



## Susceptibility of SARS-CoV-2 Infection in Relation to ABO Blood Groups

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### Abstract

Following the first study during the coronavirus disease pandemic, numerous studies reported an association between ABO blood groups, a host risk factor, and susceptibility to SARS-CoV-2 infection, though the relationship remained unclear. This study aimed to investigate SARS-CoV-2 infection susceptibility in relation to ABO blood groups among staff and students at Rangsit University from March to May 2024. Demographic data and blood samples were collected from 132 participants. ABO blood typing was performed using the conventional tube test. Blood group frequencies were distributed as follows: A (27.3%), O (27.3%), AB (22.7%), and B (22.7%). Mean ages across groups ranged from  $20.2 \pm 0.9$  to  $21.5 \pm 3.7$  years. The infection rate was highest in blood group A (86.1%), followed by groups AB (83.3%) and B (83.3%), while group O exhibited the lowest rate (63.9%). Notably, individuals with blood group A showed a significantly higher risk of infection (OR 3.054, 95% CI 1.094-11.223) compared to those with blood group O. These findings indicate that individuals with blood group A may have a higher susceptibility to SARS-CoV-2 infection than those with blood group O. Nevertheless, maintaining strict protective measures remains essential for all individuals, regardless of blood type.

**Keywords:** SARS-CoV-2, COVID-19, ABO blood group, anti-A antibodies

### 1. Introduction

The emergence of coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in late December 2019, resulted in a global health crisis characterized by significant morbidity and mortality worldwide (Syapitri et al., 2021). Various host risk factors contribute to disease susceptibility and severity, including age, gender, chronic comorbidities, and genetic predispositions. Among these, the ABO blood group system has been identified as a potentially significant factor influencing the susceptibility to and progression of SARS-CoV-2 infection (Hu et al., 2023; Soares et al., 2023).

First discovered by Karl Landsteiner in 1901, the ABO blood group system has long been associated with host susceptibility to various infectious diseases, including *Helicobacter pylori* (Borén et al., 1993), hepatitis B virus (Jing et al., 2021), and SARS-CoV (Cheng et al., 2003). Specifically, the initial link between ABO blood groups and SARS-CoV-2 susceptibility was first reported by Zhao et al. (2021). Subsequently, numerous studies have suggested that individuals with blood group A face an increased risk of infection compared to the general population, whereas those with blood group O exhibited a decreased risk (Ad'hiah et al., 2020; Asad et al., 2024; Rana et al., 2021; Ray et al., 2021; Marcos et al., 2020; Zietz et al., 2020). However, other research, such as the study by Dzik et al. (2020), failed to confirm this association. Consequently, the relationship between ABO blood groups and SARS-CoV-2 infection remains a subject of debate and requires further investigation. Understanding the definitive link between ABO blood groups and SARS-CoV-2 susceptibility might offer critical benefits for personalized medicine and public health strategies.

### 2. Objective

To investigate the susceptibility of SARS-CoV-2 infection in relation to the ABO blood group.

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### 3. Materials and Methods

#### 3.1 Study Design and Participants

This research involved 132 staff members and students at Rangsit University, Pathum Thani, Thailand, between March and May 2024. Ethical approval was granted by the Institutional Ethics Committee, Research Ethics Office, Rangsit University (No. RSUERB2023-151) in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to the collection of 3 mL clotted blood samples. Demographic data, including age, gender, and SARS-CoV-2 infection status, were collected using a Google Forms-based questionnaire.

#### 3.2 Antiserum and Standard Cells

All antiserum reagents including anti-A, anti-B, anti-AB, and all standard cells including 3% A cells, 3% B cells, and 3% O cells were purchased from the National Blood Centre, Thai Red Cross Society, Thailand.

#### 3.3 ABO Blood Group Typing

Participants' clotted blood samples were processed to separate red blood cells and serum. Cell grouping and serum grouping were performed using the conventional tube test, following the standard protocol of the National Blood Centre, Thai Red Cross Society. All ABO blood typing results were independently verified by two medical technologists.

#### 3.4 Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 23. Descriptive statistics, including the frequencies of blood groups, gender, and SARS-CoV-2 infection rates, were analyzed. Comparisons between these categorical variables were conducted using Pearson's chi-square test. Risk estimates were reported as odds ratios (OR) with 95% confidence intervals (CI). The normality of data distribution was assessed using the Shapiro–Wilk test. For continuous variables, such as age across blood groups, a one-way ANOVA was employed if the data were normally distributed; otherwise, the Kruskal–Wallis test was used. Statistical significance was defined as a  $p$ -value  $< 0.05$ .

### 4. Results and Discussion

#### 4.1 Results

Table 1 showed that the most frequent blood groups among the 132 participants were group A (27.3%) and O (27.3%), followed by AB (22.7%) and B (22.7%). The frequencies of all blood groups were not statistically significant. In addition, the Rh blood group of all 132 participants was D positive. The ratio of males to females within each blood group also did not differ significantly. The mean age across all blood groups ranged from  $20.2 \pm 0.9$  to  $21.5 \pm 3.7$  years, with no statistical significance. The SARS-CoV-2 infection rate was highest in blood group A (86.1%), followed by AB (83.3%) and B (83.3%), while group O showed the lowest rate (63.9%).

The risk of SARS-CoV-2 infection in relation to ABO blood group was presented in Table 2. Although blood groups AB and B showed increased susceptibility to SARS-CoV-2 infection (odds ratio 2.826, 95% CI 0.871-9.166) compared to group O, this difference was not statistically significant ( $p$ -value = 0.077). In comparison to blood group O, blood group A showed a 3.054-fold (95% CI 1.094-11.223) increased susceptibility to SARS-CoV-2 infection, with a statistically significant difference ( $p$ -value = 0.029).

**Table 1** Blood group and demographic data of 132 participants

Blood group	Number	Age	N (%) of gender*	N (%) of SARS-CoV-2 infection
A	36 (27.3%)	21.5 ± 3.7	M 10 (27.8) F 26 (72.2)	31 (86.1)
AB	30 (22.7%)	20.2 ± 1.3	M 6 (20.0) F 24 (80.0)	25 (83.3)
B	30 (22.7%)	20.2 ± 0.9	M 10 (33.3) F 20 (66.7)	25 (83.3)
O	36 (27.3%)	20.5 ± 0.9	M 7 (19.4) F 29 (52.8)	23 (63.9)

\*Gender M=Male, F=Female

**Table 2** Analysis of risk of SARS-CoV-2 infection

Comparison of blood group	Odds ratio	95% CI	p-Value
A vs AB	1.240	0.322-4.768	0.754
A vs B	1.240	0.322-4.768	0.754
A vs O	3.054	1.094-11.223	0.029*
AB vs B	1.000	0.257-3.888	1.000
AB vs O	2.826	0.871-9.166	0.077
B vs O	2.826	0.871-9.166	0.077
A&B vs B&O	2.100	0.885-4.982	0.089

\*Tested by Pearson Chi-Square with *p*-value < 0.05

## 4.2 Discussions

In this study, the relationship between ABO blood group phenotypes and susceptibility to SARS-CoV-2 infection was investigated in 132 Thai participants. Although the sample size was quite small, it was sufficient for analysis. Consistent with previous reports on host risk factors, our data analysis focused on age, gender, and SARS-CoV-2 infection rates. Furthermore, our unpublished data revealed that all 132 participants were RhD positive.

This study found a significant association, with blood group A showing a 3.054-fold higher SARS-CoV-2 infection rate compared to blood group O. Our findings suggest that individuals with blood group A may require enhanced personal protective measures to mitigate the risk of SARS-CoV-2 infection. Despite variations in sample size, ethnicity, or geographic distribution, our findings show a consistent association with previous studies in China (Zhao et al., 2021), India (Rana et al., 2021), Pakistan (Asad et al., 2024), Iraq (Ad'hiah et al., 2020), Spain (Marcos et al., 2020), Canada (Ray et al., 2021), and the USA (Zietz et al., 2020).

Proposed mechanisms suggest anti-A antibodies in blood groups O and B block the interaction between the SARS-CoV-2 spike protein and the angiotensin-converting enzyme 2 (ACE2) receptor on human cells, potentially preventing viral entry into lung epithelium (Guillon et al., 2008). However, our results did not find significant protective anti-A antibodies in blood group B. A study by Gérard et al. (2020) reported that anti-A antibodies from blood group O were more protective than those from blood group B, possibly because anti-A antibodies in group O are of the IgG class, while in group B, they are IgM. Therefore, future studies should investigate the association between antibody class, titer, and SARS-CoV-2 infection rates.

## 5. Conclusion

Overall results indicate a significant correlation between ABO blood groups and susceptibility to SARS-CoV-2, with blood group A exhibiting a higher infection rate compared to blood group O. While these findings confirmed the association between blood group polymorphism and infection risk, individuals with blood group O should remain vigilant. Conversely, those with blood group A should not panic, however, maintaining strict protective measures remains essential for all groups.



## 6. Acknowledgements

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## 7. References

- Ad'hiah, A. H., Abdullah, M. H., Alsudani, M. Y., Shnawa, R. M., Al-Sa'ady, A. J., Allami, R. H., ... & Taqi, E. A. (2020). Association between ABO blood groups and susceptibility to COVID-19: Profile of age and gender in Iraqi patients. *The Egyptian Journal of Medical Human Genetics*, 21(1), Article 76. <https://doi.org/10.1186/s43042-020-00115-y>
- Asad, L., Mirza, T., Kumar, S., & Khatoun, A. (2024). Effect of ABO blood group on the severity and clinico-pathological parameters of COVID-19. *Pakistan Journal of Medical Sciences*, 40(5), 1022–1029. <https://doi.org/10.12669/pjms.40.5.9037>
- Boren, T., Falk, P., Roth, K. A., Larson, G., & Normark, S. (1993). Attachment of helicobacter pylori to human gastric epithelium mediated by blood group antigens. *Science*, 262(5141), 1892-1895. <https://doi.org/10.1126/science.8018146>
- Cheng, Y., Cheng, G., Chui, C. H., Lau, F. Y., Chan, P. K., Ng, M. H., ... & Wong, R. S. (2005). ABO blood group and susceptibility to severe acute respiratory syndrome. *JAMA*, 293(12), 1450–1451. <https://doi.org/10.1001/jama.293.12.1450-c>
- Dzik, S., Eliason, K., Morris, E. B., Kaufman, R. M., & North, C. M. (2020). COVID-19 and ABO blood groups. *Transfusion*, 60(8), Article 1883. <https://doi.org/10.1111/trf.15946>
- Gérard, C., Maggipinto, G., & Minon, J. M. (2020). COVID-19 and ABO blood group: Another viewpoint. *British Journal of Haematology*, 190(2), Article e93. <https://doi.org/10.1111/bjh.16884>
- Guillon, P., Clément, M., Sébille, V., Rivain, J. G., Chou, C. F., Ruvoën-Clouet, N., & Le Pendu, J. (2008). Inhibition of the interaction between the SARS-CoV spike protein and its cellular receptor by anti-histo-blood group antibodies. *Glycobiology*, 18(12), 1085-1093. <https://doi.org/10.1093/glycob/cwn093>
- Hu, F. H., Jia, Y. J., Zhao, D. Y., Fu, X. L., Zhang, W. Q., Tang, W., ... & Chen, H. L. (2023). Clinical outcomes of the severe acute respiratory syndrome coronavirus 2 Omicron and Delta variant: systematic review and meta-analysis of 33 studies covering 6 037 144 coronavirus disease 2019-positive patients. *Clinical Microbiology and Infection*, 29(7), 835–844. <https://doi.org/10.1016/j.cmi.2023.03.017>
- Jing, W., Zhao, S., Liu, J., & Liu, M. (2020). ABO blood groups and hepatitis B virus infection: A systematic review and meta-analysis. *BMJ Open*, 10(1), Article e034114. <https://doi.org/10.1136/bmjopen-2019-034114>
- Marcos, S. Z., Antelo, M. L., Galbete, A., Etayo, M., Ongay, E., & García-Erce, J. A. (2020). Infection and thrombosis associated with COVID-19: Possible role of the ABO blood group. *Medicina Clínica (English Edition)*, 155(8), 340-343. <https://doi.org/10.1016/j.medcle.2020.06.013>
- Rana, R., Ranjan, V., & Kumar, N. (2021). Association of ABO and Rh blood group in susceptibility, severity, and mortality of coronavirus disease 2019: A hospital-based study from Delhi, India. *Frontiers in Cellular and Infection Microbiology*, 11, Article 767771. <https://doi.org/10.3389/fcimb.2021.767771>
- Ray, J. G., Schull, M. J., Vermeulen, M. J., & Park, A. L. (2021). 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*, 174(3), 308-315. <https://doi.org/10.7326/M20-4511>
- Soares, D. M. B., Araújo, D. A. B. S., de Souza, J. L. D. B., Maurício, R. B., Soares, E. M. B., Neto, F. D. C. A., ... & Aragão, G. F. (2023). Correlation between ABO blood type, susceptibility to SARS-CoV-2 infection and COVID-19 disease severity: A systematic review. *Hematology, Transfusion and Cell Therapy*, 45(4), 483–494. <https://doi.org/10.1016/j.htct.2022.11.001>



- Syapitri H., Sinaga J., Purba, I.E., Aritonang J., & Saragih M. (2021). The potential of coronavirus (COVID-19) transmission in Medan city, Indonesia. *Journal of Southwest Jiaotong University*, 56(4), 724–732. <https://doi.org/10.35741/issn.0258-2724.56.4.61>
- Zhao, J., Yang, Y., Huang, H., Li, D., Gu, D., Lu, X., ... & Wang, P. G. (2021). Relationship Between the ABO Blood Group and the Coronavirus Disease 2019 (COVID-19) Susceptibility. *Clinical Infectious Diseases*, 73(2), 328–331. <https://doi.org/10.1093/cid/ciaa1150>
- Zietz, M., Zucker, J., & Tatonetti, N. P. (2020). Associations between blood type and COVID-19 infection, intubation, and death. *Nature Communications*, 11(1), Article 5761. <https://doi.org/10.1038/s41467-020-19623-x>