https://doi.org/10.3329/cbmj.v14i2.83259

Association of ABO Blood Groups with Secretor Status among Healthy Blood Donors

*Nahar K[1], Binni SY[2], Nine SMAZ[3]

Abstract

The ABO blood group system and secretor status are genetically determined polymorphic traits with potential associations to various health conditions. Understanding the distribution of secretor status across different ABO blood groups in a healthy population is crucial for genetic and epidemiological studies. This study aims to determine the association between ABO blood groups and secretor status among healthy blood donors in Bangladesh. This prospective cross-sectional study was conducted in the Department of Transfusion Medicine of Committee of Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, a tertiary level hospital in Bangladesh, between January and December 2023. A purposive sampling technique was used to recruit a total of 187 healthy blood donors. ABO blood groups were determined using standard haemagglutination tests. Secretor status was determined by detecting the presence of ABH antigens in saliva. We found blood group 'B' (36.9%) as the most prevalent, followed by 'O' (31.6%). Secretors (76.5%) outnumbered non-secretors (23.5%), with the highest secretor frequency in group 'O' (82.8%). ABO blood groups showed a significant association with secretor status (χ^2=6.24, p=0.044). Rh-positive individuals had more secretors (77.3%). Blood group 'A' had the highest odds of being secretors (OR=1.85). Our study confirms a significant association between ABO blood groups and secretor status among healthy donors, with group 'O' having the highest secretor frequency. These findings may aid in understanding genetic and immunological interactions linked to blood group antigens and secretor phenotypes.

CBMJ 2025 July: vol. 14 no. 02 P:34-39

Keywords: ABO blood groups, blood donors, genetic markers, Rh-factor, secretor status

Introduction

Safe blood transfusion is crucial for all hospitals across the country; the quality and safety of all blood and blood components must be assured throughout the process from the selection of blood donors through to the administration of the product to the patient.[1] The ABO blood group system, discovered by Karl Landsteiner in the early 20th century, remains one of the most significant polymorphic genetic markers in humans.[2] This system is characterized by the presence or absence of A and B antigens on the surface of red blood cells, leading to four main blood types: A, B, AB, and O. The distribution of these blood groups varies significantly across different populations worldwide, reflecting historical migration patterns and selective pressures.[3,4] Apart from its critical role in blood transfusion compatibility, the ABO blood group has been implicated in susceptibility and resistance to various infectious and non-infectious diseases, including certain cancers, cardiovascular diseases, and infections.[3] Another independently inherited genetic trait is the secretor status, which determines whether water-soluble forms of ABO blood group antigens are secreted into bodily fluids such as saliva, mucus, and plasma.[5] This trait is governed by the FUT2 gene, with individuals possessing at least one functional FUT2 allele classified as secretors, while those homozygous for a non-functional allele are termed non-secretors.[6] Approximately 80% of individuals are secretors, while the remaining 20% are non-secretors, although this

1. *Dr. Kamrun Nahar, Assistant Professor, Department of Transfusion Medicine, Bangladesh Medical College and Hospital, Dhaka.
2. Dr. Subrina Yeasmin Binni, Associate Professor, Department of Transfusion Medicine, Rajshahi Medical College and Hospital, Rajshahi.
3. Dr. S. M. A. Zulker Nine, Assistant Professor, Department of Cardiothoracic Surgery, Bangladesh Medical University, Dhaka.

Address of Correspondence:
Email: kamrunznp@gmail.com

proportion can vary among different ethnic groups.[7] The secretor status has also been associated with various health outcomes. For instance, non-secretors have been reported to have an increased susceptibility to certain infections like norovirus and Helicobacter pylori, as well as inflammatory bowel diseases.[8,9] Conversely, secretor status has been linked to increased susceptibility to other conditions.[10] Given that both ABO blood groups and secretor status are genetically determined and have been independently linked to disease susceptibility, exploring potential associations between these two systems is of biological interest. Some studies have investigated the relationship between ABO blood groups and secretor status in different populations.[11,12] Understanding such associations could provide further insights into the genetic architecture of disease susceptibility and resistance within specific populations. In Bangladesh, a densely populated country with a diverse genetic background, information on the distribution of ABO blood groups is available[13], and some studies have explored the prevalence of secretor status in specific contexts.[14] However, a comprehensive investigation into the association between ABO blood groups and secretor status among healthy individuals, particularly blood donors, has been limited. Healthy blood donors represent a relatively unbiased segment of the population, free from acute illnesses that might influence the expression or detection of these markers. Therefore, this study aims to investigate the association between ABO blood groups and secretor status among healthy blood donors in a tertiary level hospital in Bangladesh. The findings of this research will contribute to the existing knowledge on the distribution and potential interplay of these two important genetic markers within the Bangladeshi population. This information may be valuable for future genetic association studies and for understanding population-specific variations in susceptibility to various diseases.

Methods

This prospective, cross-sectional study was conducted in the Department of Transfusion Medicine of Committee of Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, a tertiary level hospital in Bangladesh, between January and December 2023. The study population comprised healthy blood donors who attended the hospital's blood donation center. A purposive sampling technique was employed to recruit participants, targeting a sample size of 187 individuals. For each participant, venous blood samples were collected into EDTA tubes for ABO blood group determination. Saliva samples were also collected in sterile containers for secretor status testing. ABO blood grouping was performed using standard hemagglutination tests with commercially available antisera (anti-A, anti-B, and anti-D).[1] Secretor status was determined by detecting the presence of ABH antigens in saliva using the haemagglutination inhibition method, following established protocols.[2]

Data was collected from each participant’s data sheet and scrutinized and compiled. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 23.0 for Windows (IBM Corp., Armonk, NY, USA). The distribution of ABO blood groups and secretor status was determined. The association between ABO blood groups and secretor status was assessed using the chi-square ($\chi 2$) test. A p-value of less than 0.05 was considered statistically significant. This study was approved by the Ethical Review Committee of Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, Bangladesh.

Results

This study included 187 healthy blood donors. The mean age was 32.5±8.7 years, with a male predominance (78.6%) (Table-I). The distribution of ABO blood groups revealed that blood group B was the most prevalent (36.9%), followed by O (31.6%), A (23.0%), and AB (8.6%). The majority of donors were Rh-positive (94.1%), while only a small proportion were Rh-negative (5.9%). Analysis of secretor status showed that 76.5% of participants were secretors, while 23.5% were non-secretors. When stratified by ABO blood groups, the highest proportion of secretors was found in blood group O (82.8%), followed by B (78.3%), A (72.1%), and AB (62.5%). Further stratification by Rh factor indicated that Rh-positive individuals had a higher frequency of secretors (77.3%) compared to Rh-negative individuals (63.6%) (Table-II). A statistically significant association was observed between ABO blood groups and secretor status (χ^2=6.24, p=0.044) (Table-III). Blood group A had the highest odds of being a secret or (OR=1.85, 95% CI: 1.12–3.05), while blood group AB had the lowest (OR=0.62, 95% CI: 0.28–1.39) (Table-IV). The combined distribution of ABO/Rh blood groups and secretor status demonstrated that O-positive donors had the highest number of secretors (84.7%), whereas AB-negative donors had the lowest (50.0%) (Table-V).

Table-I: Demographic characteristics of study participants (n=187)

Variables	Category	Frequency	Percentage
Gender	Male	147	78.6
	Female	40	21.4
Age (years)	18-25	52	27.8
	26-35	68	36.4
	36-45	45	24.1
	>45	22	11.8
Mean±SD	32.5±8.7 years		

Table-II: Secretor status distribution across ABO blood groups (n=187)

Blood Group	Secretors	Non-Secretors	Total
	Frequency (Percentage)	Frequency (Percentage)	
A	31 (72.1)	12 (27.9)	43
B	54 (78.3)	15 (21.7)	69
AB	10 (62.5)	6 (37.5)	16
O	48 (82.8)	11 (17.2)	59
Rh-factor			
Rh+	136 (77.3)	40 (22.7)	176
Rh-	7 (63.6)	4 (36.4)	11

Table-III: Association between ABO blood groups and secretor status

Variable	χ^2 Value	p-value
ABO Groups	6.24	0.044

Chi-square test was employed to reach p-value.

Table-IV: Odds ratios (OR) for secretor status by ABO blood group

ABO Group	OR	95% CI	p-value
A	1.85	1.12–3.05	0.016
B	1.42	0.89–2.27	0.142
AB	0.62	0.28–1.39	0.248
O (Ref)	1		

Table-V: Combined ABO/Rh and secretor status distribution (n=187)

Blood Group	Secretors	Non-Secretors	Total
	Frequency (Percentage)	Frequency (Percentage)	
A+	29 (74.4)	10 (25.6)	39
A-	2 (50.0)	2 (50.0)	4
B+	52 (78.8)	14 (21.2)	66
B-	2 (66.7)	1 (33.3)	3
AB+	10 (66.7)	5 (33.3)	15
AB-	0 (0.0)	1(100.0)	1
O+	45 (84.7)	8 (15.3)	53
O-	3 (50.0)	3 (50.0)	6

Discussion

The findings of this study provide valuable insights into the distribution of ABO blood groups and secretor status among healthy blood donors in Bangladesh. Our results demonstrate that blood group B (36.9%) was the most prevalent, followed by O (31.6%), A (23.0%), and AB (8.6%). This distribution pattern is consistent with previous reports from South Asia, where blood group B predominates in the population.[15] The high frequency of Rh-positive individuals (94.1%) observed in our study aligns with the known rarity of Rh negativity in Asian populations.[16] A particularly interesting finding was the overall secretor prevalence of 76.5%, which shows close similarity with another study done in India (75-80%).[17] However, variation may reflect in population-specific genetic differences in the FUT2 gene, which encodes the α(1,2)-fucosyltransferase enzyme responsible for secretor status.[18] The observed distribution suggests that genetic factors influencing secretor phenotype may vary across ethnic groups, possibly due to different evolutionary pressures or founder effects. The stratification of secretor status by ABO blood groups revealed significant variations, with group O showing the highest proportion of secretors (82.8%) and group AB the lowest (62.5%). This finding supports the hypothesis of a biological interaction between the ABO and secretor systems.[19] The statistically significant association between ABO blood groups and secretor status ($\chi^2=6.24$, $p=0.044$) adds to growing evidence that these two genetically independent systems may influence each other's expression patterns.[10] One possible mechanism for this interaction could involve competition between ABO glycosyltransferases and the FUT2 enzyme for their common substrate, the H antigen.[20] The higher frequency of secretors among Rh-positive individuals (77.3%) compared to Rh-negative (63.6%) presents an intriguing observation, as no direct biochemical link between the Rh system and secretor status has been established. This finding warrants further investigation in larger cohorts to determine whether it represents a true biological phenomenon or a sampling artifact. From an epidemiological perspective, our findings contribute to the growing body of knowledge about the distribution of these important genetic markers in South Asian populations. The observed patterns may have implications for understanding disease susceptibility patterns in Bangladesh, as both ABO blood groups and secretor status have been independently associated with varying risks for infectious diseases and certain chronic conditions.[4,21,22] For instance, the relatively high prevalence of blood group B and secretor status in our population may influence susceptibility to pathogens like norovirus and Helicobacter pylori, which are known to interact with these blood group antigens.[9,17,19] The demonstration of an association between ABO blood groups and secretor status in this Bangladeshi cohort adds to the limited data available for South Asian populations. While similar studies have been conducted in other regions[12,23,24], our findings highlight the importance of population-specific investigations, as genetic and phenotypic distributions can vary significantly across different ethnic groups. This underscores the need for further research to elucidate the mechanisms underlying the observed associations and their potential health implications in the Bangladeshi population.

Our study has some limitations. We used purposive sampling, which may limit generalizability. The sample size, though adequate, was restricted to a single hospital. Additionally, environmental and genetic factors influencing secretor status were not analyzed. Further multicenter studies with larger cohorts are recommended for broader validation.

Conclusion

This study demonstrates a significant association between ABO blood groups and secretor status among healthy blood donors, with blood group O exhibiting the highest secretor frequency. The findings suggest potential genetic and immunological linkages between blood group antigens and secretor phenotypes. These insights could have implications for transfusion medicine, disease susceptibility research, and personalized healthcare strategies. Further investigations with larger, diverse populations are warranted to validate and expand upon these observations for broader clinical relevance. The single-center design of this study and purposive sampling may affect generalizability. Potential confounding factors like diet, genetics, and infections were not assessed. The modest sample size limited subgroup analyses. Future multicentre studies with comprehensive demographic data could strengthen these findings.

References

1. *Nurunnabi ASM, Jahan MU, Alam MA, Hoque MM. Safe blood transfusion and ethical issues in transfusion medicine. J Dhaka Med Coll. 2010;19(2):144-9.*
2. *Shaw LB, Shaw RA. The Pre-Anschluss Vienna School of Medicine – the medical scientists: Karl Landsteiner (1868-1943) and Otto Loewi (1873-1961). J Med Biogr. 2016;24(3):289-301.*
3. *Abegaz SB. Human ABO blood groups and their associations with different diseases. Biomed Res Int. 2021;2021:6629060*
4. *Franchini M, Mannucci PM. ABO blood group and thrombotic vascular disease. Thromb Haemost. 2014;112(6):1103-9.*
5. *Watkins WM. Biochemistry and genetics of the ABO, Lewis, and P blood group systems. Adv Hum Genet. 1980;10:1-136, 379-85.*
6. *Kelly RJ, Rouquier S, Giorgi D, Lennon GG, Lowe JB. Sequence and expression of a candidate for the human Secretor blood group alpha(1,2)fucosyltransferase gene (FUT2). Homozygosity for an enzyme-inactivating nonsense mutation commonly correlates with the non-secretor phenotype. J Biol Chem. 1995;270(9):4640-9.*
7. *Metgud R, Khajuria N, Mamta, Ramesh G. Evaluation of the secretor status of ABO blood group antigens in saliva among southern Rajasthan population using absorption inhibition method. J Clin Diagn Res. 2016;10(2):ZC01-3.*
8. *Nordgren J, Svensson L. Genetic susceptibility to human norovirus infection: An update. Viruses. 2019;11(3):226.*
9. *de Oliveira IA, Corvelo TCO. ABH and Lewis blood group systems and their relation to diagnosis and risk of Helicobacter pylori infection. Microb Pathog. 2021;152:104653.*
10. *Le Pendu J, Marionneau S, Cailleau-Thomas A, Rocher J, Le Moullac-Vaidye B, Clément M. ABH and Lewis histo-blood group antigens in cancer. APMIS. 2001;109(1):9-31.*
11. *Balaouras G, Eusebi P, Kostoulas P. Systematic review and meta-analysis of the effect of ABO blood group on the risk of SARS-CoV-2 infection. PLoS One. 2022;17(7):e0271451.*
12. *Pai MU, Samanth J, Rao S, Rekha V, Megha A, Ganesh P, et al. Association of ABO blood groups with the severity of coronary artery disease in southern India population: A prospective cross-sectional study. Indian Heart J. 2023;75(4):285-7.*
13. *Chima OK, Mohammed TB, Aisha K-G, Alhaji SA, Muhammad BM, Kwaru AH. ABO and rhesus blood groups among blood donors in Kano, North-Western Nigeria. Nigerian J Basic Clin Sci. 2012;9(1):11-13.*
14. *Palit P, Ahmed MMM, Gazi MA, Haque MA, Alam MA, Haque R, et al. Association of secretor status with enteropathy and growth among children in Bangladesh aged 1-24 months. Am J Trop Med Hyg. 2022;107(2):449-56.*

15. *Khan MAS, Al Mosabbir A, Raheem E, Ahmed A, Rouf RR, Hasan M, et al. Clinical spectrum and predictors of severity of dengue among children in 2019 outbreak: A multicenter hospital-based study in Bangladesh. BMC Pediatr. 2021;21(1):478.*

16. *Li HY, Guo K. Blood Group Testing. Front Med (Lausanne). 2022;9:827619.*

17. *Menon VK, George S, Sarkar R, Giri S, Samuel P, Vivek R, et al. Norovirus gastroenteritis in a birth cohort in southern India. PLoS One. 2016;11(6):e0157007.*

18. *Ferrer-Admetlla A, Sikora M, Laayouni H, Esteve A, Roubinet F, Blancher A, et al. A natural history of FUT2 polymorphism in humans. Mol Biol Evol. 2009;26(9):1993-2003.*

19. *Haga K, Ettayebi K, Tenge VR, Karandikar UC, Lewis MA, Lin SC, et al. Genetic manipulation of human intestinal enteroids demonstrates the necessity of a functional fucosyltransferase 2 gene for secretor-dependent human norovirus infection. mBio. 2020;11(2):e00251-20.*

20. *Cooling L. Blood groups in infection and host susceptibility. Clin Microbiol Rev. 2015;28(3):801-70.*

21. *Groot HE, Villegas Sierra LE, Said MA, Lipsic E, Karper JC, van der Harst P. Genetically determined ABO blood group and its associations with health and disease. Arterioscler Thromb Vasc Biol. 2020;40(3):830-8.*

22. *Kaur P, Gupta M, Sagar V. FUT2 gene as a genetic susceptible marker of infectious diseases: A Review. Int J Mol Epidemiol Genet. 2022;13(1):1-14.*

23. *Mostafa D, Elkhatat EI, Koppolu P, Mahgoub M, Dhaifullah E, Hassan AH. Correlation of ABO blood groups and Rh factor with the severity of generalized chronic periodontitis: A cross sectional study in Riyadh, Saudi Arabia. Open Access Maced J Med Sci. 2019;7(4):617-22.*

24. *Das P, Slong D, Ropmay AD, Patowary AJ, Naidu LRV, Mukherjee B. Prevalence of ABH(O) blood group secretors among indigenous population of Shillong: A cross-sectional study. Cureus. 2024;16(11):e73266.*