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Coronavirus Pandemic

Clinical characteristics, depression, anxiety, and stress of medical workers during the COVID-19 pandemic: a cross-sectional survey

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Abstract

Introduction: Coronavirus disease 2019 (COVID-19) has an extremely high infection rate. This study aimed to investigate emotional states and COVID-19 infection of medical workers during the self-management strategy to COVID-19.

Methodology: Questionnaires were collected via an online questionnaire platform from 20 December 2022 to 19 January 2023, including demographic characteristics, number of vaccine doses, COVID-19 test results, occupation, attendant situations of workers, clinical symptoms, disease duration, and the Depression, Anxiety and Stress Scale 21.

Results: A total of 748 complete questionnaires were collected. The average age of participants was 33.61 ± 8.94 years, and 79.55% participants were female. The proportion of anxiety was significantly higher in the infection group (52.32%) than in the non-infection group (28.45%) ($p < 0.001$), as was the proportion of stress (41.47% vs. 31.90%, $p = 0.046$). Medical students (odds ratios (OR) 0.54, 95% confidence interval (CI) 0.31–0.93) and other staff (OR 0.63, 95% CI 0.40–0.98) had a lower risk for depression than doctors ($p = 0.024$), and attendant and infective situations of workers was the risk factor for depression ($p = 0.007$). Occupation ($p = 0.029$) and infected workers ($p = 0.001$) were related to anxiety. Infected attendant workers had a higher risk for stress (OR 1.97, 95% CI 1.12–3.48) than uninfected attendant workers ($p = 0.019$).

Conclusions: Most medical workers infected with COVID-19 had emotional disorders during the COVID-19 pandemic. Attention and useful measures are suggested to support medical workers.

Key words: COVID-19; medical workers; DASS-21; risk factors.

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Introduction

Coronavirus disease 2019 (COVID-19) has an extremely high infection rate [1]. The cause of COVID-19 is the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The virus is an enveloped positive-sense single-stranded genomic RNA virus, and it has some variants to escape from neutrafigurelizing antibodies [2]. The Omicron variant, with extremely high levels of contagion, was first identified as a novel variant in South Africa and Botswana on 24 November 2021, rapidly causing a global public health emergency in a short period [3]. Compared with the Delta variant, COVID-19 cases infected with the SARS-CoV-2 Omicron BA.1 variant had reduced risk for hospitalization, length of stay in hospital, and intensive care admission [4]. In Shanghai, China, the number of symptomatic or asymptomatic children infected with Omicron (B.1.1.529) was 4530 (48.42%) and 4825 (51.58%), respectively [5].

With the approval of the State Council of the People's Republic of China, the measures for the prevention and control of COVID-19 infection changed from December 2022. This means that the fight against SARS-CoV-2 has been adjusted from isolation to self-management. Thus, the COVID-19 wave in China from December 2022 to January 2023 caused a huge shortage of medical personnel, medical equipment, and medicines. Faced with a massive acute workload against the Omicron wave in the early days of policy adjustments, medical workers were at high risk for exposure to the coronavirus and required a lot of labor and physical strength to fight the disease.

A previous meta-analysis reported that the pooled prevalence rates of post-traumatic stress disorder, anxiety, depression, and distress were 49%, 40%, 37%, and 37%, respectively during the COVID-19 pandemic [6]. A previous case-control study reported that frontline medical workers had higher rates of any

mental problem (52.6% vs. 34.0%), anxiety symptoms (15.7% vs. 7.4%), depressed mood (14.3% vs. 10.1%) and insomnia (47.8% vs. 29.1%) than non-frontline medical workers in China in February 2020, when the SARS-CoV-2 was strictly prevented and under controlled [7]. Next, the physical and psychological health of medical workers was under great threat during the early period of the self-management strategy for SARS-CoV-2. To this end, this study investigated COVID-19 infection and emotional states of medical workers. To our knowledge, this is the first study demonstrating the prevalence of COVID-19 infection and emotional disorders among Chinese medical workers since Chinese people self-managed SARS-CoV-2.

Methodology

Design and participants

This cross-sectional study was conducted at Beijing Friendship Hospital, Capital Medical University by the online questionnaire platform, Wenjuanxing [8], from 20 December 2022 to 19 January 2023. This questionnaire was specially designed to assess the well-being of doctors, nurses, medical students, and other staff (scientific researchers, administrators, and support staff).

Questionnaire variables

The questionnaire assessed the following variables: demographic characteristics, number of vaccine doses, COVID-19 test results, occupation, attendant situations of workers, clinical symptoms, disease duration, and the Depression, Anxiety and Stress Scale 21 (DASS-21). Body temperature measurements were categorized as normal (< 37.3°C), mild (37.3–38.0°C), moderate (38.1–39.0°C), high (39.1–41°C) and extremely high fever (>41°C) [9]. Pain was evaluated using a 10-point Numerical Rating Scale (NRS) and visual analog scale (VAS) [10]. Participants self-reported test results of the SARS-CoV-2 (including nucleic acid and antigen tests), and self-reported symptoms (no symptom and negative test, no symptom but positive test, no symptom and negative test, symptom but negative test, or symptom without test) were collected via questionnaire. Participants with no symptoms and negative tests were classified as the uninfected group. The infected group included patients who were symptomatic or tested positive. The duration of sick days was self-reported by infected participants.

The short-form version of DASS-21 is a modified version of the 42-item Depression, Anxiety and Stress Scale, which has been demonstrated to be a self-reported reliable tool for assessing mental health [11]. Previous studies reported the overall Cronbach's alpha value was 0.74 for the Chinese version of DASS-21 scale; along with the values of the subscales of 0.66, 0.29, and 0.52 for the DASS-21 subscales of depression, anxiety, and stress, respectively. Thus, the Chinese version DASS-21 had good internal reliability [12]. Depression, anxiety, or stress was measured by the four-point Likert scale of 0–3 from DASS-21 (0 = did not apply at all; 1 = some degree or some of the time; 2 = a considerable degree or a good part of the time; and 3 = very much or most of the time). The final scores of each scale were multiplied by 2, due to the scoring standard of the 42-item DASS [13]. Items 3, 5, 10, 13, 16, 17, and 21 in DASS formed the depression subscale; while items 2, 4, 7, 9, 15, 19, and 20 formed the anxiety subscale; and items 1, 6, 8, 11, 12, 14, and 18 formed the stress subscale. Higher scores indicate more severe symptoms.

Outcomes

Depression scores were divided into normal (0–9), mild (10–12), moderate (13–20), severe (21–27), and extremely severe depression (28–42). Anxiety scores were divided into normal (0–6), mild (7–9), moderate (10–14), severe (15–19), and extremely severe anxiety (20–42). Stress scores were divided into normal (0–10), mild (11–18), moderate (19–26), severe (27–34), and extremely severe stress (35–42). Participants with depression, anxiety, and stress scores higher than normal were ascertained as emotional disorders. The primary outcomes were the prevalence of depression, anxiety, and stress among these participants; secondary outcomes were the clinical manifestations of COVID-19 and the related risk factors for emotional disorders. Possible risk factors in all populations included age, gender, occupation, doses of COVID-19 vaccine, attendant situations of workers and infection; and in the infection group included age, gender, occupation, doses of COVID-19 vaccine, COVID-19 test, recovery, attendant situations of workers, symptom duration, and common symptoms of COVID-19.

Sample size

Considering α as 0.05, power as 0.80, a 10% confidence interval width and a 10% missing rate, at least 424 participants were required to be recruited, with the depression and anxiety rates as a primary outcome at 35% and 45%, respectively.

Statistics

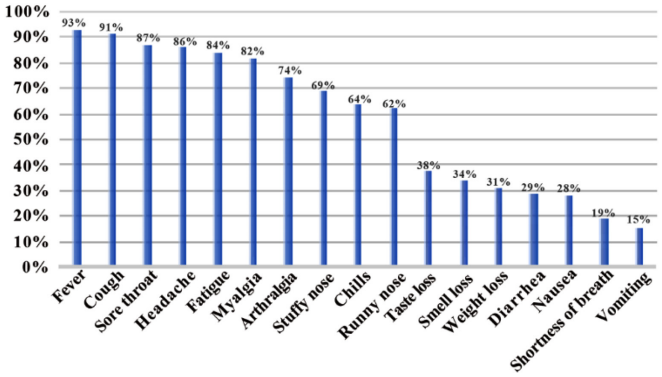
Data were expressed as frequency (percentage), mean ± standard deviation (normal distribution), or median (interquartile range, IQR) (non-normal distribution) and analyzed using Student's *t*-test, Chi-square test, or Fisher's exact test. A binary logistic regression model was used to identify the risk factors associated with depression, anxiety, and stress, respectively. Potential confounders in the model included age, gender, occupation, doses of COVID-19 vaccine, COVID-19 test, recovery, attendant situations of workers, symptom duration, and common symptoms of COVID-19. The power of each variable for depression, anxiety, and stress was evaluated using univariable logistic analysis. Binary stepwise forward LR multivariable logistic analysis was used to further analyze factors with $p < 0.1$ in the univariable analysis. Odds ratios (ORs) and 95% confidence intervals (CI) were calculated to evaluate the relevance of risk factors for depression, anxiety, and stress. All two-sided p values < 0.05 were considered to be statistically significant. Statistical analyses were performed using SPSS, version 25.0.

Results

Baseline characteristics

A total of 805 people participated in the questionnaire survey. Fifty-seven questionnaires with incomplete information were excluded. In total, 748 participants completed questionnaires, for a completion rate of 92.92%, including 240 doctors, 211 nurses, 147 medical students, and 150 other staff (scientific researchers, administrators, and support staff). A total of 632 individuals (84.49%) had been infected with COVID-19 and 116 individuals (15.51%) had not. The mean age was 33.61 ± 8.94 years, and 79.55% of participants were female. The proportion of participants with three doses or more vaccination was higher in the uninfected group (88.8%) than in the infected group (82.6%); however, there was no statistical difference (p = 0.177). According to the resolution of medical workers' emotional problems, 62 medical workers required rest, 25 asked for subsidies, 19 needed psychological counseling, and 14 suggested improving physical protection to support themselves in the questionnaire. The details of the characteristics are shown in Table 1.

Figure 1. Common symptoms of COVID-19 infection.



COVID-19 infection symptoms

In the non-infection group, 116 workers self-reported no symptoms and negative tests. Of the 632 infected group, 578 (91.46%) tested positive for nucleic acids or antigens, 19 (3.01%) had symptoms but tested negative, and 35 (5.54%) had symptoms without test. The most common symptoms were fever (93%), cough

Table 1. Baseline characteristics of participants.

Characteristic	Total (n = 748)	Non-infection group (n = 116)	Infection group (n = 632)	*p* value
Age (years)	33.61 ± 8.94	31.48 ± 8.67	34.00 ± 8.94	0.005
Gender, n (%)				
Male	153 (20.45)	29 (25.00)	124 (19.62)	0.187
Female	595 (79.55)	87 (75.00)	508 (80.38)	
Occupation, n (%)				
Doctor	240 (32.09)	40 (34.48)	200 (31.65)	
Nurse	211 (28.21)	22 (18.97)	189 (29.91)	< 0.001
Medical student	147 (19.65)	42 (36.21)	105 (16.61)	
Other	150 (20.05)	12 (10.34)	138 (21.84)	
Doses of vaccine, n (%)				
None	43 (5.75)	2 (1.72)	41(6.49)	
One	10 (1.34)	1 (0.86)	9 (1.42)	0.177
Two	70 (9.36)	10 (8.62)	60 (9.49)	
Three and above	625 (83.56)	103 (88.79)	522 (82.59)	
Attendant situations of workers, n (%)				
Attendant	649 (86.76)	89 (76.72)	560 (88.61)	0.001
Absent	99 (13.24)	27 (23.28)	72 (11.39)	
Depression (Yes), n (%)	271 (36.23)	38 (32.76)	233 (36.87)	0.397
Anxiety (Yes), n (%)	351 (46.93)	33 (28.45)	318 (50.32)	< 0.001
Stress (Yes), n (%)	301 (40.24)	37 (31.90)	264 (41.77)	0.046

(91%), sore throat (87%), headache (86%), fatigue (84%), and myalgia (82%), and other common symptoms included arthralgia, stuffy nose, chills, runny nose, taste loss, smell loss, weight loss, diarrhea, nausea, shortness of breath, and vomiting (Figure 1). A total of 14.40%, 47.94%, 28.96%, and 0.95% of participants had a mild, moderate, high, and extremely high fever, respectively; 0.79% of participants did not measure body temperature. The NRS and VAS scores for myalgia, arthralgia, sore throat, and headache were 4 (2, 7), 3 (0, 6), 4 (2, 7), and 4 (2, 7), respectively. The mean symptom duration was 12.66 ± 8.09 days. In total, 132 participants (20.89%) continued to work before recovery, 428 (67.72%) returned to work after recovery, and only 72 (11.39%) rested at home.

Emotional disorders

The prevalence of depression, anxiety, and stress were 36.23%, 46.93%, and 40.24%, respectively, during the COVID-19 pandemic. The mild, moderate, severe, and extremely severe depression rates were 13.50%, 16.71%, 3.48%, and 2.54%, respectively, while the mild, moderate, severe, and extremely severe anxiety rates were 8.56%, 21.79%, 9.09%, and 7.49%, respectively. The mild, moderate, severe, and extremely severe stress rates were 27.00%, 8.82%, 3.48%, and 0.94%, respectively. The proportion of anxiety (52.32% vs. 28.45 %; $p < 0.001$) and stress (41.77% vs. 31.90%; $p = 0.046$) was significantly higher in the infection group than in the non-infection group. (Table 1).

Risk factors for emotional disorders in the total population

Medical students (OR 0.54, 95% CI 0.31–0.93) and other staff (OR 0.63, 95% CI 0.40–0.98) had a lower risk for depression than doctors ($p = 0.024$). Compared with uninfected attendant workers, infected attendant workers (OR 2.20, 95% CI 1.23–3.95), infected absent workers (OR 2.67, 95% CI 1.29–5.49), and uninfected absent workers (OR 3.12, 95% CI 1.15–8.44) had increased the risk for depression ($p = 0.007$) (Supplementary Table 1). Nurses (OR 1.54, 95% CI 1.06–2.25) had a higher risk for anxiety than doctors ($p = 0.025$). Infected attendant workers (OR 3.57, 95% CI

Table 2. Risk factors for depression in infection group.

Risk factor	Univariable analysis			Multivariable analysis		
	OR	95% CI	*p* value	OR	95% CI	*p* value
Characteristic						
Age (one more year)	1.00	0.98, 1.02	0.914			
Gender (female *vs*. male)	0.87	0.58, 1.30	0.495			
Occupation			0.040			0.038
Nurse *vs*. doctor	0.85	0.57, 1.28	0.432	0.66	0.43, 1.03	0.070
Medical student *vs*. doctor	0.85	0.52, 1.38	0.510	0.74	0.43, 1.25	0.259
Others *vs*. doctor	0.51	0.32, 0.81	0.004	0.48	0.29, 0.80	0.005
Complete three doses of vaccine (yes *vs*. no)	1.19	0.77, 1.83	0.440			
COVID-19 test			0.890			
Negative *vs*. positive	1.26	0.50, 3.17	0.630			
Unknown *vs*. positive	1.02	0.50, 2.07	0.956			
Recovery (yes *vs*. no)	0.51	0.35, 0.74	< 0.001	0.53	0.34, 0.80	0.003
Attendant workersce (yes *vs*. no)	0.16	0.43, 1.15	0.700			
Symptom duration (one more day)	1.03	1.01, 1.05	0.001			
Symptom						
Fever			0.003			
Mild *vs*. no	1.10	0.45, 2.65	0.840			
Moderate *vs*. no	2.62	1.22, 5.65	0.014			
Severe *vs*. no	2.76	1.25, 6.08	0.012			
Extremely severe *vs*. no	3.89	0.67, 22.60	0.130			
Unknown *vs*. no	5.83	0.84, 40.32	0.074			
Chills (yes *vs*. no)	1.84	1.30, 2.62	0.001			
Cough (yes *vs*. no)	2.15	1.14, 4.08	0.019			
Stuffy nose (yes *vs*. no)	1.35	0.95, 1.93	0.099			
Runny nose (yes *vs*. no)	1.29	0.92, 1.81	0.133			
Shortness of breath (yes *vs*. no)	2.18	1.45, 3.26	< 0.001			
Fatigue (yes *vs*. no)	2.48	1.50, 4.10	< 0.001	1.74	1.01, 2.97	0.045
Nausea (yes *vs*. no)	2.46	1.73, 3.51	< 0.001	1.73	1.17, 2.56	0.006
Taste loss (yes *vs*. no)	2.71	1.94, 3.79	< 0.001	2.26	1.58, 3.25	< 0.001
Smell loss (yes *vs*. no)	2.34	1.67, 3.28	< 0.001			
Weight loss (yes *vs*. no)	1.75	1.24, 2.47	0.001			
Myalgia (one more score)	1.10	1.04, 1.16	< 0.001			
Arthralgia (one more score)	1.10	1.05, 1.16	< 0.001			
Sore throat (one more score)	1.12	1.06, 1.18	< 0.001	1.09	1.03, 1.15	0.002
Headache (one more score)	1.12	1.06, 1.18	< 0.001			
Diarrhea (yes *vs*. no)	1.95	1.38, 2.77	< 0.001	1.46	0.99, 2.16	0.057
Vomiting (yes *vs*. no)	1.01	0.65, 1.59	0.956			

1.97–6.47), recovery attendant workers (OR 2.48, 95% CI 1.49–4.15), and infected absent workers (OR 2.81, 95% CI 1.35–5.79) had higher risks of anxiety than uninfected attendant workers (p = 0.001) (Supplementary Table 2). Infected attendant workers (OR 1.97, 95% CI 1.12–3.48) had a higher risk for stress than uninfected attendant workers (p = 0.019) (Supplementary Table 3).

Risk factors for emotional disorders in the infection group

In the infection group, other staff (vs. doctors; OR 0.48, 95% CI 0.29–0.80) (p = 0.005) and recovery (OR 0.53, 95% CI 0.34–0.80) (p = 0.003) were associated with lower risks for depression; fatigue (OR 1.74, 95% CI 1.01–2.97), nausea (OR 1.73, 95% CI 1.17–2.56), taste loss (OR 2.26, 95% CI 1.58–3.25), and sore throat (OR 1.09, 95% CI 1.03–01.15) were the risk factors for depression (Table 2). Recovery from COVID-19 (OR 0.59, 95% CI 0.39–0.90) was associated with reduced the risk for anxiety (p = 0.015). Cough (OR 2.29, 95% CI 1.21–4.33), shortness of breath (OR 2.83, 95% CI 1.74–4.62), smell loss (OR 2.06, 95% CI 1.44–2.97), myalgia (OR 1.13, 95% CI 1.06–1.20), and diarrhea (OR 1.97, 95% CI 1.33–2.90) increased the risk for anxiety (Table 3). Shortness of breath (OR 2.54, 95% CI 1.62–3.96), taste loss (OR 1.99, 95% CI 1.40–2.84), arthralgia (OR 1.08, 95% CI 1.02–1.14), sore throat (OR 1.10, 95% CI 1.04–1.16), and diarrhea (OR 1.60, 95% CI 1.10–2.33) were independent risk factors for stress (Table 4).

Discussion

In this study, 84.49% of participants were found to be infected with COVID-19. The most common symptoms were fever, cough, sore throat, headache, fatigue, and myalgia. During the pandemic, depression, anxiety, and stress rates were as high as 36.23%, 46.93%, and 40.24%, respectively. Multivariable logistic regression analysis indicated that occupation, attendant situations of workers, recovery, and infective symptoms were risk factors for emotional disorders.

The COVID-19 pandemic significantly increased the global prevalence of depressive and anxiety

Table 3. Risk factors for anxiety in infection group.

Risk factor	Univariable analysis			Multivariable analysis		
	OR	95% CI	*p* value	OR	95% CI	*p* value
Characteristic						
Age (one more year)	1.01	0.99, 1.03	0.262			
Gender (female *vs*. male)	1.15	0.77, 1.70	0.497			
Occupation			0.081			
Nurse *vs*. doctor	1.39	0.93, 2.07	0.107			
Medical student *vs*. doctor	0.88	0.57, 1.36	0.572			
Others *vs*. doctor	0.80	0.50, 1.28	0.345			
Complete three doses of vaccine (yes *vs*. no)	0.89	0.59, 1.34	0.578			
COVID-19 test			0.496			
Negative *vs*. positive	0.70	0.28, 1.76	0.446			
Unknown *vs*. positive	0.72	0.36, 1.43	0.349			
Recovery (yes *vs*. no)	0.55	0.37, 0.81	0.002	0.59	0.39, 0.90	0.015
Attendant workersAttendance (yes *vs*. no)	1.31	0.78, 2.14	0.291			
Symptom duration (one more day)	1.05	1.03, 1.08	< 0.001			
Symptom						
Fever			0.004			
Mild *vs*. no	1.10	0.52, 2.34	0.805			
Moderate *vs*. no	2.08	1.07, 4.03	0.030			
Severe *vs*. no	2.60	1.31, 5.18	0.006			
Extremely severe *vs*. no	3.87	0.63, 23.59	0.143			
Unknown *vs*. no	7.73	0.79, 75.47	0.078			
Chills (yes *vs*. no)	1.83	1.31, 2.54	< 0.001			
Cough (yes *vs*. no)	2.66	1.48, 4.79	0.001	2.29	1.21, 4.33	0.011
Stuffy nose (yes *vs*. no)	1.41	1.01, 1.98	0.046			
Runny nose (yes *vs*. no)	1.59	1.15, 2.20	0.005			
Shortness of breath (yes *vs*. no)	4.10	2.59, 6.47	< 0.001	2.83	1.74, 4.62	< 0.001
Fatigue (yes *vs*. no)	2.40	1.54, 3.74	< 0.001			
Nausea (yes *vs*. no)	2.17	1.52, 3.10	< 0.001			
Taste loss (yes *vs*. no)	2.87	2.05, 4.00	< 0.001			
Smell loss (yes *vs*. no)	2.18	1.56, 3.05	< 0.001	2.06	1.44, 2.97	< 0.001
Weight loss (yes *vs*. no)	1.67	1.19, 2.35	0.003			
Myalgia (one more score)	1.19	1.12, 1.25	< 0.001	1.13	1.06, 1.20	< 0.001
Arthralgia (one more score)	1.18	1.12, 1.24	< 0.001			
Sore throat (one more score)	1.11	1.05, 1.16	< 0.001			
Headache (one more score)	1.14	1.08, 1.21	< 0.001			
Diarrhea (yes *vs*. no)	2.40	1.68, 3.43	< 0.001	1.97	1.33, 2.90	0.001
Vomiting (yes *vs*. no)	1.35	0.88, 2.09	0.173			

disorders in 2020 due to the COVID-19 pandemic [14]. Mario *et al*. screened the psychiatric symptoms of 402 patients surviving COVID-19, of which 31% for depression, and 42% for anxiety in 2020 [15]. The prevalence of depression symptoms was more than 3-fold higher during COVID-19 compared with before the COVID-19 pandemic in 2020 [16]. Le *et al*. conducted an online survey that mental health symptoms were common during the COVID-19 outbreak among the general population in China in 2020 [17]. Our survey is specially focused on medical workers, who were at high risk for Omicron infection and worked consistently to respond to public health emergencies. In addition, this study was carried out when millions of people, including medical workers, were acutely infected with COVID-19 at the beginning of the self-management period in China. Naturally, the prevalence of depression, anxiety, and stress among medical workers is higher than previously reported.

Nurses were more susceptible to anxiety compared to doctors (OR, 1.54; 95% CI, 1.06–2.25; $p = 0.025$). Due to the shortage of nurses, they had a heavy workload and long shifts. Medical workers who did not have COVID-19 and were on duty had a lower risk for developing emotional disorders. Medical students could voluntarily study at home, and the attendant workers in the non-infection group (76.72%) was less than that in the infection group (88.61%).

A previous review summarized symptoms of COVID-19 from 2021 to 2022 that the 10 most prevalent reported symptoms were fatigue, shortness of breath, muscle pain, joint pain, headache, cough, chest pain, altered smell, altered taste, and diarrhea; other common symptoms were cognitive impairment, memory loss, anxiety, and sleep disorders [18]. On the Faroe Islands, the most common symptoms of Omicron among adult cases were fatigue, headache, sneezing, and stuffy nose [19]. In this study, the top six most common symptoms of Omicron infection were fever, cough, sore throat, headache, fatigue, and myalgia, all with a prevalence of more than 80%. Most participants with myalgia, sore throat, and headache experienced moderate to severe pain.

Table 4. Risk factors for stress in infection group.

Risk factor	Univariable analysis			Multivariable analysis		
	OR	95% CI	*p* value	OR	95% CI	*p* value
Characteristic						
Age (one more year)	1.00	0.99, 1.02	0.767			
Gender (female *vs*. male)	0.84	0.57, 1.25	0.394			
Occupation			0.226			
Nurse *vs*. doctor	0.96	0.64, 1.43	0.834			
Medical student *vs*. doctor	0.71	0.44, 1.15	0.162			
Others *vs*. doctor	0.68	0.44, 1.06	0.090			
Complete three doses of vaccine (yes *vs*. no)	1.09	0.72, 1.66	0.678			
COVID-19 test			0.583			
Negative *vs*. positive	0.79	0.31, 2.04	0.631			
Unknown *vs*. positive	0.71	0.35, 1.45	0.348			
Recovery (yes *vs*. no)	0.62	0.42, 0.90	0.012			
Attendant workersAttendance (yes *vs*. no)	0.94	0.57, 1.55	0.815			
Symptom duration (one more day)	1.04	1.02, 1.06	< 0.001			
Symptom						
Fever			0.009			
Mild *vs*. no	0.77	0.35, 1.69	0.510			
Moderate *vs*. no	1.61	0.82, 3.16	0.166			
Severe *vs*. no	2.07	1.03, 4.17	0.040			
Extremely severe *vs*. no	2.14	0.38, 11.98	0.386			
Unknown *vs*. no	3.21	0.48, 21.46	0.228			
Chills (yes *vs*. no)	1.90	1.36, 2.68	< 0.001			
Cough (yes *vs*. no)	1.82	1.01, 3.28	0.046			
Stuffy nose (yes *vs*. no)	1.44	1.02, 2.04	0.039			
Runny nose (yes *vs*. no)	1.46	1.05, 2.04	0.023			
Shortness of breath (yes *vs*. no)	3.50	2.30, 5.33	< 0.001	2.54	1.62, 3.96	< 0.001
Fatigue (yes *vs*. no)	1.96	1.24, 3.10	0.004			
Nausea (yes *vs*. no)	2.27	1.60, 3.22	< 0.001			
Taste loss (yes *vs*. no)	2.70	1.94, 3.76	< 0.001	1.99	1.40, 2.84	< 0.001
Smell loss (yes *vs*. no)	1.98	1.42, 2.77	< 0.001			
Weight loss (yes *vs*. no)	1.32	0.94, 1.86	0.107			
Myalgia (one more score)	1.14	1.08, 1.20	< 0.001			
Arthralgia (one more score)	1.14	1.09, 1.21	< 0.001	1.08	1.02, 1.14	0.012
Sore throat (one more score)	1.14	1.08, 1.20	< 0.001	1.10	1.04, 1.16	0.001
Headache (one more score)	1.14	1.08, 1.20	< 0.001			
Diarrhea (yes *vs*. no)	1.97	1.39, 2.78	< 0.001	1.60	1.10, 2.33	0.014
Vomiting (yes *vs*. no)	1.19	0.77, 1.84	0.436			

In the infection group, recovery from COVID-19 significantly reduced the risk for depression and anxiety. Nurses and other staff had a lower risk for depression; however, presence of symptoms such as fatigue, nausea, taste loss, sore throat, and diarrhea increased the risk. Factors associated with anxiety included cough, shortness of breath, loss of smell, myalgia score, and diarrhea. Shortness of breath, taste loss, arthralgia, sore throat, and diarrhea were found to be the independent risk factors for stress. Fatigue in COVID-19 patients is frequently accompanied by mental dysfunction [20]. Moreover, Speth *et al*. reported that a decreased sense of smell and taste was associated with depressed mood and anxiety [21]. Sung reported an association between sore throat and exacerbated anxiety symptoms [22]. The consistency of gastrointestinal symptoms and emotional disorders might be due to the reduction of gut microbiome L-tryptophan biosynthesis in 5-HT signaling [23].

This study reveals that clinical symptoms were the risk factors for emotional disorders including fatigue, nausea, taste loss, sore throat, cough, shortness of breath, smell loss, myalgia, diarrhea, and arthralgia. In this cross-sectional study, we confirmed the extremely high prevalence of COVID-19 infection and emotional disorders in medical workers, which indicated that the physical and psychological health of healthcare workers needs to be adequately addressed. Baseline characteristics, symptoms, and duration of COVID-19 infection were described in detail, and multivariable logistic regression analysis confirmed that occupation, attendant situations of workers, and several symptoms were independent risk factors for emotional disorders. Compared with online survey, this study had exact objects and the special period of acute infection with a relatively large sample size, which fully reflects the emotional states of medical workers at the time of the pandemic. To the best of our knowledge, this is the first cross-sectional study to focus on the physical and emotional states of medical workers during the COVID-19 pandemic, providing strong evidence of the need for physical protection and psychological care to support medical workers.

This study has several limitations. First, information on physical activities, smoking, drinking, and comorbidities was not collected in the questionnaire. Physical activities, smoking, and drinking might be changed due to the COVID-19 infection. Further, the emotional disorders might not be changed greatly according to comorbidities. Second, this cross-sectional study made it difficult to distinguish between causes and effects and lacked controls for non-pandemic periods. Third, as a single-center study, these results cannot be extrapolated to other locations. Fourth, there was no unified COVID test for participants, and antigen or nucleic acid tests for COVID were self-reported by participants. Last, there is an urgent need for specific intervention studies to mitigate the impact on the physical and mental health of healthcare workers and help combat disease outbreaks. On the one hand, it is necessary to improve the protection of medical workers against viruses by developing effective and convenient protective devices; on the other hand, psychological counseling, balancing work and rest, and increasing subsidies are particularly important in public health emergencies to support medical stuff.

Conclusions

Medical workers infected with COVID-19 showed emotional disorders at the beginning of the self-management period during the pandemic. Occupation, attendant situations of workers, and COVID-19 symptoms influenced the risk for emotional disorders, while recovery from COVID-19 significantly decreased depression or anxiety risk. During the COVID-19 pandemic, medical workers are both susceptible to disease and health defenders. However, it is often difficult to balance limited medical resources with huge needs in the event of a global disease outbreak. Therefore, governments, policymakers, and relevant departments are strongly encouraged to pay close attention to the physical and psychological health of medical workers.

Authors' contributions

PL designed the study. XL and QZ drafted the manuscript. XL and QZ analyzed the data. XL, QZ, WKL, JW, JX, XY, and PL designed the survey. STZ, XY and PL interpreted the results, incorporated comments from the co-authors, and finalized the manuscript. All authors approved the final version of the paper.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Beijing Friendship Hospital, Capital Medical University (No. 2023-P2-077-01) and conducted in accordance with the Helsinki Declaration as revised in 1989. The requirement for informed consent was waived by the Ethics Committee of Beijing Friendship Hospital, Capital Medical University due to the anonymous participation.

Availability of data

The datasets used and analyzed are available from the corresponding author on reasonable request.

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Annex – Supplementary Items

Supplementary Table 1. Univariable and multivariable logistic analysis of risk factors related to depression in total population.

Risk factor	Univariable analysis			Multivariable analysis		
	OR	95% CI	*p* value	OR	95% CI	*p* value
Age (one more year)	1.00	0.98, 1.02	0.942			
Gender (female *vs*. male)	0.91	0.63, 1.32	0.628			
Occupation			0.130			0.024
Nurse *vs*. doctor	1.01	0.69, 1.47	0.980	1.01	0.69, 1.49	0.945
Medical student *vs*. doctor	0.92	0.60, 1.40	0.692	0.54	0.31, 0.93	0.026
Others *vs*. doctor	0.62	0.40, 0.96	0.031	0.63	0.40, 0.98	0.039
Complete three doses of vaccine (yes *vs*. no)	1.12	0.74, 1.68	0.599			
Attendant and infective situations			0.033			0.007
Infected attend workers *vs*. uninfected attendant workers	1.96	1.11, 3.47	0.021	2.20	1.23, 3.95	0.008
Recovered attendant workers *vs*. uninfected attendant workers	1.20	0.73, 1.98	0.468	1.18	0.71, 1.96	0.535
Infected absent workers *vs*. uninfected attendant workers	1.94	1.01, 3.72	0.047	2.67	1.29, 5.49	0.008
Uninfected absent workers *vs*. uninfected attendant workers	1.94	0.80, 4.70	0.143	3.12	1.15, 8.44	0.025

Supplementary Table 2. Univariable and multivariable logistic analysis of risk factors related to anxiety in total population.

Risk factor	Univariable analysis			Multivariable analysis		
	OR	95% CI	*p* value	OR	95% CI	*p* value
Age (one more year)	1.02	1.00, 1.03	0.062			
Gender (female *vs*. male)	1.17	0.82, 1.68	0.384			
Occupation			0.013			0.029
Nurse *vs*. doctor	1.60	1.11, 2.33	0.013	1.54	1.06, 2.25	0.025
Medical student *vs*. doctor	0.82	0.54, 1.25	0.363	1.01	0.67, 1.54	0.954
Others *vs*. doctor	1.08	0.72, 1.62	0.723	0.74	0.43, 1.26	0.267
Complete three doses of vaccine (yes *vs*. no)	0.88	0.60, 1.30	0.517			
Attendant and infective situations			<0.001			0.001
Infected attendant workers *vs*. uninfected attendant workers	3.35	1.88, 5.99	<0.001	3.57	1.97, 6.47	<0.001
Recovered attendant workers *vs*. uninfected attendant workers	2.68	1.62, 4.45	<0.001	2.48	1.49, 4.15	0.001
Infected absent workers *vs*. uninfected attendant workers	2.17	1.12, 4.19	0.022	2.81	1.35, 5.79	0.005
Uninfected absent workers *vs*. uninfected attendant workers	1.35	0.54, 3.42	0.522	1.97	0.71, 5.49	0.195

Supplementary Table 3. Univariable logistic analysis of risk factors related to stress in total population.

Risk factor	Univariable analysis		
	OR	95% CI	*p* value
Age (one more year)	1.01	0.99, 1.02	0.456
Gender (female *vs*. male)	0.95	0.66, 1.37	0.791
Occupation			0.116
Nurse *vs*. doctor	1.21	0.83, 1.76	0.313
Medical student *vs*. doctor	0.78	0.51, 1.19	0.251
Others *vs*. doctor	0.78	0.51, 1.19	0.244
Complete three doses of vaccine (yes *vs*. no)	0.94	0.64, 1.39	0.762
Attendant and infective situations			0.209
Infected attendant workers *vs*. uninfected attendant workers	1.97	1.12, 3.48	0.019
Recovered attendant workers *vs*. uninfected attendant workers	1.54	0.94, 2.52	0.084
Infected absent workers *vs*. uninfected attendant workers	1.74	0.91, 3.32	0.096
Uninfected absent workers *vs*. uninfected attendant workers	1.35	0.55, 3.33	0.514