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

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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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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.
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direction. The primary objective of this study in Pakistan
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Massachusetts, which found that RH-D positivity was more
coronaviruses. RH factor association was also reported by
blood group O shows a shielding effect against
infection. As stated by Zhao blood groups have different levels of severity to
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. 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.

M E T H O D S

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. 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 Systaag
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.

R E S U L T S

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.
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.

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.

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

<table>
<thead>
<tr>
<th>Factor</th>
<th>O (n = 129)</th>
<th>A (n = 116)</th>
<th>B (n = 165)</th>
<th>AB (n = 118)</th>
<th>Overall (n = 528)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentages of ABO blood group</td>
<td>24.5%</td>
<td>22%</td>
<td>31.2%</td>
<td>22.3%</td>
<td>100%</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-45</td>
<td>78 (47.9%)</td>
<td>66 (42.0%)</td>
<td>118 (22.3%)</td>
<td>65 (12.3%)</td>
<td>327 (62.2%)</td>
</tr>
<tr>
<td>46-65</td>
<td>44 (3.8%)</td>
<td>46 (8.7%)</td>
<td>43 (8.1%)</td>
<td>46 (8.7%)</td>
<td>179 (34%)</td>
</tr>
<tr>
<td>66-90</td>
<td>7 (1.3%)</td>
<td>4 (0.8%)</td>
<td>4 (0.8%)</td>
<td>7 (1.3%)</td>
<td>22 (4%)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>80 (15.2%)</td>
<td>71 (13.4%)</td>
<td>103 (19.5%)</td>
<td>90 (16.2%)</td>
<td>334 (63.3%)</td>
</tr>
<tr>
<td>Female</td>
<td>49 (9.3%)</td>
<td>45 (8.5%)</td>
<td>62 (11.7%)</td>
<td>38 (7.2%)</td>
<td>194 (36.7%)</td>
</tr>
<tr>
<td>Rh(D) Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh(D) +ve</td>
<td>103 (19.5%)</td>
<td>71 (13.4%)</td>
<td>119 (22.5%)</td>
<td>63 (11.9%)</td>
<td>356 (67.5%)</td>
</tr>
<tr>
<td>Rh(D) –ve</td>
<td>26 (4.9%)</td>
<td>45 (8.5%)</td>
<td>46 (8.7%)</td>
<td>55 (10.4%)</td>
<td>172 (32.5%)</td>
</tr>
</tbody>
</table>

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...
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

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