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The Humoral Immunity Features of COVID-19 in West Georgia Population

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ABSTRACT

Background: SARS-CoV-2 is still active and spreading among us, even though the COVID-19 disease pandemic is believed to have been terminated due to the extraordinary efforts of healthcare professionals and scientists. Thousands of people are being infected today.

Objectives: The current study aimed to analyze existing data on the transmission of the SARS-CoV-2 virus among the West Georgia population and investigate the humoral immune response generated by the viral infection and vaccination as well.

Methods: The research was conducted between March 2022 and March 2023. The study group included 400 adults (69% women and 31% men) residing in Kutaisi. Study patients were distributed among four groups: (i) Group 1: patients with confirmed SARS-CoV-2 infection without previous vaccination; (ii) Group 2: previously vaccinated patients without SARS-CoV-2 infection; (iii) Group 3: previously vaccinated patients with confirmed SARS-CoV-2 infection; and (iv) Group 4: uninfected and unvaccinated patients. All groups were divided into subgroups with positive and negative humoral responses. Each subgroup was further divided into subgroups based on gender. Data were analyzed by STATA 17. Statistical significance was defined as $p < 0.05$.

Results: 55% of the study population was vaccinated, mainly with Pfizer's vaccine. The incidence of SARS-CoV-2 infection was equal for women and men, and they developed active immunity almost equally. The average rate of humoral immunity was 60%, with the highest rate (≈85% ($r<0.05$, $p<0.001$) in the triple-vaccinated individuals. Finally, the concentration of anti-SARS-CoV-2 IgG antibodies was particularly high (32%) in the previously vaccinated patients with confirmed SARS-CoV-2 infection. The average duration of effective concentration of G class immunoglobulins was maintained for 6-12 months.

Conclusions: In most cases, the SARS-CoV-2 infection in combination with the Pfizer vaccination induces a maximal humoral immune response, although not always and not for long.

Keywords: COVID-19; humoral immunity; SARS-CoV-2 viral infection; vaccination.

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BACKGROUND

Among many different global crises, the one in 2019 was triggered by a widespread new strain of the coronavirus (SARS-CoV-2) with a high morbidity and mortality rate.1 The virus overwhelmed both the human immune system and global health systems, which were unprepared for such an enormous challenge.[2] This was not unexpected given that the line of human defense against the virus runs through its phylogenetic memory; consequently, immunocompetent cells acquire an appropriate immune response only against known infectious pathogens.[3] SARS-CoV-2 was not known to affect humans until 2019, and our immune system was not yet prepared for dealing with this new agent.[2,4,5]

The COVID-19 pandemic seems to have been halted by the tremendous efforts of healthcare professionals and scientists. However, SARS-CoV-2 has not disappeared; it is still active and spreading among us. In this context, it was decided to process the available data on the transmission of the SARS-CoV-2 virus among the West Georgia population investigate the humoral immune response generated by the viral infection and vaccination as well.

METHODS

The study was conducted between March 2022 and March 2023. The research sample consisted of 400 adults (69% females and 31% males) from Kutaisi. Patients in the study were divided into four groups: (i) Group 1: patients with confirmed SARS-CoV-2 infection who had not previously been vaccinated; (ii) Group 2: previously vaccinated patients without SARS-CoV-2 infection; (iii) Group 3: previously vaccinated patients who had confirmed SARS-CoV-2 infection; and (iv) Group 4: uninfected and unvaccinated patients. All groups were subdivided into positive and negative humoral responses. Each subgroup was further divided based on gender. STATA 17 was used to analyze the data. The statistical significance level was set at p 0.05.

RESULTS

The baseline characteristics of the study participants are presented in Table 1.

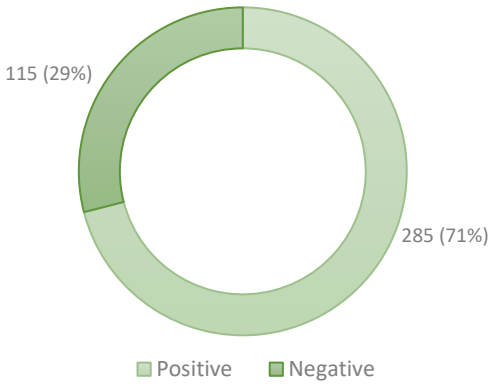
TABLE 1. Baseline characteristics of study patients

	Group1		Group2		Group3		Group4	
	N	%	N	%	N	%	N	%
Number of participants	107	27	86	22	132	32	75	20
Gender (F/M)	78/29	19/7	61/25	15/6	85/47	21/12	53/22	13/6
Age, M±SD	23±14.5		32.5±17.5		26±18.0		38±13.0	
BMI (kg/m2), M±SD	64±10		78±14		75±21		69±16	

Abbreviations: F/M, female/male; Group 1, patients with confirmed SARS-CoV-2 infection without previous vaccination; Group 2, previously vaccinated patients without SARS-CoV-2 infection; Group 3, previously vaccinated patients with confirmed SARS-CoV-2 infection; Group 4, uninfected and unvaccinated patients; M±SD, mean ± standard deviation; N, number.

The positive anti-SARS-CoV-2 antibody test was confirmed in 285 (71%) study participants and negative in 115 (29%) (Fig. 1). Concerning gender, 195 (71%) females and 90 (73%) males had a positive antibody test, and 82 (29%) females and 33 (27%) males had a negative test. There was no statistically significant difference between females' and males' humoral immunity rates.

FIGURE 1. Humoral immunity rates in all 400 study participants



Among 107 patients in Group 1 with acute COVID-19 disease, 66 (62%) had anti-SARS-CoV-2 antibodies, while the antibody test was negative in 41 (Fig.2).

47 of 86 patients with the first episode of acute COVID-19 had positive humoral immunity, and 39 patients did not have specific antibodies against SARS-CoV-2 (Fig.2).

17 of 19 patients with the second episode and one patient with the third episode of acute SARS-CoV-2 infection had positive antibody tests (Fig.2).

There was only one seropositive patient with a fourth episode of acute COVID-19 disease (Fig.2).

FIGURE 2. Humoral immunity in patients with COVID-19 disease

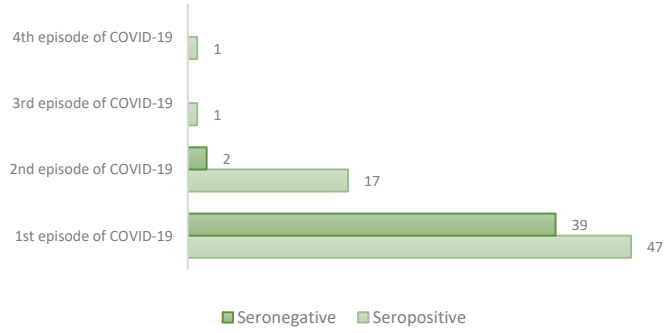


Figure 3 represents the utilization rate of different COVID-19 vaccines in Groups 2 and 3, or in previously vaccinated patients without SARS-CoV-2 infection and in previously vaccinated patients with confirmed SARS-CoV-2 infection, respectively. Out of 400 patients, 219 (55%) were vaccinated, of which 164 (41%) were vaccinated with Pfizer, 43 (11%) with Sinopharm, 11 (2.75%) with Sinovac, and only 1 (0.25%) with AstraZeneca.

FIGURE 3. Utilization rate of different COVID-19 vaccines in Groups 2 and 3

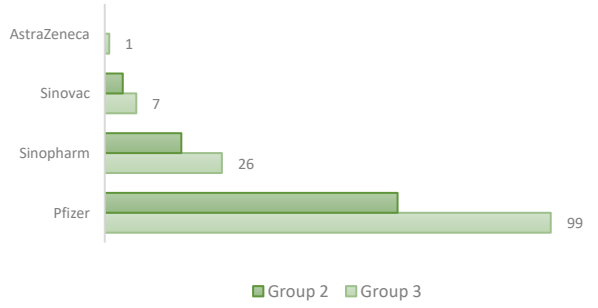


Figure 4 depicts the rate of vaccination and revaccination among all 219 vaccinated study participants.

FIGURE 4. Vaccination and re-vaccination rates of study participants

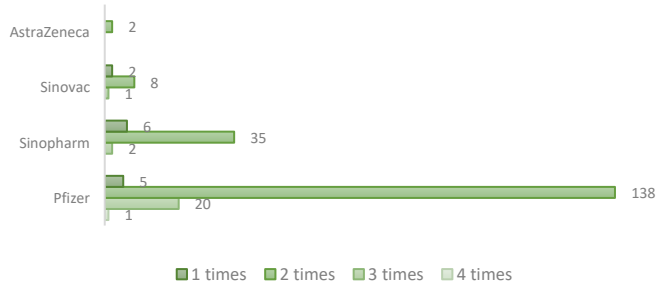


Table 2 represents the data of humoral immunity in the vaccinates study participants. It was found that >1-year

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length of immunity was provided among 75% of previously vaccinated patients without SARS-CoV-2 infection (Group 2) and 82% of previously vaccinated and infected patients (Group 3).

TABLE 2. Humoral immune response on different vaccines

	Humoral immunity	Pfizer	Sinopharm	Sinovac	AstraZeneca	All
Group 2	Positive	54(13.5%)	6(1.5%)	4(1%)	-	64(16%)
	Negative	11(2.7%)	9(2.3%)	2(0.5%)	-	22(5.5%)
Group 3	Positive	93(23.3%)	18(4.5%)	3(0.75%)	1(0.3%)	114(29%)
	Negative	10(2.5%)	6(1.5%)	2(0.5%)	-	18(4.5%)

Abbreviations: Group 2, previously vaccinated patients without SARS-CoV-2 infection; Group 3, previously vaccinated patients with confirmed SARS-CoV-2 infection.

DISCUSSION

The majority of blood group antigens are found on red blood cells, thrombocytes, leukocytes, plasma proteins, and some epithelial tissues.1

The Rhesus (Rh) blood group system is one of the most complex, polymorphic, and immunogenic systems of our body and consists of approximately 45 independent antigens.[23]

It is known that the ABO and Rh blood group systems are linked with infection, malignancy, and coagulation. Rhesus-negative subjects were reported to have more frequent allergic, digestive, cardiovascular, hematological, immune, mental health, and neurological problems.[24]

Several studies investigating possible relationships between blood types, SARS-CoV-2 susceptibility, and the severity of COVID-19 disease have been conducted during the past two years.

According to the results of the current study, Rh+ and Rh- phenotypes were equally distributed in the control and post-infection groups (chi-square is 0.2867, the p-value is 592363, and the results are not reliable $p<0.05$). Particularly in the control group, the prevalence rate of the Rh-positive phenotype was 78.9% and the Rh-negative phenotype was 21.1%, while in the post-infection group, the prevalence rates of the Rh+ and Rh- phenotypes were 81.7% and 18.8%, respectively. These results allowed us to conclude that there is no correlation between the Rhesus factor and SARS-CoV-2 susceptibility.

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In our previous work, we demonstrated an association between ABO blood types and SARS-CoV-2 infection.[25] Evaluating the relationship between combined ABO and Rhesus phenotypes and SARS-CoV-2 susceptibility, we found some statistically significant correlations. Particularly, the O(I)Rh-phenotypic group was presented at approximately 1.4 times lower frequency in post-infection individuals than the controls. This fact gives the O(I)Rh- group the status of a relatively resistant phenotype to the SARS-CoV-2 infection. On the other side, the prevalence of the A(II)Rh+ phenotypic combination was higher in the group of post-infection patients than in the controls. This indicates that this phenotype is more susceptible to SARS-CoV-2 virus infection.

Our findings are consistent with those of other authors. In a single-center, retrospective investigation, Rana and colleagues[26] hypothesized that blood groups O, AB, and Rh-negative are less likely to be infected with SARS-CoV-2 infection than blood groups A, B, and Rh+. The cited authors found no association between blood types and COVID-19 disease severity or mortality.

Zeits and co-authors suggested that blood type is important for the risk of infection, intubation, and death.[21] They predict that all three outcomes are less likely for Rh-negative individuals. A protective relationship between Rh-negative blood types and SARS-CoV-2 infection, intubation, and death was also suggested by them.

There are several hypotheses that explain why Rh-negative individuals are more resistant to viral infections. One of the most well-known is that those who are Rh-negative are more likely to develop a variety of cardiac and respiratory conditions, as well as some immunological and autoimmune disorders, like rheumatoid arthritis. According to the global population pattern, Rh-negative people may struggle with autoimmunity, may be more resistant to viral infections, and conversely, may be less resistant to illnesses of bacterial origin.[24]

There are alternative suggestions by several authors.[27] Laurys and coauthors didn't find any relationship between blood group and infection rate.

We think that larger sample sizes or meta-analyses are required to estimate these effects more clearly. We hope that our findings will be used in meta-analyses.

CONCLUSIONS

According to the findings of the present study, there was no correlation between the Rhesus blood group and SARS-CoV-2 susceptibility. On the other hand, the highest prevalence of the A(II)Rh+ and lowest O(I)Rh- phenotypic combinations are found among patients in the post-infection period. Due to this, the O(I)Rh- the group might be classified as relatively

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resistant to SARS-CoV-2 infection. On the other hand, SARS-CoV-2 virus infection is more likely to affect the O(I)Rh-phenotype.

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