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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, uncon- fianced 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-
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 breakout, 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 We-Chat 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 \( \geq 15 \) 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?”, “It is 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 (χ²) 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%) |
| Tuja                  | 1118 (12.7%) | High | 2284 (25.9%) |
| Educational background | Junior or below | 2734 (31.0%) | Willingness of working in COVID-19 ward | No | 2363 (26.8%) |
|                       | College   | 5176 (58.7%) | Willingness of join in parties | No | 8676 (96.4%) |
|                       | 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 | Yes | 2216 (25.1%) |
| Experienced SARS      | No        | 7750 (87.9%) | Psychologist | 69 (0.8%) |
|                       | Yes       | 1067 (12.1%) | Psychi atrist | 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%) | Need of psychological assistance before epidemic | No | 8170 (92.7%) |
|                       | Temporary staff | 4709 (53.4%) | Need of psychological assistance during epidemic | Yes | 647 (7.3%) |
|                       | Doctor    | 3212 (36.4%) | Need of psychological assistance before epidemic | No | 8180 (92.8%) |
|                       | Nurse     | 4685 (53.1%) | Need of psychological assistance during epidemic | No | 637 (7.2%) |
|                       | Others    | 920 (10.4%) | Yes | 2160 (24.5%) |
| Employment year       | <=4 year  | 4697 (53.3%) | Necessary of regularly psychological intervention | No | 6657 (75.5%) |
|                       | >4 year   | 4120 (46.7%) | Yes | 2160 (24.5%) |

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%) | 6992 (79.3%) | 4745 (53.8%) | 8241 (93.5%) |
| Minimal symptom  | 1836 (20.8%) | 1375 (15.6%) | 2329 (26.4%) | 576 (6.5%) |
| Mild symptom     | 546 (6.2%) | 282 (3.2%) | 1206 (13.7%) | N.A. |
| Moderate symptom | 188 (2.1%) | 167 (1.9%) | 537 (6.1%) | N.A. |
| Severe symptom   | 96 (1.1%) | 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 | χ2/Z | GAD-7 ≥10 | χ2/Z | PHQ-15 ≥10 | χ2/Z |
|----------------------------|-----------|------|-----------|------|------------|------|
| Gender                     |           |      |           |      |            |      |
| Female                     |           |      |           |      |            |      |
| Male                       |           |      |           |      |            |      |
| Nationality                |           |      |           |      |            |      |
| Han                        | 661 (8.9%) | 14.290 | 1401 (18.9%) | 25.540 |            |      |
| Tujia                      | 139 (12.4%) | 280 (25.0%) |            |      |            |      |
| Else                       | 28 (10.3%) | 63 (22.2%) |            |      |            |      |
| Marital status             |           |      |           |      |            |      |
| Single                     | 295 (12.2%) | 30.620 |            |      |            |      |
| Married                    | 538 (8.4%) | 63 (22.2%) |            |      |            |      |
| 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 |            |      |            |      |
| Designated vs. county      | 113 (12.5%) |            |            |      |            |      |
| Main district vs. county   | 9.988 | 7.852 |            |      |            |      |
| Profession                 |           |      |           |      |            |      |
| Doctor                     |           | 537 (16.7%) |            |      |            |      |
| Nurse                      | 1046 (22.3%) |            |            |      |            |      |
| Others                     | 161 (17.5%) |            |            |      |            |      |
| *Educational background    |           |      |           |      |            |      |
| Junior or below College    | 312 (11.4%) | 21.630 | 175 (6.4%) | 13.960 | 620 (22.7%) | 45.300 |
| College                    | 455 (8.8%) | 239 (4.6%) |            |      |            |      |
| Master or above            | 63 (6.9%) | 37 (4.1%) |            |      |            |      |
| #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).

| Variables                  | Stress source Mean | SD | F  | Support source Mean | SD | F  | SSI 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 | | 32.109 | |
|                           | Designated vs. county | 3.97 | | 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          | Yes                | 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 | | |      |
|                           | Yes                | 8.77 | 3.559 | | | |      |
| 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                 | 7.80 | 2.876 | 17.400 | | |      |
|                           | Yes                | 8.63 | 3.137 | | | |      |
| 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.
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

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

| Variables                  | Stress source Mean* | SSI Mean | Support source Mean |
|---------------------------|---------------------|----------|---------------------|
|                          | n                   | χ2/Z     | χ2/Z                |
| Self-rated health condition# |                     |          |                     |
| Good                      | 5149                | 1063.142 | 179.106             |
| Normal                    | 3403                | 4685.57  | 4589.96             |
| Poor                      | 265                 | 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                 | 1389.320 | 75.090              |
| Low                       | 5814                | 4572.24  | 4323.34             |
| High                      | 2284                | 4035.14  | 4586.17             |
| None vs. low              | −12.659             | −5.034   | −4.841              |
| None vs. high             | −27.097             | −8.468   | −8.673              |
| Low vs. high              | −33.395             | −8.944   | −9.457              |
| Lasting time of COVID-19# |                     |          |                     |
| 1–2 months                | 5585                | 101.457  | 4367.28             |
| 3–6 months                | 3002                | 4225.83  | 4462.17             |
| >6 months                 | 230                 | 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   | −3.050              |
| 3–6 months vs. > 6 months |                     |          |                     |

*Mean: rank mean value. # Kruskal-Wallis test and Mann-Whitney test were conducted. SSI: suicidal and self-harm ideation.
Table 5
Risk factors associated with high-level psychological symptoms and SSI in 8817 hospital workers.

| High-level PHQ-9 Variables | Wald | 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      |              |
| Tuja                        | 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 | Wald | 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               | Wald | P     | Exp(B) | EXP(B) 95% CI |
|-----------------------------|------|-------|--------|--------------|
| Need of psychological       |      |       |        |              |
| assistance before           | No   |       |        |              |
| epidemic                    | Yes  | 12.641| <0.001| 1.826 1.310  | 2.545 |
| Need of psychological       |      |       |        |              |
| assistance during           | No   |       |        |              |
| epidemic                    | Yes  | 23.771| <0.001| 2.277 1.636  | 3.171 |
| Confidence about            |      |       |        |              |
| defeating COVID-19          | Yes  | 5.855| 0.016 | 2.435 1.184  | 5.005 |
| Concern about               |      |       |        |              |
| epidemic                    | No   |       |        |              |
| Willingness of attending    | No   | 10.539| 0.001 | 2.559 1.451  | 4.513 |
| parties                     | 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, last 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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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.

References

Balleste, A., Lombardo, C., Lucidi, F., Violani, C. 2020. Caring for the carers: advice for dealing with sleep problems of hospital staff during the COVID-19 outbreak. J. Sleep Res. 1-9. https://doi.org/10.1111/1365-2869.13483. May.
Brooks, Samantha K., Rubin, G.J., Greenberg, N., 2019. Traumatic stress within disaster-exposed occupations: overview of the literature and suggestions for the management of traumatic stress in the workplace. Br. Med. Bull. 129 (1), 35-51. https://doi.org/10.1093/bmb/ldy040.

Chan, A.O.M., Chan, V.H., 2004. Psychological impact of the 2003 severe acute respiratory syndrome outbreak on health care workers in a medium size regional general hospital in Singapore. Occup. Med. (Chic Ill) 54 (3), 190-196. https://doi.org/10.1093/occmed/kuq027.

Chongqing People’s Government. Chongqing has launched a First-level Response to Major Public Health Emergencies. Available from http://www.cq.gov.cn/xwzx/jqxx/hc.html (Accessed Mar 6, 2020).

Chua, S.E., Cheung, V., Cheung, M., McAlloon, G.M., Wong, J.W.S., Cheung, E.P.T., Chan, M.T.Y., Wong, M.M.C., Tang, S.W., Choy, K.M., Wong, M.K., Chu, C.M., Tsang, K.W.T., 2004. Psychological effects of the SARS outbreak in Hong Kong on high-risk health care workers. Can. J. Psychiatry 49 (6), 391-393. https://doi.org/10.1177/0706743704098069.

Dimitriu, M.C.T., Pantea-Stoian, A., Smaranda, A.C., Nica, A.A., Carap, A.C., Constantin, V.D., Davitoum, A.I., Cirstoveanu, C., Bacalabna, N., Bratu, O.G., Jacoteca-Alexe, F., Badu, C.D., Smarandache, G.C., Socea, B., 2020. Burnout syndrome in Romanian medical residents in time of the COVID-19 pandemic. Med. Hypotheses 144 (January). https://doi.org/10.1016/j.mehy.2020.109972.

Dingxiangyuan (Dxy). Real-time status of the outbreak of new coronary pneumonia. https://ncov.dxy.cn/ncovh5/view/pneumonia_peopleapp (Accessed Mar 6, 2020).

Dimitriu, M.C.T., Pantea-Stoian, A., Smaranda, A.C., Nica, A.A., Carap, A.C., Constantin, V.D., Davitoum, A.I., Cirstoveanu, C., Bacalabna, N., Bratu, O.G., Jacoteca-Alexe, F., Badu, C.D., Smarandache, G.C., Socea, B., 2020. Burnout syndrome in Romanian medical residents in time of the COVID-19 pandemic. Med. Hypotheses 144 (January). https://doi.org/10.1016/j.mehy.2020.109972.

Kelsey, S., Warren, N., McMahon, D., Dalain, C., Henry, J., Siskind, D., 2020. Occurrence, prevention, and management of the psychological effects of emerging virus outbreaks on healthcare workers: rapid review and meta-analysis. BMJ. https://doi.org/10.1136/bmj.m1642. 569, 1662.

Kontougalos, K., Economou, M., Papageorgiou, C., 2020. Mental health effects of COVID-19 pandemic: a review of clinical and psychological traits. Psychiatry Investig. 17 (6), 191-505. https://doi.org/10.4306/pi.2020.17.6.191.

Kroenke, K., Spitzer, R.L., 2002. The PHQ-15: validity of a new measure for evaluating the severity of somatic symptoms. Psychosom. Med. 64 (2), 258-266. https://doi.org/10.1097/00006842-200203000-00008.

Lai, J., Wang, R., Yang, Y., Cai, H., Fu, J., Wei, N., Wu, J., Du, H., Chen, T., Li, R., Tan, H., Kang, L., Yao, L., Huang, M., Wang, H., Wang, G., Liu, Z., Hu, S., 2020. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. JAMA Netw. Open. 3 (3), e203976. https://doi.org/10.1001/jamanetworkopen.2020.3976.

Li, J., Ye, G.M., Chen, L.J., Wang, J.J., Li, Y.R., 2020. Analysis of false-negative results for 2019 novel coronavirus nucleic acid test and related countermeasures. Chin. J. Lab. Med. 34 (6), 221-225. https://doi.org/10.3760/cma.j.issn.1009-9158.2020.06.006. [Epub ahead of print].

Lin, C.Y., Peng, Y.C., Wu, Y.H., Chang, J., Chen, C.H., Yang, D.Y., 2007. The psychological effects of mental health crisis on acute mental patients for emergency department staff. Emerg. Med. J. 24 (1), 12-17. https://doi.org/10.1136/emj.2006.035889.

Luo, M., Guo, L., Yu, M., Wang, H., 2020. The Psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public – A systematic review. Psychiatry Res. 113190. https://doi.org/10.1016/j.psychres.2020.113190. January.

Marjanovic, Z., Greenfield, G.R., Cofrey, S., 2017. The relevance of psychosocial variables and personal characteristics in predicting nurses’ coping strategies during a pandemic: an online questionnaire survey. Int. J. Nurs. Stud. 44 (6), 991-998. https://doi.org/10.1016/j.ijnurstu.2006.02.012.

Nausad, V.A., Bierens, J.J.L.M., Nishan, K.P., Frijters, C.P., Mohammad, O.H., Maliyakkal, A.M., Khalid, S., Schreiber, M.D., 2019. A systematic review of the impact of disaster on the mental health of medical responders. Prehosp. Disast. Med. 34 (6), 632-643. https://doi.org/10.1097/PHM.0000000000001487.

National Health Commission of China. A notice on the issuance of guidelines for emergency psychological crisis intervention in pneumonia for novel coronavirus infections. http://www.nhc.gov.cn/xcs/zwgk/202001/hyfw107340.shtml (Accessed Mar 6, 2020).

O’Connor, C.R., 2011. The integrated motivational-volitional model of suicidal behavior. Crisis 32 (6), 295–298. https://doi.org/10.1027/0227-5910/a000120.

Patients. 2016. Acute Stress Reaction/Stress Advice. patient.info. https://patient.info/medical-health/stress-management/acute-stress-reaction (Accessed Jul 4, 2020).

Qian, J., Ren, Z.Q., Yu, D.H., Kang, L., Yao, L., Huang, M., Wang, H., Wang, G., Liu, Z., Hu, S., 2020. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. JAMA Netw. Open. 3 (3), e203976. https://doi.org/10.1001/jamanetworkopen.2020.3976.

Spitzer, R.L., Kroenke, K., Williams, J.B., 2002. The PHQ-15: validity of a new measure for evaluating the severity of somatic symptoms. Psychosom. Med. 64 (2), 258-266. https://doi.org/10.1097/00006842-200203000-00008.

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Declaration of Competing Interest

The authors declare that there is no conflict of interest.