



# Prevalence of ABO and Rh Blood Groups in General Population and Comparing Male and Female Blood Group Distribution: A Retrograde Study in a Tertiary Care Hospital in Delhi

Neelam Sahani\*, Chintamani Pathak, Somshankar Chowdhury, Preeti Sharma  
Shweta Sushmita and Indrani Dhawan

Department of pathology, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi

## ABSTRACT

**Background:** The ABO and Rhesus (Rh) blood group systems are the most important of the various blood group systems known so far in human beings. The distribution of blood groups varies in various parts of the world and also in different parts of the country.

**Method:** This study was conducted to determine the distribution of ABO and Rh blood groups in females comprising pregnant females coming for antenatal visits as well as females coming for blood donation and thus representing general female population and distribution of blood groups in males coming for blood donation, representing general male population and to show if there was any sex wise variation in blood group distribution. A retrospective study was conducted at the department of Pathology (Blood bank and Gynaecology laboratory), VMMC and Safdarjung hospital, New Delhi from January 2017 to March 2017 consisting of 2832 females (2810 pregnant females and 22 female donors). During this period total number of male donors both voluntary and replacement were 7567. To ensure proper comparison equal numbers of males (2832) were included in the study. First 2832 male donors were taken for the study. The blood samples were obtained in EDTA vacutainers by venepuncture and blood group antigens were determined by commercially available monoclonal antisera by electromagnetic technology. Both ABO and Rh status was tested.

**Results:** The blood group B was the commonest in both males and females followed by O, A, AB group.

**Conclusion:** The commonest blood group in males and females in New Delhi and nearby areas was B group.

**Keywords:** Blood Groups, ABO, Rh, Tertiary Care Hospital

## Introduction

The human red blood cell (RBC) membrane is complex and contains a variety of blood group antigens, the most clinically significant being the ABO system and the Rh system.<sup>1</sup> The Austrian scientist Karl Landsteiner was the first to discover the ABO blood group system in the year 1900.<sup>2</sup> He described A, B and O blood groups in ABO system. In 1902, Alfred Von Decastello and Adriano Sturli discovered the fourth type of blood group, AB.<sup>3</sup> The Rh system was described by Karl Landsteiner and A.S. Weiner in the year 1940. There are two types of Rh phenotype, Rh positive and Rh negative depending on the presence or absence of Rh antigen on the RBCs. These discoveries revolutionised the practice of blood transfusion. Since then many RBC antigens have been described and accordingly multiple blood group systems exist. However, ABO and Rh systems are still the most important blood group systems as A, B and Rh D antigens are strongly immunogenic and can elicit an antibody response on stimulation causing red blood cell destruction and thereby, transfusion reactions or haemolytic disease of the newborn.

Blood groups are genetically determined and are inherited in a Mendelian fashion. The genes of ABO and Rh are located on the chromosome 9 and 1 respectively. The particular allele constitute the genotype while the outward expression is the phenotype. The distribution of blood groups varies worldwide in different ethnic groups and races.<sup>4</sup> It may vary in different populations and from one region to other in the same country.

It is important to know the frequency of ABO and Rh group in a region to ensure safe and effective blood transfusion services and also to prevent the erythroblastosis fetalis in a Rh negative mother carrying Rh positive fetus. Apart from this, certain blood groups have been found to be associated with diseases like duodenal ulcer, diabetes mellitus, Rh incompatibility and ABO incompatibility of newborn.<sup>5</sup> So, the knowledge of the blood group distribution not only helps in understanding genetics, geographical information, inheritance pattern and there by determining the paternity but also it helps in predicting disease susceptibility and ensuring transfusion safety. It will also help in reducing the maternal morbidity and mortality rate by safe and sufficient

blood supply as well as have role in effective management of blood bank inventory,<sup>6,7</sup> organ transplantation and forensic purposes.

The distribution of ABO and Rh blood groups in Indian population is different from the Western population. It is therefore important to have information regarding the distribution of blood groups not only in a particular population but also in the same population sex-wise distribution to handle the blood needs and various situations accordingly. So far many studies have been conducted to know the distribution of blood groups, almost all of them focussing on blood donors, which mostly comprises of male donors.

This study is aimed to determine the frequency and distribution of the ABO and Rhesus D blood groups in blood donors as well as in females coming to the VMMC and Safdarjung hospital, New Delhi for antenatal check ups over the same period and to show if there was any sex wise variation in distribution as well as comparing the data from similar studies in India and other parts of the world, and also to assess the efficiency of the hospital blood bank in the provision of blood and blood products.

## Materials and Methods

The present retrospective study was conducted at the department of antenatal clinic and the department of Blood bank and Transfusion medicine, VMMC and Safdarjung Hospital, New Delhi from 1<sup>st</sup> January 2017 to 31<sup>st</sup> March 2017 consisting of 2832 females (2810 pregnant females and 22 female donors). The blood collections were taken from voluntary as well as from replacement donors at the blood bank. A total of 7567 donors were considered medically fit including female donors and were accepted for blood donation during the study period. To ensure proper comparison equal numbers of males (2832) were included in the study. First 2832 male donors were taken for the study. All the donors belonged to age group between 18-60 years. After blood donation, the blood samples were collected in EDTA containing vacutainer. The blood samples of antenatal patients were collected by venepuncture in EDTA containing vacutainer. ABO and Rh

(D) blood groups were determined using fully automated and high output QWALYS 3 (DIAGAST FRANCE) which uses Erythromagnetic technology (EMT). The EM technology is based on the principle of magnetization of red blood cells. ABO and Rh blood grouping was done and the blood group data of both donors and antenatal patients were recorded on proforma, tabulated, analyzed and compared with the similar studies by other authors.

**Ethical Issues:** Both the study populations consisting of donors and antenatal patients were informed that their blood will be tested for grouping and the results may be used in future for research purposes. Written consent was also taken from the donors prior to donation regarding their acceptability for the tests to be carried out for the transfusion transmitted diseases.

## Results

The frequency of ABO and Rh blood groups in total of 2832 antenatal pregnant females and female blood donors was compared with frequency of blood groups in 2832 male blood donors during a period of three months. Equal number of cases were taken to ensure comparable study population. The study comprised of 99.23 % of male blood donors and 0.77 % of female blood donors. The female donors were included in the study group of antenatal females. Male donors formed the separate study population. B positive group was the most common phenotype in male donors comprising 36.90 % of total male donors followed by O positive group accounting 29.77 %, A positive group 23.06 % and AB positive group 6.11 %. O positive blood group was the most common phenotype in female donors comprising 36.36 % of total female donors followed by B positive group accounting 22.73 %, A positive group 18.18 % and AB positive group 13.64 % (Table 1 and Figure 1). A total of 95.66 % male donors were Rh positive and 4.34 % were Rh negative. A total of 94.63% females (donors + antenatal females) were Rh positive and 5.37 % were Rh negative (Figure 2). Most common blood group overall in females including female donors and antenatal females was B positive accounting 36.65%, followed by group O positive (27.36%), group A positive(20.55%) and group AB positive (10.06%) (Table 2 & Figure 3).

**Table 1: ABO and Rh blood groups expressed in percentage in male donors (N= 2832 ) female donors (N= 22 ).**

Blood group	Male donors		Total
	Rh pos(%)	Rh neg(%)	
A	651(23.06)	30(1.06)	681(24.04%)
B	1045(36.90)	43(1.52)	1088(38.42%)
AB	173(6.11)	10(0.35)	183(6.46%)
O	840(29.77 )	40(1.41)	880(31.07%)
<b>Grand Total</b>	<b>2709</b>	<b>123</b>	<b>2832</b>

Blood group	Female donors		Total
	Rh pos(%)	Rh neg(%)	
A	4(18.18 %)	0	4(18.18 %)
B	5(22.73 %)	0	5(22.73 %)
AB	3(13.64 %)	0	3(13.64 %)
O	8(36.36%)	2(9.09%)	10(45.45%)
<b>Grand Total</b>	<b>20</b>	<b>2</b>	<b>22</b>

Table 2: ABO and Rh blood groups expressed in percentage in females (Donors+Antenatal) (N= 2832 ).

Blood group	Female donors+Antenatal females		Total
	Rh pos(%)	Rh neg(%)	
A	578+4(20.55%)	35+0(1.23%)	617(21.79%)
B	1033+5(36.65%)	55+0(1.94%)	1093(38.59%)
AB	282+3(10.06%)	11+0(0.39%)	296(10.45%)
O	767+8(27.36%)	49+2(1.80%)	826(29.17%)
<b>Grand Total</b>	<b>2680</b>	<b>152</b>	<b>2832</b>

Table: 3 Comparison of distribution of ABO and Rh blood groups in different parts of India

Place of study	A	B	O	AB	Rh+	Rh-
<b>Northern India</b>						
Lucknow	21.73	39.84	29.10	9.33	95.71	4.29
Punjab	21.91	37.56	31.21	9.3	97.3	2.7
Jodhpur	22.2	36.4	31.7	9.4	91.75	8.25
<b>Western India</b>						
Western Ahmedabad	21.94	39.40	30.79	7.86	95.05	4.95
Eastern Ahmedabad	23.30	35.50	32.50	8.80	94.20	5.80
Surat	24.10	34.89	32.32	8.69	94.18	5.82
Maharashtra	23.38	31.89	30.99	8.72	95.36	4.64
<b>Central India</b>						
Indore	24.15	32.25	31.50	9.10	95.43	4.57
<b>Eastern India</b>						
Durgapur (Steel city)	23.90	33.60	34.80	7.70	94.70	5.30
<b>Southern India</b>						
Benguluru	23.85	29.95	39.82	6.37	94.2	5.8
Vellore	21.86	32.69	38.75	6.70	94.5	5.5
Davanagere	26.15	29.85	31.76	7.24	94.8	5.2
Shimoga-Malnad	24.27	29.43	39.17	7.13	94.93	5.07
Present study	22.91	38.51	30.12	8.46	95.14	4.86

Table: 4 Comparison of distribution of ABO and Rh blood groups in different countries.

Countries	A	B	O	AB	Rh+	Rh-
<b>North India (Present Study)</b>	22.91	38.51	30.12	8.46	95.14	4.86
<b>Britain</b>	41.70	8.60	46.70	3.00	83.00	17.00
<b>USA</b>	41.00	9.00	46.00	4.00	85.00	15.00
<b>Nigeria</b>	24.43	23.88	48.94	2.75	95.67	4.33
<b>Kenya</b>	26.20	22.00	47.48	4.32	96.10	3.90
<b>Saudi Arabia</b>	25.00	19.00	52.00	4.00	93.00	7.00
<b>Bangladesh</b>	26.6	23.2	40.6	9.6	96.8	3.2
Pakistan	23.38	38	10	10	89.1	10.9
Nepal	34	29	33	4	96.7	3.33
Australia	38	10	49	3	NA	NA

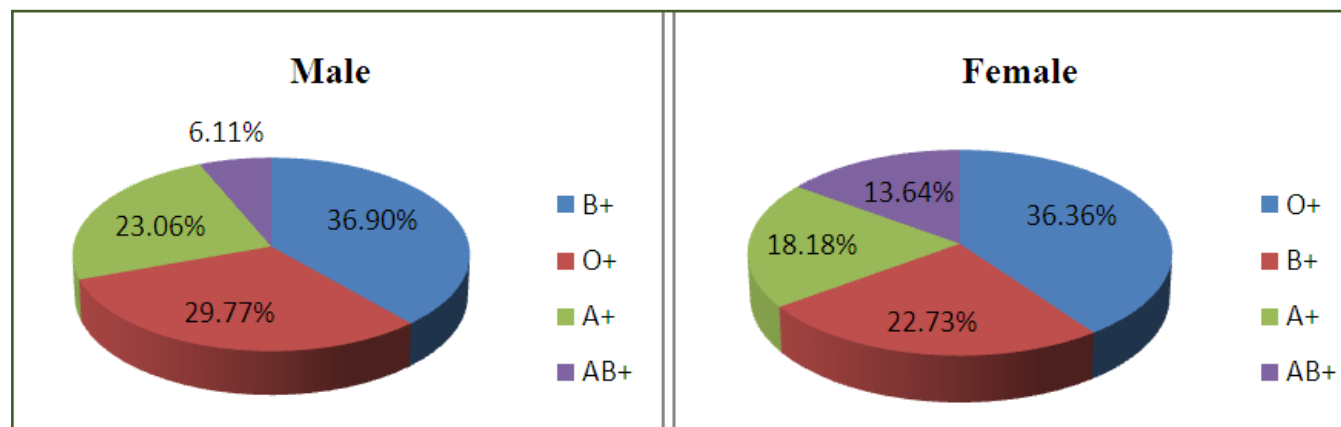


Fig. 1: Pie chart showing blood group distribution in male and female donors.

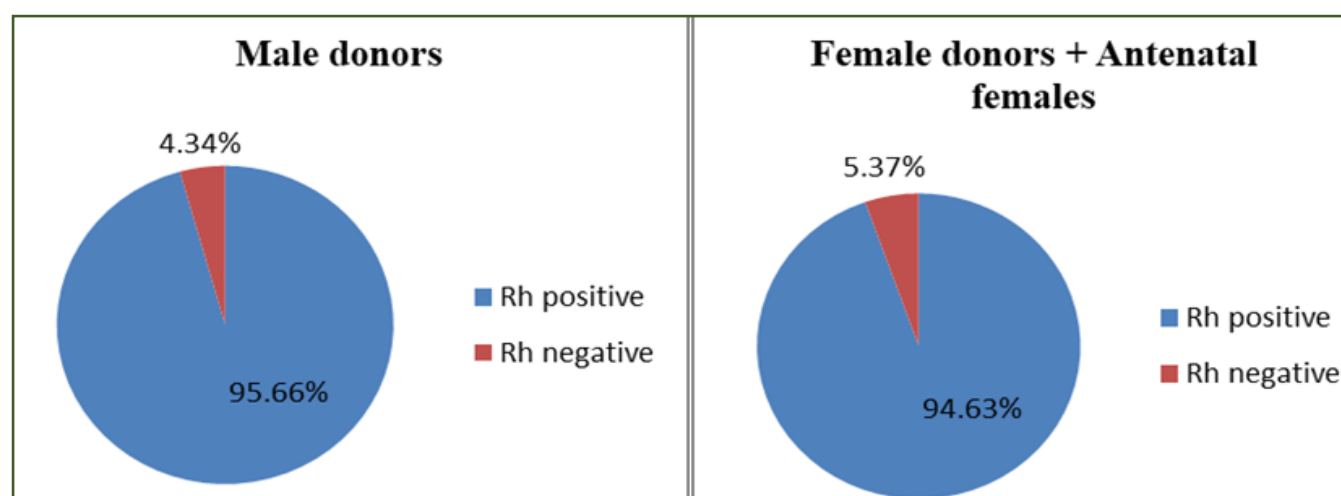


Fig. 2: Percentage distribution of Rh positivity and Rh negativity in males and females.

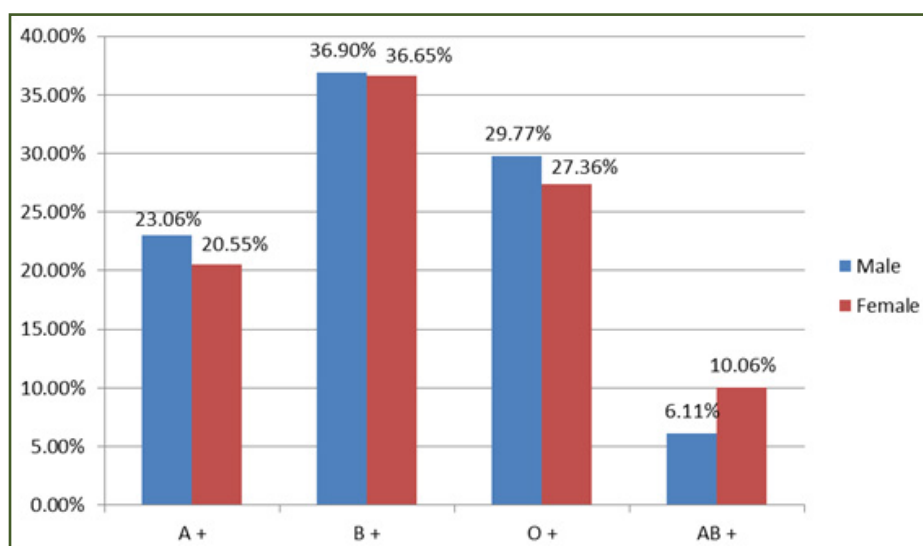


Fig. 3: Percentage distribution of blood groups in males versus females.

## Discussion

The present study describes the distribution of ABO and Rh blood groups in males and females coming to the Safdarjung hospital for blood donation and antenatal check ups respectively. There are previous studies describing prevalence of ABO and Rh blood groups in India and world wide. Most of these studies were conducted in blood banks and included donors only as the study population. Only few studies have taken into consideration separate female group for comparison with males. To the best of our knowledge this is the first study in India which is taking into consideration antenatal females apart from female blood donors for describing distribution of blood groups separately in males and females. In developing countries like India due to some social taboo and cultural habits there is lack of motivation for blood donation especially among females. Also majority of the female donors are rejected because of their low haemoglobin levels. So, majority of the donor population comprises of males. Other studies comparing blood group distribution in donor population therefore do not reflect the actual female study population. The present study therefore includes separate female study population including female blood donors and compares blood group distribution with male donors. This study provides useful information regarding sex wise distribution of blood groups as well as availability of different blood groups in blood bank in case of need for transfusion.

Our study describes large number of male donors as compared to female donors like previous studies done in other parts of the India. The predominant blood group is B positive followed by O positive, A positive and AB positive respectively in male donors while O positive is the predominant group in female donors followed by B positive, A positive and AB positive respectively. If females from antenatal units as well as female donors are taken together the most common blood group was B positive followed by O positive, A positive and AB positive respectively. These findings suggest that there is variation in blood group distribution in females as compared to female blood donors while overall males and females show similar blood group distribution if antenatal females are taken into consideration.

We compared our study with similar other studies in various parts of the world including India, which is described in Table 3. The studies done in the Northern parts of India by Chandra et al at Lucknow<sup>8</sup>, Sindhu et al at Punjab<sup>9</sup> and Behra et al at Jodhpur<sup>6</sup> and studies in Western parts of India like in Eastern Ahmedabad by Wadwa MK et al<sup>10</sup>, Western part of Ahmedabad by Patel Piyush et al<sup>11</sup>, studies done at Surat by Nidhi et al<sup>12</sup> and Giri et al<sup>13</sup> at Maharashtra, showed blood group B is the commonest followed by O, A

and AB which is similar to our study. Study done in Eastern part of India, Durgapur by Nag et al<sup>14</sup> and in Southern part of India by Periyavan et al at Bangalore<sup>15</sup>, Das PK Nair et al at Vellore<sup>16</sup>, at Davangere by Mallikarjuna S. et al<sup>17</sup> and at Shimoga – Malnad study done by Girish et al<sup>18</sup> found that commonest blood group was O followed by B, A and AB, this was different from our study.

Outside India, studies were carried out in different countries of the World like Britain<sup>19</sup>, USA<sup>20</sup>, Australia<sup>21</sup>, Nigeria<sup>22</sup>, Saudi Arabia<sup>23</sup>, Bangladesh<sup>24</sup>, Pakistan<sup>25</sup> and Nepal<sup>26</sup> to name some (Table 4). Except in Pakistan and Nepal, there is increased frequency of O blood group in these countries. In Pakistan the study done by Rahman M et al the commonest blood group is B, which is similar to our study and in Nepal, A blood group is commonest unlike our study.

Our study included New Delhi and nearby population for the study. Rh positivity in our population was 95.66 % in males and 94.63% in females and Rh negativity was 4.34 % in males and 5.37 % in females, with overall 95.14 % Rh positivity and 4.86 % Rh negativity. The incidence of Rhesus (D) positive blood group in most of the part of India varies from 94% to 98% and 2% to 6% for Rh negative. The present study results are within this range.

Our study population showed Rh negativity less as compared to Britain and USA showing 17% and 15% Rh negativity respectively, while it is similar to Nigeria (4.33%), and Bangladesh (3.2%).

## Conclusion

The present study revealed that the blood group distribution among male donors representing male population of Delhi and nearby areas was B> O> A> AB and in female donors it was O> B> A>AB respectively. However, considering antenatal females and female donors together as the representing female population of Delhi and nearby areas it was B> O> A> AB, which is similar to male blood group distribution. It can be concluded from the study that the phenotypic distribution of ABO blood group is similar in both males and females. However this study provided a comparable numbers of males and females for blood group distribution and so helping in delivering better health care and transfusion services according to the needs.

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**\*Corresponding author:**

**Dr Neelam Sahani**, G17, D. AHPL Girls's hostel, South extension part 2, New Delhi 110049, India

**Phone:** +91 7838528251

**Email:** dr.neelamsahani@gmail.com

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