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BRIEF REPORT

# Relationship Between the ABO Blood Group and the Coronavirus Disease 2019 (COVID-19) Susceptibility

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To explore any relationship between the ABO blood group and the coronavirus disease 2019 (COVID-19) susceptibility, we compared ABO blood group distributions in 2173 COVID-19 patients with local control populations, and found that blood group A was associated with an increased risk of infection, whereas group O was associated with a decreased risk.

**Keywords.** ABO blood group; coronavirus; SARS-CoV-2; COVID-19; disease susceptibility.

The novel coronavirus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), causing the new infectious disease coronavirus disease 2019 (COVID-19), has spread widely around the world. Current clinical observation suggest that people's age and sex are 2 risk factors in the susceptibility to COVID-19 [1] Older people and men are more susceptible to infection and development of more severe disease. However, no biological markers have been identified to predict the susceptibility to COVID-19 so far. Landsteiner's ABO blood types are carbohydrate epitopes that are present on the surface of human cells. The antigenic determinants of A and B blood groups are trisaccharide moieties GalNAcα1–3-(Fucα1,2)-Galβ- and Galα1–3-(Fucα1,2)-Galβ-, while O blood group antigen is Fucα1,2-Galβ-. Although blood types are genetically inherited, the environment factors can potentially influence which blood types in a population will be passed on more frequently to the next generation. Susceptibility of viral infection has been found to be related to ABO blood group. For example, Norwalk virus and hepatitis B have clear blood group susceptibility [2, 3]. It was also reported that blood group O individuals were less likely to become infected by SARS coronavirus [4]. Here we investigated the relationship between the ABO blood type and the susceptibility to COVID-19 in patients from 3 hospitals in Wuhan and Shenzhen, China.

## METHODS

We collected and ABO-typed blood samples from 1775 patients infected with SARS-CoV-2 and 206 deceased cases (came from 1775 patients) at the Jinyintan Hospital in Wuhan, Hubei province, China. Another 113 and 285 patients with COVID-19 were respectively recruited from Renmin Hospital of Wuhan University, Hubei province, and Shenzhen Third People's Hospital, Guangdong province, China. The diagnosis of COVID-19 was confirmed by a positive real-time reverse transcriptase polymerase-chain-reaction test of SARS-CoV-2 on nasal and pharyngeal swab specimens from patients. Two recent surveys of ABO blood group distribution of 3694 non-COVID-19 people from Wuhan City, and 23 386 non-COVID-19 people from Shenzhen City were used as comparison controls for the Wuhan and Shenzhen patients with COVID-19, respectively [5, 6]. Statistical analyses were performed using 2-tailed $\chi^2$. Data from different hospitals were meta-analyzed using random effects models, with calculation of odds ratio (OR) and 95% confidence interval (CI). Statistical analyses were performed using SPSS software (version 16.0) and STATA software (version 13).

## RESULTS

The ABO blood group in 3694 people in Wuhan displayed a percentage distribution of 32.2%, 24.9%, 9.1%, and 33.8% for A, B, AB, and O, respectively, whereas the 1775 patients with COVID-19 from Wuhan Jinyintan Hospital showed an ABO distribution of 37.8%, 26.4%, 10.0%, and 25.8% for A, B, AB, and O, respectively. The proportion of blood group A among patients with COVID-19 was significantly higher than that among the control group, being 37.8% in the former versus 32.2% in the latter ($P < .001$). The proportion of blood group O in patients with COVID-19 was significantly lower than that in control group, being 25.80% in the former versus 33.84% in the latter ($P < .001$, Table 1). These results showed associations between ABO blood groups and COVID-19 susceptibility. The

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**Table 1. The ABO Blood Group Distribution in Patients With COVID-19 and Normal Controls**

| | Blood Group | | | |
|---|---|---|---|---|
| | A | B | AB | O |
| Controls (Wuhan Area) | | | | |
| 3694 | 1188 (32.2%) | 920 (24.9%) | 336 (9.1%) | 1250 (33.8%) |
| **Wuhan Jinyintan Hospital** | | | | |
| Patients | | | | |
| 1775 | 670 (37.8%) | 469 (26.4%) | 178 (10.0%) | 458 (25.8%) |
| $\chi 2$ | 16.431 | 1.378 | 1.117 | 35.674 |
| *P* | **<.001** | .240 | .291 | **<.001** |
| OR | 1.279 | 1.083 | 1.114 | 0.680 |
| 95% CI | 1.136~1.440 | .952~1.232 | .920~1.349 | .599~.771 |
| Deaths | | | | |
| 206 | 85 (41.3%) | 50 (24.3%) | 19 (9.2%) | 52 (25.2%) |
| $\chi^2$ | 6.944 | 0.015 | 0.000 | 6.102 |
| *P* | **.008** | .903 | 1.000 | **.014** |
| OR | 1.482 | 0.966 | 1.015 | 0.660 |
| 95% CI | 1.113~1.972 | .697~1.340 | .625~1.649 | .479~.911 |
| **Renmin Hospital of Wuhan University** | | | | |
| 113 patients | 45 (39.8%) | 25 (22.1%) | 15 (13.3%) | 28 (24.8%) |
| $\chi^2$ | 2.601 | 0.318 | 1.815 | 3.640 |
| *P* | .107 | .573 | .178 | .045 |
| OR | 1.396 | 0.857 | 1.530 | 0.644 |
| 95% CI | .952~2.048 | .546~1.344 | .878~2.664 | .418~.993 |
| Controls (Shenzhen area) | | | | |
| 23 386 | 6728 (28.8%) | 5880 (25.1%) | 1712 (7.3%) | 9066 (38.8%) |
| **Patients from Shenzhen Third People's Hospital** | | | | |
| 285 | 82 (28.8%) | 83 (29.1%) | 39 (13.7%) | 81 (28.4%) |
| $\chi^2$ | 0.000 | 2.160 | 15.729 | 12.278 |
| *P* | 1.000 | .142 | **<.001** | .001 |
| OR | 1.000 | 1.223 | 2.008 | .627 |
| 95% CI | .773~1.294 | .946~1.582 | 1.427~2.824 | .484~.812 |

*P* value was calculated by 2-tailed $\chi^2$. The values in bold means $P < .05$.
Abbreviations: CI, confidence interval; OR, odds ratio.

COVID-19 risk significantly increased for blood group A (OR 1.279, 95% CI 1.136~1.440) and decreased for blood group O (OR 0.680, 95% CI .599~.771) (Table 1).

A similar distribution pattern of higher risk for blood group A and lower risk for blood group O was observed in the deceased patients. Specifically, the proportions of blood groups A, B, AB, and O in the 206 deceased patients were 41.3%, 24.3%, 9.2%, and 25.2%, respectively. Blood group O was associated with a lower risk of death compared with non-O groups, with an OR of 0.660 (95% CI .479~.911, $P = .014$) (Table 1). To the contrary, blood group A was associated with a higher risk of death compared with non-A groups, with an OR of 1.482 (95% CI 1.113~1.972, $P = .008$) (Table 1).

We next examined 113 patients with COVID-19 from another hospital in Wuhan City, the Renmin Hospital of Wuhan University, and found a similar risk distribution trend of ABO blood groups for the infection. Specifically, compared with non-O groups, blood group O were associated with a lower risk of infection, with an OR of 0.644 (95% CI .418~.993, $P = .045$) (Table 1). Compared with non-A blood groups, blood group A displayed a relatively higher risk (OR = 1.396; 95% CI .952~2.048) than those observed in patients from Wuhan Jinyintan Hospital, although the associations did not reach statistical significance likely due to the small sample size.

The ABO blood group in 23 368 people in Shenzhen displayed a percentage distribution of 28.8%, 25.1%, 7.3%, and 38.8% for A, B, AB, and O, respectively. Analysis of 285 patients with COVID-19 from Shenzhen showed proportions of blood groups A, B, AB, and O to be 28.8%, 29.1%, 13.7%, and 28.4%, respectively. Similarly, a significantly lower risk of infection was associated with blood group O (OR 0.627; 95% CI .484~.812). Additionally, we found that blood group AB had an increased risk of infection in this group of patients (OR 2.008; 95% CI 1.427~2.824) (Table 1).

Figure 1 shows the estimates of ORs of the risk of ABO blood groups for COVID-19 on the pooled data from the 3 hospitals by random effects models. Again, the results showed that blood group A was associated with a significantly higher risk for COVID-19 (OR 1.21; 95% CI 1.02~1.43, $P = .027$) compared with non-A blood groups, whereas blood group O was