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

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ABSTRACT

Background: 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. The 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 and 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.

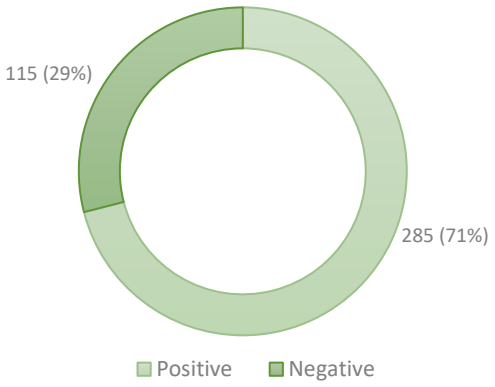
TABLE 1. Baseline characteristics of study participants

	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 (Fig.1).

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

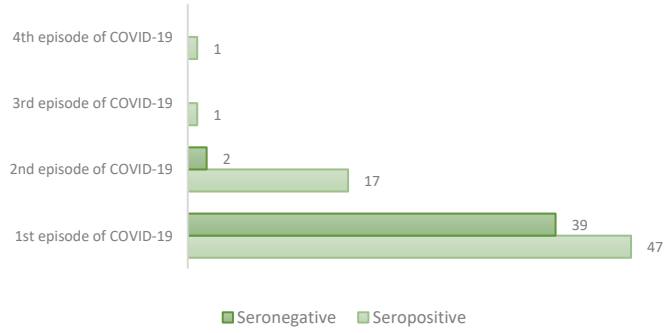


Figure 3 represents the utilization rate of different COVID-19 vaccines in Groups 2 and 3, or in previously vaccinated patients without SARS-CoV-2 infection and in previously vaccinated patients with confirmed SARS-CoV-2 infection, respectively. Out of 400 patients, 219 (55%) were vaccinated, of which 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

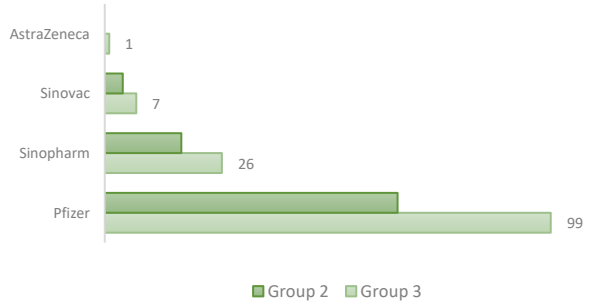


Figure 4 depicts the rate of vaccination and revaccination among all 219 vaccinated study participants.

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

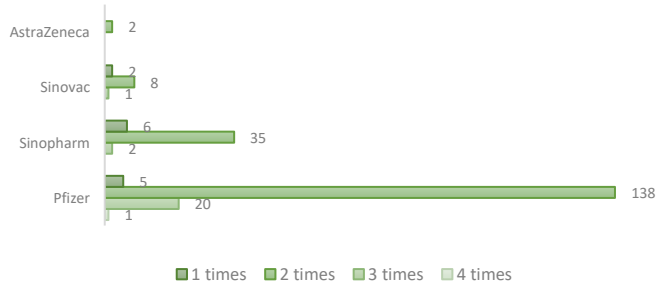


Table 2 represents the data on humoral immunity in the vaccinated study participants. It was found that >1-year

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 to 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

Humoral immunity is an effective means of protecting the host from recurring infections, and its production is highly dependent on specific antibodies created by the host immune system against the microbes.[6,7]

The intensity of newly generated memory cells determines the length and efficiency of specific immunity. It is also well understood that both the host and the microorganisms actively create a humoral immune response.[8,9]

The current study looked at existing data on the spread of the SARS-CoV-2 virus among the West Georgia population as well as the humoral immune response elicited by viral infection and vaccination.

According to the results of the current study, it can be argued that SARS-CoV-2 equally infects women and men and almost equally develops active immunity; unlike other studies, gender differences in the humoral immune response were not confirmed.[10]

55% of the studied West Georgian population was previously vaccinated, mostly by the Pfizer vaccine, with statistically higher humoral immunity (61%; $r<0.03$, $p<0.005$). A high level of seropositivity was also observed after booster doses (≈85%; $r<0.05$, $p<0.001$).

The Sinopharm vaccine was not associated with persistent immunity. However, due to the small number of cases, these data still need to be studied.

It is important to note that 71% of the 118 seronegative patients were exposed to the SARS-CoV-2 virus, vaccinated, or both but failed to develop immunity. It is worth noting the case of one patient who, after being vaccinated four times with the Pfizer vaccine in 2021, had two episodes of the acute COVID-19 disease in 2021–2022, and despite this, was seronegative at the time of the study.

The data analysis also revealed that the maximum duration of retaining antibodies against the SARS-CoV-2 virus varied between 6 months and 1 year.

CONCLUSIONS

In most cases, SARS-CoV-2 infection combined with Pfizer immunization results in a maximal humoral immune response, but not always and not for long.

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