Mental Health and Psychosocial Problems of Medical Health Workers during the COVID-19 Epidemic in China

Wen-rui Zhang, Kun Wang, and Lu Yin contributed equally to this work.

Abstract
Objective: We explored whether medical health workers had more psychosocial problems than nonmedical health workers during the COVID-19 outbreak. Methods: An online survey was run from February 19 to March 6, 2020; a total of 2,182 Chinese subjects participated. Mental health variables were assessed via the Insomnia Severity Index (ISI), the Symptom Check List-revised (SCL-90-R), and the Patient Health Questionnaire-4 (PHQ-4), which included a 2-item anxiety scale and a 2-item depression scale (PHQ-2). Results: Compared with nonmedical health workers (n = 1,255), medical health workers (n = 927) had a higher prevalence of insomnia (38.4 vs. 30.5%, p < 0.01), anxiety (13.0 vs. 8.5%, p < 0.01), depression (12.2 vs. 9.5%; p < 0.04), somatization (1.6 vs. 0.4%; p < 0.01), and obsessive-compulsive symptoms (5.3 vs. 2.2%; p < 0.01). They also had higher total scores of ISI, GAD-2, PHQ-2, and SCL-90-R obsessive-compulsive symptoms (p < 0.01). Among medical health workers, having organic disease was an independent factor for insomnia, anxiety, depression, somatization, and obsessive-compulsive symptoms (p < 0.05 or 0.01). Among nonmedical health workers, having organic disease was an independent factor for insomnia, anxiety, obsessive-compulsive symptoms, and depression (p < 0.01 or 0.05). Living in rural areas, being female, and being at risk of contact with COVID-19 patients were the most common risk factors for insomnia, anxiety, obsessive-compulsive symptoms, and depression (p < 0.01 or 0.05). Among nonmedical health workers, having organic disease was a risk factor for insomnia, depression, and obses-
The coronavirus disease 2019 (COVID-19) outbreak is a pandemic [1] in which a coronavirus has been identified as the cause of an outbreak of respiratory illness. It was first detected in Wuhan, China [2], but COVID-19 is becoming an increasing public event being a rapid epidemic [3, 4]. According to the official website of the World Health Organization [5], as of March 7, 2020, more than 100,000 people have been confirmed to have a COVID-19 infection globally. Many accomplishments on COVID-19, including virus information, clinical features, and diagnosis have been achieved, but no effective treatment is available yet [2, 6–8].

Medical health workers are first-line fighters treating patients with COVID-19. Every day, they face a high risk of being infected and are exposed to long and distressing work shifts to meet health requirements. In brief, they are exposed to a protracted source of distress which may exceed their individual coping skills, being, according to a clinimetric definition [9], in allostatic load, which is likely to result in overload with protracted time [9].

Despite messages mentioning that medical health workers’ mental health should be emphasized during the campaign against COVID-19 [10–12], no research on mental health problems in medical health workers after the maximum point of the COVID-19 epidemic in China has been reported.

Since Chinese medical health workers have been exposed to a persistent source of distress, the aim of the present research was to outline its psychological manifestations. For this purpose, the prevalence and potential factors contributing to insomnia, anxiety, depression, obsessive-compulsive symptoms, somatization symptoms, and phobic anxiety were detected.

Materials and Methods

**Design, Participants, and Procedure**

This is a cross-sectional study performed via an online survey run from February 19 to March 6, 2020. The study was performed 8 weeks after the COVID-19 epidemic outbreak in Wuhan [2]. This survey period corresponded to the reducing stage after the maximum point of the COVID-19 epidemic outbreak in China [13], i.e., the highest vulnerability period after the great distress.

Persons in the nation with at least 16 years of age were welcome to join in the online survey via the Wenjuanxing platform (https://www.wjx.cn/m/58475441.aspx).

The online survey included questions on sociodemographic and clinical variables. A simple math question (i.e., 21–7 = ?) was added at the end for ensuring the quality and completeness of the questionnaire. Thus, participants who had not completed the survey received from the online platform a warning on unanswered questions when they did the math question. The online platform did not give warnings to those who gave up. As a result, participants were those who completed all questions of the online survey.

**Measurements**

Demographic data, i.e., sex, age, occupation (medical health workers, i.e., medical doctors and nurses, and nonmedical health workers, excluding nonmedical personnel working in hospitals/medical institutions), marital status (i.e., married, unmarried, divorced, and widowed), living area (i.e., urban and rural), living with families (yes or no), education status (≤9 years, i.e., junior high school and lower, >9 years, i.e., senior high school and higher) were collected via ad hoc questions as well as the information of a risk of contact with COVID-19 patients in hospitals. Participants were also asked whether they have had insomnia or psychiatric disorders prior to COVID-19 (those who replied positively were automatically excluded by the platform) and whether they were having organic diseases (the question was “Do you currently have any organic disease? [diagnosed by medical examination in the hospital?”). In addition, insomnia, anxiety, depression, somatization, obsessive-compulsive symptoms, and phobic anxiety were assessed.

Insomnia was assessed via the Insomnia Severity Index (ISI), a 7-item self-report index assessing the severity of initial, middle, and late insomnia [14]. An ISI total score ≥ 8 indicates that insomnia is present [15]. The item “Since the outbreak, how long (in minutes) did you usually take to fall asleep each night?” was added to assess the degree of sleep onset latency in medical health workers. This item was rated as 0, 1, 2, and 3 (i.e., ≤15, 16–30, 31–60, and >60 min, respectively).

Anxious and depressive symptoms were assessed via the Patient Health Questionnaire-4 (PHQ-4) [16], which is an ultra-brief self-report questionnaire with a 2-item anxiety scale, named Generalized Anxiety Disorder 2-item (GAD-2), and a 2-item depression scale, named Patient Health Questionnaire 2-item (PHQ-2). In screening of depression and anxiety, a cutoff ≥3 in GAD-2 and PHQ-2 is recommended [16].

Somatic symptoms, obsessive-compulsive symptoms, and phobic anxiety were measured via the Symptom Check List-90-revised (SCL-90-R) [17, 18], a 90-item self-report scale with items rated on a 5-point Likert scale (from 0 “not at all” to 4 “extremely”). Subscale scores ≥2 indicate potential psychological issues [19].

The Chinese versions of ISI [20], PHQ-2 [21], GAD-2 [22], and SCL-90-R [18] were used; they were validated and showed excellent psychometric properties.

**Statistical Analyses**

χ² tests were used to compare group differences of categorical variables. Mann-Whitney tests were used to compare independent groups on continuous variables nonnormally distributed.
Table 1. Sociodemographic characteristics in medical health workers versus nonmedical health workers

| Characteristics                                      | Total (n = 2,182) | Medical health workers (n = 927) | Nonmedical health workers (n = 1,255) | p value | χ² test |
|------------------------------------------------------|-------------------|---------------------------------|---------------------------------------|---------|---------|
| Sex, % (n)                                           |                   |                                 |                                       | <0.01   |         |
| Male                                                 | 35.8 (781)        | 26.9 (249)                      | 42.4 (532)                            |         |         |
| Female                                               | 64.2 (1,401)      | 73.1 (678)                      | 57.6 (723)                            |         |         |
| Age, % (n)                                           |                   |                                 |                                       | <0.01   |         |
| <18 years                                            | 0.5 (11)          | 0.2 (2)                         | 0.7 (9)                               |         |         |
| 18–60 years                                          | 96.3 (2,101)      | 98.4 (912)                      | 94.7 (1,189)                          |         |         |
| >60 years                                            | 3.2 (70)          | 1.4 (13)                        | 4.5 (57)                              |         |         |
| Marital status, % (n)                               |                   |                                 |                                       | 0.70    |         |
| Single                                               | 18.0 (392)        | 18.3 (170)                      | 17.7 (222)                            |         |         |
| Married                                              | 82.0 (1,790)      | 81.7 (757)                      | 82.3 (1,033)                          |         |         |
| Living areas, % (n)                                 |                   |                                 |                                       | <0.01   |         |
| Urban                                                | 84.8 (1,851)      | 89.2 (827)                      | 81.6 (1,024)                          |         |         |
| Rural                                                | 15.2 (331)        | 10.8 (100)                      | 18.4 (231)                            |         |         |
| Living with families, % (n)                          |                   |                                 |                                       | <0.01   |         |
| No                                                   | 12.0 (262)        | 16.4 (152)                      | 8.8 (110)                             |         |         |
| Yes                                                  | 88.0 (1,920)      | 83.6 (775)                      | 91.2 (1,145)                          |         |         |
| Education, % (n)                                     |                   |                                 |                                       | <0.01   |         |
| ≤9 years                                             | 5.5 (120)         | 0.3 (3)                         | 9.3 (117)                             |         |         |
| >9 years                                             | 94.5 (2,062)      | 99.7 (924)                      | 90.7 (1,138)                          |         |         |
| Risk of contact with COVID-19 patients in hospitals, % (n) | – | 85.1 (789) | – | – |
| Having organic diseases, % (n)                       |                   |                                 |                                       | 0.78    |         |
| No                                                   | 89.0 (1,942)      | 88.8 (823)                      | 89.2 (1,119)                          |         |         |
| Yes                                                  | 11.0 (240)        | 11.2 (104)                      | 10.8 (136)                            |         |         |
| Insomnia Severity Index (ISI), % (n)                 |                   |                                 |                                       | <0.01   |         |
| No clinically significant insomnia (total ISI score: 0–7) | 66.1 (1,443)     | 61.6 (571)                      | 69.5 (872)                            |         |         |
| Subthreshold insomnia (total ISI score: 8–14)        | 24.3 (531)        | 27.8 (258)                      | 21.8 (273)                            |         |         |
| Moderate insomnia (total ISI score: 15–21)           | 8.1 (177)         | 8.8 (82)                        | 7.6 (95)                              |         |         |
| Severe insomnia (total ISI score: 22–28)             | 1.4 (31)          | 1.7 (16)                        | 1.2 (15)                              |         |         |
| Insomnia, % (n)                                      |                   |                                 |                                       | <0.01   |         |
| No                                                   | 66.1 (1,443)      | 61.6 (571)                      | 69.5 (872)                            |         |         |
| Yes                                                  | 33.9 (739)        | 38.4 (356)                      | 30.5 (383)                            |         |         |
| Anxiety, % (n)                                       |                   |                                 |                                       | <0.01   |         |
| No                                                   | 89.6 (1,954)      | 87.0 (806)                      | 91.5 (1,148)                          |         |         |
| Yes                                                  | 10.4 (228)        | 13.0 (121)                      | 8.5 (107)                             |         |         |
| Depression, % (n)                                    |                   |                                 |                                       | 0.04    |         |
| No                                                   | 89.4 (1,950)      | 87.8 (814)                      | 90.5 (1,136)                          |         |         |
| Yes                                                  | 10.6 (232)        | 12.2 (113)                      | 9.5 (119)                             |         |         |
| Somatization symptoms, % (n)                         |                   |                                 |                                       | <0.01   |         |
| No                                                   | 99.1 (2,162)      | 98.4 (912)                      | 99.6 (1,250)                          |         |         |
| Yes                                                  | 0.9 (20)          | 1.6 (15)                        | 0.4 (5)                               |         |         |
| Obsessive-compulsive symptoms, % (n)                 |                   |                                 |                                       | <0.01   |         |
| No                                                   | 96.5 (2,105)      | 94.7 (878)                      | 97.8 (1,227)                          |         |         |
| Yes                                                  | 3.5 (77)          | 5.3 (49)                        | 2.2 (28)                              |         |         |
| Phobic anxiety, % (n)                                |                   |                                 |                                       | 0.11    |         |
| No                                                   | 97.1 (2,119)      | 96.4 (894)                      | 97.6 (1,225)                          |         |         |
| Yes                                                  | 2.9 (63)          | 3.6 (33)                        | 2.4 (30)                              |         |         |

COVID-19, the coronavirus disease 2019.
Multivariate logistic regression analyses were performed using stepwise variable selection, and all variables were entered into the model to explore independent influence for different risk dimensions, such as insomnia, anxiety, depression, somatization, obsessive-compulsive symptoms, and phobic anxiety. Subgroup analyses were performed for medical and nonmedical health workers. All hypotheses were tested at a significance level of 0.05. Data analyses were run via SAS statistical software, version 9.4 (SAS Institute Inc.).

Results

Nationwide, a total of 2,182 participants from China (see online supplement 1; for all online suppl. material, see www.karger.com/doi/10.1159/000507639) completed the survey.

Table 1 presents sociodemographic features of the whole sample and compared 927 medical health workers (680 medical doctors and 247 nurses) to 1,255 nonmedical health workers. Medical health workers showed higher prevalence rates of insomnia (38.4% vs. 30.5%, p < 0.01), anxiety (13.0% vs. 8.5%, p < 0.01), depression (12.2% vs. 9.5%, p = 0.04), somatization (1.6% vs. 0.4%, p < 0.01), and obsessive-compulsive symptoms (5.3% vs. 2.2%, p < 0.01) than nonmedical health workers. Medical health workers also had higher total scores of ISI (p < 0.01), GAD-2 (p < 0.01), PHQ-2 (p = 0.01), and on the SCL-90-R obsessive-compulsive symptom scale (p < 0.01) than nonmedical health workers. Each item of ISI (p < 0.01 or p < 0.05), GAD-2 (p < 0.01), and PHQ-2 (p = 0.01) was significantly elevated in medical health workers compared with nonmedical health workers. On the SCL-90-R obsessive-compulsive symptom scale, 6 of the 10 items had higher scores in medical health workers than in nonmedical health workers. In the SCL-90-R somatization symptoms scale, 3 of 12 items, including questions 1 (headaches) (p = 0.01), 4 (faintness or dizziness) (p < 0.01), and 48 (trouble getting your breath) (p < 0.01), had higher scores in medical health workers than in nonmedical health workers. No difference on phobic anxiety between both groups was found (Table 2).

The multivariate logistic regression analyses (Table 3) showed that living in rural areas (odds ratio [OR], 2.18, 95% confidence interval [CI], 1.42–3.53; p < 0.01), being at risk of contact with COVID-19 patients in hospitals (OR, 2.53; 95% CI, 1.74–3.68; p < 0.01), and having organic diseases (OR, 5.49; 95% CI, 2.20–5.22; p < 0.01) were risk factors for insomnia among medical health workers, while only having organic diseases (OR, 2.23; 95% CI, 1.55–3.20; p < 0.01) was a risk factor for the nonmedical health workers.

Four variables were independently associated with anxiety risk among medical health workers: being female (OR, 1.80, 95% CI, 1.10–2.95; p = 0.02), living in rural areas (OR, 1.88; 95% CI, 1.09–3.21; p = 0.02), being at risk of contact with COVID-19 patients in hospitals (OR, 2.06; 95% CI, 1.28–3.32; p < 0.01), and having organic diseases (OR, 2.85; 95% CI, 1.73–4.68; p < 0.01).

In depression models, being female (OR, 1.85, 95% CI, 1.11–3.08; p = 0.02) and having organic diseases (OR, 2.51; 95% CI, 1.51–4.18; p < 0.01) were selected as independent factors among medical health workers, while having organic diseases (OR, 1.90; 95% CI, 1.13–3.20; p < 0.01) and living with families (OR, 0.36; 95% CI, 0.21–0.59; p < 0.01) were predictors for depression among nonmedical health workers.

For obsessive-compulsive symptoms, medical health workers had 3 risk factors: living in rural areas (OR, 2.49; 95% CI, 1.21–5.11; p = 0.01), being at risk of contact with COVID-19 patients in hospitals (OR, 3.27; 95% CI, 1.75–6.11; p < 0.01), and having organic diseases (OR, 2.24; 95% CI, 1.07–4.71; p = 0.03). On the other hand, nonmedical health workers had organic diseases (OR, 2.84; 95% CI, 1.18–6.80; p = 0.02) as only risk factor.

Regarding somatization symptoms, medical health workers had 2 risk factors: living in rural areas (OR, 4.78; 95% CI, 1.55–14.76; p = 0.01) and having organic diseases (OR, 7.89; 95% CI, 2.75–22.62; p < 0.01). No risk factors were found for nonmedical health workers.

Discussion

Medical health workers during the COVID-19 epidemic had high prevalence rates of severe insomnia, anxiety, depression, somatization, and obsessive-compulsive symptoms. They also had risk factors for developing insomnia, anxiety, depression, obsessive-compulsive symptoms, and somatization. Thus, the presence of these symptoms in addition to the life status of daily fighting against COVID-19 suggests that they must cope with psychological distress and are at risk of allostatic overload [9]. Indeed, according to clinimetric criteria, allostatic overload can be diagnosed in the presence of a current identifiable source of distress in the form of recent life events and/or chronic stress; the stressor is judged to tax or exceed the individual coping skills when its full nature and full circumstances are evaluated. In addition, the stressor is associated with difficulty in falling asleep, restless sleep, early morning awakening, lack of energy, dizziness, generalized anxiety, irritability, sadness, demoralization; significant impairment in...
Table 2. Psychological manifestations of medical health workers versus nonmedical health workers

| Characteristics                                                                 | Total               | Medical health workers | Nonmedical health workers | p value |
|--------------------------------------------------------------------------------|---------------------|------------------------|---------------------------|---------|
| Sleep onset latency (score)                                                     | 1.27±1.01           | 1.33±1.00              | 1.22±1.01                 | <0.01   |
| **Insomnia Severity Index (ISI) total score**                                  |                     |                        |                           |         |
| Item 1: Falling asleep                                                         | 0.91±0.97           | 0.96±0.95              | 0.87±0.98                 | 0.01    |
| Item 2: Staying asleep                                                         | 0.74±0.89           | 0.86±0.90              | 0.65±0.87                 | <0.01   |
| Item 3: Early awakening                                                        | 0.59±0.85           | 0.66±0.88              | 0.55±0.83                 | <0.01   |
| Item 4: Satisfaction                                                           | 1.47±1.02           | 1.57±1.02              | 1.40±1.00                 | <0.01   |
| Item 5: Interference                                                          | 0.74±0.94           | 0.82±0.97              | 0.67±0.91                 | <0.01   |
| Item 6: Noticeable                                                            | 0.93±1.01           | 0.98±1.00              | 0.90±1.01                 | 0.02    |
| Item 7: Worried                                                               | 0.79±0.96           | 0.86±0.98              | 0.74±0.94                 | <0.01   |
| **Total GAD-2 score (items 1, 2 of PHQ-4)**                                    | 1.36±1.25           | 1.51±1.28              | 1.25±1.23                 | <0.01   |
| Item 1: Feeling nervous/anxious/on edge                                        | 0.83±0.70           | 0.91±0.70              | 0.76±0.70                 | <0.01   |
| Item 2: Not being able to stop worrying                                        | 0.53±0.66           | 0.59±0.69              | 0.48±0.63                 | <0.01   |
| **Total PHQ-2 score (items 3, 4 of PHQ-4)**                                    | 1.25±1.32           | 1.35±1.37              | 1.18±1.28                 | 0.01    |
| Item 3: Feeling down/depressed/hopeless                                        | 0.64±0.73           | 0.69±0.75              | 0.60±0.72                 | 0.01    |
| Item 4: Little interest in doing things                                        | 0.61±0.70           | 0.66±0.72              | 0.58±0.68                 | 0.01    |
| **Total somatization symptoms score**                                          | 3.22±4.88           | 3.46±5.39              | 3.04±4.46                 | 0.70    |
| Question 1: Headaches                                                          | 0.44±0.74           | 0.51±0.82              | 0.40±0.67                 | 0.01    |
| Question 4: Faintness or dizziness                                             | 0.21±0.52           | 0.26±0.59              | 0.18±0.46                 | <0.01   |
| Question 12: Pain in the heart or chest                                        | 0.20±0.53           | 0.22±0.56              | 0.19±0.50                 | 0.35    |
| Question 27: Pain in the lower back                                            | 0.48±0.80           | 0.50±0.83              | 0.46±0.78                 | 0.64    |
| Question 40: Nausea or upset stomach                                           | 0.24±0.54           | 0.25±0.58              | 0.23±0.52                 | 0.62    |
| Question 42: Soreness of your muscles                                          | 0.41±0.71           | 0.41±0.73              | 0.41±0.70                 | 0.64    |
| Question 48: Trouble getting your breath                                       | 0.17±0.46           | 0.20±0.50              | 0.14±0.42                 | <0.01   |
| Question 49: Hot or cold spells                                                | 0.19±0.47           | 0.21±0.51              | 0.17±0.44                 | 0.05    |
| Question 52: Numbness/tingling in body                                          | 0.17±0.47           | 0.15±0.45              | 0.17±0.48                 | 0.32    |
| Question 53: A lump in your throat                                             | 0.23±0.54           | 0.25±0.57              | 0.21±0.52                 | 0.14    |
| Question 56: Feeling weak in your body                                          | 0.28±0.58           | 0.29±0.61              | 0.27±0.57                 | 0.91    |
| Question 58: Heavy feelings in arms/legs                                        | 0.21±0.53           | 0.21±0.55              | 0.21±0.52                 | 0.87    |
| **Total obsessive-compulsive symptom score**                                   | 5.43±5.99           | 6.02±6.55              | 4.99±5.50                 | <0.01   |
| Question 3: Unwanted thoughts/words                                            | 0.57±0.77           | 0.58±0.80              | 0.56±0.75                 | 0.81    |
| Question 9: Trouble remembering things                                        | 0.56±0.81           | 0.58±0.83              | 0.54±0.79                 | 0.28    |
| Question 10: Worried about sloppiness                                          | 0.29±0.60           | 0.37±0.68              | 0.24±0.52                 | <0.01   |
| Question 28: Feeling blocked                                                   | 0.52±0.82           | 0.56±0.85              | 0.50±0.80                 | 0.20    |
| Question 38: Having to do very slowly                                          | 0.47±0.76           | 0.54±0.79              | 0.43±0.72                 | <0.01   |
| Question 45: Check and double-check                                            | 0.55±0.82           | 0.67±0.90              | 0.47±0.74                 | <0.01   |
| Question 46: Difficulty making decisions                                       | 0.41±0.72           | 0.47±0.77              | 0.36±0.67                 | <0.01   |
| Question 51: Your mind going blank                                            | 0.48±0.84           | 0.50±0.85              | 0.47±0.83                 | 0.45    |
| Question 55: Trouble concentrating                                            | 0.49±0.82           | 0.54±0.85              | 0.46±0.80                 | 0.02    |
| Question 65: Having to repeat                                                   | 1.07±1.07           | 1.22±1.13              | 0.96±1.00                 | <0.01   |
| **Total phobic anxiety score**                                                  | 3.72±4.05           | 3.78±4.18              | 3.68±3.96                 | 0.87    |
| Question 13: Afraid in open space                                              | 0.16±0.46           | 0.17±0.46              | 0.16±0.46                 | 0.63    |
| Question 25: Afraid to go out alone                                            | 0.17±0.50           | 0.15±0.46              | 0.17±0.52                 | 0.68    |
| Question 47: Afraid to travel                                                  | 0.99±1.15           | 0.99±1.14              | 0.99±1.15                 | 0.99    |
| Question 50: Having to avoid the certain                                       | 0.97±1.06           | 0.94±1.05              | 0.98±1.07                 | 0.47    |
| Question 70: Feeling uneasy in crowds                                           | 1.05±1.19           | 1.07±1.18              | 1.03±1.21                 | 0.16    |
| Question 75: Nervous when left alone                                           | 0.22±0.57           | 0.25±0.63              | 0.19±0.51                 | 0.05    |
| Question 82: Afraid to faint in public                                          | 0.17±0.56           | 0.20±0.62              | 0.15±0.51                 | 0.13    |

GAD-2, Generalized Anxiety Disorder 2-item; PHQ-4, Patient Health Questionnaire-4; PHQ-2, Patient Health Questionnaire 2 items. Mann-Whitney test for independent samples.
| Variables | OR (95% CI) | p value |
|-----------|-------------|---------|

**Models for insomnia**

| MHWs | Risk of contact with COVID-19 patients in hospitals (yes vs. no) | OR (95% CI) | p value |
|------|-----------------------------------------------------------------|-------------|---------|
|      | Having organic diseases (yes vs. no)                           | 3.93 (2.20, 5.22) | <0.01 |

| NMHWs | Having organic diseases (yes vs. no)                           | 2.23 (1.55, 3.20) | <0.01 |

| Total population | Having organic diseases (yes vs. no)                           | 2.69 (2.05, 3.55) | <0.01 |

**Models for anxiety**

| MHWs | Sex (female vs. male) | OR (95% CI) | p value |
|------|-----------------------|-------------|---------|
|      | Living areas (rural vs. urban) | 1.88 (1.09, 3.21) | 0.02 |

| NMHWs | No variables were entered | – | – |

| Total population | Sex (female vs. male) | 1.69 (1.24, 2.32) | <0.01 |

| Marital status (married vs. single) | 1.56 (1.03, 2.35) | 0.04 |

| Risk of contact with COVID-19 patients in hospitals (yes vs. no) | 2.47 (1.59, 3.83) | 0.05 |

| Having organic diseases (yes vs. no) | 2.09 (1.45, 3.00) | <0.01 |

**Models for depression**

| MHWs | Sex (female vs. male) | OR (95% CI) | p value |
|------|-----------------------|-------------|---------|
|      | Having organic diseases (yes vs. no) | 2.51 (1.51, 4.18) | <0.01 |

| NMHWs | Living with families (yes vs. no) | 0.36 (0.21, 0.59) | <0.01 |

| Having organic diseases (yes vs. no) | 1.90 (1.13, 3.20) | 0.02 |

| Total population | Living areas (rural vs. urban) | 1.46 (1.03, 2.07) | 0.04 |

| Living with families (yes vs. no) | 0.52 (0.36, 0.74) | <0.01 |

| Having organic diseases (yes vs. no) | 2.17 (1.51, 3.12) | <0.01 |

**Models for somatization symptoms**

| MHWs | Living areas (rural vs. urban) | OR (95% CI) | p value |
|------|---------------------------------|-------------|---------|
|      | Having organic diseases (yes vs. no) | 4.78 (1.55, 14.76) | <0.01 |

| NMHWs | No variables were entered | – | – |

| Total population | Living areas (rural vs. urban) | 3.30 (1.22, 8.93) | 0.02 |

| Occupation (MHWs vs. NMHWs) | 4.70 (1.67, 13.22) | <0.01 |

| Having organic diseases (yes vs. no) | 7.14 (2.90, 17.60) | <0.01 |
social or occupational functioning; and feeling overwhelmed by the demands of everyday life [9].

The reasons for the psychological distress to which medical health workers were exposed might be related to the many difficulties of being safe at work, such as the initially insufficient understanding of the virus, the lack of prevention and control knowledge, the long-term workload, the high risk of exposure to patients with COVID-19, the shortage of medical protective equipment [13, 23], the lack of getting rest [24], and the exposure to critical life events [25], such as death. Exemplifications of such a distress are: (1) 16 of the 100 nurses at the Pohang Medical Center in North Gyeongsang Province resigned due to overwork among the COVID-19 epidemic [26]; (2) > 3,000 medical health workers in (Wuhan) Hubei Province were infected with COVID-19 at a very early stage (before and in January of 2020). Later, with continuously updated guidelines on how to handle the patients with COVID-19 [27], with rest in shifts for medical staff, with rapid supply of medical protective items (including masks, glasses, and suits), and with training on the Novel Coronavirus Infection Pneumonia Diagnosis and Treatment Plan for all medical staff [24], no doctors have been infected with COVID-19 among about 40,000 medical personnel from the nation supporting Hubei medical services [24]; and (3) as of the 20th March, 5 medical health workers in one hospital of Wuhan died due to being infected with COVID-19 [28].

Our report found potential risk factors for medical health workers to develop insomnia, anxiety, depression, obsessive-compulsive symptoms, and somatization. Undoubtedly, these risk factors might endure allostatic overload and favor the development of psychopathology, including chronic insomnia [29]. Independent factors (i.e., currently having organic disease, living in rural areas, being at risk of contact with COVID-19 patients in hospitals, or being female) were common risk factors for insomnia, anxiety, depression, and obsessive-compulsive symptoms among medical health workers. When faced with the same COVID-19 during the fight against the epidemic, medical health workers in rural areas might worry about being infected due to a different working place involving different medical skills and medical conditions. In contrast, the medical conditions in urban areas were often much better. Thus, different directions on caring for the medical health workers might be possible.

Adequate working conditions and recovery programs, i.e., programs favoring activities required to ensure the best physical, mental, and social conditions so that medical workers may progress towards an optimal state of health [30], seem necessary. This may support medical staff in adapting to the working environment quickly and
maintain a better mental and health balance to be able to
work. Lowering job demands and workload [31], while
increasing job control and reward might help to protect
medical health workers. Individual interventions ade-
quate for medical staff in the current situation, where they
wear medical protective equipment which cannot be re-
moved during work time, are still unknown. Story shar-
ing [32] would be important as well as reinforcing the
positive assets of persons [33]. Simple, easy, practical
methods are needed. Electronic devices, such as mobile
phones and computers, may help.

The present study has limitations. First, a cross-sec-
tional design was applied although a longitudinal ap-
proach might help verifying whether allostatic overload
develops (exhaustion may ensue after some time) and
whether psychiatric disorders, especially posttraumatic
stress disorder, might occur with the COVID-19 progres-
sion. Second, psychological assessment was based on an
online survey and on self-report tools. The use of clinical
interviews is encouraged in future studies to draw a more
comprehensive assessment of the problem. Third, it is not
possible to assess the participation rate since it is unclear
how many subjects received the link for the survey.

In conclusion, a higher prevalence of psychological
symptoms was found among medical health workers dur-
ing COVID-19 as well as risk factors for them. Medical
health workers are in need of health protection and ade-
quate working conditions, e.g., provision of necessary and
sufficient medical protective equipment, arrangement of
adequate rest, as well as recovery programs aimed at em-
powering resilience and psychological well-being [34].

Acknowledgment

The authors would like to thank all participants for their time
and excellent cooperation.

Statement of Ethics

All participants provided their online informed consent. The
study was approved by the local ethics committee on human re-
search.

Disclosure Statement

The authors declare that they have no conflicts of interests.

Funding Sources

H.W. was supported by grants from the National Natural Sci-
ence Foundation of China (81771862), National Key R&D Pro-
gram of China (2017YFC1310001, 2016YFC1307000), Beijing
Municipal Science and Technology Project (Z171100000117016),
Beijing Natural Science Foundation (KZ201710025017), Beijing
Municipal Hospital Research and Development Plan (PX2017069),
and Beijing Hundred, Thousand, and Ten Thousand Talents Pro-
ject (2017-CXYF-09). Y.W. was supported by the Beijing Key Clinical
Specialty Excellence Project. The funding organizations had
no role in the design and conduct of the study; collection, manage-
ment, analysis, and interpretation of the data; preparation, review,
or approval of the manuscript; and decision to submit the manu-
script for publication.

Author Contributions

H.W.: conception and design; W.Z., K.W., L.Y., W.Z., Q.X.,
Y.Y., M.P., B.M., Q.T., H.L., J.D., H.C., W.L., F.S., T.Y., H.D., Y.H.,
Y.W., and H.W.: conduct; H.W. and L.Y.: statistical analysis;
W.Z., K.W., W.Z., Q.X., and W.L.: administrative, technical, or
material support; H.W.: drafting of the manuscript; and F.C. and
H.W.: critical revision of the manuscript for important intellec-
tual content. All authors read and approved the final paper.

References

1 World Health Organization [Internet]. Ge-
neva: WHO characterizes COVID-19 as a
pandemic [cited 2020 March 11]. Available
from: https://www.who.int/emergencies/
diseases/novel-coronavirus-2019/events-as-
they-happen.
2 Li Q, Guan X, Wu P, Wang X, Zhou L, Tong
Y, et al. Early transmission dynamics in Wu-
han, China, of novel coronavirus-infected
pneumonia. N Engl J Med. 2020 Mar;382(13):
1199–207.
3 Lancet. COVID-19: too little, too late? Lan-
cet. 2020 March;395(10226):755.
4 Day M. Covid-19: surge in cases in Italy and
South Korea makes pandemic look more like-
ly. BMJ. 2020 Feb;368:m751.
5 World Health Organization [Internet]. Ge-
neva: WHO statement on cases of COVID-19
surpassing 100 000 [cited 2020 March 7].
Available from: https://www.who.int/news-
room/detail/07-03-2020-who-statement-on-
cases-of-covid-19-surpassing-100-00.
6 Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ,
He JX, et al.; China Medical Treatment Expert
Group for Covid-19. Clinical characteristics
of coronavirus disease 2019 in China. N Engl
J Med. 2020. DOI: 10.1056/NEJMoa2002032.
7 Zhou P, Yang XL, Wang XG, Hu B, Zhang
L, Zhang W, et al. A pneumonia outbreak
associated with a new coronavirus of prob-
able bat origin. Nature. 2020 Mar;579(7798):
270–3.
8 Wang M, Cao R, Zhang L, Yang X, Liu J, Xu
M, et al. Remdesivir and chloroquine effec-
tively inhibit the recently emerged novel
coronavirus (2019-nCoV) in vitro. Cell Res.
2020 Mar;30(3):269–71.
9 Fava GA, McEwen BS, Guidi J, Gostoli S, Of-
fidani E, Sonino N. Clinical characterization
of allostatic overload. Psychoneuroendocri-
nology. 2019 Oct;108:94–101.
10 Bao Y, Sun Y, Meng S, Shi J, Lu L. 2019-nCoV epidemic: address mental health care to empower society. Lancet. 2020 Feb;395(10224):37–8.
11 Kang L, Li Y, Hu S, Chen M, Yang C, Yang RX, et al. The mental health of medical workers in Wuhan, China dealing with the 2019 novel coronavirus. Lancet Psychiatry. 2020 Mar;7(3):e14.
12 Liu S, Yang L, Zhang C, Xiang YT, Liu Z, Hu S, et al. Online mental health services in China during the COVID-19 outbreak. Lancet Psychiatry. 2020 Apr;7(4):e17–8.
13 Guangming Online [Internet]. Beijing: Central Steering Group: Over 3,000 medical staff in Hubei were infected in the early stage of the epidemic, currently no infection reports among medical aid staff [cited 2020 March 6]. Available from: https://news.gmw.cn/20200306/content_33626862.htm. Chinese.
14 Morin CM, Belleville G, Belanger L, Ivers H. The Insomnia Severity Index: psychometric indicators to detect insomnia cases and evaluate treatment response. Sleep (Basel). 2011 May;34(5):601–8.
15 Wong SY, Zhang DX, Li CC, Yip BH, Chan DC, Ling YM, et al. Comparing the effects of mindfulness-based cognitive therapy and sleep psycho-education with exercise on chronic insomnia: a randomised controlled trial. Psychother Psychosom. 2017;86(4):241–53.
16 Löwe B, Wahl I, Rose M, Spitzer C, Gaasen H, Wingenfeld K, et al. A 4-item measure of depression and anxiety: validation and standardization of the Patient Health Questionnaire–4 (PHQ-4) in the general population. J Affect Disord. 2010 Apr;122(1-2):86–95.
17 Wang ZY. Symptom Check List (SCL-90). Shanghai Jingshen Yixue. 1984;2(2):68–70. Chinese.
18 Chen S, Li L. Re-testing reliability, validity, and norm applicability of SCL-90. Chin J Nerv Ment Dis. 2003;29(5):323–7. Chinese.
19 Chen X, Li P, Wang F, Ji G, Miao L, You S. Psychological results of 438 patients with persisting gastroesophageal reflux disease symptoms by Symptom Checklist 90-Revised Questionnaire. European J Hepatogastroenterol. 2017 Jul-Dec;7(2):117–21.
20 Zhang B, Zhang L, Chen S, Luo X, Dhirendra P, Lin Q, et al. The effect of e-aid cognitive behavioral therapy in treating chronic insomnia disorder: an open-label randomized controlled trial. Zhonghua Jing Shen Ke Za Zhi. 2019 Dec;52(6):373–8. Chinese.
21 Wang L, Lu K, Li J, Sheng L, Ding R, Hu D. Value of patient health questionnaires (PHQ)-9 and PHQ-2 for screening depression disorders in cardiovascular outpatients. Zhonghua Xin Xue Guan Bing Za Zhi. 2015 May;43(5):428–431. Chinese.
22 Wang L, Lu K, Wang C, Sheng L, Hu D, Ding R. Reliability and validity of GAD-2 and GAD-7 for anxiety screening in cardiovascular disease clinic. Sichuan Mental Health. 2014;27(3):198–201. Chinese.
23 World Health Organization [Internet]. Geneva: Shortage of personal protective equipment endangering health workers worldwide [cited 2020 March 3]. Available from: https://www.who.int/news-room/detail/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide.
24 SINAnews [Internet]. Beijing: In January, Hubei had more than 3,000 medical infections, and the Wuhan Health and Medical Committee reported "None" for half a month [cited 2020 March 6]. Available from: https://news.sina.com.cn/o/2020-03-06/doc-iimxysprz8395569.shtml. Chinese.
25 Theorell T. Evaluating life events and chronic stressors in relation to health: stressors and health in clinical work. Adv Psychosom Med. 2012;32:58–71.
26 The Telegraph [Internet]. London: Coronavirus: Doctors collapse from exhaustion as virus spreads through South Korea [cited 2020 March 4]. Available from: http://www.chinanews.com/gn/20200320/37949631.html. Chinese.
27 Chinanews [Internet]. Beijing: Two departments issue the novel coronavirus infection pneumonia diagnosis and treatment plan. (trial version 7) [cited 2020 March 4]. Available from: http://www.chinanews.com/gn/20200304/9113100.shtml. Chinese.
28 China.com. [Internet]. Beijing: Liu Li, Wuhan Central Hospital, infected with COVID-19, died, totally five died in the hospital. 2020 [cited 2020 March 20]. Available from: https://news.china.com/socialld/10000169/20200320/37949631.html. Chinese.
29 Wang HX, Wang L, Zhang WR, Xue Q, Peng M, Sun ZC, et al. Effect of transcranial alternating current stimulation for the treatment of chronic insomnia: a randomized, double-blind, parallel-group, placebo-controlled clinical trial. Psychother Psychosom. 2020;89(1):38–47.
30 Sonino N, Fava GA. Rehabilitation in endocrine patients: a novel psychosomatic approach. Psychother Psychosom. 2007;76(6):319–24.
31 Aronsson G, Theorell T, Grape T, Hammarström A, Hogstedt C, Marteinsdottir I, et al. A systematic review including meta-analysis of work environment and burnout symptoms. BMC Public Health. 2017 Mar;17(1):264.
32 Cummings J. Sharing a traumatic event: the experience of the listener and the storyteller within the dyad. Nurs Res. 2011 Nov-Dec;60(6):386–92.
33 Fava GA. Well-Being Therapy: Treatment Manual and Clinical applications. Basel: Kager; 2016. https://doi.org/10.1159/isbn.978-3-318-05822-2.
34 Fava GA, Cosci F, Sonino N. Current psychosomatic practice. Psychother Psychosom. 2017;86(1):13–30.