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Screening and Analysis of SARS-CoV-2 Antibody Among Unvaccinated Blood Donors in Chongqing, China

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Abstract

Objective: To investigate the rate of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) antibody among unvaccinated voluntary blood donors in Chongqing, and to provide evidence for epidemic surveillance.

Methods: A total of 10,208 voluntary blood donors from January 5 to January 20, 2021, in the Chongqing area were collected, and the SARS-CoV-2 immunoglobulin (Ig) G and IgM antibodies were detected by chemiluminescence, and the differences of antibody-positive rate in different gender, age, ABO blood group, and different risk areas were analyzed.

Results: Among 10208 blood donors, 10 were found to be positive for SARS-COV-2 IgG antibody, giving a positivity rate of SARS-COV-2 IgG at 0.10%, and 29 were positive for SARS-CoV-2 IgM antibody, with a positivity rate of SARS-CoV-2 IgM at 0.28%. There was no statistical difference in the positive rate of antibody among different genders, ages, and ABO blood types, but it was related to the number of confirmed coronavirus disease 2019 (COVID-19) cases in each city.

Conclusions: The SARS-CoV-2 seroprevalence rate in Chongqing was low and correlated with the number of confirmed COVID-19 cases.

Coronavirus disease 2019 (COVID-19) is highly contagious and pathogenic, and people are generally susceptible to it.[1] The detection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection is mainly nucleic acid testing and serological detection. Some studies have reported the serological detection data of SARS-CoV-2 in the general population, medical workers, outpatients, children, and other special populations,[2,3] but there are few reports on the serological detection of SARS-CoV-2 in blood donors. In addition, it reported that many factors affect the seroprevalence, including sex, age, and others. Therefore, in this study, the antibodies among blood donors from January 5 to January 20, 2021, in Chongqing were tested for SARS-CoV-2 to understand the seropositivity of SARS-CoV-2 and characteristics in low-risk areas.

Methods

Study Design and Participants

A total of 10,208 blood donors donated blood between January 5 to January 20, 2021, in Chongqing were enrolled in this study. All donors have not received vaccination.

Serological Tests

All samples were tested for SARS-CoV-2-specific IgM/IgG antibodies to SARS-CoV-2 IgG antibody detection kits (G202101003), and IgM antibody detection kits (G202101002) were purchased from Bioscience Diagnostic Technology Co. Ltd., Chongqing, China. Antibody levels were expressed as the ratio of the chemiluminescence signal over the cutoff (S/CO) value. An S/CO value higher than 1.0 for either IgG or IgM was regarded as positive.

Statistical Analysis

In descriptive analyses, participant's demographics were determined and compared for the whole cohort, and stratified by antibody test result, using absolute and relative frequencies. Antibody levels among different groups were analyzed by chi-squared or Fisher's exact test with SPSS 21 software. $P < 0.05$ indicated significance.

Table 1. Seroprevalence of SARS-CoV-2 antibodies in Chongqing

Variables	Subgroups	Tested no.	IgG			IgM		
			No.	%	***P*-Value**	No.	%	***P*-Value**
Sex	Male	5371	4	0.07	0.424	14	0.26	0.639
	Female	4837	6	0.12		15	0.31	
Age (y)	18-30	2398	2	0.08	0.713	5	0.21	0.414
	31-40	2537	3	0.12	0.479	6	0.24	0.316
	41-50	3398	4	0.12	0.467	16	0.47	0.030
	51-60	1875	1	0.05	–	2	0.11	–
Blood group	A	3297	2	0.06	0.634	11	0.33	0.961
	B	2524	4	0.16	0.728	9	0.36	0.883
	AB	928	1	0.11	–	3	0.32	–
	O	3459	3	0.09	0.850	6	0.17	0.370
Total		10208	10	0.10		29	0.28	

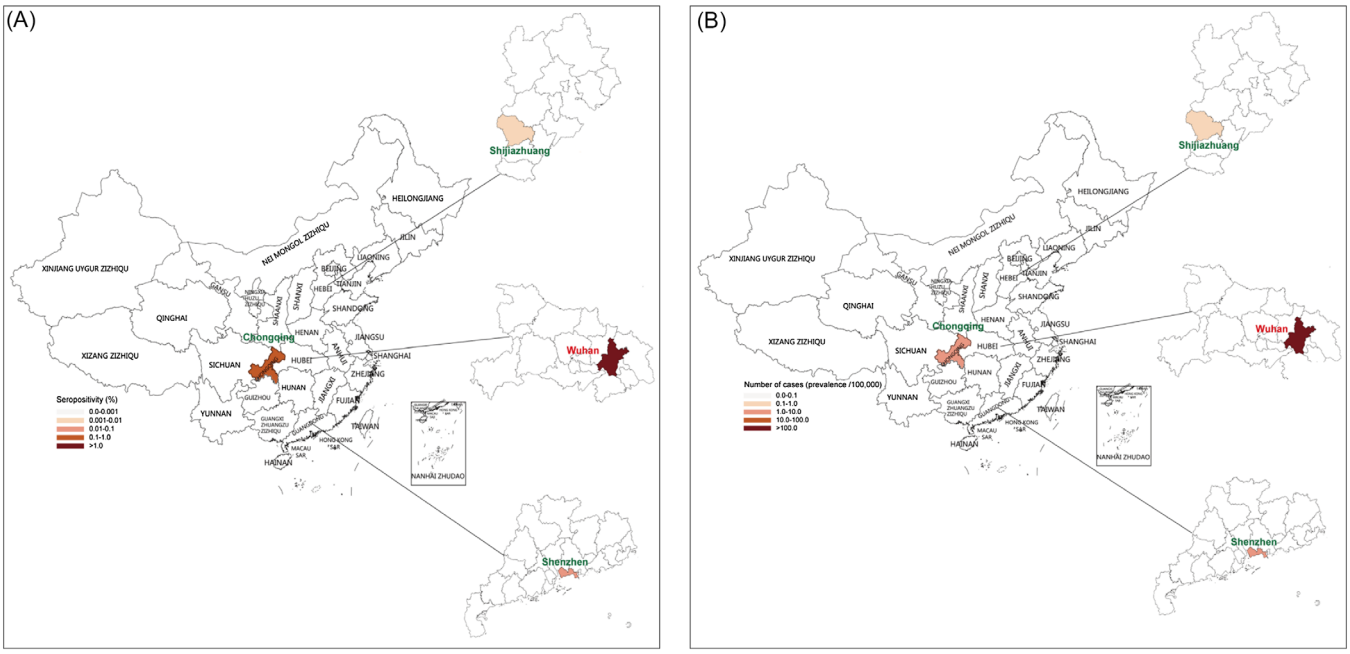

Figure 1. Geographic distribution of seropositivity in Wuhan, Shenzhen, Shijiazhuang, and Chongqing. (A): Seroprevalence (%); (B) Cases/100,000 population.

Results

Seroprevalence Estimates Stratified by Sex, Age, and Blood Group

Among 10,208 tested individuals, 5371 were males and 4837 were females (male to female ratio: 1.1:1), with no significant difference in seroprevalence between males and females. Regarding the age, significantly higher anti-SARS-CoV-2 IgM level was found in the group of 41-50 y old when compared with the group of 51-60 y old, but the rest of blood donors did not show differences. We analyzed further the seroprevalence among different blood groups, and the chi-squared test did not show significant differences (Table 1).

Seropositivity and Number of Confirmed COVID-19 Cases in Different Areas in China

In terms of geographical distribution, the seropositivity in Wuhan, Shenzhen, Shijiazhuang, and Chongqing were 2.66%, 0.033%, 0.0028%, and 0.38%, respectively (Figure 1). However, the number of confirmed COVID-19 cases reported by the Health Committee (prevalence /100,000) in those cities were 50,333 (448.92), 420 (3.22), 29 (0.26), and 576(1.84), respectively.

Discussion

Previously reported general population seroprevalence of anti-SARS-CoV-2 antibodies varied across different regions and countries. The outbreak of COVID-19 was first reported in Wuhan, China, where many people have been infected. The positive rate of SARS-CoV-2 antibody among blood donors was 2.66% in Wuhan.[4] In addition, other low-risk cities also reported a low positive rate of SARS-CoV-2 antibody among blood donors.[5] Similarly, among 10,208 blood donors included in our study, a total of 39 individuals were detected positive for at least 1 SARS-CoV-2 IgM or IgG antibody, with an overall seropositivity rate of 0.38%. It proved that the transmission of SARS-CoV-2 has been effectively blocked, which may be attributed to the effective implementation

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of rapid detection, isolation and tracking measures all over China. However, combined with the positive rate of SARS-CoV-2 antibody and the number of confirmed COVID-19 cases reported by the Health Committee, the number of confirmed COVID-19 cases in Chongqing was significantly lower than that in other low-risk cities. This could be due to its proximity to Wuhan, leading to a substantial proportion of asymptomatic infections remaining undetected.

Recent studies suggested that female and older age showed higher COVID-19 risk, which were the predominant risk factors independently associated with the seropositivity of SARS-CoV-2.[4] However, other studies based on the health population also reported that females had higher positivity rates than males.[6] Compared with females, male patients have high mortality and require longer hospitalization time.[4] Consistent with these studies, our study also noted a higher seroprevalence of SARS-CoV-2 in female than male. However, the difference was not statistically significant.

What causes the difference in the number of male and female between asymptomatic infection and symptomatic infection? In general, males generate less robust immune responses and are more susceptible to a variety of infectious agents. As early as 2017, it was reported that the protective effect of estrogen receptor signaling in mice infected with SARS-CoV, and estrogen signaling in females may directly suppress SARS-CoV replication by means of effects on cellular metabolism.[7] Therefore, more data are needed to confirm how sex differences contribute to the outcome of SARS-CoV-2 infection. On the other hand, studies reported that the proportions of subjects' positive rate of IgM or IgG varied by age and reached the peak in a certain age.[2,8] In accordance with those results, our study observed that the positivity rate of antibody showed the same trend with age, and the peak was 41-50 y old. Of note, the peak occurred in different age group, which may be related to regional differences and immune responses. Additionally, recent studies suggested that people with different blood types have different susceptibility to COVID-19.[9] However, the difference was not observed in our study.

In addition, there were several limitations in our study. First, the samples were collected from blood donors, rather than randomly selected from a wide range of people. Thus, the seropositivity of SARS-CoV-2 antibody may be affected by sampling bias. On the other hand, it was reported that over 70% COVID-19 convalescent plasma donors persist to produce IgG at detectable levels for more than 1 y postdiagnosis, and 51.67% of people with low-titer turned negative after a long period of time.[10] Our testing time was after the COVID-19 epidemic in Wuhan, which may lead to bias that some donors with low antibody levels could no longer be detected. Thus, the seropositivity of SARS-CoV-2 antibody observed in our study may be lower than the true prevalence.

Conclusions

Our study results suggest that the serological detection of SARS-CoV-2 antibody among blood donors in Chongqing further confirmed the correlation between the seropositivity and risk levels in areas, which not only enriched the prevalence of SARS-CoV-2 in low-risk areas, but also could be used to review and analyze whether the public health interventions were effective.

Ethical standard. This study was reviewed and approved by the Ethical Committee of Chongqing Blood Center (Chongqing medical scientific research project [Joint project of Chongqing Health Commission and Science and Technology Bureau]:2021MSXM149).

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