemic (in Chinese). *J. Southwest Univ.* 46, 109–115. doi: 10.13718/j.cnki.xdsk.2020.04.013
- Fu, W., Wang, C., Zou, L., Guo, Y., Lu, Z., Yan, S., et al. (2020). Psychological health, sleep quality, and coping styles to stress facing the COVID-19 in Wuhan, China. *Transl. Psychiatry* 10, 225–225. doi: 10.1038/s41398-020-00913-3
- 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. doi: 10.2139/ssrn.3541120
- Grekin, R., and O'hara, M. W. (2014). Prevalence and risk factors of postpartum posttraumatic stress disorder: a meta-analysis. *Clin. Psychol. Rev.* 34, 389–401. doi: 10.1016/j.cpr.2014.05.003
- Guo, F., Cai, Y., Wang, Y., Li, Y., and Chen, Z. (2020). Emotional health status and social mentality of the Chinese general public during the 2019 novel coronavirus pneumonia pandemic (in Chinese). *Sci. Technol. Rev.* 38, 68–76. doi: 10.3981/j.issn.1000-7857.2020.04.009
- Guo, L., Xu, P., Yao, F., Zhang, F., Qi, L., and Yang, F. (2020). The effect of acute stress disorder on negative emotions in chinese public during the NCP epidemic moderating effect of social support (in Chinese). *J. Southwest Univ.* 42, 21–30. doi: 10.13718/j.cnki.xdsk.2020.05.003
- Guo, X., Meng, Z., Huang, G., Fan, J., Zhou, W., Ling, W., et al. (2016). Meta-analysis of the prevalence of anxiety disorders in mainland China from 2000 to 2015. *Sci. Rep.* 6:28033. doi: 10.1038/srep28033

- Guo, Y., Cheng, C., Zeng, Y., Li, Y., Zhu, M., Yang, W., et al. (2020). Mental health disorders and associated risk factors in quarantined adults during the COVID-19 outbreak in China: a cross-sectional study. *J. Med. Internet Res.* 22:e20328. doi: 10.2196/preprints.20328
- He, L., Gao, Y., Gao, X., and Lei, X. (2020). Sleep patterns and physical and mental health of residents during the COVID-19: susceptibility factors and coping strategies (in Chinese). *J. Southwest Univ.* 42, 11–20. doi: 10.13718/j.cnki.xdzk.2020.05.002
- Hessami, K., Romanelli, C., Chiuazzini, M., and Cozzolino, M. (2020). COVID-19 pandemic and maternal mental health: a systematic review and meta-analysis. *J. Matern Fetal Neonatal Med.* doi: 10.1080/14767058.2020.1843155. [Epub ahead of print].
- Higgins, J., Green, S., and Collaboration, C. (2011). Cochrane handbook for systematic reviews for interventions. *Cochrane Database Syst. Rev.* 2011:S38.
- Huang, J., Liu, F., Teng, Z., Chen, J., Zhao, J., Wang, X., et al. (2020). Public behavior change, perceptions, depression, and anxiety in relation to the COVID-19 outbreak. *Open Forum Infect. Dis.* 7:ofaa273. doi: 10.1093/ofid/ofaa273
- Huang, Y., and Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* 288:112954. doi: 10.1016/j.psychres.2020.112954
- Huo, M., Yin, Y., Jiang, L., and Duan, X. (2020). Survey on the mental status of inhabitants living in Wuhan, Huanggang, Kunming and Yuxi during epidemic outbreak stage of COVID-19 (in Chinese). *J. Int. Psychiatry* 47, 197–200. doi: 10.13479/j.cnki.jip.2020.02.002
- Jiang, W., Fang, Y., Sun, F., Gao, Y., Sun, L., Yue, L., et al. (2020a). *A Snapshot of the Mental State of Chinese Public During the 2019 Novel Coronavirus Outbreak [Gray Literature]*. Shanghai: Shanghai Mental Health Center.
- Jiang, W., Liu, X., Zhang, J., and Feng, Z. (2020b). Mental health status of Chinese residents during the COVID-19 epidemic. *BMC Psychiatry* 20:580. doi: 10.1186/s12888-020-02966-6
- Kristian, T., Wetterslev, J., Awad, T., Thabane, L., and Gluud, C. (2011). Comparison of statistical inferences from the DerSimonian-Laird and alternative random-effects model meta-analyses – an empirical assessment of 920 cochrane primary outcome meta-analyses. *Res. Synth. Methods.* 2, 238–253. doi: 10.1002/jrsm.53
- Lau, J., Antman, E., and M. (1992). Cumulative meta-analysis of therapeutic trials for myocardial infarction. *N. Engl. J. Med.* 327, 248–254. doi: 10.1056/NEJM199207233270406
- Li, S., Ye, Z., Du, C., Wei, Q., and He, C. (2020). The residents' mental health status and community's role during the COVID-19 pandemic: a community-based cross-sectional study in China. *Ann. Transl. Med.* 8:1321. doi: 10.21037/atm-20-6687
- Li, W., Zhang, C., Luo, J., Zhang, H., Wu, H., Yang, B., et al. (2020). Psychological status among different populations during COVID-19 epidemic: a systematic review and meta-analysis. *J. Tongji Univ.* 41, 147–154. doi: 10.16118/j.1008-0392.2020.02.002
- Li, Y., Wang, X., Zhang, J., Du, S., and Zeng, L. (2020). Psychological survey of the general population during COVID-19 (in Chinese). *Infect. Int.* 9, 308–310.
- Liang, L., Ren, H., Cao, R., Hu, Y., Qin, Z., Li, C., et al. (2020). The effect of COVID-19 on youth mental health. *Psychiatr. Q.* 91, 841–852. doi: 10.1007/s11126-020-09744-3
- Lin, G., Zhao, C., Zhang, F., Feng, H., Lin, L., and Zhai, Y. (2020). Survey and analysis of anxiety of 804 residents in Hainan during the COVID-19 epidemic (in Chinese). *J. Hainan Med. Univ.* 26, 646–650. doi: 10.13210/j.cnki.jhmu.20200424.003
- Lin, L., Wang, T., Pi, L., Chen, L., He, M., Yu, W., et al. (2020). Survey of emotion, stress and five viscera symptoms of population during the epidemic of Corona Virus Disease 2019 based on internet questionnaire (in Chinese). *Chin. J. Tradit. Chin. Med. Pharm.* 35, 1390–1394.
- Lin, L.-Y., Wang, J., Ou-Yang, X.-Y., Miao, Q., Chen, R., Liang, F.-X., et al. (2020). The immediate impact of the 2019 novel coronavirus (COVID-19) outbreak on subjective sleep status. *Sleep Med.* 77, 348–354. doi: 10.1016/j.sleep.2020.05.018
- Lin, Y., Hu, Z., Alias, H., and Wong, L. P. (2020). Knowledge, attitudes, impact, and anxiety regarding COVID-19 infection among the public in China. *Front. Public Health* 8:236. doi: 10.3389/fpubh.2020.00236
- 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. doi: 10.1016/j.comppsy.2011.02.003
- Liu, X., Luo, W.-T., Li, Y., Li, C.-N., Hong, Z.-S., Chen, H.-L., et al. (2020). Psychological status and behavior changes of the public during the COVID-19 epidemic in China. *Infect. Dis. Poverty* 9, 58–58. doi: 10.1186/s40249-020-00678-3
- Liu, Y., Chen, Y., and Luo, J. (2020). Study on the status of public mental health during the epidemic period of COVID-19 (in Chinese). *J. Gannan Med. Univ.* 40, 330–334. doi: 10.3969/j.issn.1001-5779.2020.04.002
- Liu, Z., Zhang, X., Lv, Z., Liang, J., Deng, Y., and Feng, L. (2020). Mental health status and its influencing factors among general population and medical personnel in Guangdong Province during COVID-19 pandemic (in Chinese). *J. Southern Med. Univ.* 40, 1530–1537. doi: 10.12122/j.issn.1673-4254.2020.10.22
- Luo, F., Luo, D., Wang, B., Lai, S., Chen, Y., Peng, W., et al. (2020). Analysis of anxiety and depression of residents outside Wuhan in Hubei Province during the outbreak of COVID-19 and its influencing factors (in Chinese). *Chin. J. Dis. Control Prev.* 24, 643–648.
- Luo, M., Guo, L., Yu, M., Jiang, W., and Wang, H. (2020). The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public - A systematic review and meta-analysis. *Psychiatry Res.* 291:113190. doi: 10.1016/j.psychres.2020.113190
- Mak, I. W. C., Chu, C., Pan, P. C., Yiu, M. G. C., and Chan, V. L. (2009). Long-term psychiatric morbidities among SARS survivors. *Gen. Hosp. Psychiatry* 31, 318–326. doi: 10.1016/j.genhosppsych.2009.03.001
- Pan, A., Liu, L., Wang, C., Guo, H., Hao, X., Wang, Q., et al. (2020). Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. *JAMA.* 323, 1915–1923. doi: 10.1001/jama.2020.6130
- Person, B., SY, F., Holton, K., Govert, B., Liang, A., Garza, B., et al. (2004). Fear and stigma: the epidemic within the SARS outbreak. *Emerg. Infect. Dis.* 10, 358–363. doi: 10.3201/eid1002.030750
- Prati, G., Catufi, V., and Pietrantonio, L. (2012). Emotional and behavioural reactions to tremors of the Umbria-Marche earthquake. *Disasters* 36, 439–451. doi: 10.1111/j.1467-7717.2011.01264.x
- Qi, M., Li, P., Moyle, W., Weeks, B., and Jones, C. (2020). Physical activity, health-related quality of life, and stress among the Chinese adult population during the COVID-19 pandemic. *Int. J. Environ. Res. Public Health* 17:6494. doi: 10.3390/ijerph17186494
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., and Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen Psychiatr.* 33:e100213. doi: 10.1136/gpsych-2020-100213
- Ran, L., Wang, W., Ai, M., Kong, Y., Chen, J., and Kuang, L. (2020). Psychological resilience, depression, anxiety, and somatization symptoms in response to COVID-19: a study of the general population in China at the peak of its epidemic. *Soc. Sci. Med.* 262:113261. doi: 10.1016/j.socscimed.2020.113261
- Ren, X., Huang, W., Pan, H., Huang, T., Wang, X., and Ma, Y. (2020). Mental health during the COVID-19 outbreak in China: a meta-analysis. *Psychiatr. Q.* 91, 1033–1045. doi: 10.1007/s11126-020-09796-5
- Ren, Y., Qian, W., Li, Z., Liu, Z., Zhou, Y., Wang, R., et al. (2020). Public mental health under the long-term influence of COVID-19 in China: geographical and temporal distribution. *J. Affect. Disord.* 277, 893–900. doi: 10.1016/j.jad.2020.08.045
- Ren, Z., Zhou, Y., and Liu, Y. (2020). The psychological burden experienced by Chinese citizens during the COVID-19 outbreak: prevalence and determinants. *BMC Public Health* 20:1617. doi: 10.1186/s12889-020-09723-0
- Santos-Reyes, J., and Gouzeva, T. (2020). Mexico city's residents emotional and behavioural reactions to the 19 September 2017 earthquake. *Environ. Res.* 186:109482. doi: 10.1016/j.envres.2020.109482
- Shi, L., Lu, Z.-A., Que, J.-Y., Huang, X.-L., Liu, L., Ran, M.-S., et al. (2020). Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. *JAMA Network Open* 3:e2014053. doi: 10.1001/jamanetworkopen.2020.14053
- Shultz, J. M., Cooper, J. L., Baingana, F., Oquendo, M. A., Espinel, Z., Althouse, B. M., et al. (2016). The role of fear-related behaviors in the 2013–2016 West Africa ebola virus disease outbreak. *Curr. Psychiatry Rep.* 18:104. doi: 10.1007/s11920-016-0741-y

- Song, F., Wang, X., Ju, Z., Liu, A., Liu, J., and Wang, T. (2020). Mental health status and related influencing factors during the epidemic of coronavirus disease 2019 (COVID-19) (in Chinese). *J. Public Health Prev. Med.* 31, 23–27. doi: 10.3969/j.issn.1006-2483.2020.02.006
- Song, J. Y., Jeong, K. S., Choi, K. S., Kim, M. G., and Ahn, Y. S. (2018). Psychological risk factors for posttraumatic stress disorder in workers after toxic chemical spill in Gumi, South Korea. *Workplace Health Saf.* 66, 393–402. doi: 10.1177/2165079917750168
- Song, L., Wang, Y., Li, Z., Yang, Y., and Li, H. (2020). Mental health and work attitudes among people resuming work during the COVID-19 pandemic: a cross-sectional study in China. *Int. J. Environ. Res. Public Health* 17:5059. doi: 10.3390/ijerph17145059
- Sun, L., Sun, Z., Wu, L., Zhu, Z., Zhang, F., Shang, Z., et al. (2021). Prevalence and risk factors for acute posttraumatic stress disorder during the COVID-19 outbreak. *J. Affect. Disord.* 283, 123–129. doi: 10.1016/j.jad.2021.01.050
- Sun, M., Li, S., Yue, H., Li, X., Li, W., and Xu, S. (2020). Analysis on anxiety status of Chinese netizens under the outbreak of the coronavirus disease 2019 (COVID-19) and its influencing factors (in Chinese). *World Sci. Technol. Modern. Tradit. Chin. Med.* 22, 703–708. doi: 10.11842/wst.20200301003
- Sun, Q., Qin, Q., Chen, B., Shao, R., Zhang, J., and Li, Y. (2020). Stress, anxiety, depression and insomnia in adults outside Hubei province during the COVID-19 pandemic (in Chinese). *Natl. Med. J. China* 100, 3419–3424. doi: 10.3760/cma.jcn112137-20200302-00557
- Tan, W., Hao, F., McIntyre, R. S., Jiang, L., Jiang, X., Zhang, L., et al. (2020). Is returning to work during the COVID-19 pandemic stressful? A study on immediate mental health status and psychoneuroimmunity prevention measures of Chinese workforce. *Brain Behav. Immun.* 87, 84–92. doi: 10.1016/j.bbi.2020.04.055
- The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team (2020). The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19)-China, 2020. *China CDC Weekly* 2, 113–122. doi: 10.46234/ccdcw2020.032
- Tian, F., Li, H., Tian, S., Yang, J., Shao, J., and 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. doi: 10.1016/j.psychres.2020.112992
- Vandenbroucke, J. P., Von Elm, E., Altman, D. G., Gøtzsche, P. C., Mulrow, C. D., Pocock, S. J., et al. (2007). Strengthening the reporting of observational studies in epidemiology (STROBE). *Epidemiology* 18, 805–835. doi: 10.1097/EDE.0b013e3181577511
- Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *J. Stat. Softw.* 36:48. doi: 10.18637/jss.v036.i03
- Wallace, B. C., Dahabreh, I. J., Trikalinos, T. A., Lau, J., Trow, P., and Schmid, C. H. (2012). Closing the gap between methodologists and end-users: R as a computational back-end. *J. Stat. Softw.* 49:15. doi: 10.18637/jss.v049.i05
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020). 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. doi: 10.3390/ijerph17051729
- Wang, J., Gong, Y., Chen, Z., Wu, J., Feng, J., Yan, S., et al. (2020). Sleep disturbances among Chinese residents during the coronavirus disease 2019 outbreak and associated factors. *Sleep Med.* 74, 199–203. doi: 10.1016/j.sleep.2020.08.002
- Wang, J., Wu, X., Lai, W., Long, E., Zhang, X., Li, W., et al. (2017). Prevalence of depression and depressive symptoms among outpatients: a systematic review and meta-analysis. *BMJ Open* 7:e017173. doi: 10.1136/bmjopen-2017-017173
- Wang, M., Liu, X., Guo, H., Fan, H., Jiang, R., and Tan, S. (2020). Mental health of middle-aged and elderly population during outbreak of coronavirus disease 2019 (in Chinese). *Chin. J. Mult. Organ Dis. Elderly* 19, 241–245. doi: 10.11915/j.issn.1671-5403.2020.04.056
- Wang, Y., Gao, J., Chen, H., Mao, Y., Chen, S., Dai, J., et al. (2020a). The relationship between media exposure and mental health problems during COVID-19 outbreak (in Chinese). *Fudan Univ. J. Med. Sci.* 47, 173–178. doi: 10.3969/j.issn.1672-8467.2020.02.005
- Wang, Y., Wang, C., Liao, Z., Zhang, X., and Zhao, M. (2020b). A comparative analysis of anxiety and depression level among people and epidemic characteristics between COVID-19 and SARS (in Chinese). *Life Sci. Res.* 24, 180–186. doi: 10.16605/j.cnki.1007-7847.2020.03.002
- World Health Organization (2020). *WHO Coronavirus Disease (COVID-19) Dashboard [Online]*. Available online at: <https://covid19.who.int/> (accessed July 1, 2020).
- Wu, M., Han, H., Lin, T., Chen, M., Wu, J., Du, X., et al. (2020). Prevalence and risk factors of mental distress in China during the outbreak of COVID-19: a national cross-sectional survey. *Brain Behav.* 10:e01818. doi: 10.1002/brb3.1818
- Wu, P., Fang, Y., Guan, Z., Fan, B., Kong, J., Yao, Z., et al. (2009). The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk. *Can. J. Psychiatry* 54, 302–311. doi: 10.1177/070674370905400504
- Wu, T., Jia, X., Shi, H., Niu, J., Yin, X., Xie, J., et al. (2020). Prevalence of mental health problems during the COVID-19 pandemic: a systematic review and meta-analysis. *J. Affect. Disord.* 281, 91–98. doi: 10.1016/j.jad.2020.11.117
- Xiao, J., Chen, Y., Fang, F., Liu, W., Zhong, Y., Tao, J., et al. (2020). Public anxiety and depression and its influencing factors under public health emergencies (in Chinese). *Mod. Prev. Med.* 47, 3557–3562.
- Yáñez, J. A., Afshar Jahanshahi, A., Alvarez-Risco, A., Li, J., and Zhang, S. X. (2020). Anxiety, distress, and turnover intention of healthcare workers in Peru by their distance to the epicenter during the COVID-19 crisis. *Am. J. Trop. Med. Hyg.* 103, 1614–1620. doi: 10.4269/ajtmh.20-0800
- Yang, B., Yang, Y., Jia, Y., Li, Z., Qin, X., and Duan, J. (2020). Survey on the psychological state of the masses in the plain area of Chengdu during the epidemic of COVID-19 (in Chinese). *World Latest Med. Inf.* 20, 251–253. doi: 10.3969/j.issn.1671-3141.2020.43.134
- Yang, L., Zhang, Y., Xu, Y., Zheng, J., and Lin, Z. (2020). Investigation on psychological stress in fighting against corona virus disease 2019 among community residents (in Chinese). *Chin. Nurs. Res.* 34, 1140–1145. doi: 10.12102/j.issn.1009-6493.2020.07.009
- Yang, S., Lin, H., Zhu, J., Chen, Y., Wang, N., Zhao, Q., et al. (2020). Depression and anxiety symptoms among returning workers during the COVID-19 period in East China. *Soc. Psychiatry Psychiatr. Epidemiol.* doi: 10.1007/s00127-020-01983-w. [Epub ahead of print].
- Yang, T., Qu, X., and Wang, H. (2020). Mental health of community residents in Wuhan during the epidemic of COVID-19 and the influencing factors (in Chinese). *J. Nurs. Sci.* 35, 76–78. doi: 10.3870/j.issn.1001-4152.2020.13.076
- Yang, X., Xiong, Z., Li, Z., Li, X., Xiang, W., Yuan, Y., et al. (2020). Perceived psychological stress and associated factors in the early stages of the coronavirus disease 2019 (COVID-19) epidemic: evidence from the general Chinese population. *PLoS ONE* 15:e0243605. doi: 10.1371/journal.pone.0243605
- Yang, Y., Liu, K., Li, S., and Shu, M. (2020). Social media activities, emotion regulation strategies, and their interactions on people's mental health in COVID-19 pandemic. *Int. J. Environ. Res. Public Health* 17, 1–16. doi: 10.3390/ijerph17238931
- Yao, H., Chen, J.-H., and Xu, Y.-F. (2020). Patients with mental health disorders in the COVID-19 epidemic. *Lancet Psychiatry* 7:e21. doi: 10.1016/S2215-0366(20)30090-0
- Yu, Y., Tan, D., Wan, Y., Wang, Y., and Jiang, X. (2020). Investigation and analysis of anxiety state of residents in Enshi during the COVID-19 (in Chinese). *World Latest Med. Inf.* 20, 267–269. doi: 10.3969/j.issn.1671-3141.2020.78.117
- Zhang, J., Li, P., and Li, Z. (2020). Analysis of influencing factors of community female residents' psychology and evaluation of intervention effect during the outbreak of novel coronavirus pneumonia (in Chinese). *J. Changzhi Med. Coll.* 34, 81–86.
- Zhang, L., Ma, M., Li, D., and Xin, Z. (2020a). The psychological typhoon eye effect during the COVID-19 outbreak in China: the role of coping efficacy and perceived threat. *Global Health* 16:105. doi: 10.1186/s12992-020-00626-8
- Zhang, L., Zhang, B., and Hu, L. (2020b). The relationship between perceived stress and sleep quality of Wuhan residents during COVID-19 outbreak: psychological resilience as a moderator (in Chinese). *Chin. J. Dis. Control Prev.* 24, 638–642. doi: 10.16462/j.cnki.zbjbkz.2020.06.004
- Zhang, S. X., Huang, H., and Wei, F. (2020). Geographical distance to the epicenter of Covid-19 predicts the burnout of the working population: ripple effect or typhoon eye effect? *Psychiatry Res.* 288:112998. doi: 10.1016/j.psychres.2020.112998

- Zhang, Y., Cao, X., Wang, P., Wang, G., Lei, G., Shou, Z., et al. (2020). Emotional “inflection point” in public health emergencies with the 2019 new coronavirus pneumonia (NCP) in China. *J. Affect. Disord.* 276, 797–803. doi: 10.1016/j.jad.2020.07.097
- Zhao, X., Lan, M., Li, H., and Yang, J. (2020). Perceived stress and sleep quality among the non-diseased general public in China during the 2019 coronavirus disease: a moderated mediation model. *Sleep Med.* 77, 339–345. doi: 10.1016/j.sleep.2020.05.021
- Zhen, R., and Zhou, X. (2020). Predictive factors of public anxiety under the outbreak of COVID-19 (in Chinese). *Chin. J. Appl. Psychol.* 26, 99–107.
- Zhong, X., Yuan, D., and Wang, B. (2020). Detection status and influencing factors of residents with symptoms of acute stress disorder during the COVID-19 (in Chinese). *Sichuan Mental Health* 33, 398–402. doi: 10.11886/scjsws20200419001
- Zhou, Y., and Liu, Q. (2020). Analysis of the emotional response of residents under COVID-19 and its influencing factors (in Chinese). *J. Front. Med.* 10, 252–254.
- Zhu, J., Su, L., Zhou, Y., Qiao, J., and Hu, W. (2020a). The effect of nationwide quarantine on anxiety levels during the COVID-19 outbreak in China. *Brain Behav.* 11:e01938. doi: 10.1002/brb3.1938
- Zhu, J., Xu, N., Pan, Y., Ying, P., Ye, J., Liu, C., et al. (2020b). Investigation research on cognition, prevention and control behavior and psychosomatic healthy status of different types of adults during the epidemic period of corona virus disease-19 (in Chinese). *China Med.* 15, 816–820. doi: 10.3760/j.issn.1673-4777.2020.06.004
- Zhu, X., Liu, D., Yan, F., Qu, W., Fan, H., Zhao, Y., et al. (2020). Psychological status of school students and employees during the COVID-19 epidemic (in Chinese). *Chin. Mental Health J.* 34, 549–554. doi: 10.3969/j.issn.1000-6729.2020.6.013
- Zhu, Z., Liu, Q., Jiang, X., Manandhar, U., Luo, Z., Zheng, X., et al. (2020). The psychological status of people affected by the COVID-19 outbreak in China. *J. Psychiatr. Res.* 129, 1–7. doi: 10.1016/j.jpsychires.2020.05.026

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2021 Li, Zhang, Zhang, Luo, Wang, Wu, Zhu, Cui, Wang, Li, Zhu, Xu and Li. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.