

CROSS SECTIONAL STUDY OF FREQUENCY AND DISTRIBUTION OF ABO AND Rh BLOOD GROUP IN DONORS VISITING A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: ABO and Rh are the most important blood group system in transfusion medicine. This study was carried out with an objective to provide data regarding frequency and distribution of ABO and Rh blood groups among the blood donors in tertiary care hospital, Bangalore.

Objectives:

To assess the distribution of ABO and Rh blood group among blood donors visiting tertiary care hospital.

To assess the frequency of rare blood group.

Source of data:

All the ABO and Rh blood grouping done on donors during the study period at Department of IHBT, Victoria hospital, BMCRI.

Methodology: The present study is a cross-sectional study conducted from May 2023 to April 2024 over a period of 1 year. All the blood donors, who donated blood in blood centre and outdoor blood donation camps organized by the Department of Immunohematology and Blood Transfusion, Victoria hospital, Bangalore Medical College and Research Institute were included in the study.

After blood donation, blood group of all the blood donor was determined by both forward cell grouping and reverse serum grouping by conventional tube method from the pilot samples of the donors according to standard operative procedure of the blood bank.

ABO and Rh typing were determined by commercially available monoclonal anti-A, anti-B and anti -D antisera in forward grouping and A, B and O pooled cells were used in reverse grouping. A₁ subgroups were confirmed using A₁ lectin. Individuals with O blood group were also tested with H lectin. Final blood group was confirmed only if forward and reverse grouping are identical. All Rh (D) negative blood groups were confirmed by weak D (Du) test.

Total 8672 donor blood groups were studied. Frequency and distribution of ABO and Rh blood groups were calculated in percentage.

Results: Out of the total 8672 blood donors, 8485 (97.84%) were males and 187 (2.15%) were females. The study shows that the O blood group formed the most common with 3173 (36.58%), followed by B blood group with 2699 (31.12%), blood group A with 2179 (25.12%) and AB blood group with 619 (7.11%). Rh positivity among donors was 8139 (93.85%), rest were Rh negative 533 (6.14%).

This study also identified four Bombay blood group 4 (0.04%)

Conclusion: The study confirms that blood group O is the most frequent in the ABO blood group system. AB blood group is the least prevalent in our tertiary care hospital. Most of the blood donors were Rh (D) positive.

Key words: ABO and Rh blood group, Blood donor,

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Introduction

Karl Landsteiner first described the ABO blood group system in 1990 and it is still the most significant blood group system in transfusion and transplant medicine¹. At present, 45 blood group system and over 600 different blood group antigens are listed by ISBT². All human population are part of the same blood group system; however, the frequency of different types varies. The incidence of ABO and Rh group varies significantly among racial and ethnic groups in worldwide³. The ABO and Rh

group system are most important for transfusion purpose, parental testing, legal medicine and in population genetic study⁴. Individuals blood groups are determined by genetics and classified according to the presence of particular antigens on the surface of RBS's⁵.

The four main ABO groups in the ABO system are A, B, O and AB. Two antigens (A and B) on red blood cell either present or absent determines one of the four phenotypes¹. ABO and Rh antigens are typically located on the surface of red blood cells

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and platelets in blood. ABO antigens are also found on lymphocytes, organs, endothelial cells and epithelial cells^{6,7}. Antibodies of ABO systems are usually “natural occurring”. Because they are produced without any exposure to RBC’s and are predominantly IgM type^{8,9}. These blood group antibodies have the potential to cause haemolytic transfusion reaction and Haemolytic disease of foetus and newborn². The ABO system follows the mendelian law of inheritance. ABO gene is located on chromosome 9 and FUT1 (H) gene is found on chromosome 19⁸. H antigen is the basic precursor structure from which A and B antigen are formed, inheritance of the H gene causes the production of H antigen⁹.

In the formation of blood group: -

- A gene codes for the production of α - 3 - N acetyl galactosaminyl transferase, that transfers N - acetyl D - galactosamine to the H substance.
- B gene codes for the prediction of α - 3 - D - galactosyl transferase and attached D - galactose to the precursor substance.
- The H gene causes the production of an enzyme known as α L - fucosyl transferase which adds L - fucose to the terminal galactose of type chains⁸.

The A and B are co - dominant while O gene is an amorphic⁸.

ABO grouping is the most frequently performed test in blood bank. Both ABO forward and reverse grouping test need to be performed on every patients & donors⁹. Understanding the distribution of the ABO and Rh blood groups is useful for managing blood centres and providing safe blood transfusion services⁴. The frequencies of ABO and Rh blood groups vary from one population to another and time to time in the same region⁴.

The study aims to analyse the region distribution of ABO and Rh blood groups among donors in tertiary care hospital. Assessing rare blood group frequency and to provide safe blood transfusion services.

Aim and objective

- To assess the distribution of ABO and Rh blood group among blood donors visiting tertiary care hospital.
- To assess the frequency of rare blood group.

Material and methods

Source of data All the ABO and Rh blood grouping done on donors during study period at department of IHBT, Victoria hospital BMCRI.

Inclusion Criteria

1. Whole blood donors presenting to the department of IHBT, Victoria hospital BMCRI.
2. Donors attending outdoor blood donation camps organised by department of IHBT, Victoria hospital BMCRI, are fulfilling all the criteria for whole blood donation

according to National Guidelines under Drugs and Cosmetics Act, 1940 and rules, 2020 and National AIDS Control organization, Ministry of Health and Family welfare, Government of India

Exclusion Criteria

1. Deferred donors blood samples
2. Autologous blood donors
3. Apheresis blood donors
4. Blood bag received from outside blood centres

Sample size estimation

Based on previous study conducted by Kruti A. Raja et al. 34.43% had blood group B among blood donors, the sample size is calculated by using the formula

$$n = \frac{(Z^2 \alpha/2 p q)}{d^2}$$

Where, $Z_{\alpha/2} = 1.96$

$p = 34.43$

$q = 100 - p = 65.57$

$d = \text{precision} = 1\% \text{ of } p = 1.72$

$$n = \frac{(1.96)^2 \times 34.43 \times 65.57}{(1)^2} = 8,672.700$$

$n = 8672$

Total sample size is: 8672

Methodology

After

blood donation

Blood group of the blood donors was determined by forward and reverse grouping by conventional tube method from the pilot sample.

ABO forward grouping was done by using commercially available monoclonal anti-A, anti-B antisera and reverse grouping was done by A, B and O pooled cells.

Rh typing was done by the using Anti-D antisera

A₁ subgroup was confirmed by A₁

lectin

Final blood group was confirmed only, if forward and reverse grouping are identical

All Rh (D) negative blood groups were confirmed by weak D test.

Result

A total of 8672 donor samples were tested during the study period for ABO grouping and Rh typing, 8485 (97.84%) were males and 187 (2.15%) were female donors. Blood group distribution among the donors were O 3173 (36.58%) followed by B 2699 (31.12%), A 2179 (25.12%) and AB 617 (7.11%). In donors having A blood group 2179, A₁ is found to be 2051 (23.65%), and in AB blood group 617, A₁B is found to be 572 (6.59%). The most common blood group in the present study was O (36.58%) and least common being AB 617 (7.11%). The majority of the blood group of Bombay was also found in this study

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4 (0.004%). Combining ABO and Rh blood groups, frequencies of different blood groups were in following order O>B>A>AB.

Table 1: Distribution of ABO and Rh Blood groups among donors

Blood group	Rh phenotypes		Total number of donors	Percentage
	Rh positive	Rh negative		
A1	1942 (22.39%)	109 (1.25%)	2051	23.65%
A2	124 (1.42%)	4 (0.04%)	128	1.47%
B	2527 (29.13%)	172 (1.98%)	2699	31.12%
O	2975 (34.30%)	198 (2.28%)	3173	36.58%
A1B	529 (6.10%)	43 (0.49%)	572	6.59%
A2B	40 (0.46%)	5 (0.05%)	45	0.51%
Bombay	2 (0.02%)	2 (0.02%)	4	0.04%
Total	8139 (93.8%)	533 (6.14%)	8672	100.0%

Graph 1: Blood group distribution Among Donors

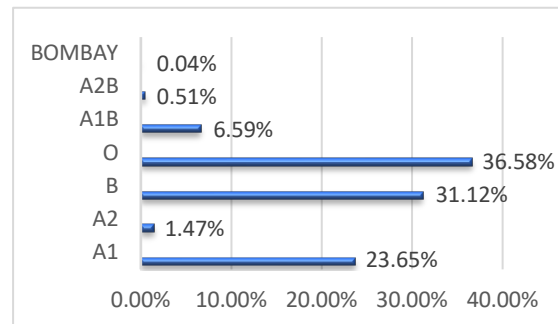


Table 2: Gender wise blood group distribution among donors

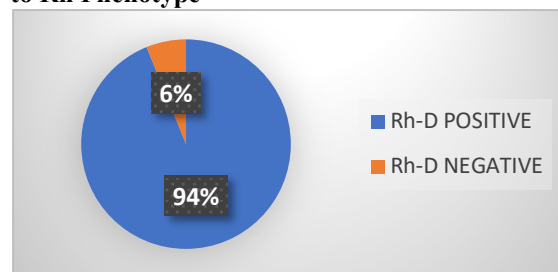
GENDER	NUMBER OF DONORS	PERCENTAGE
Male	8485	97.84%
Female	187	2.16%
Total	8672	100%

Graph 2: Gender wise Blood group distribution among donors

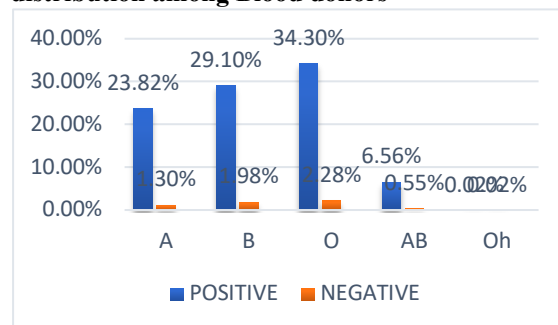
Table 3: Distribution of Blood Donors According to Rh Phenotype

Rh phenotype	Blood donors	
	N	(%)
Rh-D positive	8139	93.85%
Rh-D negative	533	6.14 %
Total	8672	100.0 %

Graph 3: Distribution of blood Donors According to Rh Phenotype



Graph 4: ABO and Rh – D blood group distribution among Blood donors



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Discussion

ABO grouping is the foundation for all pretransfusion testing and is crucial for providing safe blood components in transfusion centres. ABO discrepancy may cause Haemolytic transfusion reaction; hence accurate reporting of ABO grouping maintains transfusion safety. All ABO discrepancies must be resolved before reporting a patient or donor ABO group.

The human population has the same blood group system, even though they are differing in their frequencies of specific type. The distribution pattern of ABO and Rh blood group system varies markedly in different races, ethnic groups and even from time to time in the same place³. Knowledge of the distribution of blood groups can help to minimize the morbidity and mortality rate, access to a safe and sufficient blood supply will helpful in the effective management of blood centre inventory³. The most common blood group in present study was O 3173 (36.58%) followed by B 2699 (31.12%), A 2179(25.12 %) and blood group AB 617(7.11%). Out of 2179 (25.12) donors of group A, 2051 (23.65%) were A₁, 128(1.47) were A₂ and in group AB 617 (7.11%), 572 (6.59%) were A₁B and A₂B was 45 (0.51%). In Rh group, the frequency of Rh (D) positive was 8139(93.85%) and Rh (D) negative was 533(6.14%).

The present study, carried out in the department of IHBT Victoria hospital, Bangalore, was compared with various other studies on the distribution of ABO and Rh blood groups conducted in different parts of India.

Table 4: Comparative study on Frequency of ABO and Rh Blood group in India

Place of study	A	B	O	A B	Rh (D) positive	Rh (D) negative
Southern India						
Present study	25.1 2%	31.1 2.0 %	36.58 %	7.1 1%	93.85 %	6.14 %
Tirupathi Suresh B et.al ³	2 1.1 %	40.8 %	30.5 %	7.6 %	91.4 %	8.6 %
Bangalore						

Periyavan S et.al ¹⁸	23.8 %	29.9 %	39.8 %	6.3 7%	94.2 %	5.7 %
Tamil Nadu Sigamani et.al ⁵	22.0 %	30.9 %	39.1 %	7.8 %	95.9 %	4.0 %
Northern India						
Himachal Pradesh Singh et.al ¹⁹	28.8 %	38.1 %	21.8 %	11.8 %	93.8 %	6.1 %
Srinagar Kumar et.al ²⁰	30.3 %	31.6 %	26.2 %	11.7 %	93.5 %	6.4 %
Central India						
Maharashtra Aravind Chavhan ²¹	22.9 %	37.4 %	27.6 %	12.0 %	97.4 %	2.5 %
Eastern India						
Durgapur Nag I et.al ²²	23.9 %	33.6 %	34.8 %	7.7 %	94.7 %	5.3 %
Western India						
Rajasthan Behra R et.al ²³	22.2 %	36.4 %	31.7 %	9.4 %	91.7 %	8.2 %

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Gujarat Raja et.al ²	24.3 %	34.4 %	32. 2%	8.9 %	95. 1%	4.8 %
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In the studies done in South part of India by Periyavan S et.al at Bangalore, and Sigamani et.al at Tamil Nadu, blood group O showed the highest frequency, followed by B, A and AB. The same incidence was found in the present study. In the study by Suresh B et.al done in Tirupati, blood group B was the commonest followed by O, A and AB. which was different from our study. In a Study by Singh et.al from Himachal Pradesh and in Srinagar, Kumar et.al located in Northern India, showed that the B blood group formed the most common, followed by A, O and AB which is different from our study. Study done at central India, Maharashtra by Aravind chavhan et.al and in western part of India like Rajasthan by Behra R et.al and Raja et.al at Gujarat, B blood group having the highest prevalence followed by O, A and AB. In contrast the commonest blood group in present study was O followed by B, A and AB. In Eastern India, Nag I et.al. at Durgapur reported the greatest frequency of blood group was O followed by B, A and AB. The present study also showed similar findings. Based on the distribution of blood groups in the Northern, Central and Western part of India, B is the most prevalent blood type, while O is the most common blood group in Eastern portion of India and in some part of South India such as Bangalore and Tamil Nadu. In most part of India, the occurrence of Rh (D) positive ranges from 92-97%, while Rh (D) negative blood group from 3-8 %. Our study found that 93.8% of donors where Rh (D) positive and 6.14 % were Rh (D) . In Tirupati by Suresh B et.al reported the highest frequency of Rh (D) negative was found as compared to other regions in India.

Table 5: comparative study on frequency of ABO Rh Blood group in India

Place of study	A	B	O	A B	Rh (D) posi tive	Rh (D) neg ativ e
Southern India						
Prese nt study	25.1 2%	31.1 2.0 %	36. 58 %	7.1 1%	93. 85 %	6.14 %
Tirup ati						

Suresh B et.al ³	2 1.1 %	40.8 %	30. 5%	7.6 %	91. 4%	8.6 %
Bangalore Periyavan S et.al ¹⁸		29.9 23.8 %	39. 8%	6.3 7%	94. 2%	5.7 %
Tamil Nadu Sigamani et.al ⁵	22.0 %	30.9 %	39. 1%	7.8 %	95. 9%	4.0 %
Northern India						
Himachal Pradesh Singh et.al ¹⁹	28.8 %	38.1 %	21. 8%	11. 8%	93. 8%	6.1 %
Srinagar Kumar et.al ²⁰	30.3 %	31.6 %	26. 2%	11. 7%	93. 5%	6.4 %
Central India						
Maharashtra Aravind chavhan ²¹	22.9 %	37.4 %	27. 6%	12. 0%	97. 4%	2.5 %
Eastern India						
Durgapur Nag I et.al ²²	23.9 %	33.6 %	34. 8%	7.7 %	94. 7%	5.3 %
Western India						

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Rajasthan Behra R et.al ²³	22.2 %	36.4 %	31.7 %	9.4 %	91.7 %	8.2 %
Gujarat Raja et.al ²	24.3 %	34.4 %	32.2 %	8.9 %	95.1 %	4.8 %

In the studies done in South part of India by Periyavan S et.al at Bangalore, and Sigamani et.al at Tamil Nadu, blood group O showed the highest frequency, followed by B, A and AB. The same incidence was found in the present study. In the study by Suresh B et.al done in Tirupati, blood group B was the commonest followed by O, A and AB. which was different from our study. In a Study by Singh et.al from Himachal Pradesh and in Srinagar, Kumar et.al located in Northern India, showed that the B blood group formed the most common, followed by A, O and AB which is different from our study. Study done at central India, Maharashtra by Aravind chavhan et.al and in western part of India like Rajasthan by Behra R et.al and Raja et.al at Gujarat, B blood group having the highest prevalence followed by O, A and AB. In contrast the commonest blood group in present study was O followed by B, A and AB. In Eastern India, Nag I et.al. at Durgapur reported the greatest frequency of blood group was O followed by B, A and AB. The present study also showed similar findings. Based on the distribution of blood groups in the Northern, Central and Western part of India, B is the most prevalent blood type, while O is the most common blood group in Eastern portion of India and in some part of South India such as Bangalore and Tamil Nadu. In most part of India, the occurrence of Rh (D) positive ranges from 92-97%, while Rh (D) negative blood group from 3-8 %. Our study found that 93.8% of donors where Rh (D) positive and 6.14 % were Rh (D). In Tirupati by Suresh B et.al reported the highest frequency of Rh (D) negative was found as compared to other regions in India.

TABLE 6: FREQUENCY OF BLOOD GROUP IN DIFFERENT COUNTRIES

NAMES OF COUNTRIES	A	B	O	A B	Rh (D) POSITIVE	Rh (D) NEGATIVE

Present study	25.12 %	31.12.0 %	36.58 %	7.11 %	93.8 %	6.14 %
Pakistan ²⁴	23.2 %	38.0 %	28.7 %	9.9 %	89.0 %	10.8 %
Mexico ²⁵	27.4 %	8.9 %	61.8 %	1.8 %	95.5 %	4.4 %
Kenya ²⁶	26.2 %	22.0 %	47.4 %	4.4 %	96.1 %	3.9 %
Ethiopia ²⁷	32.2 %	22.5 %	39.0 %	6.4 %	92.9 %	7.1 %
Nepal ²⁸	34.0 %	29.0 %	32.5 %	4.0 %	96.6 %	3.3 %

Outside of India, studies were conducted in different countries such as Pakistan, Mexico, Kenyan, Ethiopia and Nepal. Our study coincides with the study conducted in other countries of the world, such as Mexico, Kenyan, and Ethiopia, frequency of blood group O is the highest. While in Pakistan, B is the most common blood group which is in contrast to the present study. One study from Nepal found that the commonest blood group was A which is different from our observation. In major parts of India, commonest blood group was either B or O. Looking at the Rh grouping, the majority of the population on the worldwide were Rh (D) positive, the present study also showed the similar findings. There was a greatest frequency of Rh (D) negative individuals in Pakistan compared to other populations of the world.

TABLE 7: FREQUENCY OF A1 AND A2 IN A AND AB POPULATION

Place of study	A1	A Subgroup	A1B	AB Subgroup
Present study	94.12 %	5.87%	92.70 %	7.29%
Gwalior, Madhya Pradesh	92.0%	8.0%	91.4%	8.6%

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Pradesh ²⁹				
Vellore, Tamil Nadu ³⁰	96.9%	3.01%	98.57%	1.43%

Our study results of A₁ and A₂ in A and AB population is relatively comparable to the study done in Madhya Pradesh.

Conclusion The present study concludes that most common blood group is O and AB which is the least common among the blood donors. Rh (D) positive was commoner than Rh (D) negative. In our study male donors were more in number compared to female donors. The study on the frequency occurrence of different blood groups among the people in a given area helps to prepare a database for the blood centres and also to create awareness as to which blood groups should be stored and given importance. Blood group should be clearly displayed on all types of identify cards, especially in emergencies requiring urgent transfusion.

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