

Coronavirus Pandemic

A retrospective study of the proportional distribution of ABO blood types in SARS-CoV-2 patients in Jodhpur (western India)

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Abstract

Introduction: Coronavirus disease 2019 (COVID-19) has infected millions of people globally. Many recent studies have suggested that the ABO blood type may contribute to COVID-19 infection immunopathogenesis. We aimed to determine the proportional distribution of COVID-19 infection among ABO blood types.

Methodology: This retrospective research was conducted in the city of Jodhpur (Rajasthan), India. The research involved 1140 COVID-19 patients, whose medical records were available in blood banks. The data was evaluated statistically using IBM SPSS 26.

Results: The proportion of blood group B among infected patients was highest (37.36%). Among all the cases, blood group A had the highest odds ratio of 1.062 (CI 95%, 0.92-1.21, $p = 0.412$). All versus one blood group analysis also showed that blood group A (odds ratio = 1.062 [CI 95%, 0.92-1.22] $p = 0.412$) was more likely to be infected with COVID-19 than the remaining blood groups. In the year 2021, blood group B had the highest risk of COVID-19 infection (odds ratio = 1.138).

Conclusions: Based on our findings, the blood groups A and B are more likely to be infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The overall average age for COVID-19 infection was lower, and the number of incidences in female patients was higher in 2021, relative to 2020. We found no evident relationship between COVID-19 vulnerabilities and blood group. A summary of the research is presented in Supplementary Figure 1.

Key words: COVID-19; ABO blood group; gender; age.

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Introduction

A new and divergent coronavirus was identified in Wuhan, China in December of 2019 [1]. The new coronavirus, named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), spread globally, resulting in 42,21,88,754 confirmed cases and 58,76,766 confirmed fatalities till February 2022 [2]. On March 11, 2020, the coronavirus disease 2019 (COVID-19) outbreak was officially acknowledged as a pandemic [3,4]. The word “coronavirus” comes from the Greek prefix “κορώνα”, which means “crown”. Severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome MERS are similar to SARS-CoV-2 and are members of the Coronaviridae family. SARS-CoV-2 is an RNA virus with only one circular positive strand that typically ranges from 26 to 32 kilobases (kb) [5]. The pathogen is a beta coronavirus with polycistronic RNA sequences that include a 5' cap and a 3' poly (A) tail, and a G+C content that ranges

from 32 to 43%. The coronaviruses use the angiotensin-converting enzyme 2 (ACE2) to infect the host cell [6,7].

The SARS-CoV-2 virus has spread globally since the outbreak. It spreads from person to person primarily using airborne transmission including sneezing, coughing, dust particles, and fomites [8]. COVID-19 has been linked to a variety of symptoms, ranging from mild to fatal. Asymptomatic patients have no obvious indications or symptoms of the condition, yet they can still spread it to others [9]. The clinical manifestations of COVID-19 are cough, weariness, mild dyspnea, sore throat, and headache [10,11]. Real-time reverse transcriptase polymerase chain reaction (RT-PCR) is used as a primary diagnostic test for COVID-19 [10,12].

Numerous investigations have shown the ABO blood types influence susceptibility to a variety of illnesses, including cardiovascular disease, Norwalk

virus, cancer, SARS, and MERS [13-17]. Recent studies investigated the association involving coronavirus transmission and the ABO and Rh blood types [18] and suggested that blood group A is associated with a greater incidence of infection [19], whereas blood group O is associated with the least infection and severity [20,21]. Clinical investigations showed that human natural anti-A antibodies interfere with interaction involving the virion spike protein with ACE-2 offering protection to persons with non-type A blood types [22-24]. Following on previous assumptions, several studies found no major connection between the blood types and the likelihood of infection [25,26]. The ABO genes encode proteins that determine the blood group system, located on chromosome 9q34.2. When the chromosome 9 SNP rs657152 was used for investigation, the blood groups and SARS-CoV-2 vulnerability were not connected [27,28]. These conflicting reports led us to assess the proportion of COVID-19 incidence based on ABO blood groups in infected and healthy individuals.

Methodology

Selection criteria for COVID-19 patients

This was retrospective research conducted in the city of Jodhpur, Rajasthan. We included only those COVID-19 patients who received COVID-19 convalescent plasma (CCP) to prevent a repetition of the prior research patterns. The data of CCP recipients was available from different blood banks (Ambika Blood Bank, MDM Blood Bank, Paras Blood Bank, and Rotary Blood Bank). After obtaining all the available data, we excluded repeated, incomplete, and

unregistered socio-demographic description data, and finally included 1140 patients, of which 726 were male and 414 were female. The focus was on the proportion of the ABO blood groups in infected patients and in healthy people.

Proportional distribution of ABO blood type in COVID-19 patients

The association was investigated using the ABO blood type and the Rh blood group to assess the normal distribution of blood groups. The information was obtained from blood group research done with 83,631 participants within a local city in 2013 and was used as the control group [28].

Statistical analysis

The IBM SPSS 26 software was used for statistical analysis. The distribution of ABO and the Rh blood types was examined through the Chi-square test. 95% confidence intervals and odds ratio (OR) were used to investigate the proportion of ABO and the Rh blood types.

Results

Proportional distribution of ABO blood types among COVID-19 patients

The blood group frequencies of infected patients were similar to the general population’s blood group frequencies in Jodhpur (Figure 1). The proportions of blood groups B, O, A, and AB were 36.40 %, 31.70 %, 22.20 %, and 9.40 % respectively in the reference population. The distribution of Rh (+ve) and Rh (-ve) blood groups was 91.75 % and 8.25 %, respectively

Figure 1. The distribution of the ABO and Rh blood groups in COVID-19 patients.

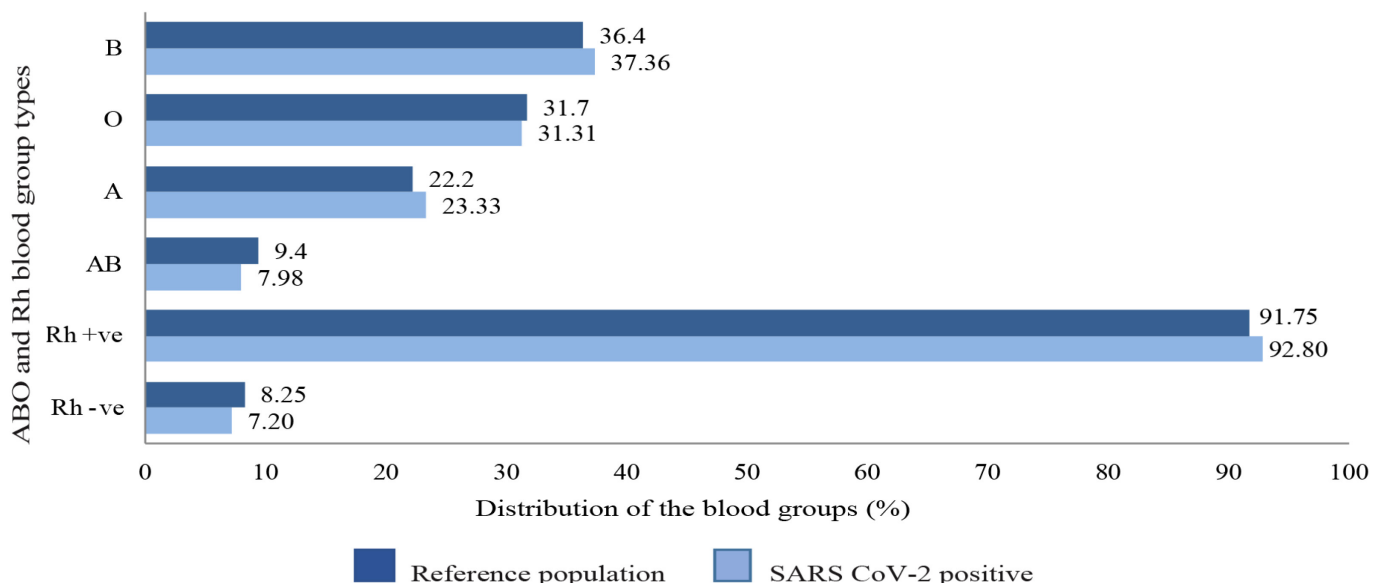


Table 1. COVID-19 infection dissemination in blood groups by odds ratio all versus one.

Blood Groups	Odds ratio (95% confidence interval)	χ^2	p value
A-B	1.02 (0.87-1.19)	0.058	0.809
A-O	1.06 (0.90-1.24)	0.508	0.475
A-AB	0.804 (0.63-1.02)	2.990	0.083
A Non A	1.062 (0.92-1.22)	0.671	0.412
B Non B	1.040 (0.92-1.17)	0.357	0.550
O Non O	0.978 (0.86-1.11)	0.094	0.758
AB Non AB	0.828 (0.66-1.02)	2.755	0.097

[28]. The proportional distribution of blood types B, O, A, and AB among COVID-19 affected individuals was 37.36 %, 31.31 %, 23.33 %, and 7.98 %, respectively while the Rh (+ve) and Rh (-ve) individuals were 92.8 % and 7.20 %, respectively.

Based on the analysis of spread of COVID-19 infection in blood groups by odds ratio, all versus one (Table 1), the disease was more likely to affect blood group A [odds ratio = 1.062 (CI 95%, 0.92-1.22) $p = 0.412$] than the remaining blood groups.

Blood group A had the highest odds ratio 1.062 (CI 95 %, 0.92-1.21, $p = 0.412$) for testing positive for COVID-19 disease, followed by blood group B, with an odds ratio of 1.039 (CI 95 %, 0.92-1.17, $p = 0.550$). In addition, Rh +ve had a high odds ratio of screening positive at 1.160 (CI 95 %, 0.92-1.45, $p = 0.215$).

In 2020, there was a greater likelihood of screening positive among individuals with blood group A (odds ratio 1.184, CI % 0.91-1.53, $p = 0.229$) than in the other groups (Table 2). In 2021, a considerable increase in the possibility of coronavirus transmission was in blood group B with an odds ratio of 1.138 (CI 95 %, 0.99-1.30, $p = 0.072$). The blood group AB had the lowest

value = 0.013 with an odds ratio of 0.708 (CI 95 %, 0.54-0.92) (Table 3).

As presented in Table 3, those with blood types B, A, and Rh +ve had a greater possibility of COVID-19 infection, while those with blood types O, AB, and Rh -ve had a lesser possibility. Despite the fact that there was percentile variation in the distribution across ABO blood types, these variations were not analytically consequential.

Comparison by age

The average age of all patients was 52.66 years. The average age of all males was 52.78 years and that of all females was 52.45 years (Figure 2). In 2020, the patients had an average age of 60.67 years, but by 2021, that age had dropped to 49.80 years. In the year 2020, average age of males was 61.86 ± 11.94 (average ± standard deviation) years and the average age of females was 57.80 ± 15.66 years and this difference was statistically significant ($p = 0.0155$). Similarly, for the year 2021 average age was 49.03 ± 13.65 years for males and 51.00 ± 13.80 for females and this difference was statistically significant ($p = 0.042$). The average

Table 2. ABO and Rh blood groups in COVID-19 patients and control for the year 2020.

Blood group 2020	Total number of patients n = 300 (%)	Distribution of blood groups in Jodhpur n = 83631 (%)		χ^2	p value	Odds ratio (95% confidence interval)
B	94 (31.33)	30497 (36.40)		3.182	0.074	0.80 (0.62-1.01)
O	97 (32.33)	26584 (31.70)		0.019	0.881	1.025 (0.80-1.30)
A	76 (25.33)	18626 (22.20)		1.44	0.229	1.184 (0.91-1.53)
AB	33 (11.00)	7924 (9.40)		0.642	0.422	1.180 (0.82-1.69)
Rh +ve	275 (91.66)	76728 (91.74)		0.002	0.960	0.989 (0.65-1.49)
Rh -ve	25 (8.33)	6903 (8.25)		0.002	0.960	1.010 (0.67-1.52)

Table 3. ABO and Rh blood groups in COVID-19 patients and control for the year 2021.

Blood group 2021	Total number of patients n = 840 (%)	Distribution of blood groups in Jodhpur n = 83631 (%)		χ^2	p value	Odds ratio (95% confidence interval)
B	332 (39.52)	30497 (36.40)		3.224	0.072	1.138 (0.99-1.30)
O	260 (30.95)	26584 (31.70)		0.230	0.631	0.962 (0.83-1.11)
A	190 (22.16)	18626 (22.20)		0.039	0.842	1.020 (0.86-1.200)
AB	58 (6.90)	7924 (9.40)		6.124	0.013	0.708 (0.54-0.92)
Rh +ve	783 (93.21)	76728 (91.74)		2.182	0.139	1.235 (0.94-1.61)
Rh -ve	57 (6.78)	6903 (8.25)		2.182	0.139	0.809 (0.61-1.06)

age of Rh +ve patients (52.51 years) was lesser than that of Rh -ve patients (54.54 years).

Comparison by gender

COVID-19 incidence in the year 2020-2021 distributed by gender is presented in Figure 3. Out of 1140 patients, 726 (63.68%) were male and 414 (36.31%) were female. The male-to-female proportion in this study was 1.7:1. The incidence of COVID-19 was the lowest among blood group AB individuals (males 7.98% and females 7.97%). As compared to 2020, the number of COVID-19 incidences among female patients increased by 9.8% in 2021.

Discussion

Since the ABO gene is highly diverse, the associated ABO blood types are distributed unequally among ancestries and geographies [25]. This study included a total of 1140 patients, and there were more patients with COVID-19 in blood groups B, O, and Rh +ve compared to the control. Similarly, there were fewer patients in blood groups A, AB, and Rh -ve compared to the control. Several studies found that blood types influence the transmission of COVID-19 and that population-based antigen distribution might influence the spread of infection [24,29].

Based on our study's odds ratio for all blood groups versus one, it was concluded that people with blood type A were more likely to be infected by the disease than non-A blood group type. A previous study reported that non-A blood group individuals exhibited a lower chance of being infected than those of A blood type [30]. Additionally, it was observed that there was a

decreased probability of developing serious COVID-19 infection or dying in the O blood group type than in non-O blood group individuals [31].

A study discovered that having blood type O corresponded with a poor chance of developing COVID-19 infection [32]. Another research study comparing a total of 2173 COVID-19 -infected patients to local control groups showed that a blood type O was associated with lesser probability of infection, while blood type A had a greater incidence of infection [23]. Another study also reported that COVID-19 patients with blood group A were higher in number, although COVID-19 recovery time was not influenced by ABO blood types [18]. A recently published study also discovered no link between ABO blood type and mortality, but they did observe that those people who had blood group A were more likely to be infected [33]. Similar results have been reported in other studies [19]. In addition, COVID-19 was reported to be more likely among individuals who had blood types A, B, and Rh+. These investigators discovered no link between blood groups and COVID-19 infection severity and mortality [21]. The results of our analysis showed that blood group A had the highest probability of contracting the disease in the year 2020 and blood group B had the highest odds of contracting the disease in the year 2021.

Research by Almadhi *et al.* concluded that blood group B had a greater probability of being infected by COVID-19 [34]. Another study reported that blood types B and AB had higher odds of being COVID-19 positive than blood type A [35]. A study reported that an increased likelihood of transmission of COVID-19 was correlated with blood type AB. Additionally, they concluded that the blood group ‘O’ was more receptive to viruses than the ‘A’ group [36].

Figure 2. COVID-19 cases (2020-2021) distribution by per mean age.

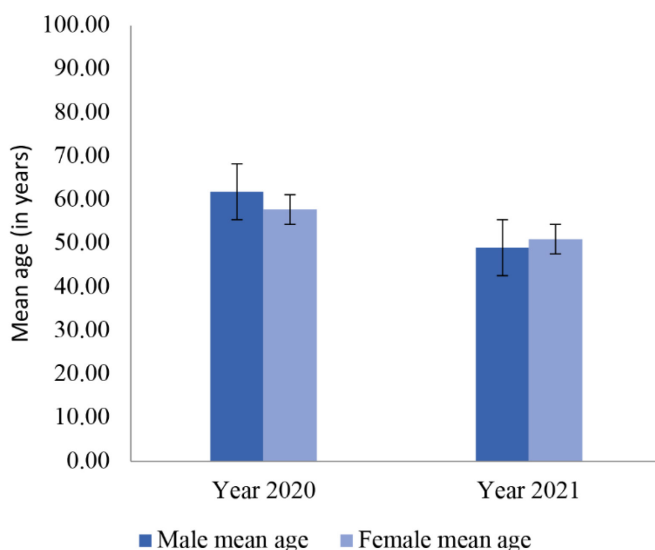
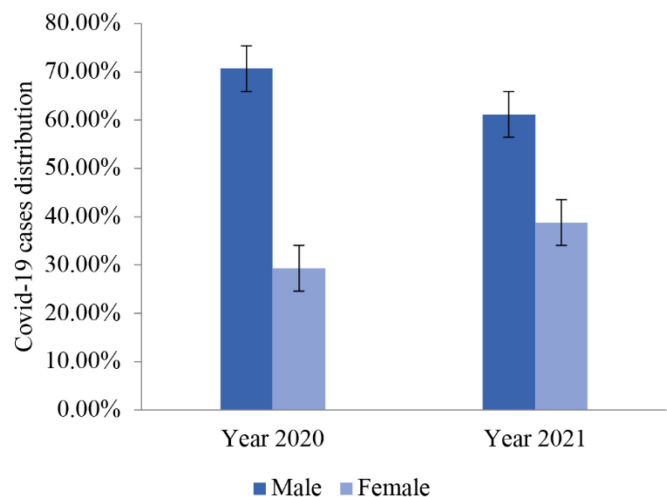


Figure 3. COVID-19 cases (2020-2021) distribution by gender.



Contrary to earlier study findings, several recent investigations have identified no connection between blood types and COVID-19 infection. Genetics-based research identified no link between chromosome 9q34.2 single nucleotide polymorphism (SNP) rs657152 and COVID-19 positive testing or mortality [28]. A study found no positive relation between ABO blood types and coronavirus infectivity and mortality [22]. In a potential case-control study, it was observed that there were no relationships between ABO blood groups and COVID-19 susceptibility or severity [25]. Parallel research demonstrated that the COVID-19 infection seemed to be potentially predisposed to all blood types [26]. A recently published study found no meaningful correlation associating blood types and disease [37]. Another recently published study found no substantial correlation with the severity of the disease [38].

Age has been recognized as a COVID-19 predicting factor in several investigations. The average age of patients in our research was lower during the second wave in 2021. In most of the COVID-19 infection cases, individuals were under the age of 55. A previous study suggested that young people were quite receptive to COVID-19 infection throughout the second wave and that many people between 25 to 50 years of age died early [39]. Individuals of average age of 51.66 years who had blood group B were further susceptible to influenza. A similar study by Mahmud *et al* [17] found that the majority of COVID-19 infected patients admitted in Dhaka Medical College Hospital (Bangladesh) in 2020 were younger than 40 years with a mean age of 39.8 years.

Gender-based COVID-19 susceptibility studies have also been conducted globally. Male patients with blood type B and Rh+ve were reported to be significantly susceptible to COVID-19. It was also reported that the coronavirus-affected group was overrepresented by men with blood type B [21,22]. In our study, males of all ages were more susceptible to COVID-19 infection than females. However, there was an increase in the number of female patients in 2021 compared to 2020. Similar results were reported in a study conducted in Bronx, New York where there was also an increase in female cases in 2021 as compared to 2020 [39].

Conclusions

We observed no predisposition of any blood group type to COVID-19 infection, and all individuals had an equal and independent likelihood of getting infected with the SARS-CoV-2 virus. When comparing the data

from 2020 and 2021, we observed that the average age of incidents for both genders and all blood types had decreased in 2021. In comparison to the year 2020, there is an increase in the proportion of female patients in 2021. Although our study found no predisposition of any blood group type to COVID-19 infection, it opens several avenues for future research. Conducting multicenter studies with more extensive participant pools would contribute to a more comprehensive understanding of the relationship between blood types and susceptibility to COVID-19. This can help validate and strengthen our current findings. Additionally, investigating and understanding the dynamics of the above temporal changes may provide valuable insights into the evolving nature of the pandemic COVID-19.

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Authors' contributions

Study conception and design: VC, NJ and PKK; initial draft of the manuscript: VC, NJ; statistical analysis: VC, PK, GKA, NJ; editing and finalizing the manuscript: NJ, PKK, PK, GKA.

Ethics approval

The research study was approved by the Dr. S.N. Medical College Institutional Ethical Committee under certificate reference number: SNMC/IEC/2021/plan/472

Consent to participate

Informed consent from individual patients was not required since the data was taken from the blood banks' database.

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Annex – Supplementary Items

Supplementary Figure 1. Graphical abstract.

