JRMC Open Access Original Article DOI: 10.37939/jrmc.v29i1.2776

Biochemical Markers, Medications, and COVID-19 Complications in Vaccinated Versus Unvaccinated Pakistani Patients

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Abstract

Objectives: This study aimed to explore the association between COVID-19 vaccination and prolonged post-COVID symptoms (long COVID) in adults reporting this condition.

Methods: This is a cross-sectional design of the study design. With the consent, the data were collected through questionnaire from patients (N=308) who visited OPD or were admitted to the hospital with COVID-19 infection. The patient demographic details, vaccination status, type of complications, and haematological and pathological blood tests including complete blood count (CBC), D-dimer, white blood cells (WBC), and platelet count along with medication details the patient used. Patients used either Group I medicines (Panadol and Azomax) or Group 2 (Azomax, Surbex-Z, Loprine, Multivitamin, Ivermectin, and anti-allergy). Using. The data was analyzed using characteristics and inferential statistics such as chi-square and Fischer's exact tests.

Results: A significant association is observed between the duration of infections and the type of medication used (group 1 & group 2). For infection duration of more than a week with group 1 medications 65.9% ($p<0.001$) and for two weeks or more with group II medications 87.9% ($p<0.001$). Data analysis showed no correlation between vaccination status and POST-Covid-19 complications. A significant association was observed when WBC count was compared with neuro-psychological and cardiovascular complications at the 0.05 significance level (p-values <0.001 & 0.008). No significant association was observed between neutrophil count and the type of vaccination used.

Conclusions: Biochemical and haematological diagnostic markers, such as blood CBC, platelet count, and neutrophil count, exhibit a correlation with the type of medication used in managing COVID-19 complications, highlighting differences between vaccinated and unvaccinated patients.

Keywords: Blood CBC, Neutrophil count, Platelet count, COVID-19, Hypertension

Review began 20/11/2024
Review ended 14/03/2025
Published 31/03/2025

How to cite this article: Durrani HM, Uzair MT, Mukhtar A, Sadaf H, Nasir R, Raza SI. Biochemical Markers, Medications, and COVID-19 Complications in Vaccinated Versus Unvaccinated Pakistani Patients. JRMC. 2025 Mar. 29;29(1). https://doi.org/10.37939/jrmc.v29i1.2776

Introduction

The COVID-19 pandemic has underscored the vital role that accurate diagnostics play in the management and treatment of infectious diseases. Early detection, precise assessment of disease severity, timely management and ongoing monitoring are essential for optimizing patient outcomes and guiding public health responses. As the virus continues to evolve and impact populations globally, the reliance on both laboratory tests and imaging techniques has proven indispensable in the fight against COVID-19.[1.]

Research is underway to identify novel vaccines and therapeutics for COVID-19, including repurposing of medications. Based on evidence from in vitro studies on the suppression of activity of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and other

coronavirus strains, interest increased in the use of paracetamol, azithromycin, Ivermectin, multivitamins, herbal medicines or home remedies for the treatment of COVID-19.[3-7.]

Laboratory markers, such as white blood cells (WBCs), neutrophils, D-Dimer and platelets, have emerged as critical tools for understanding the immune response and progression of COVID-19. While early studies have highlighted the role of lymphopenia (reduced lymphocyte count) as a marker of disease severity, there is still a significant gap in the literature regarding the broader implications of WBC differentials, including neutrophil-to-lymphocyte ratios, and their prognostic value. Neutrophilia, an elevated neutrophil count, has been linked to severe disease and a hyper-inflammatory state, often described as a "cytokine storm." Similarly, abnormalities in platelet counts, whether elevated or reduced, have been associated with thrombotic complications, which are increasingly recognized as significant contributors to morbidity and mortality in COVID-19 patients. However, more research is needed to clarify the thresholds at which these changes become clinically significant and to establish how they can be used to predict outcomes or tailor therapeutic interventions.[8-10]

In the current study, we have enrolled 308 vaccinated and unvaccinated patients suffering from COVID-19 infection. We have investigated the efficacy of commonly used medications and home remedies in association with diagnostic markers and duration of infection. By combining these diagnostic approaches, clinicians can tailor treatments, allocate medical resources more effectively, and make informed decisions about patient care. This article will explore the significance of these diagnostic tools in COVID-19 management, their impact on clinical outcomes, and the ongoing need for advancements in diagnostic technologies as the pandemic—and the virus—continues to evolve.

Materials And Methods

This study employed a cross-sectional design to investigate the association between COVID-19 vaccination status, the duration of infection, and the presence of complications related to the cardiovascular system and neurological and medications. Data was collected using a structured questionnaire administered to 308 adult patients (after data cleaning) who had experienced COVID-19 infection. The questionnaire captured demographic details, vaccination status, post-COVID complications, hematological and biochemical test results (CBC, D-dimer, WBC, platelet count), and medication history. The data collectors, who were physicians, were provided with a detailed explanation of the questionnaire before administering it. They then filled out the questionnaires based on patient responses and shared the completed forms with us for analysis. Statistical analyses included descriptive statistics to summarize participant characteristics and inferential statistics, such as chi-square and Fisher's exact tests, to examine associations between variables. The significance level was set at $p < 0.05$.

The study was conducted in five hospitals, including HBS Medical College, Islamabad; Rawal Institute of Health Sciences (RIHS), M. Islam Medical College Teaching Hospital, Gujranwala; CMH-Kharian Medical College Hospital, Kharian; and Shifa International Hospital, Islamabad. Patients were recruited from both outpatient departments (OPD) and hospital admissions during the study period. The study was conducted over two years and two months, from May 2021 to July 2023. Data collection was completed within this timeframe.

The questionnaire was shared with the COVID patients as well who visit physicians in the clinics or hospitalized. Oral as well as written consent was obtained from all patients to share their information for research purposes. We inquired about their current health status and if they agreed to participate in the study. We asked whether the patient has noticed any particular problems during the past seven days, compared with their pre-COVID-19 condition. We specifically asked about experiencing these problems during the past seven days to minimize the risk of recall bias. Before the start of this study ethical approval was obtained from the ethical board of HBS Medical and Dental College Islamabad.

Results

The demographic profile as presented in Figure 1 shows that the study included a total of 308 participants, with a slightly higher number of males (163, 52.9%) compared to females (145, 47.1%). The age distribution of the participants shows a diverse range. The largest age group is 18-30 years, comprising 142 participants or 46.1% of the total sample. This is followed by the 31-45 years age group, which includes 101 participants (32.8%). Participants aged 46-60 years account for 46 individuals, representing 14.9% of the sample. The younger and older ages are less represented, with 10 participants (3.2%) being less than 18 years old and 9 participants (2.9%) being more than 60 years old. This demographic profile suggests a predominantly young adult sample, with a balanced representation of genders.

This bar graph represents the distribution of enrolled patients by gender and age groups. The total number of patients (N=308m) includes 145 females and 163 males. Patients are categorized into five age groups: <18, 18–30, 31–45, 46–60, and >60 years. The number of subjects in each group is indicated above the respective bars. The study gathered information on the various medicines used by participants, allowing for multiple responses as participants could select more than one medicine. The data are presented in Figure 2. The most commonly used medicine among participants is Panadol, with 255 responses, accounting for 22.1% of the total responses. This is followed by Azomax, selected by 204 participants (17.7%). Home remedies were also frequently used, with 145 responses, representing 12.6% of the total. Multivitamins were used by 139 participants (12.0%), and anti-allergy medications

were chosen by 123 participants (10.6%). Similarly, Surbex Z was selected by 123 participants (10.6%). Loprine was used by 103 participants, making up 8.9% of the responses. Less commonly used medicines include Ivermectin, with 57 responses (4.9%), and CIPROFLOXACIN500, with 4 responses (0.3%).
The last selected medicines were Calcee and Moxifloxacin, each with only 1 response, accounting for 0.1% of the bar graph illustrates the types of medications used by COVID-19 patients. The percentages of patients using each medication are displayed along with the corresponding number of subjects above each bar.

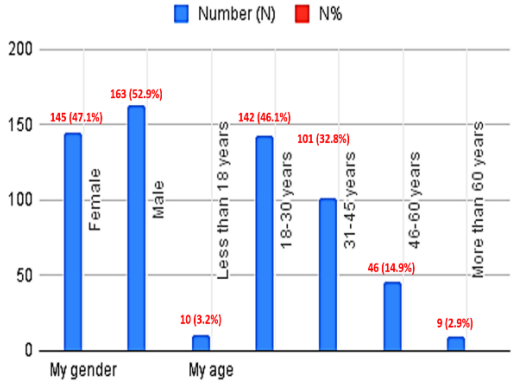

Figure 1: Demographic profile

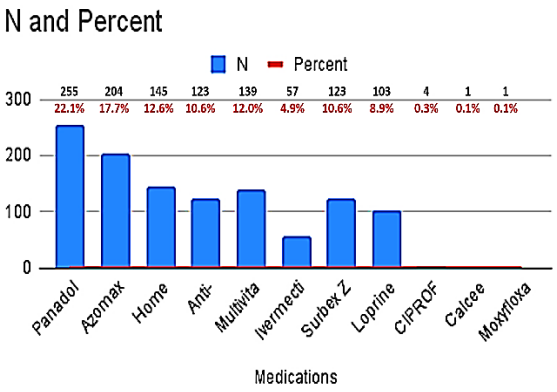

Figure 2: Medications frequencies

The study examined the relationship between the duration of COVID-19 infection and the type of medications used, categorized into two groups: Group 1 (Panadol and Azomax) and Group 2 (all other medications). This analysis was further divided based on participants' vaccination status (vaccinated vs. unvaccinated) (Table 1).
For vaccinated participants, there is a significant association between the duration of infection and the type of medications used. Among those whose infection lasted less than a week, 34.1% didn't use Group 1 medications, while 65.9% did use them. For infections lasting more than a week, only 91.6% used Group 1 medications compared to 8.4% who did not. For infections lasting two weeks or more, 95.7% used Group 1 medications, whereas 4.3% did not ($p < 0.001$). In Group 2, 61.0% of participants with infections lasting less than a week used these medications, with 39.0% not using them. For infections lasting more than a week, 94.1% used Group 2 medications compared to 5.9% who did not. For infections of two weeks or more, 87.9% used Group 2 medications, while 12.1% did not ($p < 0.001$) (Table 1).

Table 1: Medications and Time of recovery with vaccination

I have been vaccinated for (SARS-CoV-2)			Group 1 Medications			Group 2 Medications		
			No	Yes	P-value	No	Yes	P-value
Yes	The duration of my infection was:	Less than a week	14 34.1%	27 65.9%	0.000	16 39.0%	25 61.0%	0.000
		More than a week	10 8.4%	109 91.6%		7 5.9%	112 94.1%	
		2 weeks or more	5 4.3%	111 95.7%		14 12.1%	102 87.9%	
No	The duration of my infection was:	Less than a week	1 33.3%	2 66.7%	0.100	2 66.7%	1 33.3%	0.007
		More than a week	0 0.0%	16 100.0%		0 0.0%	16 100.0%	
		2 weeks or more	0 0.0%	11 100.0%		2 18.2%	9 81.8%	

Among unvaccinated participants, the association between the duration of infection and the type of medications used shows varying levels of significance. For infections lasting less than a week, 66.7% used Group 1 medications, and 33.3% did not ($p = 0.100$). Participants with infections lasting more than a week or two weeks or more used Group 1 medications. In Group 2, 66.7% of participants with infections lasting less than a week didn't use these medications, with 33.3% using them. For infections lasting more than a week, participants used Group 2 medications. For infections lasting two weeks or more, 81.8% used Group 2 medications, while 18.2 did not ($p = 0.007$).

Among vaccinated participants, there is a strong and significant association between the duration of infection and the type of medications used, with those experiencing longer infections being more likely to use either Group 1 or Group 2 medications. While some significant associations are noted for unvaccinated participants, the small sample sizes in certain categories suggest a cautious interpretation. The data indicate that unvaccinated individuals who used Group 2 medications were more likely to have longer infections (Table 1).

The study explored the association between the presence of complications (neuro-psychological and cardiovascular) and the COVID-19 vaccination status of participants as given in Figure 3. Among vaccinated participants, 75.4% (208 participants) reported no neuropsychological complications, while 24.6% (68 participants) reported having such complications. In contrast, among unvaccinated participants, a higher percentage of 86.7% (26 participants) reported no neuro-psychological complications, and 13.3% (4 participants) reported experiencing complications. The p-value for this association is 0.120, indicating that the difference is not statistically significant. For cardiovascular complications, 68.1% (188 participants) of vaccinated individuals reported no complications, while 31.9% (88 participants) reported experiencing cardiovascular complications. Among unvaccinated participants, 76.7% (23 participants) reported no cardiovascular complications, and 23.3% (7 participants) reported having complications. The p-value for this association is 0.229, suggesting that this difference is also not statistically significant. The analysis indicates that there is no statistically significant association between the occurrence of neuro-psychological or cardiovascular complications and COVID-19 vaccination status. While a higher percentage of unvaccinated participants reported no complications compared to vaccinated participants, the differences in complication rates between the groups were not statistically significant ($p > 0.05$). This suggests that vaccination status does not significantly impact the likelihood of experiencing neuropsychological or cardiovascular complications in the study sample as shown in Figure 3.

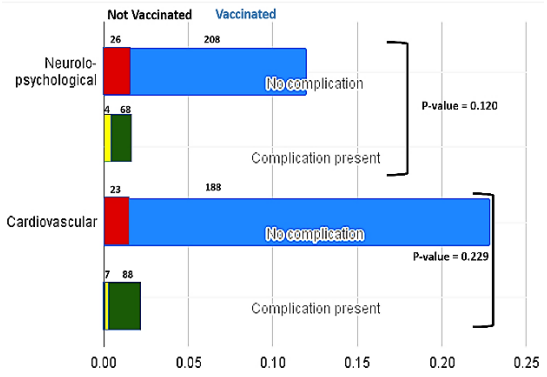

Figure 3: Vaccination Status and Complications

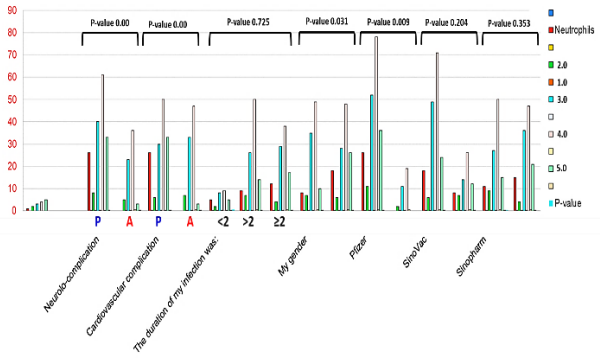

Figure 4: Neutrophils and Other Factors Association

The bar graph compares the occurrence of neurological and cardiovascular complications between vaccinated and unvaccinated patients. Each bar represents the number of patients in the respective groups, with P-values displayed alongside the bars.

Based on Table 2, chi-square test results the relationship between D-Dimer test results and various factors such as neurological and cardiovascular complications, duration of infection, gender, and type of COVID-19 vaccination received has been observed. For neurological-psychological complications, the chi-square test results show that 44.9% of participants without complications had a D-Dimer level of 1, while 30.3% had a level of 2, and 13.5% had a level of 3. None of the participants with complications had a D-Dimer level of 1 or 3, with 100% showing a level of 2. The p-value for this association is 0.140, indicating no significant relationship between neurological-psychological complications and D-Dimer test results. Regarding cardiovascular complications, 45.3% of participants without complications had a D-Dimer level of 1, and 29.1% had a level of 2. In contrast, 14.3% of participants with complications had a D-Dimer level of 1, and 85.7% had a level of 2. The p-value of 0.103 suggests no significant association between cardiovascular complications and D-Dimer test results. The duration of infection also does not show a significant relationship with D-Dimer levels. Participants who were infected for less than a week had D-Dimer levels of 1 (31.3%), 2 (43.8%), and 3 (12.5%). Those infected for more than a week had levels of 1 (45.7%), 2 (34.3%), and 3 (11.4%). Participants infected for two weeks or more had levels of 1 (45.2%), 2 (28.6%), and 3 (14.3%). The p-value here is 0.880. When examining gender, 37.8% of female participants had a D-Dimer level of 1, 24.3% had a level of 2, and 21.6% had a level of 3. For male participants, 46.4% had a level of 1, 39.3% had a level of 2, and 7.1% had a level of 3. The p-value of 0.065 indicates that there might be a trend, but it is not statistically significant. For vaccination types, participants who did not receive the Pfizer vaccine had D-Dimer levels of 1 (43.3%), 2 (32.2%), and 3 (13.3%), while those who received it had levels of 1 (33.3%) and 2 (66.7%). The p-value is 0.814. For the Sinovac vaccine, non-recipients had levels of 1 (40.9%), 2 (37.8%), and 3 (12.1%), whereas recipients had levels of 1 (48.1%), 2 (22.2%), and 3 (14.8%), with a p-value of 0.394. Lastly, for the Sinopharm vaccine, non-recipients had levels of 1 (43.2%), 2 (35.1%), and 3 (10.8%), while recipients had levels of 1 (42.9%), 2 (32.1%), and 3 (14.3%). The p-value is 0.855 (Table 2).

Thus, the chi-square test results indicate that none of the factors analyzed—neurological-psychological complications, cardiovascular complications, duration of infection, gender, and type of COVID-19 vaccination show a statistically insignificant association with the D-Dimer test results at the 0.05 significance level. This means that within this sample of 308 participants, these factors do not appear to influence the D-Dimer levels in a significant way (Table 2).

Table 2: D-Dimer test relationship with other factors

		D-Dimers test										P-value
		1 <100		2 150		3 250		4 250		5 >250		
		N	N%	N	N%	N	N%	N	N%	N	N%	
Neurolo-psychological	No complication	40	44.9%	27	30.3%	12	13.5%	3	3.4%	7	7.9%	0.140
	Complication present	0	0.0%	4	100.0%	0	0.0%	0	0.0%	0	0.0%	
Cardiovascular	No complication	39	45.3%	25	29.1%	12	14.0%	3	3.5%	7	8.1%	0.103
	Complication present	1	14.3%	6	85.7%	0	0.0%	0	0.0%	0	0.0%	
The duration of my infection was:	Less than a week	5	31.3%	7	43.8%	2	12.5%	1	6.3%	1	6.3%	0.880
	More than a week	16	45.7%	12	34.3%	4	11.4%	0	0.0%	3	8.6%	
	2 weeks or more	19	45.2%	12	28.6%	6	14.3%	2	4.8%	3	7.1%	
My gender	Female	14	37.8%	9	24.3%	8	21.6%	1	2.7%	5	13.5%	0.065
	Male	26	46.4%	22	39.3%	4	7.1%	2	3.6%	2	3.6%	
Pfizer	No	39	43.3%	29	32.2%	12	13.3%	3	3.3%	7	7.8%	0.814
	Yes	1	33.3%	2	66.7%	0	0.0%	0	0.0%	0	0.0%	
SinoVac	No	27	40.9%	25	37.9%	8	12.1%	1	1.5%	5	7.6%	0.394
	Yes	13	48.1%	6	22.2%	4	14.8%	2	7.4%	2	7.4%	
Sinopharm	No	16	43.2%	13	35.1%	4	10.8%	2	5.4%	2	5.4%	0.855
	Yes	24	42.9%	18	32.1%	8	14.3%	1	1.8%	5	8.9%	

Based on the Table 3 chi-square test results, the relationship between white blood cell (WBC) count and various factors such as neurological and cardiovascular complications, duration of infection, gender, and type of COVID-19 vaccination received has been observed.For neurological-psychological complications, the chi-square test results show that 96.7% of participants without complications had a WBC count of 1.0, while 65.2% had a count of 2.0, and 55.8% had a count of 3.0. Only 3.3% of participants with complications had a WBC count of 1.0, while 34.8% had a count of 2.0, and 44.2% had a count of 3.0. The p-value for this association is 0.000, indicating a statistically significant relationship between neurological-psychological complications and WBC count. Regarding cardiovascular complications, 96.7% of participants without complications had a WBC count of 1.0, 47.8% had a count of 2.0, and 48.4% had a count of 3.0. Among participants with complications, 3.3% had a WBC count of 1.0, 52.2% had a count of 2.0, and 51.6% had a count of 3.0. The p-value of 0.000 suggests a significant association between cardiovascular complications and WBC count. The duration of infection does not show a significant relationship with WBC count. Participants who were infected for less than a week had WBC counts of 1.0 (23.3%), 2.0 (8.7%), and 3.0 (6.3%). Those infected for more than a week had counts of 1.0 (23.3%), 2.0 (52.2%), and 3.0 (50.5%). Participants infected for two weeks or more had counts of 1.0 (53.3%), 2.0 (39.1%), and 3.0 (43.2%). The p-value here is 0.100. When examining gender, 26.7% of female participants had a WBC count of 1.0, 56.5% had a count of 2.0, and 49.5% had a count of 3.0. For male participants, 73.3% had a count of 1.0, 43.5% had a count of 2.0, and 50.5% had a count of 3.0. The p-value of 0.125 indicates that there is no statistically significant association between gender and WBC count. For vaccination types, participants who did not receive the Pfizer vaccine had WBC counts of 1.0 (100.0%), 2.0 (80.4%), and 3.0 (80.0%), while those who received it had counts of 1.0 (0.0%), 2.0 (19.6%), and 3.0 (20.0%). The p-value is 0.008, indicating a significant association between receiving the Pfizer vaccine and WBC count. For the Sinovac vaccine, non-recipients had counts of 1.0 (60.0%), 2.0 (65.2%), and 3.0 (73.7%), whereas recipients had counts of 1.0 (34.8%), 2.0 (34.8%), and 3.0 (26.3%), with a p-value of 0.181. Lastly, for the Sinopharm vaccine, non-recipients had counts of 1.0 (53.3%), 2.0 (60.9%), and 3.0 (48.4%), while recipients had counts of 1.0 (39.1%), 2.0 (39.1%), and 3.0 (51.6%). The p-value is 0.079. Thus, the chi-square test results indicate significant associations between WBC count and neuro-psychological complications, cardiovascular complications, and receiving the Pfizer vaccine, with p-values of 0.000 and 0.008, respectively.

These factors appear to influence WBC levels significantly. However, the duration of infection, gender, and receiving the Sinovac or Sinopharm vaccines do not show a statistically significant association with WBC count at the 0.05 significance level (Table 3).

The relationship between neutrophil counts and various factors such as neurological and cardiovascular complications, duration of infection, gender, and type of COVID-19 vaccination received has been observed in Figure 4.

For neurological complications, the chi-square test results show that 15.5% of participants without complications had a neutrophil count of 1.0, while 4.8% had a count of 2.0, and 23.8% had a count of 3.0. Among participants with complications, 0.0% had a neutrophil count of 1.0, 7.5% had a count of 2.0, and 34.3% had a count of 3.0. The p-value for this association is 0.000, indicating a statistically significant relationship between neurological complications and neutrophil counts.

Table 3: WBC count and its relationship with other factors

		WBC count										P-value
		1.0 $4x10^9/L$		2.0 $6x10^9/L$		3.0 $8x10^9/L$		4.0 $10x10^9/L$		5.0 $11x10^9/L$		
		N	N %	N	N %	N	N %	N	N %	N	N %	
Neurolo-psychological	No complication	29	96.7%	30	65.2%	53	55.8%	25	69.4%	26	96.3%	0.000
	Complication present	1	3.3%	16	34.8%	42	44.2%	11	30.6%	1	3.7%	
Cardiovascular	No complication	29	96.7%	22	47.8%	46	48.4%	21	58.3%	26	96.3%	0.000
	Complication present	1	3.3%	24	52.2%	49	51.6%	15	41.7%	1	3.7%	
The duration of my infection was:	Less than a week	7	23.3%	4	8.7%	6	6.3%	5	13.9%	5	18.5%	0.100
	More than a week	7	23.3%	24	52.2%	48	50.5%	15	41.7%	13	48.1%	
	2 weeks or more	16	53.3%	18	39.1%	41	43.2%	16	44.4%	9	33.3%	
My gender	Female	8	26.7%	26	56.5%	47	49.5%	19	52.8%	13	48.1%	0.125
	Male	22	73.3%	20	43.5%	48	50.5%	17	47.2%	14	51.9%	
Pfizer	No	30	100.0%	37	80.4%	76	80.0%	32	88.9%	27	100.0%	0.008
	Yes	0	0.0%	9	19.6%	19	20.0%	4	11.1%	0	0.0%	
SinoVac	No	18	60.0%	30	65.2%	70	73.7%	30	83.3%	17	63.0%	0.181
	Yes	12	40.0%	16	34.8%	25	26.3%	6	16.7%	10	37.0%	
Sinopharm	No	16	53.3%	28	60.9%	46	48.4%	11	30.6%	11	40.7%	0.079
	Yes	14	46.7%	18	39.1%	49	51.6%	25	69.4%	16	59.3%	

Regarding cardiovascular complications, 17.9% of participants without complications had a neutrophil count of 1.0, 4.1% had a count of 2.0, and 20.7% had a count of 3.0. Among participants with complications, 0.0% had a neutrophil count of 1.0, 7.8% had a count of 2.0, and 36.7% had a count of 3.0. The p-value of 0.000 suggests a significant association between cardiovascular complications and neutrophil counts. The duration of infection does not show a significant relationship with neutrophil counts. Participants who were infected for less than a week had neutrophil counts of 1.0 (17.2%), 2.0 (6.9%), and 3.0 (27.6%). Those infected for more than a week had counts of 1.0 (8.5%), 2.0 (6.6%), and 3.0 (24.5%). Participants infected for two weeks or more had counts of 1.0 (12.0%), 2.0 (4.0%), and 3.0 (29.0%). The p-value here is 0.725. When examining gender, 7.3% of female participants had a neutrophil count of 1.0, 6.4% had a count of 2.0, and 32.1% had a count of 3.0. For male participants, 14.3% had a count of 1.0, 4.8% had a count of 2.0, and 22.2% had a count of 3.0. The p-value of 0.031 indicates a statistically significant association between gender and neutrophil counts. For vaccination types, participants who did not receive the Pfizer vaccine had neutrophil counts of 1.0 (12.8%), 2.0 (5.4%), and 3.0 (25.6%), while those who received it had counts of 1.0 (0.0%), 2.0 (6.3%), and 3.0 (34.4%). The p-value is 0.009, indicating a significant association between receiving the Pfizer vaccine and neutrophil counts. For the Sinovac vaccine, non-recipients had counts of 1.0 (10.7%), 2.0 (3.6%), and 3.0 (29.2%), whereas recipients had counts of 1.0 (11.9%), 2.0 (10.4%), and 3.0 (29.9%), with a p-value of 0.204. Lastly, for the Sinopharm vaccine, non-recipients had counts of 1.0 (9.8%), 2.0 (8.0%), and 3.0 (24.1%), while recipients had counts of 1.0 (12.2%), 2.0 (3.3%), and 3.0 (29.3%). The p-value is 0.353. In conclusion, the chi-square test results indicate significant associations between neutrophil counts and neurological complications, cardiovascular complications, gender, and receiving the Pfizer vaccine, with p-values of 0.000, 0.031, and 0.009, respectively. These factors appear to influence neutrophil levels significantly. However, the duration of infection and receiving the Sinovac or Sinopharm vaccines do not show a statistically significant association with neutrophil counts at the 0.05 significance level.

The bar graph compares the presence (P) and absence (A) of neurological and cardiovascular complications among COVID-19 patients. The data highlights the distribution of complications within the studied groups.

Based on the provided table 4 chi-square test results the relationship between platelet counts and various factors such as neurological and cardiovascular complications, duration of infection, gender, and type of COVID-19 vaccination received can be seen.

For neurological complications, the chi-square test results show that 16.6% of participants without complications had a platelet count of 1.0, while 14.7% had a count of 2.0, and 38.0% had a count of 3.0. Among participants with complications, 5.7% had a platelet count of 1.0, 14.3% had a count of 2.0, and 71.4% had a count of 3.0. The p-value for this association is 0.000, indicating a statistically significant relationship between neurological complications and platelet counts. Regarding cardiovascular complications, 18.2% of participants without complications had a platelet count of 1.0, 15.4% had a count of 2.0, and 35.0% had a count of 3.0. Among participants with complications, 5.6% had a platelet count of 1.0, 13.3% had a count of 2.0, and 68.9% had a count of 3.0. The p-value of 0.000 suggests a significant association between cardiovascular complications and platelet counts. The duration of infection does not show a significant relationship with platelet counts. Participants who were infected for less than a week had platelet counts of 1.0 (28.6%), 2.0 (7.1%), and 3.0 (42.9%). Those infected for more than a week had counts of 1.0

(10.7%), 2.0 (12.6%), and 3.0 (51.5%). Participants infected for two weeks or more had counts of 1.0 (11.8%), 2.0 (19.7%), and 3.0 (46.1%). The p-value here is 0.109. When examining gender, 9.0% of female participants had a platelet count of 1.0, 18.9% had a count of 2.0, and 50.5% had a count of 3.0. For male participants, 17.2% had a count of 1.0, 10.7% had a count of 2.0, and 45.9% had a count of 3.0. The p-value of 0.093 indicates that there is no statistically significant association between gender and platelet counts. For vaccination types, participants who did not receive the Pfizer vaccine had platelet counts of 1.0 (14.9%), 2.0 (13.4%), and 3.0 (46.3%), while those who received it had counts of 1.0 (3.1%), 2.0 (21.9%), and 3.0 (59.4%). The p-value is 0.058, which is close to the significance level but still not statistically significant. For the Sinovac vaccine, non-recipients had counts of 1.0 (13.4%), 2.0 (15.2%), and 3.0 (48.2%), whereas recipients had counts of 1.0 (13.0%), 2.0 (13.0%), and 3.0 (47.8%), with a p-value of 0.850. Lastly, for the Sinopharm vaccine, non-recipients had counts of 1.0 (11.5%), 2.0 (15.0%), and 3.0 (49.6%), while recipients had counts of 1.0 (15.0%), 2.0 (14.2%), and 3.0 (46.7%). The p-value is 0.627.

Table 4. Platelet and other factors association

		Platelet count										P-value
		1.0 <150X10^9/L		2.0 200X10^9/L		3.0 300X10^9/L		4.0 400X10^9/L		5.0 >400X10^9/L		
		Count	Row N%	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	
Neurolo-complication	No complication	27	16.6 %	24	14.7%	62	38.0%	26	16.0%	24	14.7%	0.000
	Complication present	4	5.7%	10	14.3%	50	71.4%	6	8.6 %	0	0.0 %	
Cardiovascular complication	No complication	26	18.2 %	22	15.4%	50	35.0%	21	14.7%	24	16.8%	0.000
	Complication present	5	5.6%	12	13.3%	62	68.9%	11	12.2%	0	0.0 %	
The duration of my infection was:	Less than a week	8	28.6 %	2	7.1 %	12	42.9%	1	3.6 %	5	17.9%	0.109
	More than a week	11	10.7 %	13	12.6%	53	51.5%	17	16.5%	9	8.7 %	
	2 weeks or more	12	11.8 %	19	18.6%	47	46.1%	14	13.7%	10	9.8 %	
My gender	Female	10	9.0%	21	18.9%	56	50.5%	16	14.4%	8	7.2 %	0.093
	Male	21	17.2 %	13	10.7%	56	45.9%	16	13.1%	16	13.1%	
Pfizer	No	30	14.9 %	27	13.4%	93	46.3%	27	13.4%	24	11.9%	0.058
	Yes	1	3.1%	7	21.9%	19	59.4%	5	15.6%	0	0.0 %	
SinoVac	No	22	13.4 %	25	15.2%	79	48.2%	20	12.2%	18	11.0%	0.850
	Yes	9	13.0 %	9	13.0%	33	47.8%	12	17.4%	6	8.7 %	
Sinopharm	No	13	11.5 %	17	15.0%	56	49.6%	18	15.9%	9	8.0 %	0.627
	Yes	18	15.0 %	17	14.2%	56	46.7%	14	11.7%	15	12.5%	

Conclusively, the chi-square test results indicate significant associations between platelet counts and neurological complications, as well as cardiovascular complications, with p-values of 0.000. These factors appear to influence platelet levels significantly. However, the duration of infection, gender, and receiving the Pfizer, Sinovac, or Sinopharm vaccines do not show a statistically significant association with platelet counts at the 0.05 significance level. The p-value for the Pfizer vaccine is close to significant, suggesting a potential trend that warrants further investigation.

Discussion

Studying these laboratory markers is essential for advancing our understanding of the immune dysregulation caused by COVID-19 and for developing more personalized treatment strategies. For instance, tracking neutrophil and platelet levels over the course of infection could help identify patients at risk for complications such as acute respiratory distress syndrome (ARDS) or thrombosis, enabling earlier and more targeted interventions. Additionally, since COVID-19 affects individuals differently depending on factors such as age, pre-existing conditions, and viral load, further investigation into how these laboratory markers behave across diverse patient populations is crucial. Since the global COVID-19 pandemic began, a significant number of COVID-19 patients presented critical illnesses, and developed multiple organ failures including the lung, heart, and neurological dysfunction.[11- 14]

Effect of Medications on COVID-19 Symptoms Durations

In the current study the list of medication administered to COVID-19 patient over the course of disease were divided into two groups group I (Panadol and Azithromycin) and group II including all the other medicines in Figure 2. This study showed that unvaccinated individuals who used Group 2 medications were more likely to have longer infections symptoms. In reported

published earlier it is shown that patients who use azithromycin along with Panadol (aspirin) and hydroxychloroquine had higher level of ICU admissions and entered intensive care within 1 day.[15] Similarly, previously it is reported that use of paracetamol (Panadol) in COVID-19 patients showed significant results.[16] These findings are not coherent with these reports we observed more significant findings with group II medicines shown in Figure 2. The findings presented here (Figure 2) are coherent to those reported earlier where home remedies including (drinks, gargars, steam inhalation etc) along with Ivermectin revealed significant results.[17]

Association of Neuro-psychological and Cardiac complications and COVID-19 Vaccination:

When tested whether COVID-19 Vaccination has any impact on development of neuro-psychological and cardiac complications. We observed no significant effect on likelihood of development of these complications. Previously is shown in a report that COVID-19 vaccination has no impact on post COVID-19 complications such as neurological and cardiovascular. These findings are coherent to findings in the current study.[18]

Association of Dimer test with Vaccination, Gender and Complications

D-Dimer tests levels of 308 participants were compared with in gender, sex, age, vaccination and neurological and cardiovascular complications. No significance was observed at 0.05 significance level. This shows D-Dimer has no influence on these parameters (Table 2). These findings are in contrast to those reported earlier in which significant findings were observed between D-Dimer and age and sex.[19, 20]

Association of White Blood Cells, Neutrophils and platelets with Vaccination, Gender and Complications

White blood cells, lymphocytes, platelets and hemoglobin are signs of a regular inflammatory reaction and often predict the severity of the disease based on the complete blood count. A significant associations (p-0.000 and p-0.008) between WBC count and neurological-psychological, cardiovascular complications, and receiving the Pfizer vaccine (Figure 4, Table 4). These factors appear to influence WBC levels significantly. However, the duration of infection, gender, and receiving the Sinovac or Sinopharm vaccines do not show a statistically significant association with WBC count at the 0.05 significance level. In a study reported earlier a positive correlation was observed between WBCs and gender and age.[21] In a more recent study lymphocyte and neutrophils in gender few significance was observed. While no significance was observed in WBCs, neutrophils lymphocyte levels when compared with vaccination.[22]

Complementing the insights gained from laboratory markers and medication for COVID-19 cannot be overstated. As the new variants of the virus emerge, investigating whether they produce distinct imaging patterns becomes critical for earlier diagnosis and differentiation from other respiratory conditions. Given the evolving nature of the virus and its potential long-term effects on pulmonary function, cardiovascular and neuro-psychological may reveal vital insights not only for acute infection management but also for understanding the post-recovery phase of the disease. Taking in account the medications used and hematological markers presents a comprehensive approach to enhancing patient care in the context of COVID-19.

Conclusion

Our study provides valuable insights into the association between COVID-19 infection duration, medication use, and vaccination status. We observed that among vaccinated individuals, medication use was significantly associated with a shorter infection duration, suggesting a potential benefit of treatment in reducing disease severity, while no significant association was found between vaccination status and neuropsychological or cardiovascular complications. Additionally, D-dimer levels showed no significant correlation with any analyzed factors, whereas higher WBC counts were significantly associated with increased neuropsychological and cardiovascular complications, suggesting a potential link to post-COVID inflammatory response. Monitoring WBC levels may help identify patients at risk, warranting further investigation.

These findings enhance our understanding of COVID-19 treatment, complications, and laboratory markers within the study sample. Future research should focus on optimizing targeted therapies through well-maintained patient registries and robust statistical analysis to improve disease management and outcomes.

The study's limitations include its cross-sectional design, reliance on self-reported data, and heterogeneity in vaccination and medication use, which may affect causal inferences or a correlation. Additionally, the absence of pre-COVID baseline data and limited laboratory markers restrict a comprehensive analysis of post-COVID complications.

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Institutional Review Board Approval
EC20/4
18-08-2022
HBS Medical & Dental College

Conflicts of Interest: None
Financial Support: None to report
Potential Competing Interests: None to report

Contributions:
H.M.D, S.I.R, - Conception of study
- Experimentation/Study Conduction
M.T.U, A.M, H.S, R.N, S.I.R, -
Analysis/Interpretation/Discussion
M.T.U, A.M, H.S, S.I.R, - Manuscript Writing
H.M.D, R.N, SW.I.R, - Critical Review

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