

Research Article



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**Trends of A B O, Rh Positive and Rh-Negative Blood Groups in Voluntary Non-Remunerated Blood Donors in Tertiary Care Hospital Blood Centre, Maharashtra, India.**

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## ABSTRACT

**Introduction:** The term “blood group” refers to the entire blood group system comprising red blood cell (RBC) antigens whose specificity is controlled by a series of genes that can be allelic or linked very closely on the same chromosome. “Blood type” refers to a specific reaction pattern to testing antisera within a given system.<sup>1</sup> The ABO blood group antigens remain important in transfusion medicine as they are the most immunogenic of all the blood group antigens. The most common cause of death from a blood transfusion is a clerical error in which an incompatible type of ABO blood is transfused. The ABO blood group antigens also appear to have been important because the frequencies of different ABO blood types vary among various populations. **Aim:** This study aims to know the Trend of A, B, O, Rh-positive, and Rh-negative blood Groups in Voluntary non-remunerated blood Donors in the Tertiary Care Hospital Blood Centre, India. **Material and method:** The Retrospective study was conducted at the Government Medical College and Hospital Blood Centre, Miraj, from period of January 2022 to January 2025. A total of 14950 non-remunerated blood donors were selected and accepted for blood donation at Blood Donation Camps, as well as in-house Donors who come to donate blood at the Blood Centre. Donors were selected as per the Blood Donor selection guidelines of the Drug and Cosmetics Act,1940, and G.S.R. 122(E) March 2020. **Result:** Out of 14950 non-remunerated blood donors, 13571(90.77%) were males and 1379 (9.23 %) were females with an average age of 35.7 years. The commonest A B O group present was B Rh Positive 32.96 %, A Rh Positive 26.94%, O Rh Positive 25.97 %, and AB Rh Positive 8.94 %. 14177(94.82%) donors were Rh Positive, and 773 (5.17%) donors were Rh Negative. One unit of Bombay Blood Group, ABO Variant also Discovered during present study. **Conclusion:** Blood group is crucial for safe blood transfusions and

organ transplants, as well as understanding potential risk associated with different blood types. It's vital to match blood donations with recipients to prevent severe reactions, and it can also provide insights into certain health conditions. It also helps to maintain the donor registry, which is useful in a blood crisis.

**Keywords:** A B O, Rh-Positive, Rh-Negative, blood donation, donor registry.

**INTRODUCTION:** The term “blood group” refers to the entire blood group system comprising red blood cell (RBC) antigens whose specificity is controlled by a series of genes that can be allelic or linked very closely on the same chromosome. “Blood type” refers to a specific reaction pattern to testing antisera within a given system. <sup>1</sup> As of October 2024, a total of 47 human blood group systems are recognized by the International Society of Blood Transfusion (ISBT).<sup>2</sup> The ABO system is the most important blood group system in transfusion therapy and was the first blood group system to be discovered. This great contribution to medicine was made by Landsteiner in 1900 when he observed that ‘the serum of healthy humans not only has an agglutinating effect on animal blood corpuscles, but also on human blood corpuscles from different individuals’.<sup>3</sup> The ABO blood group antigens remain important in transfusion medicine as they are the most immunogenic of all the blood group antigens. The most common cause of death from a blood transfusion is a clerical error in which an incompatible type of ABO blood is transfused. The ABO blood group antigens also appear to have been important because the frequencies of different ABO blood types vary among various populations. The second most important Blood Group system is Rh. The Rh blood group system has been extensively studied and remains clinically relevant to transfusion medicine. The system has over 50 antigens; the 5 most significant antigens are D, C, c, E, and e. <sup>4</sup> Presence or absence of the Rh antigen D reveals the Rh Positive or Rh-Negative blood type of a person. Landsteiner and Wiener would describe the offending antigen as the Rhesus (Rh) factor because of the agglutination in their experiments using rhesus monkey blood, assuming rhesus RBCs expressed the same antigens as humans. Their work would also describe the autosomal dominant inheritance pattern of the Rh factor. <sup>5</sup> The significance of the Rh blood group is related to the fact that the Rh antigens are highly immunogenic. In the case of the D antigen, individuals who do not produce the D antigen will produce anti-D if they encounter the D antigen on transfused RBCs (causing a hemolytic transfusion reaction, HTR) or on fetal RBCs (causing HDN). For this reason, the Rh status is routinely determined in blood donors, transfusion recipients, and in mothers-to-be.<sup>6</sup> ABO grouping and Rh typing prove valuable in clinical and genetic studies, aiding in population

research and medico-legal problem-solving. Knowing the trend of different blood groups is crucial for blood centres and transfusion services, contributing significantly to the overall health system. This study was conducted at a tertiary care Government medical college and hospital Blood Centre India, to determine the frequency of ABO and Rh blood groups, furthering our understanding of the local blood landscape and to maintain blood donor registry. The study is aimed to know the trend of A B O Rh Positive and Rh-Negative Blood Groups in Voluntary Non-Remunerated Blood Donors in Tertiary Care Hospital Blood Centre India. The objective of the study was to maintain a rare blood group registry in the blood centre.

**Material and method:** The present study was conducted at the Government Medical College and Hospital blood centre, Miraj tertiary care hospital in India. It is a cross-sectional, retrospective study with a sample size of 14950 non-remunerated blood donors. All non-remunerated blood donors were selected and accepted for blood donation at Blood Donation Camps, as well as in-house Donors who came to donate blood at the Blood Centre from 1<sup>st</sup> January 2022 to 30 January 2025. Donors were selected as per the Blood Donor selection guidelines of the Drug and Cosmetics Act ,1940, and G.S.R. 122(E) March 2020. Donors who were deferred as per the guidelines of the Drug and Cosmetics Act, 1940, and G.S.R. 122(E) March 2020, and non-labelled samples were excluded from this study. Information regarding personal details, demographic details, and past medical history was elicited. Individuals with good health, mental alertness, and physical fitness were selected as Voluntary Non-Remunerated blood donors. The donors were then asked to sign the donor questionnaire as well as donor register, inclusive of informed consent. After blood donation, A B O and Rh typing were done on each collected sample from Blood bag of donor having unique donor identification number, using tube agglutination method according to Standard Operative Procedures which is used by blood centre. The Monoclonal type Antisera reagents anti-A and anti-B B and anti-D D manufactured by Tulip Diagnostics, were used. O blood group donors were tested by anti-H Lectin to rule out the Bombay blood group. Each new lot of Antisera was used after a quality control test with a minimum titer of 1:256. and avidity. On each day daily quality control test is also performed before use of Antisera. Normal saline was also checked for appearance, tested for specificity, and pH on each day of use. For reverse blood grouping, pooled Cells were used from three different known donor samples. These were prepared on each day of use. Known samples were run as control. The final blood group is confirmed only if both the Forward group and Reverse group are identical. All the

week D blood groups were considered as Rh Positive. Data on the trend of ABO and Rh-D blood groups was reported in simple numbers and percentages.

**Observation and Results:** A total of 14950 samples were evaluated. Of these, 13571 (90.77%) were males and 1379 (9.23 %) were females with an average age of 35.7 years. 100% of them were voluntary donors. 43.92 % were first-time donors while 56.08% were repeat donors. (Table No.1)

Table 1: Demographic profile of Blood Donors.

Demographic Profile	Category	Nos.	Percentage	Category	Nos.	Percentage
Sex	Male	13571	90.77%	females	1379	9.23 %
Type of Donor	Voluntary	14950	100%	Replacement	00	00%
Frequency of Donation	Frequent /Multiple Time Donation	8384	56.08%	First Time Donor	6566	43.92 %

Figure No.1: Male and Female Donors among Non-Remunerated Blood Donors.

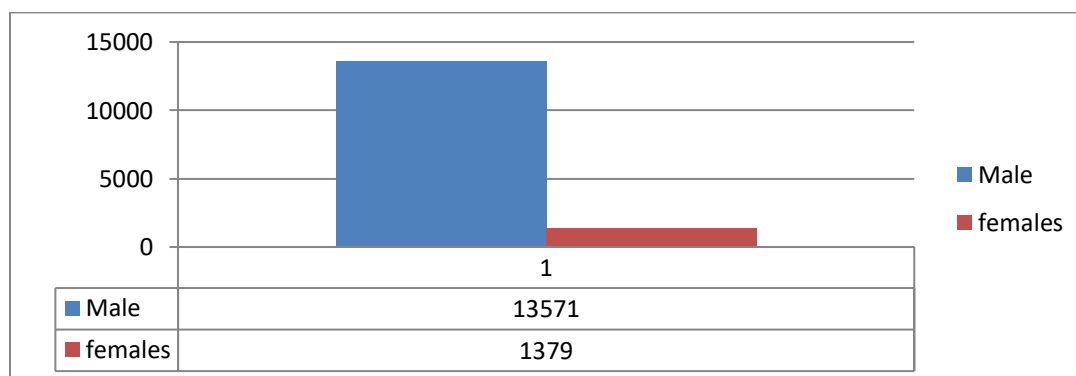
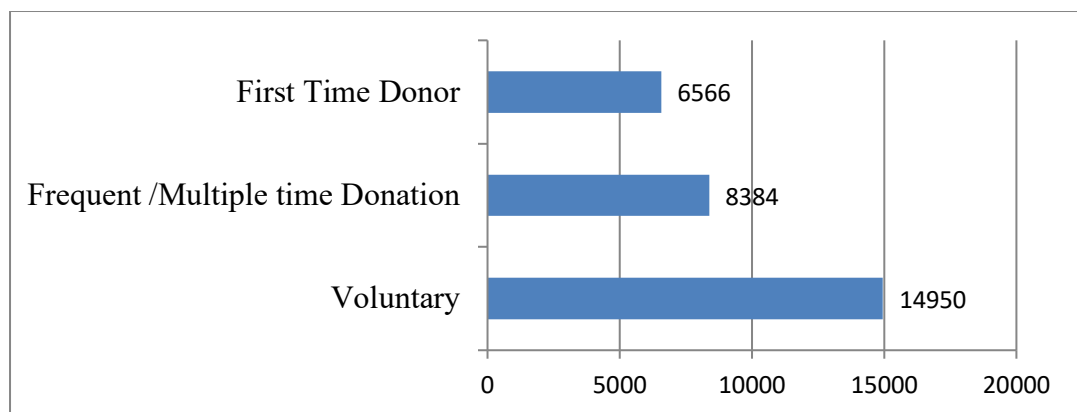


Figure 2: First-time donors and Frequent Donors among voluntary Donors.



Among 14950 non-remunerated blood donors, the commonest A B O group present was B Rh-Positive 32.96 %, followed by A Rh- Positive 26.94%, followed by O Rh Positive 25.97 % and AB Rh Positive 8.94 % .14177(94.82%) donors were Rh Positive and773 (5.17%) donors were Rh Negative. One unit of Bombay Blood Group was also discovered during the present study. (Table No.2)

Table 2: ABO Blood Groups among Voluntary Non-Remunerated Donors

Types of Blood Group	Number of donors	Percentage
A Rh-positive	4028	26.94%
A Rh-Negative	266	1.77%
B Rh-Positive	4929	32.96 %
B Rh-Negative	221	1.47%
O Rh-Positive	3883	25.97 %
O Rh-Negative	217	1.45%
AB Rh-Positive	1337	8.94 %
AB Rh-Negative	68	0.45%
Oh Bombay Blood Group	01	0.006%
Total	14950	100%

Figure No.3: Trend of ABO Blood Groups among Voluntary Non-Remunerated Donors.

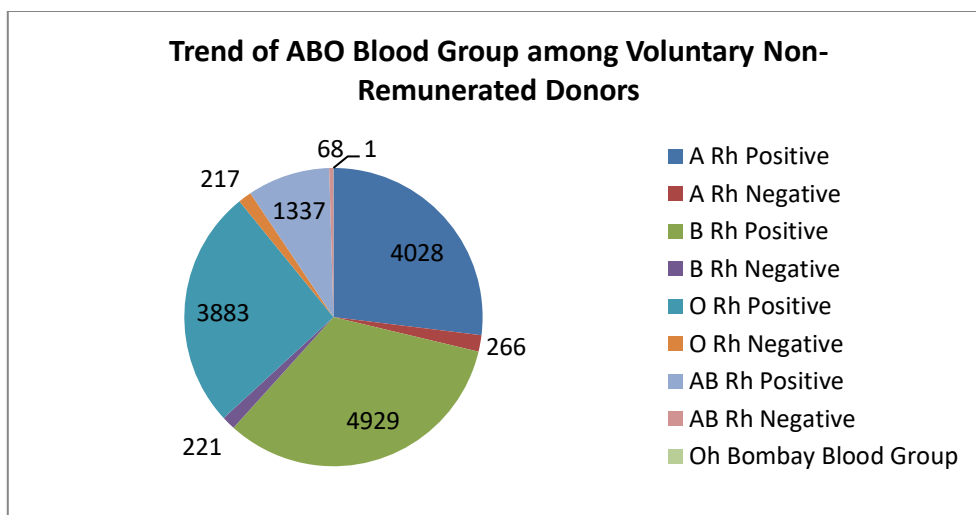
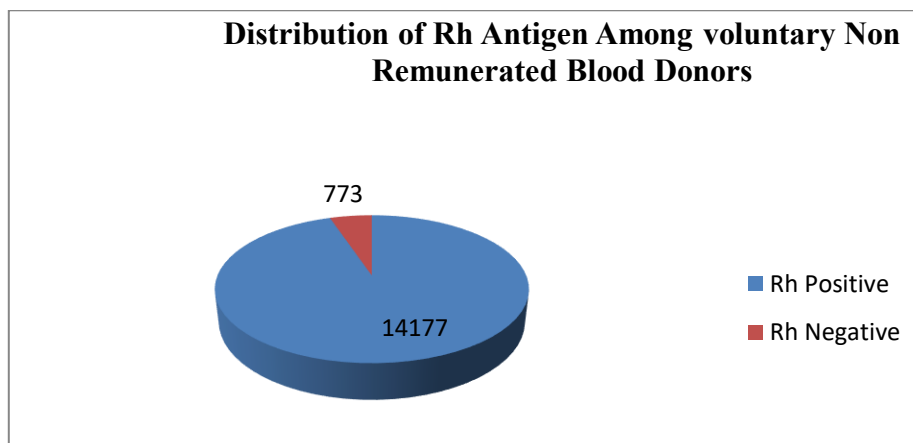


Table 3: Comparative studies with this study in percentage

Study	Place	No. studied	ABO blood group				Rh blood group	
			A	B	AB	O	Rh D Positive	Rh D Negative
Studies from India								
Periyavan et al <sup>7</sup>	Bengaluru	36,964	23.9	29.9	6.4	39.8	94.2	5.8
Das et al <sup>8</sup>	Vellore	150,536	21.8	32.7	6.7	38.8	94.5	5.5
Mallikarjuna et al <sup>9</sup>	Devanagere	19,413	26.1	29.9	7.2	36.8	94.5	5.5
Girish et al <sup>10</sup>	Shimoga Malnad	ND	24.3	29.4	7.1	39.2	94.9	5.5
Chandra et al <sup>11</sup>	Lucknow	1,40,320	21.7	39.8	9.3	29.1	95.7	4.3
Sidhu et al <sup>12</sup>	Punjab	1,150	21.9	37.6	9.3	31.2	97.3	2.7
Patel et al <sup>13</sup>	Western Ahmedabad	5,316	21.9	39.4	7.9	30.8	95.1	4.9
Wadhwa et al <sup>14</sup>	eastern Ahmedabad	ND	23.3	35.5	8.8	32.5	94.2	5.8
Gupta et al <sup>15</sup>	Indore	17,080	24.2	35.2	9.1	31.5	95.4	4.6
Present Study	Maharashtra	14950	28.7	34.4	9.4	27.4	94.8	5.2
Studies from other parts								
Anees et al <sup>16</sup>	Punjab, Pakistan	2542	34	29	4	33	96.7	3.3
Pramanik et al <sup>17</sup>	Khatmandu, Nepal	120	26.2	22	4.4	47.5	80.3	19.7

Lyco et al <sup>18</sup>	Nairobi, Kenya	38898	20.0	32.2	6.1	41.7	92.8	7.2
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Figure 4: Distribution of Rh Antigen among voluntary non-remunerated blood donors.



**Discussion:**

The trends of ABO and Rh blood groups vary from one person to another person and time to time in the same region. All human population shares the same ABO blood group systems, although they differ in the frequency of specific types. The current study shows that most donors were repeat, voluntary male (90.77%). Table 1, which is the same as other studies in most regions globally. The lower rate of donation in females (9.23 %) is due to fear of donation, Low Hb, and low weight among young female donors. But the trend is increasing in the case of Female donors. This is quite good. The achievement of 100% voluntary non-remunerated blood donation in every country of the world it is based on the recognition that voluntary non-remunerated blood donors are the foundation of a safe, sustainable blood supply. Without a system based on voluntary, unpaid blood donation, particularly regular voluntary donation, no country can provide sufficient blood for all patients who require transfusion. Also, Frequent or repeated voluntary donations contribute to a consistent and reliable blood supply, ensuring that the blood centre's needs are met. The improved interest and ability among the younger to donate may be related to awareness, better Physical health, and greater mobility. Older individuals may suffer from multiple medical conditions, hence negatively impact their ability to be well enough to donate blood. The Bombay blood group is a rare variant within the ABO blood group system, characterized by the lack of H antigen on red blood cells. The Bombay blood group, also known as the hh blood group, is a rare blood type with a prevalence of approximately 0.0004% (one in 4 million) of the global population.

In India, the Bombay blood group is found in about 0.01% of the population, which translates to roughly one in 10,000 individuals. The Bombay blood group is more prevalent in India compared to other parts of the world, and in our study, there was one case observed. Table 3 shows that studies were done at Shimoga Malnad by, at Bangalore by Periyavan A et al<sup>7</sup> Das et al<sup>8</sup>, Mallikarjuna et al<sup>9</sup>, and Girish CJ<sup>10</sup> et al, the commonest A B O blood group was 'O' which is in contrast to present study where B is the most common A B O blood group. Trend of A B O blood groups of the present study was compared to the studies done at Lucknow by Chandra et al<sup>11</sup>, at Punjab Sidhu et al<sup>12</sup> at Ahmedabad by Patel PA et al<sup>13</sup> and, at Surat by Mehta T et al<sup>14</sup> and at Indore by Gupta H et al.<sup>15</sup> In all these studies predominant blood group was 'B' which was same with present study. In other countries of the world like in Pakistan, by Anees et al<sup>16</sup>, Pramanik et al<sup>17</sup> in Khatmandu, Nepal, Lyco et al<sup>18</sup> in Nairobi, Kenya, showed that blood group O was highly frequent, which contrasts with our present study. Figure 4 shows that in the present study frequency of Rh-positive blood groups was 94.82% and 5.17% for Rh-negative. Which is like all studies except in the USA, where it is 85% and 15% respectively. Other factors which can affect the overall distribution of the ABO Rh blood group depend upon the donor selection method and donor deferral conditions which are unique to specific location.

### **Conclusion:**

Blood group is crucial for safe blood transfusions and organ transplants, as well as understanding potential health risks associated with different blood types. It's vital for matching blood donations with recipients to prevent severe reactions and can also provide insights into certain health conditions. The ABO system classifies blood based on the presence or absence of specific antigens (A and B) on red blood cells and corresponding antibodies in the plasma. Transfusing incompatible blood types (e.g., giving A blood to a person with B antibodies) can trigger a severe immune response, leading to red blood cell destruction and potentially life-threatening complications. By accurately identifying ABO blood types, healthcare professionals can select compatible blood products for transfusions, minimizing the risk of adverse reactions. It also helps to maintain donor registry which is useful in blood crisis. The registry helps to facilitate blood donation during emergencies, save lives by sharing blood with other blood centres, and provide a secure supply for needy patients.

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**Conflicts of interest:** There are no conflicts of interest.

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