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Original Article

Association between COVID-19 Infection Susceptibility and ABO Blood Groups and Rhesus Antigen

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ABSTRACT

COVID-19, caused by the SARS-CoV-2 virus, is a highly contagious disease that has been declared a global pandemic by the World Health Organization, leading to widespread impacts. **Objective:** To investigate the potential relationship between ABO blood groups and susceptibility to the coronavirus. **Methods:** This study was conducted at The University of Lahore between April and September 2021. Blood groups of 528 SARS-CoV2-positive patients admitted to various hospitals in Punjab was calculated by both forward and reverse blood grouping technique. Data analysis was performed using the SPSS version 25.0. **Results:** The mean age was found to be 41.5 years, with a range of 16-90 years, among which 63.3% were male (n = 334) and 36.7% (n = 194) were female. The data were categorized according to blood group type. A+ (13.4%), A- (8.5%), B- (8.7%), B+ (22.5%), O+ (19.5%), O- (4.9%), AB+ (11.9%), and AB- (10.4%). A, B, and AB were associated with high susceptibility to COVID-19 infection, i.e., 75.5% (n = 399), and less frequent in the O blood group, 24.5% (n = 129). RH (D) ve+ type blood group was highest at 67.5% (n = 356) in COVID-19 patients as compared to the RH (D) –ve type blood group at 32.5% (n = 172), respectively. **Conclusions:** Individuals with blood groups A, B, and AB have been observed to be more susceptible to COVID-19 than those with blood group O. Similarly, individuals who are RH positive are considered more vulnerable to coronavirus than those who are RH negative.

INTRODUCTION

In December 2019, a new disease, known as COVID-19, which was caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) originated in Wuhan, a city in China in December 2019 [1]. The agent responsible for causing the disease was identified from throat swab samples carried out by the Chinese Center for Disease Control and Prevention (CCDC), and after some time, the name was given as SARS-CoV-2 by the World Health Organization (WHO) [2]. The WHO announced SARS-CoV-2 as a global pandemic in March 2020 [3]. At the end of June 2020, more than 200 countries around the world were affected by the coronavirus infection, resulting in more than 10.3 million cases and 506,000 deaths worldwide [4]. A wide spectrum of symptoms indicates the infection of COVID-19 including shortness of breath, cough, fever, loss of smell, and taste and muscle pain. Asymptomatic conditions can also be seen, even in cases of severe infection or death [5]. Initially, COVID-19 disease was clinically diagnosed by observing a broad spectrum of symptoms. COVID-19 is diagnosed at the molecular level using different molecular technologies, such as real-time polymerase chain reaction (PCR), which amplifies viral

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DNA. Chest X-rays are also beneficial in the initial diagnosis, and different serological tests are considered beneficial in the COVID-19 diagnosis [6]. In 1901, the ABO blood group system was first discovered in humans [7]. Since then, studies on the association between ABO blood group systems have continued because they are inherited and can be easily determined. ABO blood groups are statistically and biologically associated with different diseases, such as cancer, heart disease, and viral infections [8]. Based on different literature surveys, there is a relationship between different viral diseases and blood groups (ABO) in some aspects. Different clinical reports have revealed that ABO blood groups are highly associated with various viral infections. Evidence revealed in different studies that hepatitis B and dengue are associated with blood groups, and Rotavirus and Norwalk virus infection linkage with blood groups has also been revealed in some studies [3, 6, 8]. Many studies on the relationship between different diseases and ABO blood groups have focused on further investigations related to this association. Furthermore, investigations related to this association could help determine the susceptibility to viral infections in individuals according to blood groups. Many past studies have revealed that there is a direct association between ABO blood groups and viral infections, including SARS-CoV. In particular, past studies revealed a relationship between blood groups (ABO) and SARS-CoV, indicating that there is a relationship between SARS-CoV-2 and ABO blood groups [9, 10]. Based on the previous studies, different blood groups (ABO) are linked to coronavirus infection concerning susceptibility. Gullion *et al.*, discussed in their study that the O blood group is protective against COVID-19 infection, as they observed 265 hospitalized patients and found that blood group A is prominent in severe COVID infection and blood group O is slightly seen in critically ill patients [11]. Further evidence revealed that different blood groups have different levels of severity to coronavirus infection. As stated by Zhao *et al.*, blood group A is more prone to COVID-19 infection, and blood group O showed resistance against the coronavirus as compared to other blood groups [12, 13]. Moreover, blood group B is also reported to be susceptible to COVID-19 infection, whereas blood group O shows a shielding effect against coronaviruses. RH factor association was also reported by Massachusetts, which found that RH-D positivity was more prone to COVID-19 infection as compared to RH-D negativity [14]. Pakistan is also a victim of the COVID-19 infection but unfortunately, there is a lack of literature related to the association of ABO blood groups with coronavirus susceptibility. There is a need to work in this direction. The primary objective of this study in Pakistan was to investigate the correlation between various blood groups and coronavirus susceptibility.

METHODS

This cross sectional study was conducted at The University of Lahore, Lahore, Pakistan. Many hospitalized, symptomatic, confirmed COVID-19 patients admitted in different hospitals of Punjab were considered in this study through non-probability sampling technique. We mainly focused on determining the relationship between different blood groups and COVID-19 susceptibility. The distribution of ABO blood types was compared in confirmed SARS-CoV-2 patients who were admitted to different hospitals in Punjab. Sample size was calculated by WHO formula keeping confidence interval of 95%. A total of 528 confirmed cases of COVID-19 were tested in the ABO blood group. 41.5 is the mean age in our study population (range: 16-90 years), of which (n = 334) patients were male (n = 194). All the patients were admitted to different hospitals in Pakistan. Data were collected from hospitals in Punjab, Pakistan. Only those patients who were positive for SARS-CoV-2 were included in the study. All patients (n = 528) were SARS-CoV-2 positive using real-time PCR from the Systaaq Super Extract Universal Auto Extraction Kit, and ABO blood grouping was performed through Atlas Medical ABO reagents by tube and slide methods. To determine which ABO "group" or "type" you belong to, Medical health professionals need to observe the expression of both A and B antigens in a patient's red blood cells, which is called (forward typing). Anti-A and anti-B antibodies are found in the plasma, which is called (reverse typing). Monoclonal sera were used for forward typing. Reverse typing was performed with commercially available preparations of type A and B erythrocytes. Concordance between forward and reverse typing. The findings must be verified before a patient's ABO type can be identified. For example, a type A individual must agglutinate anti-A typing sera but not anti-B typing sera. However, their plasma must agglutinate B-type cells but not A-type cells. An ABO typing discrepancy is defined as a lack of concordance between forward and reverse typing and must be described before the ABO type can be interpreted. Statistical analysis was performed using SPSS software (version 20.0). The Chi-squared test and bar chart were used to assess the blood group data. The statistical P value was set at <0.05.

RESULTS

The study analyzed a total of 528 patients who were infected with SARA-CoV-2. The mean age of the patients was 41.5 ± 12.5 years, with ages ranging from 16 to 90 years. The distribution of age, gender and ABO blood group type of patients and Rh (Positive and Negative Status) is presented in Table 1.

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Table 1: Distribution of ABO blood groups, Age, Gender and Rh (Positive and Negative) Status

Factor	O (n = 129)	A (n = 116)	B (n = 165)	AB (n = 118)	Overall (n = 528)
Percentages of ABO blood group	24.5%	22%	31.2%	22.3%	100%
Age					
16-45	78 (14.8 %)	66 (12.5 %)	118 (22.3%)	65 (12.3%)	327 (62%)
46-65	44 (8.3%)	46 (8.7%)	43 (8.1%)	46 (8.7%)	179 (34%)
66-90	7 (1.3%)	4 (0.8%)	4 (0.8%)	7 (1.3%)	22 (4%)
Gender					
Male	80 (15.2%)	71 (13.4%)	103 (19.5%)	80 (15.2%)	334 (63.3%)
Female	49 (9.3%)	45 (8.5%)	62 (11.7%)	38 (7.2%)	194 (36.7%)
Rh(D) Group					
Rh(D)+ve	103 (19.5%)	71 (13.4%)	119 (22.5%)	63 (11.9%)	356 (67.5%)
Rh(D)-ve	26 (4.9%)	45 (8.5%)	46 (8.7 %)	55 (10.4%)	172 (32.5%)

Among the patients, 63.3% were male and 36.7% were female. The number of male patients was significantly higher than the number of female patients (Figure 1a). The patients were distributed into three age groups: (16-45 years), (46-65 years), and (66-90 years). The study found that COVID-19 patients had the highest distribution in the age group of 16-45 years and lowest in the 66-90 years' age group.

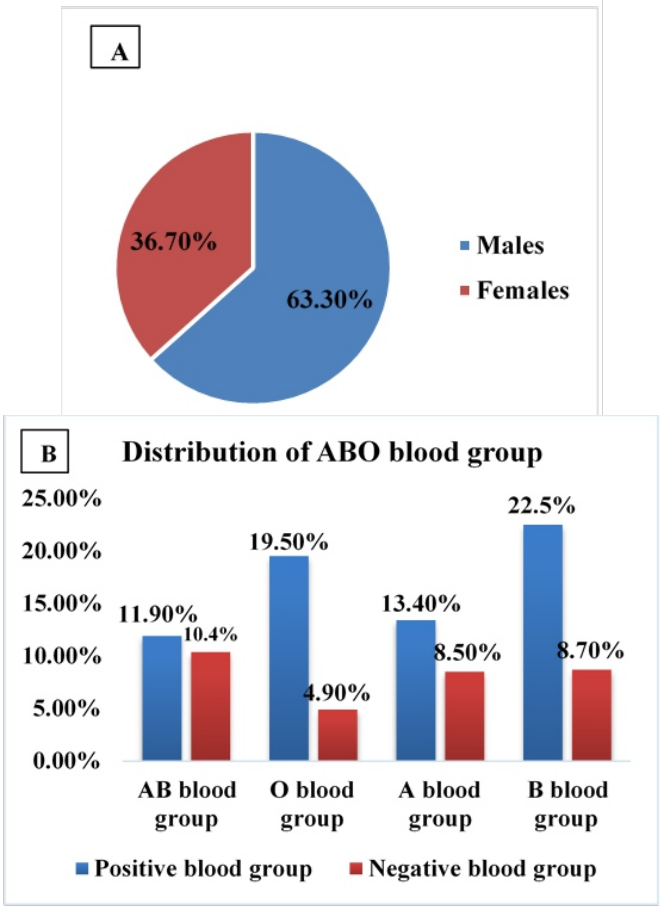

Figure 1: (A) Percentage of COVID-19 patients according to gender (B) Distribution of Positive and Negative blood group

The ABO and Rh blood group systems showed the variation in different populations. The distribution of ABO blood groups among patients have been shown in Figure Ib. The current study revealed that non-O blood groups (A, B, and AB) were more dominant among the patients affected by COVID-19 as compared to the O blood group. The percentage of non-O blood groups in COVID-19 patients was 75.5% higher as compared to blood group O (Figure 2). Interestingly, the percentage of Rh (D) positive blood group type was higher patients in contrast to the Rh (D) negative blood group type.

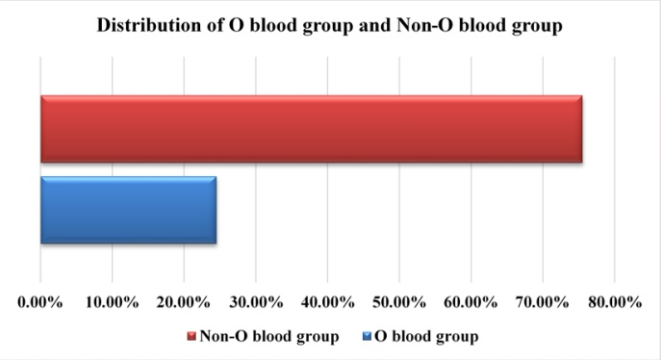

Figure 2: The distribution of the O blood group and the non-O blood group (A, B, AB) of SARA-CoV-2 patients

DISCUSSION

This Cross Sectional study designed to find out association of SARS-Cov-2 susceptibility with ABO blood groups, was conducted at University of Lahore. The study included 528 SARS-CoV-2 positive patients from different hospital in Punjab Pakistan. Mean age of individuals included in study was 41.5±12.5, with male gender predominance that has also been observed in earlier studies. The correlation between ABO blood groups and COVID-19 susceptibility was one of the major findings of our analysis. In contrast to COVID-19 patients, where the O blood group represented just 24.5% of cases, we observed that non-O blood groups (A, B and AB) were more prevalent, accounting for 75.5% of cases. This shows that those with A, B or AB blood groups may be more susceptible to COVID-19 infection. This is consistent with earlier studies that suggested different susceptibilities depending on blood group [15]. For instance, Cheng *et al.*, found that Hong Kong used the ABO blood group system to identify infection susceptibility [9]. In their investigation, the authors found that hospital employees with blood group O were less likely to contract an infection than staff with non-O blood group. Various research have provided reasons, with one study concluding that a person with blood group O may recognize particular proteins found in viruses, and that foreign proteins make the person less susceptible to coronavirus sickness [16]. The male gender is more prominent in our study as compared to females. Some studies gave some

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explanations for why females are less susceptible to COVID-19. As mentioned, different factors make the female gender less prone to COVID-19 infection, as females have two copies of x chromosomes, which contain genes that are involved in regulating innate immunity. They also have more expressive toll-like receptors (TLR-7) and contain more CD4 lymphocytes, which play a significant role in the neutralization of viral particles as well as preventing many different infections [17]. Additionally, our findings also showed the importance of the Rh factor (D antigen) in COVID-19 vulnerability. Patients with Rh-positive blood types were more likely to be infected by the virus, accounting for 67.5% of cases, compared to Rh-negative patients, who accounted for 32.5% of cases. This suggests that those with Rh-positive blood types are more likely to get COVID-19 that is in accordance to previously reported findings of Ray *et al.*, [18]. In our study, blood group B is more dominant as compared to other groups. We conclude that blood group B is more prone and susceptible to coronavirus infection, which is also similar to findings reported by Latz *et al.*, [14] and meta-analysis by Liu *et al.*, [19]. It was concluded from another study that the activity of ACE2 is higher in the B blood group as compared to the blood group O [20]. This gives the virus more opportunity to infect the patients having blood group B as compared to patients having blood group O. While our research provides significant insight into the potential correlation between blood types and COVID-19 vulnerability, more research is needed to fully understand the underlying mechanisms. Furthermore, additional factors such as genetics, comorbidities, and environmental factors that may contribute to an individual's vulnerability to this virus must be considered. Finally, our work adds to the expanding body of information indicating a link between ABO blood groups and COVID-19 vulnerability. Individuals with blood groups A, B, and AB may be more susceptible to infection, although individuals with blood group O appear to have some protection.

CONCLUSIONS

The COVID-19 pandemic has shown the crucial role that numerous circumstances play in determining an individual's susceptibility to the virus. According to the recent study, men and individuals with non-O blood groups (A, B, and AB), in addition to people having Rh-positive blood groups, are more vulnerable. It is critical to underline that having blood group O does not guarantee immunity; therefore, everyone must recognize the continuous threat posed by COVID-19 and follow recommended Standard Operating Procedures (SOPs) and precautionary measures. Since the pandemic's effects are universal and affect everyone, our united commitment to address this global disaster remains crucial.

Authors Contribution

Conceptualization: MUK
Methodology: MUK
Formal analysis: MUG, SY
Writing-review and editing: NK, MAA, IA, MS, IU, RM, SA

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

The authors declare no conflict of interest.

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REFERENCE

[1] Zhou F, Fan G, Liu Z, Cao B. SARS-CoV-2 shedding and infectivity–Authors' reply. The Lancet. 2020 Apr; 395(10233): 1340. doi: 10.1016/ S0140-6736(20)30869-2.

[2] World Health Organization. Clinical management of severe acute respiratory infection when novel coronavirus (2019-nCoV) infection is suspected: interim guidance. 2020. [Last cited: 27th Oct 2023]. Available at: https://www.who.int/publications/i/item/10665-332299.

[3] Heneka MT, Golenbock D, Latz E, Morgan D, Brown R. Immediate and long-term consequences of COVID-19 infections for the development of neurological disease. Alzheimer's Research & Therapy. 2020 Dec; 12: 1-3. doi: 10.1186/s13195-020-00640-3.

[4] Mahase E. COVID-19: Demand for dexamethasone surges as RECOVERY trial publishes preprint. BMJ. 2020 Jun; 369: m2512. doi: 10.1136/bmj.m2512

[5] Lovato A, de Filippis C, Marioni G. Upper airway symptoms in coronavirus disease 2019 (COVID-19). American Journal of Otolaryngology. 2020 Apr: 102474. doi: 10.1016/j.amjoto.2020.102474.

[6] Goyal P, Choi JJ, Pinheiro LC, Schenck EJ, Chen R, Jabri A, *et al.* Clinical characteristics of Covid-19 in New York city. New England Journal of Medicine. 2020 Jun; 382(24): 2372-4. doi: 10.1056/NEJMc2010419.

[7] Lesky E. Viennese serological research about the year 1900: its contribution to the development of clinical medicine. Bulletin of the New York Academy of Medicine. 1973 Feb; 49(2): 100.

[8] Jing W, Zhao S, Liu J, Liu M. ABO blood groups and hepatitis B virus infection: a systematic review and meta-analysis. BMJ Open. 2020 Jan; 10(1): e034114. doi: 10.1136/bmjopen-2019-034114.

[9] Cheng Y, Cheng G, Chui CH, Lau FY, Chan PK, Ng MH, *et al.* ABO blood group and susceptibility to severe acute respiratory syndrome. JAMA. 2005 Mar; 293(12):

DOI: https://doi.org/10.54393/pjhs.v4i10.1031

1447-51. doi: 10.1001/jama.293.12.1450-c.
[10] Umer KM, Bashir MW, Rehman R, Kiani RA. Frequency of ABO and Rh (D) blood groups among blood donors in Lahore, Pakistan. International Journal of Advanced Biological and Biomedical Research. 2014 Mar; 2(3): 597-600.
[11] Guillon P, Clément M, Sébille V, Rivain JG, Chou CF, Ruvoën-Clouet N, *et al*. Inhibition of the interaction between the SARS-CoV spike protein and its cellular receptor by anti-histo-blood group antibodies. Glycobiology. 2008 Dec; 18(12): 1085-93. doi: 10.1093/glycob/cwn093.
[12] Zhao J, Yang Y, Huang H, Li D, Gu D, Lu X, *et al.* Relationship between the ABO blood group and the coronavirus disease 2019 (COVID-19) susceptibility. Clinical Infectious Diseases. 2021 Jul; 73(2): 328-31. doi: 10.1093/cid/ciaa1150.
[13] Zietz M, Zucker J, Tatonetti NP. Associations between blood type and COVID-19 infection, intubation, and death. Nature Communications. 2020 Nov; 11(1): 5761. doi: 10.1038/s41467-020-19623-x.
[14] Latz CA, DeCarlo C, Boitano L, Png CM, Patell R, Conrad MF, *et al.* Blood type and outcomes in patients with COVID-19. Annals of Hematology. 2020 Sep; 99: 2113-8. doi: 10.1007/s00277-020-04169-1.
[15] 15.Fan Q, Zhang W, Li B, Li DJ, Zhang J, Zhao F. Association between ABO blood group system and COVID-19 susceptibility in Wuhan. Frontiers in Cellular and Infection Microbiology. 2020 Jul; 10: 404. doi: 10.3389/fcimb.2020.00404.
[16] 16.Samra S, Habeb M, Nafae R. ABO groups can play a role in susceptibility and severity of COVID-19. The Egyptian Journal of Bronchology. 2021 Dec; 15: 1-5. doi: 10.1186/s43168-020-00051-w.
[17] Conti P and Younes A. Coronavirus COV-19/SARS-CoV-2 affects women less than men: clinical response to viral infection. Journal of Biological Regulators and Homeostatic Agents. 2020 Apr; 34(2): 339-43.
[18] Ray JG, Schull MJ, Vermeulen MJ, Park AL. Association between ABO and Rh blood groups and SARS-CoV-2 infection or severe COVID-19 illness: a population-based cohort study. Annals of Internal Medicine. 2021 Mar; 174(3): 308-15. doi: 10.7326/M20-4511.
[19] Liu N, Zhang T, Ma L, Zhang H, Wang H, Wei W, *et al.* The impact of ABO blood group on COVID-19 infection risk and mortality: A systematic review and meta-analysis. Blood Reviews. 2021 Jul; 48: 100785. doi: 10.1016/j.blre.2020.100785.
[20] Chung CM, Wang RY, Chen JW, Fann CS, Leu HB, Ho HY, *et al.* A genome-wide association study identifies new loci for ACE activity: potential implications for response to ACE inhibitor. The Pharmacogenomics Journal. 2010 Dec; 10(6): 537-44. doi: 10.1038/tpj.2009.70.