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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Research paper

The psychological status of 8817 hospital workers during COVID-19 Epidemic: A cross-sectional study in Chongqing

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ABSTRACT

Background: There was an outbreak of COVID-19 towards the end of 2019 in China, which spread all over the world rapidly. The Chinese healthcare system is facing a big challenge where hospital workers are experiencing enormous psychological pressure. This study aimed to (1) investigate the psychological status of hospital workers and (2) provide references for psychological crisis intervention in the future.

Method: An online survey was conducted to collect sociodemographic features, epidemic-related factors, results of PHQ-9, GAD-7, PHQ-15, suicidal and self-harm ideation (SSI), and the score of stress and support scales. Chi-square test, *t*-test, non-parametric, and logistic regression analysis were used to detect the risk factors to psychological effect and SSI.

Results: 8817 hospital workers participated in this online survey. The prevalence of depression, anxiety, somatic symptoms, and SSI were 30.2%, 20.7%, 46.2%, and 6.5%, respectively. Logistic regression analysis showed that female, single, Tujia minority, educational background of junior or below, designated or county hospital, need for psychological assistance before or during the epidemic, unconfident about defeating COVID-19, ignorance about the epidemic, willingness of attending parties, and poor self-rated health condition were independent factors associated with high-level depression, somatic symptom, and SSI among hospital workers ($P < 0.05$).

Limitations: This cross-sectional study cannot reveal the causality, and voluntary participation could be prone to selection bias. A modified epidemic-related stress and support scale without standardization was used. The number of hospital workers in each hospital was unavailable.

Conclusion: There were a high level of psychological impact and SSI among hospital workers, which needed to be addressed. County hospital workers were more severe and easier to be neglected. More studies on cognitive and behavioral subsequence after a public health disaster among hospital workers are needed.

1. Introduction

The coronavirus disease 2019 (COVID-19), a rapidly spread epidemic, has gained global attention since December 2019 (Wang et al., 2020). By January 29, 2020, all of the provinces in China have confirmed patients (Health Emergency Office, 2020) . Chongqing, a municipality directly under the central government, has a population of 31 million and borders Hubei on the east (The State Statistical Bureau, 2020). More than 70% of the 5 million people from Wuhan, who left for other cities during this Lunar spring festival, went to cities within Hubei province. However, Chongqing, among others, received the third-highest number of people (1.19%) from Wuhan between January 1 to 26, 2020, (Economic Observer, 2020) the peak duration of infection due to migration. Although Chongqing had begun the first-

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level response to major public health emergencies on January 24, 2020 (Chongqing People's Government, 2020), the cumulative confirmed population reached 576 (on March 6, 2020). It ranked the ninth in all in all 34 Chinese first-level administrative regions (Dxy, 2020).

The majority of hospital workers changed into an increasing awareness of hygiene and a new attitude to a relationship after an emergency health crisis (Chan and Chan, 2004). However, most previous studies have confirmed a high percentage of psychological impacts in hospital worker during or after a public health disaster since the outbreak of Severe Acute Respiratory Syndrome (SARS) (Chan and Chan, 2004; Lin et al., 2007; Jeong et al., 2016). Half of them are on posttraumatic stress disorder (PTSD) (Franco-Martin et al., 2018), while few studies focus on other psychological symptoms and needs, behaviors, and perceived stresses and support, or attitudes to disaster (Zhang et al., 2020b; Xiang et al., 2020; Lai et al., 2020; Chan and Chan, 2004). That was hard to fully understand the psychology impacts on hospital workers. Furthermore, COVID-19 was much “smarter” than the contagions we have ever met before, its quick spread, non-typical symptoms, and asymptomatic infection (Li et al., 2020) brought great stress on hospital workers on emotion, body, cognition, and behavior. Additionally, to our knowledge, suicidal and self-harm ideation (SSI) has never been mentioned and studied. This study was aimed to give a timely profile, detect the risk and protective factors, and provide some directional suggestions about the implementation of a psychological intervention for hospital workers during and after the COVID-19 epidemic.

2. Methods

2.1. Design, participants, and data collection

This was a cross-sectional study using an online survey based on a specified psychological screening platform, Chongyixinli. Data was conducted from February 14 to 23, 2020, three to four weeks after the COVID-19 epidemic outbreak in Chongqing (Chongqing People's Government, 2020).

We included that hospital workers who were on the job, worked in the 48 Hospitals mentioned above, confirmed the informed consent, and completed the whole questionnaire. This study excluded hospital workers who did not belong to the 48 hospitals. The completeness and logistic errors were also be checked.

This study was carried out under the cooperation between our team and Chongqing Health Committee following the introduction of an emergency psychological crisis intervention in the COVID-19 epidemic promulgated by the National Health Commission of China on January 27, 2020 (National Health Commission of China, 2020). At the beginning of the epidemic outbreak, Chongqing Health Committee assigned 48 hospitals to treat COVID-19 patients. All the participants were recruited from these hospitals, which were classified three levels in this study: 4 designated hospitals were in charge of all the confirmed patients; 16 main district hospitals located in the urban center area; 30 county hospitals located in the rural area. Hospital workers were encouraged by administrative guidance to finish the online survey voluntarily by scanning a QR-code shared in their workgroup in the WeChat application after confirming the informed consent. The results were analyzed automatically on a specialized psychological assessment platform. Finally, workers from 46 hospitals completed the survey. Data protection was declared in the informed consent that all the data only could be used for research in population level. Private data can be protected unless it showed high mental risk (PHQ-9 > = 15 or positive SSI) and need further professional evaluation and intervention. This study conformed to the ethical guidelines of the 1975 Declaration of Helsinki and got the ethics approval authorized by the Ethics Committee of Chongqing Medical University.

2.2. Measures

This survey was implemented by using a structured questionnaire that included four domains, sociodemographic features, epidemic-related factors, psychological outcomes, and the source of stress and support. Sociodemographic features included age, gender, nationality, marital status, educational background, career class, profession, employment year, clinical department, level of hospital, frontline department, and SARS experience. The epidemic-related factors included epidemic-related attitudes and behaviors, such as “Please evaluate the possibility of you being infected.”, “Are you willing to work in a COVID-19 ward?”, “Are you concerned about the progress of the COVID-19 pandemic?”, “Do you have confidence about your country defeating COVID-19?”, “Please estimate how long you think COVID-19 would last in China.”, "Please estimate your health condition during COVID-19.","Did you require the services from a psychological profession before/during COVID-19?", "Is it necessary for healthcare workers to regularly participate a face-to-face or group psychological therapy during this epidemic?", “How did you moderate your emotion while feeling obvious depression or anxiety?”, and “Are you still willing to attend parties with many people during the epidemic?”.

The Patient Health Questionnaire (PHQ-9) (Spitzer et al., 1999), a five-point Likert-type scale from “not at all” (score 0) to “extremely” (score 4) were used to detect how often the participants had been bothered by depression over the past two weeks. The total score of the PHQ-9 ranged from 0 to 27. Scores of 5, 10, 15, and 20 are taken as the cut-off points for minimal, mild, moderate, moderately severe, and severe depression, respectively. A cut-off score of 7 or higher on the PHQ-9 has a sensitivity of 0.86 and a specificity of 0.86 in the general Chinese population (Wang et al., 2014). The severity of anxiety was evaluated by the Generalized Anxiety Disorder 7-item Scale (GAD-7) (Spitzer et al., 2006). The GAD-7 score was calculated by assigning scores of 0, 1, 2, and 3, to the response categories of “not at all”, “several days”, “more than half the days”, and “nearly every day”, respectively, and adding together the scores for the seven questions. Scores of 5, 10, and 15 are taken as the cut-off points for mild, moderate, and severe anxiety, respectively. A cut-off score of 10 on the GAD-7 had a sensitivity of 0.86 and a specificity of 0.96 in Chinese general hospital outpatients (He et al., 2010). The Patient Health Questionnaire, a somatic symptom severity scale (PHQ-15) was employed to assess the severity of somatic symptoms (Kroenke et al., 2002). The internal consistency coefficient of PHQ- 15 is 0.73, and the test-retest reliability coefficient was 0.75 in Chinese general hospital outpatients (Qian et al., 2014). The scale consists of 15 items that ask whether somatic symptoms, such as stomach pain or dizziness, were present in the last four weeks with varying levels of severity (response categories of “not bothered at all,” “bothered a little,” and “bothered a lot”). The PHQ-15 scores of 5, 10, and 15 represent cut-off points for levels of the low, medium, and high symptom severity, respectively. In this study, high-level depressive, anxiety, and somatic symptoms were defined as a score equal to or more than 10 on PHQ-15, GAD-7, and PHQ-9.

An eighteen-item stress source scale and a six-item support source scale that originated from a survey on frontline healthcare in Taiwan province during SARS (Tam et al., 2004) were reformulated and used in this study (more details are provided in the appendix supplementary). In the stress source scale, five initial items including “Lack of feedback of senior”, “Being blamed for mistakes”, “Lack of appreciation at work”, “Hospital service restructuring, uncertain job prospect”, and “Public had high expectations of medical professions” were changed into four current items including "Did you work in the isolated ward?", "Did you directly contact confirmed patients?", "Did your family member or relative get infected?", and “Did your community member get infected?”. For convenience, the options were adapted for a “yes” or “no”. There were two items originated from Tam et al.’s 6-item support source scale, “Do you get adequate support from your family?” and “Do you get

adequate insurance and compensation support?". The other four items were self-made by referring to other studies on social and occupational factors associated with psychological outcomes in healthcare employees during an infectious disease outbreak (Brooks et al., 2018; Naushad et al., 2019; Williamson et al., 2018). The total number of positive responses was counted as the respective scores for stress and support sources.

2.3. Statistical analysis

Data were analyzed using SPSS version 25.0 (SPSS, Chicago, IL, USA). Chi-square ($\chi 2$) test was used to compare the differences in categorical variables. T-test was used to compare the differences in continuous variables. Kruskal-Wallis test and Mann-Whitney test were conducted to examine the differences in rating variables. Logistic regression analysis (forward LR) was used to detect independent factors for psychological outcomes and SSI. $P < 0.05$ was considered statistically significant (two-sided test).

3. Results

There were 8817 questionnaires after excluding 913 questionnaires for incompletion of the survey (447), non-hospital workers (231), non-local hospitals (158), systematic duplication (29), and logistic errors (48) (younger than 18 years or the difference between age and employment year less than 18). The profile of sociodemographic features and epidemic-related factors are listed in Table 1. The mean value and standard deviation of age, employment year, stress score, and support score were 33.25 ± 8.257, 10.23 ± 8.435, 7.90 ± 2.921, and 3.55 ± 2.644, respectively. The median was considered as the cut-off point for age (31) and employment year (5).

The results of the PHQ-9 GAD-7, PHQ-15, and SSI are listed in Table 2. The percentage of high-level depression, anxiety, and somatic symptoms in hospital workers during the COVID-19 epidemic were 9.4%, 5.1%, and 19.8%, respectively. The prevalence of SSI was 6.5%.

High-level symptoms, SSI, and the stress and support source were compared separately in different sociodemographic and epidemic-related groups. Depression, anxiety, and somatic symptoms were found significantly different among hospital workers with various sociodemographic characteristics, especially the level of hospital and educational background ($P < 0.05$). The lower the educational background was, the higher percentage of depressive, anxiety, and somatic symptoms were (Table 3). Meanwhile, SSI and mean value of stress and support sources were significantly different in the groups of epidemic-related attitudes and behaviors. Hospital workers who were working in frontline departments, unwilling to work in COVID-19 ward, unconfident about defeating COVID-19, in need of psychological assistance before or during the epidemic, and admitting regular psychological intervention during the epidemic got more stress, less support, and SSI ($P < 0.05$). (Table 4a and Table 4b). Note that, except SSI, county hospital workers showed various psychological impact, higher epidemic-related stress, and less support, as compared with those in designated or main district hospitals ($P < 0.05$).

Forward LR logistic regressive analysis was conducted. In the PHQ-9 model, nationality, marital status, educational background, level of hospital, and employment years were included. In the PHQ-15 model, gender, nationality, educational background, level of hospital, and profession were included. In the SSI model, self-rated health condition, self-rated infection possibility, the willingness of attending parties, concern about COVID-19, confidence about defeating COVID-19, lasting time of COVID-19, and previous and current need of psychological intervention were included, with adjustment of stress, support, frontline department, the willingness of working in COVID-19 ward, and necessary of regular psychological intervention (Table 5). Taken together, the educational background of junior or below (OR = 1.404, 95%CI = 1.047–1.883), single (OR = 1.498, 95%CI = 1.285–1.746), main district hospital (OR = 0.719, 95%CI = 0.575–0.899), and Tujia minority (OR = 1.290, 95%CI = 1.005–1.577) were associated with

Table 1
Sociodemographic and epidemic-related profile of 8817 hospital workers.

Sociographic features	Variables	n (%)	Epidemic-related factors	Variables	n (%)
Gender	Female	6874 (78.0%)	Self-rated health condition	Good	5149 (58.4%)
	Male	1943 (22.0%)		Normal	3403 (38.6%)
Age	< =31	4659 (52.8%)		Poor	265 (3.0%)
	>31	4158 (47.2%)	Self-rated infected possibility	None	719 (8.2%)
Nationality Na	Han	7428 (84.2%)		Low	5814 (65.9%)
	Tujia	1118 (12.7%)		High	2284 (25.9%)
	Else	271 (3.1%)	Willingness of working in COVID-19 ward	No	2363 (26.8%)
Educational background	Junior or below	2734 (31.0%)		Yes	6454 (73.2%)
	College	5176 (58.7%)	Willingness of join in parties	No	8676 (98.4%)
	Master or above	907 (10.3%)		Yes	141 (1.6%)
Marital status	Single	2415 (27.4%)	Way of moderating emotion	By self	6151 (69.8%)
	Married	6402 (72.6%)		Relatives or acquaintance	2216 (25.1%)
Experienced SARS	No	7750 (87.9%)		Psychologist	69 (0.8%)
	Yes	1067 (12.1%)		Psychiatrist	8 (0.1%)
Frontline department	No	7748 (87.9%)		Other way	373 (4.2%)
	Yes	1069 (12.1%)	Concern about epidemic	No	102 (1.2%)
Level of hospital	Designated	2151 (24.4%)		Yes	8715 (98.8%)
	Main district	2000 (22.7%)	Confidence about defeating COVID-19	No	53 (0.6%)
	County	4666 (52.9%)		Yes	8764 (99.4%)
Clinical department	No	1888 (21.4%)	Lasting time of COVID-19	1–2 months	5585 (63.3%)
	Yes	6929 (78.6%)		3–6 months	3002 (34.0%)
Career class	Formal staff-	4108 (46.6%)		> 6 months	230 (2.7%)
	Temporary staff	4709 (53.4%)	Need of psychological assistance before epidemic	No	8170 (92.7%)
Profession	Doctor	3212 (36.4%)		Yes	647 (7.3%)
	Nurse	4685 (53.1%)	Need of psychological assistance during epidemic	No	8180 (92.8%)
	Others	920 (10.4%)		Yes	637 (7.2%)
Employment year	< =8 year	4697 (53.3%)	Necessary of regularly psychological intervention	No	2160 (24.5%)
	>8 year	4120 (46.7%)		Yes	6657 (75.5%)

Frontline department: infection department, pneumology department, intensive care unit, COVID-19 designated ward, or emergency department. SARS: severe acute respiratory syndrome.

Table 2
Results of the PHQ-9, GAD-7, PHQ-15, and suicidal and self-harm ideation in 8817 hospital workers.

	PHQ-9 (n%)		GAD-7 (n%)	PHQ-15 (n%)	SSI (n%)
No symptom	6151 (69.8%)	No symptom	6992 (79.3%)	4745 (53.8%)	8241 (93.5%)
Minimal symptom	1836 (20.8%)	Low symptom	1375 (15.6%)	2329 (26.4%)	576 (6.5%)
Mild symptom	546 (6.2%)	Medium symptom	282 (3.2%)	1206 (13.7%)	N.A.
Moderate symptom	188 (2.1%)	High symptom	167 (1.9%)	537 (6.1%)	N.A.
Severe symptom	96 (1.1%)	N.A.	N.A.	N.A.	N.A.

SSI: suicidal and self-harm ideation. N.A.: not applicable.

Table 3
High-level systems in different sociodemographic and epidemic-related categories of 8817 hospital workers ($P<0.05$).

	Variables	PHQ-9>=10 n%	χ2/Z	GAD-7>=10 n%	χ2/Z	PHQ-15>=10 n%	χ2/Z
Gender	Female					1501(21.8%)	83.100
	Male					243(12.5%)	
Nationality	Han	661 (8.9%)	14.290			1401 (18.9%)	25.540
	Tujia	139 (12.4%)				280 (25.0%)	
	Else	28 (10.3%)				63 (23.2%)	
Marital status	Single	295 (12.2%)	30.620				
	Married	538 (8.4%)					
Employment year	<=8 year	476(10.1%)	5.940				
	>8 year	354(8.6%)					
Level of hospital	Designated	227(10.6%)	13.970	122(5.7%)	9.410	459(21.3%)	25.500
	Main districts	147(7.3%)		76(3.8%)		317(15.9%)	
	County	456(9.8%)		253(5.4%)		968(20.8%)	
	Designated vs. main district		12.971		7.994		20.543
	Designated vs. county						
	Main district vs. county		9.988		7.852		21.564
Profession	Doctor					537(16.7%)	41.450
	Nurse					1046(22.3%)	
	Others					161(17.5%)	
*Educational background	Junior or below	312 (11.4%)	21.630	175 (6.4%)	13.960	620 (22.7%)	45.300
	College	455 (8.8%)		239 (4.6%)		1011 (19.5%)	
	Master or above	63 (6.9%)		37 (4.1%)		113 (12.5%)	
	#Junior or below vs. College		−3.747		−3.387		−3.288
	Junior or below vs. master or above		−3.834		−2.587		−6.650
	college vs. master or above		−1.836		−0.718		−5.063

*Kruskal-Wallis test was conducted. # Mann-Whitney test was conducted. SSI: suicidal and self-harm ideation.

Table 4a
The comparation of SSI, stress score, and support score in different sociodemographic and epidemic-related groups among 8817 hospital workers ($P<0.05$).

		Stress source			Support source			SSI	
	Variables	Mean	SD	F	Mean	SD	F	n%	χ2
Clinical department	Yes	7.99	2.887	11.724	3.51	2.648	4.150		
	No	7.61	3.025		3.68	2.626			
Level of hospital	Designated	7.50	2.816	39.550	3.77	2.592	16.108		
	Main district	7.78	2.962		3.65	2.623			
	County	8.15	2.927		3.40	2.668			
	Designated vs. main district			5.204					
	Designated vs. county			3.397			32.109		
	Main district vs. county			0.675			10.395		
Frontline department	No	8.99	3.043	2.933	3.30	2.651	1.677	484 (6.25%)	8.564
	Yes	7.75	2.872		3.58	2.641		92 (8.61%)	
Experienced SARS	No	7.80	2.876	17.400					
	Yes	8.63	3.137						
Willingness of working in COVID-19 ward	No	8.24	2.952	0.587	3.34	2.574	19.672	176 (7.45%)	4.429
	Yes	7.78	2.900		3.62	2.665		400 (6.20%)	
Willingness of participant in parties	No	7.89	2.908	13.602				552 (6.36%)	25.816
	Yes	8.77	3.559					24 (17.02%)	
Confidence about defeating COVID-19	No	10.66	3.942	15.792	2.00	2.210	13.699	17 (32.01%)	56.972
	Yes	7.89	2.906		3.56	2.644		559 (6.38%)	
Concern about epidemic	No							21 (6.37%)	33.387
	Yes							555 (6.53%)	
Need of psychological assistance before epidemic	No	7.71	2.821	2.574	3.60	2.648	13.424	409 (5.01%)	425.004
	Yes	10.41	3.008		2.90	2.509		167 (25.81%)	
Need of psychological assistance during epidemic	No	7.69	2.820	0.507	3.60	2.649	22.176	403 (4.93%)	478.371
	Yes	10.63	2.830		2.84	2.468		173 (27.16%)	
Necessary of regularly psychological intervention	No	7.59	2.911	1.359	3.55	2.615	4.025	113 (5.23%)	7.935
	Yes	8.01	2.917		3.55	2.653		463 (6.96%)	

SSI: suicidal and self-harm ideation.

Table 4b
The comparation of SSI, stress score, and support score in different sociodemographic and epidemic-related groups among 8817 hospital workers ($P<0.05$).

	Variables	n	Stress source Mean*	χ2/Z	Support source Mean	χ2/Z	SSI Mean	χ2/Z
Self-rated health condition#	Good	5149	3695.12	1063.142	4685.57	179.106	4240.87	415.114
	Normal	3403	5306.90		4062.73		4589.96	
	Poor	265	6749.36		3481.81		5352.05	
	Poor vs. Normal			−10.506		−3.939		−8.374
	Poor vs. Good			−18.102		−7.976		−20.535
	Normal vs. Good			−29.044		−11.813		−15.248
Self-rated infected possibility#	None	719	2813.42	1389.320	4572.24	75.090	4323.34	81.909
	Low	5814	3971.35		4535.68		4349.99	
	High	2284	6025.35		4035.14		4586.17	
	None vs. low			−12.659				
	None vs. high			−27.097		−5.034		−4.841
	Low vs. high			−33.395		−8.468		−8.673
Lasting time of COVID-19#	1–2 months	5585	4209.51	101.457	4516.56	30.716	4367.28	33.782
	3–6 months	3002	4721.29		4225.83		4463.17	
	>6 months	230	5177.16		4187.88		4715.19	
	1–2 months vs.3–6 months			−8.944		−5.355		−3.942
	1–2 months vs.> 6 months			−4.720				−4.978
	3–6 months vs. >6 months							−3.050

*Mean: rank mean value. # Kruskal-Wallis test and Mann-Whitney test were conducted. SSI: suicidal and self-harm ideation.

high-level depressive symptom among hospital workers ($P<0.05$). Male (OR = 0.526, 95%CI = 0.454–0.610), main district hospital (OR = 0.781, 95%CI = 0.676–0.904), and educational background of college or below (OR = 1.556, 95%CI = 1.241–1.952) were associated with high-level somatic symptom ($P<0.05$). Various epidemic-related attitudes and behaviors were independent factors for SSI, such as the need for psychological assistance before or during the epidemic (OR = 1.826, 95%CI = 1.310–2.545; OR = 2.277, 95%CI = 1.636–3.171), unconfident about defeating COVID-19 (OR = 2.435, 95%CI = 1.184–5.005), ignorance about the epidemic (OR = 2.559, 95%CI = 1.451–4.531), willingness of attending parties (OR = 2.235, 95%CI = 1.339–3.731), and poor self-rated health condition (OR = 5.228, 95%CI = 3.650–7.489) among hospital workers ($P<0.05$).

4. Discussion

As the most severe public health crisis in the recent half-century, COVID-19 pandemic has affected emotion, body, cognition, and behavior among hospital workers (Williams et al., 2014). Many studies had found significant emotional and physical reactions to this crisis in hospital workers, such as depression, anxiety, PTSD, insomnia, and somatic symptom (Ho et al., 2020; Kisely et al., 2020; Luo et al., 2020; Ballesio et al., 2020). Various sociodemographic factors were found associated to emotional and physical symptoms among hospital workers in this study such as lower educational background, female, and single, which were consistent with the findings in previous studies (Kisely et al., 2020; Zhang et al., 2020a; Luo et al., 2020). Although attitudes to a crisis were considered crucial for deteriorating or relieving the psychological impact in an epidemic (Tam et al., 2004), no significant differences in the emotional and physical outcomes were found among hospital workers with different epidemic-related attitudes and behaviors.

Compared with emotional and physical effects on hospital workers, few studies focus on cognitive and behavioral outcomes after a public health crisis (Tam et al., 2004; Naushad et al., 2019). Some symptoms, such as insomnia, were found to gradually improved in hospital workers after two weeks of SARS outbreak (Patients 2016; Zhang et al., 2020a). This survey was conducted three to four weeks after the COVID-19 outbreak in Chongqing, which was a duration when four mixed reactions of individuals facing disasters: relieved soon, proportionately distressed, disproportionately distressed, and mentally disordered (Williams et al., 2014). Furthermore, a previous study found 13% of hospital workers used alcohol to cope with the upset feelings experienced in SARS (Vyas et al., 2016). The hospital workers who preferred more adventurous behavior such as attending parties with many people, although this was not encouraged by government and medical guidance, got a higher stress score and a lower support score in this study. According to the mechanism of allostatic overload, the unexpected, fast spread, and highly infectious virus broke the balance of neuro-endocrine-immune network, which based on the interaction of genes, personality traits, and environmental factors, hence formulated an allostatic load or overload on hospital workers and aroused their cognitive and affective responses. Adequate coping could lead to a new homeostatic balance. Otherwise, the impairment occurred (Zhang et al., 2020a; Fava et al., 2019). Negative emotions (anxiety, guilt, and loneliness) were reported to activate cognitive mechanisms and result in poor self-rated health and high self-rated infected possibility (Ballesio et al., 2020). However, compared with emotional and physical outcomes, epidemic-related attitudes and behaviors had showed a close relationship to stress and support in this study. This result provided evidence that the stressful public health crisis was more likely to affect hospital workers' cognition and behavior directly.

The unique factor in this study, which was ignored previously but showed a broad spectrum of influence on hospital workers under the contagion, was the level of hospital. As we previously predicted, workers in the designated hospital would have the most emotional and physical symptoms and the highest perceived pressure, followed by those in the main district hospitals and county hospitals. The reason was that designated hospitals received almost all the confirmed COVID-19 patients, while the main district hospitals received mostly the patients with non-infected diseases, and county hospitals were far away from the center of the epidemic. Unexpectedly, county hospital workers presented high-level depression, anxiety, and somatic symptoms, which almost as many as designated hospital workers. Moreover, they had the highest stress score and the lowest support score. Two reasons may explain these findings. First, previous studies have shown that frontline hospital workers suffer heavy workload, quarantine, direct contact with confirmed patients, and inconvenience brought by personal protective equipment (PPE), all of which result in emotional, somatic symptoms, and perceived stress (Marjanovic et al., 2007; Lai et al., 2020; Dimitriu et al., 2020). Second, county hospital workers worked with insufficient specialize instrument and PPE, less experience and training to cope with contagion, and without knowing if the patients were infectious, all of which increased their psychologic symptoms and pressures (Tsamakis et al., 2020; Kisely et al., 2020; Chua et al., 2004).

To our best knowledge, this is the first study on the prevalence of

Table 5
Risk factors associated with high-level psychological symptoms and SSI in 8817 hospital workers.

High-level PHQ-9	Variables	Walt	P	Exp(B)	EXP(B) 95% CI	
Educational background	Master or above	7.088	0.029	1		
	Junior or below	5.130	0.024	1.404	1.047	1.883
	College	1.411	0.235	1.184	0.896	1.564
Level of hospital	Designated	8.663	0.013	1		
	Main district	8.369	0.004	0.719	0.575	0.899
	County	0.947	0.331	0.920	0.777	1.089
Marital status	Married			1		
	Single	26.728	<0.001	1.498	1.285	1.746
Nationality	Han	6.185	0.045	1		
	Tujia	6.176	0.013	1.290	1.055	1.577
	Else	0.116	0.733	1.073	0.717	1.603
High-level PHQ-15	**Variables**	**Walt**	**P**	**Exp(B)**	**EXP(B) 95% CI**	
Gender	Male			1		
	Female	72.095	<0.001	0.526	0.454	0.610
Level of hospital	County	15.276	<0.001	1		
	Designated	1.060	0.303	1.069	0.942	1.212
	Main district	11.073	0.001	0.781	0.676	0.904
Educational background	Master or above	14.949	0.001	1		
	Junior or below	14.623	<0.001	1.556	1.241	1.952
	College	9.083	0.003	1.391	1.122	1.724
SSI	**Variables**	**Walt**	**P**	**Exp(B)**	**EXP(B) 95% CI**	
Need of psychological assistance before epidemic	No			1		
	Yes	12.641	<0.001	1.826	1.310	2.545
Need of psychological assistance during epidemic	No			1		
	Yes	23.771	<0.001	2.277	1.636	3.171
Confidence about defeating COVID-19	Yes			1		
	No	5.855	0.016	2.435	1.184	5.005
Concern about epidemic	Yes			1		
	No	10.539	0.001	2.559	1.451	4.513
Willingness of attending parties	No			1		
	Yes	9.465	0.002	2.235	1.339	3.731
Self-rated health condition	Good	123.335	<0.001	1		
	Poor	81.382	<0.001	5.228	3.650	7.489
	Normal	99.673	<0.001	2.947	2.384	3.644

SSI: suicidal and self-harm ideation. In the PHQ-9 model, ethnic group, marital status, educational background, level of hospital, and employ years were included. In the PHQ-15 model, gender, nationality, educational background, level of hospital, and profession were included. In the SSI model, self-rated health condition, self-rated infection possibility, the willingness of attending parties, concern about COVID-19, confidence about defeating COVID-19, lasting time of COVID-19, and previous and current need of psychological intervention were included, with adjustment of stress, support, frontline department, the willingness of working in COVID-19 ward, and necessary of regular psychological intervention.

SSI in hospital workers during a public health crisis. Similar to perceived stress and support, SSI in hospital workers was significantly different in epidemic-related groups. Previous studies found a history of mental disorder as a risk factor for psychological impact in hospital workers (Kisely et al., 2020). Considering that the percentage in hospital workers who ask for professional psychological assistance was less than 1%, it is reasonable to suspect many hospital workers had already had psychological problems before the epidemic. According to the integrated motivational-volitional model of suicidal behavior (O'Connor, 2011), there are three phases of suicidal behavior development: pre-motivational phrase, motivational phase, and volitional phase, during which various moderators affect the process to suicidal behavior. A minority of hospital workers experienced defeat or humiliation during the COVID-19 epidemic. This feeling could develop into entrapment if their self-moderators (social problem-solving, coping, et al.) were threatened. After that, suicidal ideation might emerge under the effect of motivational moderators, such as belongingness, burdensomeness, social support, and attitudes. Finally, volitional moderators prompt the thought to behavior. The SSI is not only the inadequate coping of cognitive reaction to allostatic load (Fava et al., 2019), but also a negative result of motivational moderation (O'Connor, 2011). Several things should be considered for psychological intervention in hospital workers. First, cognitive and behavior changes (suicidal ideation or risk behavior) as responses to a crisis are noteworthy, as they are possible to evolve into prolonged impairment. Regular follow-up evaluation and personalized psychological intervention strategy (if necessary) were encouraged to conduct at hospital level (Brooks et al., 2019; Dimitriu et al., 2020). Second, adequate PPE, sufficient rest, and practical support can reduce the stress in hospital workers, especially those working in county hospitals (Kisely et al., 2020; Kontoangelos et al., 2020). Third, the promulgation of the first nation-level introduction of psychological crisis intervention indicated that the government has realized the psychological impact of epidemic on the general population and medical professionals (National Health Commission of China, 2020). We recommend the government to integrate the sporadic psychological screening and intervention platform in many provinces to establish a national psychological strategy for coping with emergency public health crisis and improve the mental wellbeing of hospital workers.

4.1. Implications and contributions

This study made a timely assessment of the psychological status in a large number of hospital workers, with the use of standardized online questionnaires to make an accurate comparison with other studies. We found various sociodemographic and epidemic-related factors for emotional and physical impacts, perceived stress and support, and SSI. We also give some practical advice to reduce the effect of the COVID-19 epidemic on hospital workers.

4.2. Limitations

First, this cross-sectional study cannot reveal the causality, and voluntary participation may result in selection bias. Second, a modified epidemic-related stress and support questionnaire from the previous studies were used in this study, for there is no standard one for investigation during an epidemic. Third, it was impossible to evaluate the response rate for the unavailable number of hospital workers.

In conclusion, we investigated the psychological status of hospital workers at a city level, and recommend more attention should be paid to county hospital workers, SSI, and perceived stress and support. More studies on cognitive and behavioral subsequence after a public health disaster among hospital workers are needed.

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CRediT authorship contribution statement

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Visualization, Formal analysis, Validation. **Hong Su:** Writing - original draft, Writing - review & editing, Resources. **Wang Wo:** Visualization, Formal analysis, Validation. **Chen Jianmei:** Writing - review & editing. **Zhang Qi:** Visualization, Formal analysis. **Hu Hua:** . **Li Xuemei:** . **Wang Lixia:** Resources, Visualization. **Cao Jun:** Resources, Visualization. **Shi Lei:** Resources, Visualization. **Lv Zhen:** Resources. **Du Lian:** Resources. **Li Jing:** Supervision. **Yang Handan:** Supervision. **Qiu Haitang:** Supervision. **He Xiaoting:** Resources. **Chen Xiaorong:** Supervision. **Chen Ran:** Supervision. **Luo Qinghua:** Supervision. **Zhou Xinyu:** Supervision. **Tan Jian:** . **Tu Jing:** Supervision. **Jiang Guanghua:** Supervision. **Han Zhiqin:** Supervision. **Baltha Nkundimana:** Resources. **Kuang Li:** Writing - review & editing, Visualization, Validation.

Declaration of Competing Interest

The authors declare that there is no conflict of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2020.07.092.

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