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Coronavirus Pandemic

An examination of Wuhan City healthcare personnel afflicted with SARS-CoV-2 Omicron variants between December 15, 2022, and January 5, 2023, during the rapid Omicron outbreak in China

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Dear Editor,

On December 7, 2022, China began to relax the zero COVID-19 policy, following which SARS-CoV-2 spread rapidly throughout China. At the time of writing this paper, BA. 5.2 and BF. 7 of SARS-CoV-2 Omicron variants are still the dominant strains prevalent in China. Healthcare workers fall into a special group by not only being the infected population but also the rescue force against the disease. Yet there are very few reports on the infection situation among medical staff under the rapid transmission of Omicron. In this investigation, medical workers (N = 750) from four large hospitals (Tongji Hospital, Zhongnan Hospital, Wuhan People's Hospital, and General Hospital of Central Theater Command) in Wuhan, Hubei province who were recently infected with Omicron, were surveyed through an online questionnaire between December 15, 2022, and January 5, 2023.

The survey participants were divided into two groups the booster immunization group ("BI", N = 483) and the primary immunization group ("PI", N = 267) according to whether the enhanced immunization of COVID-19 vaccines was completed. Completing primary immunization means receiving two doses of inactivated vaccines (made in Beijing or Wuhan Institute of Biological Products Co., Ltd., Beijing or Wuhan, China or Sinovac Life Sciences Co., Ltd., Beijing, China; respectively) or one dose of adenovirus vector vaccines (made in CanSino Biologics Co., Ltd., Tianjin, China). Completing booster immunization means receiving three doses of inactivated vaccines or two doses of adenovirus vector vaccines. We excluded individuals who were not vaccinated or did not complete primary immunization.

Through this study, we intended to understand the disease manifestations in healthcare workers infected with Omicron variants during its rapid spread in China, as well as whether vaccination with booster shots affects the disease characteristics. Surprisingly, we found that only 64.4% (483/750) of the enrolled medical staff completed intensive immunization.

The demographic and baseline characteristics of these subjects are shown in Table 1. The proportion of healthcare workers in each age group 18-29 years, 30-45 years, and 46-59 years was 36.0%, 51.6%, and 12.4%, respectively, and 70.8% of the staff were women. Among the total surveyed population, 33.2% were doctors, 26.0% were nurses, and 40.8% included technicians and other staff. After Omicron infection, 84.8% of these medical personnel chose to purchase

self-medication for treatment, and no one needed hospitalization. The most commonly used drugs (78.0%) were antipyretics and analgesics, and the proportions of staff using antiviral drugs, antibiotics, and traditional Chinese medicine were 23.2%, 15.6%, and 30.4%, respectively. In addition, the medical personnel considered that the three most likely ways of infection were being in contact with patients, colleagues, and family members.

The clinical characteristics of these healthcare workers are shown in Table 2. The most common initial symptoms were fever (28.4%), pharyngalgia (26.0%), myalgia (15.2%), headache and dizziness (10.4%), and weakness (6.4%). The SARS-CoV-2 nucleic acid or antigen usually turned positive within 2 days (81.2%) and turned negative at 7-10 days (43.6%) after the first symptom onset. Additionally, the positive conversion of antigen/nucleic acid of the PI group staff occurred earlier than that of the BI group staff ($p < 0.05$). However, the time of negative conversion of antigen/nucleic acid was longer in the PI group workers than in the BI group workers ($p < 0.05$). During the whole course of the disease, the most common symptoms were cough (93.2%), fever (92.4%), weakness (85.2%), headache and dizziness (80.0%), and expectoration (79.6%). Moreover, the proportion of ageusia and anosmia in the PI group staff was respectively and significantly higher than that in the BI group staff (29.8% vs 47.2% and 29.8% vs 40.4%, $p < 0.05$). 86.8% of the subjects had symptoms within 10 days, while the symptoms of a small number of people (6%) lasted for more than 15 days. 95.6% of these medical personnel had a fever. The proportion of these staff with the highest body temperature of 37.0-38.5 °C and 38.6-39.9 °C was respectively 34.0% and 58.8%, while 2.8% of the people had a fever exceeding 40 °C. Furthermore, 53.2% of these workers had a fever within 2 days, and 40.8% of the people had a fever for 3-4 days. The proportion of these subjects with the highest body temperature range in 38.6-39.9 °C in the PI group was significantly higher than that in the BI group (65.2% vs 55.3%, $p < 0.05$).

Table 1. Demographic and baseline characteristics of 750 healthcare workers.

Characteristics	All medical workers (N = 750)	Booster immunization (N = 483)	Primary immunization (N = 267)	*p* value
Age groups (years)				
18-29	270 (36.0)	174 (36.0)	96 (35.9)	
30-45	387 (51.6)	249 (51.6)	138 (51.7)	>0.99
46-59	93 (12.4)	60 (12.4)	33 (12.4)	
Sex				
Male	219 (29.2)	147 (30.4)	72 (27.0)	0.317
Female	531 (70.8)	336 (69.6)	195 (73.0)	
Occupation				
Doctor	249 (33.2)	165 (34.2)	84 (31.5)	
Nurse	195 (26.0)	111 (23.0)	84 (31.5)	0.038
Technician and other	306 (40.8)	207 (42.8)	99 (37.0)	
Smoke				
Yes	72 (9.6)	42 (8.7)	30 (11.2)	0.258
No	678 (90.4)	441 (91.3)	237 (88.8)	
Coexisting disorders				
Hypertension	33 (4.4)	12 (2.5)	21 (7.9)	0.001
Diabetes	9 (1.2)	6 (1.2)	3 (1.1)	>0.99
Cardiovascular and cerebrovascular diseases	9 (1.2)	6 (1.2)	3 (1.1)	>0.99
Past history of COVID-19				
Yes	9 (1.2)	3 (0.6)	6 (2.2)	0.108
No	741 (98.8)	480 (99.3)	261 (97.8)	
Medical treatment				
Untreated	90 (12.0)	63 (13.0)	27 (10.1)	
Self-purchase medicine	636 (84.8)	405 (83.9)	231 (86.5)	0.493
Fever outpatient treatment	24 (3.2)	15 (3.1)	9 (3.4)	
Hospitalization	0 (0.0)	0 (0.0)	0 (0.0)	
Drugs use				
Antipyretic and analgesic drugs	585 (78.0)	378 (78.3)	207 (77.5)	0.817
Antiviral drugs	174 (23.2)	126 (26.1)	48 (18.0)	0.012
Antibiotic	117 (15.6)	75 (15.5)	42 (15.7)	0.942
Traditional Chinese medicine	228 (30.4)	162 (33.5)	66 (24.7)	0.012
Most likely infection mode				
Patient	243 (32.4)	153 (31.7)	90 (33.7)	
Colleague	228 (30.4)	171 (35.4)	57 (21.4)	
Family	192 (25.6)	123 (25.5)	69 (25.8)	<0.001
Public place	81 (10.8)	30 (6.2)	51 (19.1)	
Express delivery	6 (0.8)	6 (1.2)	0 (0.0)	

According to the investigation, most health-care workers are vaccinated with the three inactivated vaccines made in China. However, our data showed that only 64.4% (483/750) of the healthcare workers completed the booster immunization and that 35.6% (267/750) only completed primary immunization. The inactivated COVID-19 vaccines can protect patients against pneumonia and severe disease from Omicron infection, and booster vaccination can enhance this effect [1-4]. A homologous or heterologous booster immunization based on inactivated vaccine administration can induce broad and potent adaptive immune responses, reduce the Omicron escape from neutralizing, and enhance virus removal capability [5,6]. Our study indicated that almost all infected healthcare workers had one or more clinical symptoms and that there was no absolute asymptomatic infected person. We found that the duration of Omicron infection was shortened and the highest body temperature was significantly lower in the medical staff who had received booster vaccines. These results indicate that whether the patients with mild symptoms of Omicron infection are vaccinated with a booster vaccine will also affect the severity of symptoms and the ability of virus clearance. However, there was no obvious effect of booster vaccination on the

Table 2. Clinical manifestations of 750 healthcare workers.

Characteristics	All medical workers (N = 750)	Booster immunization (N = 483)	Primary immunization (N = 267)	*p* value
Initial symptom				
Fever	213 (28.4)	141 (29.2)	72 (27.0)	0.517
Pharyngalgia	195 (26.0)	129 (26.7)	66 (24.7)	0.552
Myalgia	114 (15.2)	72 (14.9)	42 (15.7)	0.764
Headache and dizziness	78 (10.4)	48 (9.9)	30 (11.2)	0.577
Weakness	48 (6.4)	30 (6.2)	18 (6.7)	0.776
Days of antigen/ nucleic acid positive after symptom onset (d)				
0	138 (18.4)	96 (19.9)	42 (15.7)	0.161
1	270 (36.0)	156 (32.3)	114 (42.7)	0.005
2	201 (26.8)	111 (23.0)	90 (33.7)	0.001
3	120 (16.0)	78 (16.1)	42 (15.7)	0.881
4	33 (4.4)	21 (4.3)	12 (4.5)	0.925
≥ 5	27 (3.6)	12 (2.5)	15 (5.6)	0.027
Days of antigen/ nucleic acid negative after symptom onset (d)				
1-3	12 (1.6)	9 (1.9)	3 (1.1)	0.639
4-6	105 (14.0)	63 (13.0)	42 (15.7)	0.310
7-10	327 (43.6)	174 (36.0)	153 (57.3)	<0.001
11-14	69 (9.2)	48 (9.9)	21 (7.9)	0.347
≥ 15	25 (3.3)	16 (3.3)	9 (3.4)	0.966
Cardinal symptoms				
Cough	699 (93.2)	450 (93.2)	249 (93.3)	0.962
Fever	693 (92.4)	447 (92.5)	246 (92.1)	0.839
Weakness	639 (85.2)	414 (85.7)	225 (84.3)	0.594
Headache and dizziness	600 (80.0)	381 (78.9)	219 (82.0)	0.303
Expectoration	597 (79.6)	384 (79.5)	213 (79.8)	0.929
Pharyngalgia	585 (78.0)	381 (78.9)	204 (76.4)	0.433
Myalgia	573 (76.4)	372 (77.0)	201 (75.3)	0.592
Hoarseness	405 (54.0)	267 (55.3)	138 (51.7)	0.344
Ageusia	270 (36.0)	144 (29.8)	126 (47.2)	<0.001
Anosmia	252 (33.6)	144 (29.8)	108 (40.4)	0.003
Diarrhea	186 (24.8)	129 (26.7)	57 (21.3)	0.104
Vomit	147 (19.6)	102 (21.1)	45 (16.9)	0.159
Symptoms duration (d)				
1-3	126 (16.8)	72 (14.9)	54 (20.2)	
4-6	327 (43.6)	216 (44.7)	111 (41.6)	
7-10	198 (26.4)	126 (26.1)	72 (27.0)	0.094
11-14	54 (7.2)	42 (8.7)	12 (4.5)	
≥ 15	45 (6.0)	27 (5.6)	18 (6.7)	
Maximum body temperature (°C)				
<37.0	33 (4.4)	27 (5.6)	6 (2.2)	
37.0-38.5	255 (34.0)	174 (36.0)	81 (30.3)	0.025
38.6-39.9	441 (58.8)	267 (55.3)	174 (65.2)	
≥ 40.0	21 (2.8)	15 (3.1)	6 (2.3)	
Duration of fever (d)				
0-2	399 (53.2)	249 (51.6)	150 (56.2)	
3-4	306 (40.8)	207 (42.9)	99 (37.1)	0.093
5-6	30 (4.0)	15 (3.1)	15 (5.6)	
≥ 7	15 (2.0)	12 (2.5)	3 (1.1)	

manifestation of main symptoms in patients with mild disease, except for the loss of smell and taste. The enhancement of virus clearance ability and the reduction of fever symptoms in patients with mild infection after immunization can be explained by a boost in specific immunity post-vaccination. The reasons for the differences in clinical symptoms and manifestations (mainly ageusia and anosmia) of patients with mild Omicron infection after intensive immunization need to be further studied and elaborated. Based on this study and previous relevant research reports [7,8], we can argue that booster immunization can not only effectively enhance protection against COVID-19-related hospitalization and death but also alleviate the disease manifestations and duration of virus infection in mildly infected individuals. Therefore, completing booster immunization promptly is very necessary, especially for the elderly, children, and special populations with low immune function.

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Authors' contributions

Lei Liu: Conceptualization, Methodology, Writing-Review & Editing, Funding acquisition. Yingyu He and Wanbing Liu: Study design and Statistical analysis. Yingyu He and Fang Zhang: Investigation. Yuan Huang, Shangen Zheng and Wanbing Liu: Formal analysis, Visualization, Writing-Original Draft. All of the authors approved the manuscript.

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