

The Spectrum of ABO and Rhesus Blood Group Systems in a Blood Center in Southern Karnataka

Rashmi Budha, Brilsee Simeon, Satish Belagatti, Akriti Singh

Department of Transfusion Medicine, ESIC MC and PGIMSR, Bengaluru, Karnataka, India

Abstract

Introduction: Hereditary characteristics, such as ABO and Rhesus (Rh) blood group antigens, are helpful for population genetic studies, for settling medicolegal disputes, and most vitally immunologic safety of blood during transfusion. Having firm knowledge of blood grouping is essential for managing the collection of blood banks. It can lower the likelihood of morbidity and mortality brought on by lack of blood in specific areas. The objective of our study was to screen and determine the frequencies of the occurrence of ABO and Rh blood groups among residents from both the urban and rural populations of the South Karnataka region. **Materials and Methods:** This was a retrospective study. The study was conducted in a blood center and included all the donors from January 17 to December 22. Hemoglobin estimation was estimated by copper sulfate method and ERMA INC-PCE-210 3-Part analyzer. After blood bank validation, Tulip Diagnostics Limited standard anti-sera of anti-A, anti-B, and anti-D were used to conduct antigen-antibody slide agglutination test to determine the ABO grouping and Rh typing following blood donation. Simple percentages were used to report data on the ABO and Rh blood group distribution patterns. **Results:** Out of 19497 donors, predominant age group was 25–29 years (29.46%). The male:female ratio was 108:1. Voluntary donors (91.03%) were more than replacement donors, with predominant donors being Rh positive. Maximum donors had the blood group O (42.5%), followed by B > A > AB. There were also four Bombay blood group donors in our study. **Conclusion:** Good knowledge and understanding of blood grouping have an imperative involvement in the management of blood bank inventory. It can help to minimize the morbidity and mortality rate due to lack of blood in a particular geographical area.

Keywords: ABO, blood groups, donors, Rhesus

INTRODUCTION

Transfusion, which is the act of giving blood to another person, has been around for a very long time. It has been a long, arduous road from a concept and an idea to a well-established therapy. The first successful transfusion of human blood was carried out by British physician, James Blundell, in 1818 for a case of postpartum hemorrhage. The ABO blood types were discovered by Karl Landsteiner in 1901, which is a significant year in the history of transfusion medicine. For this discovery, he was awarded the Nobel Prize in Medicine in 1930. Karl Landsteiner and A. Weiner made the discovery of the Rhesus (Rh) blood group system in 1940.

Blood group antigens, which are minuscule glycoproteins and glycolipids with enough molecular weight to function as antigens, are carried by the membrane of red blood cells. The

ABO system follows the Mendelian laws of inheritance. There is a gene responsible for the specificity of our ABO blood groups since the ABO gene locus is located on Chr 9 and is occupied by one of the three primary allelic genes, A, B, or O. The H gene, which has a locus on Chr 19, is another gene that is crucial in determining ABO blood types.

As any person over the age of 6 months has clinically significant anti-A and/or anti-B antibodies in their blood, the ABO and Rh (D) group continues to be the most crucial in transfusion medicine and transplantation surgery.

All individuals also have antigens from other blood group systems in addition to the ABO and Rh blood groups.

Address for correspondence: Dr. Satish Belagatti, ESIC MC and PGIMSR, Rajajinagar, Bengaluru - 560 010, Karnataka, India. E-mail: drslb1977@gmail.com

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The most recent blood group system to be discovered, “Augustine,” takes the total to 36 blood group systems found so far.^[1,2]

For proper operational management at neighborhood hospitals and blood banks, it is crucial to be familiar with the frequencies of ABO and Rh blood groups among residents. Such a study could aid in the safe and dependable provision of blood transfusion services as well as the efficient administration of a blood bank’s inventory.^[3]

The management of blood bank inventory depends critically on having a solid understanding of blood grouping. It can reduce the likelihood of illness and mortality brought on by a shortage of blood in a given region. Studies relating to hereditary illnesses that are more frequently linked to a specific type of blood group can also benefit from knowledge of blood groups.^[4-6]

The objective of our study was to screen and determine the frequencies of the occurrence of ABO and Rh blood groups among residents from both the urban and rural populations of the South Karnataka region. This information also provides an idea about the distribution of particular blood groups in the area which further helps in lowering the mortality and morbidity due to shortage of that type of blood.

MATERIALS AND METHODS

This retrospective study was conducted in a blood center, Rajajinagar, Bengaluru, and included all the donors from January 2017 to December 2022. The donors included both voluntary and replacement donors. Voluntary donors are the people who donate their blood without any pressure and monetary benefit for unknown patients. Replacement donors are the members of the family, relatives, or friends of the patient, who donate their blood in replacement of the blood needs of a particular patient.

Before the donation, the donors filled the questionnaire form and signed the written informed consent.

The information of the donor such as personal details, occupation, history of prior donation, and medical history were noted down. The donors were then screened according to the criteria and guidelines of the Drugs and Cosmetics Act and the National AIDS Control Organisation for blood donor selection. Hemoglobin estimation was estimated by copper sulfate method and ERMA INC PCE-210 3-part analyzer. Donors with hemoglobin <12.5 gm% were deferred. The donors included individuals with appropriate good health and those who were mentally alert and physically fit.

A total of 19497 donors were deemed medically fit and approved to donate blood. After blood bank validation, Tulip Diagnostics Limited standard anti-sera of anti-A, anti-B, and anti-D were used to conduct an antigen-antibody slide agglutination test to determine the ABO grouping and Rh typing following blood donation. By applying the tube

agglutination method and reverse grouping with freshly prepared pooled A and B cells, grouping was reconfirmed. Simple percentages were used to report data on the ABO and Rh blood group distribution patterns.

RESULTS

The study included a total of 19497 donors which was conducted over a period of 6 years from January 2017 to December 2022 in the Department of Transfusion Medicine, Bengaluru.

The male:female ratio was 108:1, with 99% of the donors being males [Table 1]. The age groups of all the donors were divided into 6 groups, as shown in Table 2. Maximum number of donors were in the age group of 25–29 years (29.46%), followed by 18–24 years (28.95%), and the least number of donors were above 45 years (2.94%).

Among the total donors, there were a significantly higher number of voluntary donors (91.03%) than the replacement donors (8.97%) [Table 3].

The maximum number of donors were Rh positive (96.43%), with Rh-negative donors being 3.54%.

Among the Rh-positive donors, the highest number of donors has O blood group (42.5%), followed by B (28.4%) and A (24.1%) blood groups.

A similar pattern as found in Rh-positive donors, among Rh-negative donors, O blood group contributed the highest number of donors (44.36%).

Table 1: Gender distribution of the donors

Gender	Number of donors (%)
Male	19,318 (99.08)
Female	179 (0.92)
Total	19,497 (100)

Table 2: Donation type of the donors

Donation type	Frequency (%)
Voluntary	17,749 (91.03)
Replacement	1748 (8.97)
Total	19,497 (100)

Table 3: Age-wise gender distribution of the donors

Age (years)	Male	Female	Male:female ratio
18–24	5549	96	57.8:1
25–29	5713	31	184.3:1
30–34	4044	27	149.7:1
35–39	2315	15	154.3:1
40–44	1128	6	188.0:1
≥45	569	4	142.2:1
Total	19,318	179	107.9:1

In our study, we found four cases of Bombay blood group. The results are tabulated in Tables 1-6 and represented in Figures 1-4.

DISCUSSION

Blood banks play a vital role in catering the needs of catchment population to satisfy the needs of blood and various blood components. Hence, it is important to know the distribution of various blood groups in the population to manage the blood bank inventory. In the present study, male donors outnumbered female donors which was similar to other Indian studies: Garg *et al.*,^[7] Kumar *et al.*,^[2] Anushree *et al.*,^[8] Vaghela and Shah,^[9] and Mohroo *et al.*^[10] This can be attributed to mainly social taboos, economic status, cultural habits, menstruating females at the time of donation, lack of motivation, and fear of blood donation among female donors. Furthermore, on predonation screening, a large number of menstruating females were found to be anemic with low body weight and hence were deemed unfit for blood donation.

Majority of the donors were in the age group of 25–29 years, followed by 18–24 years, and least above the age of 45 years

Age (years)	2017	2018	2019	2020	2021	2022	Total
18–24	1201	968	1296	579	760	841	5645
25–29	1087	1031	1284	624	775	943	5744
30–34	754	768	909	425	507	708	4071
35–39	394	411	521	247	298	459	2330
40–44	183	191	244	113	179	224	1134
≥45	80	75	111	77	98	132	573
Total	3699	3444	4365	2065	2617	3307	19,497

Rh status	Frequency (%)
Rh positive	18,801 (96.4)
Rh negative	692 (3.5)
Bombay blood group (Oh)	4 (0.02)
Total	19,497 (100)

Rh: Rhesus

Year	Rh positive				Rh negative				Oh
	A	B	AB	O	A	B	AB	O	
2017	888	1036	182	1473	37	30	2	50	1
2018	813	938	177	1362	30	44	5	75	0
2019	992	1145	232	1801	50	48	10	84	3
2020	423	577	108	883	19	16	2	37	0
2021	639	703	108	1095	13	31	2	26	0
2022	774	941	136	1375	20	25	1	35	0
Total	4529	5340	943	7989	169	194	22	307	04
Percentage	23.2	27.4	4.8	41	0.9	1.0	0.1	1.6	0.02

Rh: Rhesus

which was in concordance with the study done by Garg *et al.*,^[7] Patel Piyush *et al.*,^[11] and Mallikarjuna.^[12] This finding can be attributed to certain common comorbidities such as anemia, diabetes, hypertension, and cardiovascular diseases. Hence, it can be noted that the main workforce of any society is of the age group of 18–35 years and the common age group encountered in blood donation.

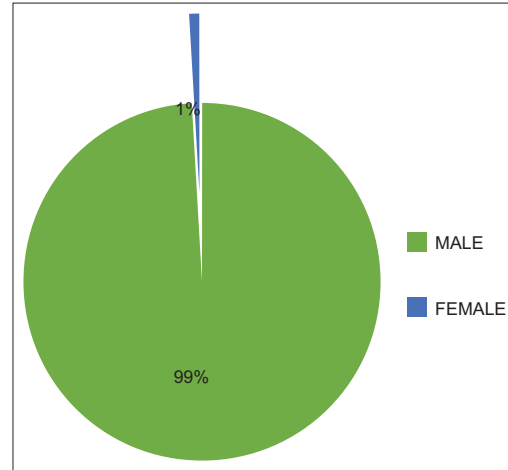


Figure 1: Gender distribution of the donors

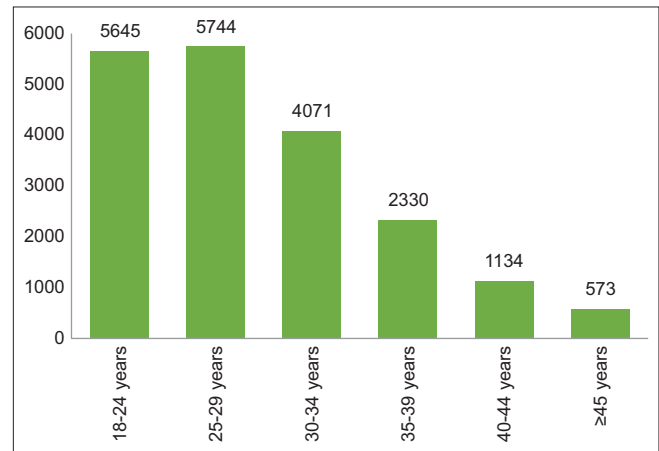


Figure 2: Age-wise categorization of donors

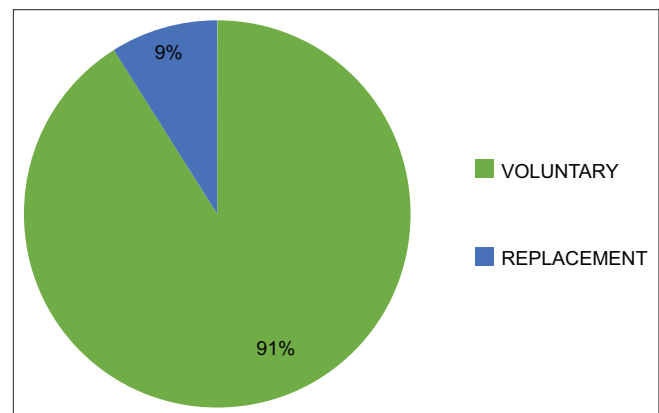
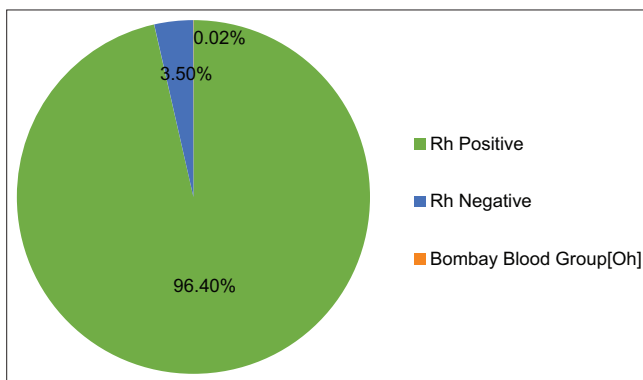


Figure 3: Donation type of the donors

Table 7: Prevalence of ABO and Rhesus blood group system in various studies

Indian location	Study title	Rh positive	Rh negative	A	B	AB	O
Northern India	Chandra T <i>et al.</i> ^[15]	95.7	4.3	21.7	39.8	9.3	29.1
	Kaur H <i>et al.</i> ^[16]	91.3	8.7	18.0	38.6	9.6	34.3
Eastern India	Nag I <i>et al.</i> ^[18]	94.7	5.3	23.9	33.6	7.7	34.8
Western India	Wadhwa MK <i>et al.</i> ^[17]	95.1	4.9	21.9	39.8	9.3	29.1
	Patel Piyush A <i>et al.</i> ^[11]	94.2	5.8	23.3	35.5	8.8	32.5
Central India	Giri PA <i>et al.</i> ^[19]	95.4	4.6	28.3	31.8	8.7	30.9
Southern India	Periyavan A <i>et al.</i> ^[20]	94.2	5.8	23.8	29.9	6.3	39.8
	Girish CJ ^[15]	94.8	5.2	26.1	29.8	7.2	31.7
	Girish <i>et al.</i> ^[21]	94.9	5.0	24.3	29.3	7.1	39.1
	Mallikarjuna S <i>et al.</i> ^[12]	97.1	2.9	21.4	34.8	5.0	38.8
	Present study	96.4	3.5	24.1	28.5	4.9	42.5
Other countries	Allawati M <i>et al.</i> ^[2]	91.65	8.35	23.55	21.84	4.2	50.41

Rh: Rhesus

**Figure 4:** Rhesus status among the donors. Rh: Rhesus

We found that in our study, majority of the donations were contributed by voluntary donors (91%) while replacement donors contributed only 9%. This finding was in concordance with Garg *et al.*,^[7] and Naik *et al.*^[13] and discordant with studies done by Garg *et al.*,^[14] Vaghela and Shah,^[9] and Pokhrel *et al.*^[6]

The prevalence of ABO and Rh blood system of the present study is compared with other Indian studies in Table 7. It was found that in the studies conducted in northern and western India by Chandra and Gupta^[15] and Kaur *et al.*,^[16] Patel Piyush *et al.*,^[11] and Wadhwa *et al.*,^[17] respectively, the predominant blood group among the donors was B blood group. Nag and Das^[18] conducted a study in eastern India and Giri *et al.*^[19] in Central India where almost the same frequency of B and O blood groups was observed. The studies conducted in South India by Periyavan *et al.*,^[20] Mallikarjuna,^[12] Girish *et al.*,^[21] and Anushree *et al.*^[8] were concordant with our study where the predominant blood group was O, followed by B blood group.

CONCLUSION

The present study concludes that the most common blood group is “O,” followed by “B,” and “AB” is the least common among the donors in the region of South Karnataka, India. Rh positive were 96.4% and Rh negative were 3.5%. We also found 4 cases of Bombay phenotype group. General health

of females needs to be improved by good nutritional diet and iron supplements to motivate and increase the number of female donors, removing fears and myths from their mind. Good knowledge and understanding of blood grouping have an imperative involvement in the management of blood bank inventory. It can help to minimize the morbidity and mortality rate due to lack of blood in a particular geographical area. When viewed in the context of numerous previous studies conducted in various parts of India and internationally, the findings from our current study may contribute in formulating and enacting policies to address upcoming health concerns.

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Conflicts of interest

There are no conflicts of interest.

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