

## Frequency and distribution of ABO and Rh blood group in North Indian population

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### Abstract:

*ABO blood group is often known as a histo - blood group system as its antigens are expressed on the surface of the red blood cells and in addition to that also present on most of the tissues and in soluble forms in the secretions. The second most important blood group system is the Rhesus system and it is categorized into two group Rh positive and Rh negative. Both the ABO and Rh blood group system are important for blood transfusion, organ transplantation, paternal testing, legal medicine, population genetic study and also in the field of forensic science investigation purposes. The study was conducted to determine the frequency of ABO and Rh blood group in Northern India Population (Delhi and nearby states). The Blood was collected from the voluntarily participated donors and blood group was determined by simple agglutination method. During the study total 584 donors were screened and the results showed that the commonest ABO blood group was O (40.70%) followed by B (30.79%), A (17.56%) and AB (10.95%), Rh positive 82.85% and Rh negative 17.15% were found. In males the O (25.75%) positive was more common while in female B (35.45%) positive blood group was more common.*

**Key Words:** ABO, Rhesus factor, Blood groups, Antigens, Agglutination.

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**Introduction**

The surface of the human red blood cell possesses various glycoproteins and glycolipids content which forms a variety of antigens (Faduyile F.A. et. al., 2016). Once these antigens formed during the fetal life it remains unchanged throughout the life until death. These blood group genes are inherited genetically from the both the parents to the child in Mendelian fashion (Bhavani et.al, 2016; Deepthi et. al., 2015). According to Bhavani et.al, 2016 around 400 different antigens are present on the surface of RBC in human blood and these antigens are divided into 30 blood group system by International Society of Blood Transfusion (ISBT). Therefore the blood group of an individual is the description of antigens that are presents on the surface of red blood cells (Faduyile F.A. et. al., 2016). Out of these 30 blood group systems, the ABO and Rhesus factor (Rh) are the two common and most important classification system. The ABO blood group system was first discovered in 1900 by Karl Landsteiner whereas the Rh system was discovered by Landsteiner and Weiner in 1941(Agrawal et. al., 2014).The ABO and Rh genes are located on chromosome 9 and 1 respectively (Deepthi et. al., 2015). These two systems together

have a great importance in blood diffusion and organ transplantation purposes as many transfusion accidents results into high immunological responses, may even cause death of a person (Faduyile F.A. et. al., 2016).In addition to this it is also useful for the population genetic studies, population migration studies, resolving many medico legal issues, disputed paternity and plays a most vital role to narrow down the search area during criminal investigation in forensic the field of forensic science (Agrawal et. al., 2014, Das et. al, 2001).

On the basis of presence and absence of A and B antigens on the surface of RBC's the ABO blood group system is divided into four blood types i.e. A, B, AB and O. In this system A and B are strongly antigenic and are dominant alleles (when present in blood, expresses its character) whereas anti A and anti B are antibodies that are naturally present in the plasma of those individuals that does not contains A and B antigens on the surface of RBC's. These antibodies have the capability of produce hyperactive immunological responses during mismatch blood transfusion or organ transplantation (Garg et. al., 2014). Below is the table showing ABO blood grouping system.

**Table 1: ABO blood grouping system**

Blood Type	Antigen on RBC's surface	Antibodies in plasma	Compatible with	Incompatible with
A	A	Anti- B	O and A	A and AB
B	B	Anti- A	O and B	B and AB
AB	A and B	Neither	O, A, B and AB	AB only
O	Neither	Anti- A and Anti- B	O only	O, A, B, and AB

Apart from ABO blood grouping, the second most important system is Rh blood group system which comprises approximately 49 highly immunogenic antigens and the most significant antigen is D antigen. Individuals with D antigens are Rh positive and those who lacks D antigens are Rh negative individuals. D negative Individuals produces anti- D antibodies in their plasma and if they encounters the D antigen through blood transfusion then these antibodies causes hemolytic transfusion reactions. This becomes a

problematic issue during pregnancy if the mother is Rh negative and the fetus have Rh positive cells. This condition causes hemolytic disease in the new born babies/fetus. So these types of problems can only be solved when blood group is prior and thoroughly checked in blood donors before transfusion and in mothers who are pregnant (Garg et. al., 2014; Singh et.al., 2015). Below is the table showing combined ABO and Rh blood grouping system.

**Table 2: Combined ABO and Rh blood grouping system**

Blood Type	Antigens present	Antibodies present	Compatible with	Incompatible with
Type A+	A and Rh antigens	B antibodies	A+, A-, O+, O-	B+, B-, AB+, AB-
Type A-	A antigen	B and Rh antibodies	A-, O-	A+, B+, B-, AB+, AB-, O+
Type B+	B and Rh antigens	A antibodies	B+, B-, O+, O-	A+, A-, AB+, AB-
Type B-	B antigen	A and Rh antibodies	B-, O-	A+, A-, B+, AB+, AB-, O+
Type AB+	Both A and B antigens and Rh antigen	None	A+, A-, B+, B-, AB+, AB-, O+, O-	None
Type AB-	Both A and B antigen	Rh antibodies	A-, B-, AB-, O-	A+, B+, AB+, O+
Type O+	Rh antigen	Both A and B antibodies	O+, O-	A+, A-, B+, B-, AB+, AB-
Type O-	None	A, B, and Rh antibodies	O-	A+, A-, B+, B-, AB+, AB-, O+

The entire human populations share the same blood group systems; although they differ only in the frequencies of occurrence of specific types. The distribution of ABO and Rh groups varies markedly in different races, ethnic groups, and socio-economic groups in different part of the world.

The data of availability of different blood groups in a region provide significant helps at various levels thus arises need of such studies and our research will definitely strengthens others studies. The aim of the present study is to determine the frequency and distribution of AB and Rh blood group patterns in North Indian population (Delhi and nearby states)and also compares the most frequent blood groups occurred in males and females (comparative analysis) within North India population India.

**Material and Methods**

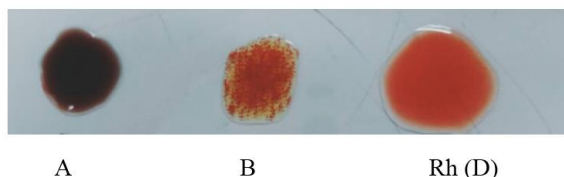
The study was carried out among 484 Individuals of North Indian population (Delhi and nearby states). The individuals of age group between 20 to 45 years, who has voluntarily participated were included in this study. The blood group was determined purely on the basis of agglutination formation.

**Subjects** – Out of 484 individuals, 264 (54.5%) were males and 220 (45.4%) were females, screened for their blood groups.

**Collection of blood samples** – The finger was firstly cleaned by cotton (dipped in ethanol) and then was pricked by a clean/ sterile lancet. The first drop was discarded or wiped by the cotton and then the next blood drops was taken on three different location on the same slide marked as A, B, Rh (D). The commercially available standard antisera’s anti-A, anti-B and anti- D sera were used.

**Table 3: Antisera used for respective blood group identification**

Blood Group	A	B	Rh (D)
Anti-sera Used	Anti B	Anti A	Anti D



**Figure 1: ABO blood grouping by agglutination method (original)**

**Determination of Blood group** – The blood grouping, (ABO) and Rhesus factor (Rh) was done using slide antigen-antibody agglutination method. Such as if anti-B agglutinates with blood and anti- D also agglutinates with Blood then the blood group of the person is A+. Similarly with B+ blood group, Blood will agglutinates with both anti-A and anti-D antisera. In case of AB+, all the three antisera will show

agglutination with the blood. If blood drop is not agglutinated with anti-A or anti-B then it was considered as O blood group.

In case of Rh negative individuals the blood will not show agglutination with Anti-D.

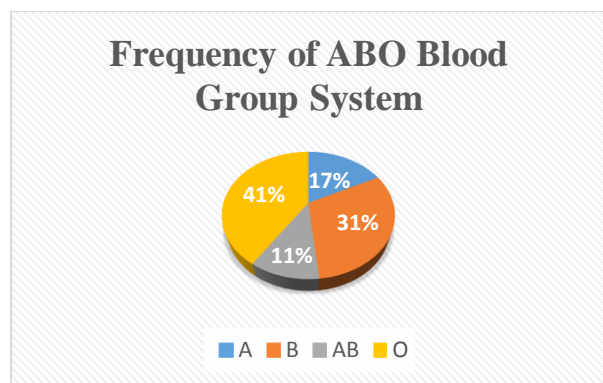
**Statistical Analysis** – The percentage of individual blood group were calculated and then determined the most frequent blood group occurred in the population. In addition to this the comparative analysis was also done between males and females.

**Observations and Results**

The data was collected from 484 individuals. The frequency distribution of the ABO blood groups is shown in Table 4.

**Table 4: Showing Frequency of ABO blood group system in north Indian population**

S. No.	Blood Group	Subjects (male &female)	Percentage (%)
1.	A	85	17.56 %
2.	B	149	30.79 %
3.	AB	53	10.95%
4.	O	197	40.70%
5.	TOTAL	484	100%



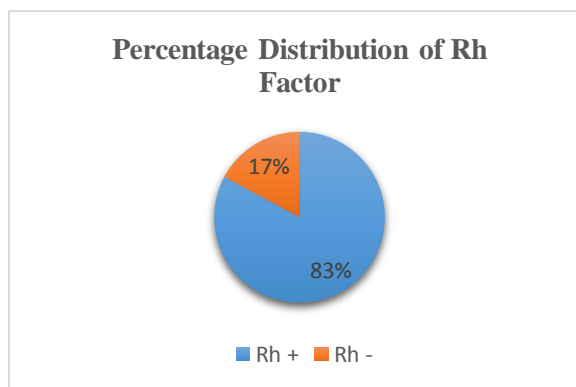
**Figure 2: Pie chart representing Percentage distribution of ABO blood group system in North Indian population**

The frequency distribution showed that the blood group O is the most common which has the highest frequency i.e. 40.48%, whereas the blood group AB has the lowest frequency i.e. 10.95 % among the North Indian population.

Based on Rh factor, it was found that the Rh positive individuals have high frequency than the Rh negative individuals. As shown in Table 5.

**Table 5: Percentage distribution of Rh factor among North Indian population**

Blood Group	Subjects	Percentage
Rh +	401	82.85%
Rh -	83	17.15 %
Total	484	100%

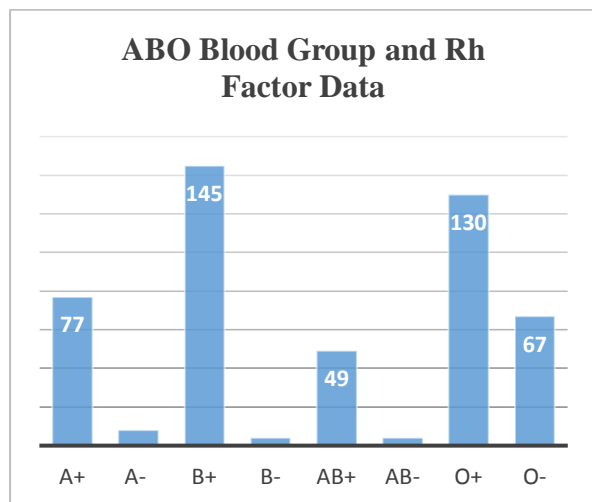


**Figure 3: Piechart representing Percentage distribution of Rh factor among the individuals of North Indian population**

Based on the overall analyses the frequency and distribution of ABO blood group and Rh factor in North Indian population it was found that the B+ blood group was the most common and has high frequency whereas the lowest frequency was found in blood group B- and AB-, shown in Table 6.

**Table 6: Showing combined percentage data of ABO blood group and Rh factor in north Indian population**

Blood Group	Subjects	Percentage
A+	77	15.9%
A-	8	1.65%
B+	145	29.95%
B-	4	0.83%
AB+	49	10.12%
AB-	4	0.83%
O+	130	26.96%
O-	67	13.84%
Total	484	100%



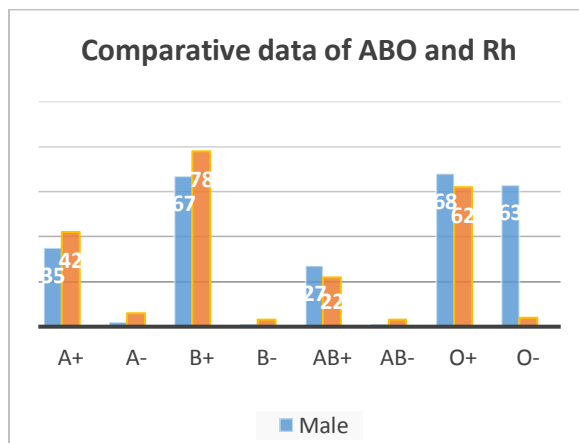
**Figure 4: Graphical representation of Frequency and Distribution of Occurrence of ABO and Rh system in population.**

The comparative study was also performed between the males and females. This has made to figure out the most common blood group (whether same or different) that occurs in males and females. After analyses, it was found that B+, O+, and O- were the most common Blood groups that occurred in males out of which the O+ has the highest frequency. In females the most commonly occurring blood group was B+ and O+ and the highest frequency was showed by blood group B+, shown in Table 7.

**Table 7: Showing a comparative data of frequency and distribution of occurrence of ABO blood group**

**and Rh factor in males and females of north Indian population**

	Blood Group	Subjects	Percentage
Males	A+	35	13.26%
	A-	2	0.75%
	B+	67	25.38%
	B-	1	0.38%
	AB+	27	10.23%
	AB-	1	0.38%
	O+	68	25.75%
	O-	63	23.86%
	Total	264	100%
Females	A+	42	19.09
	A-	6	2.73
	B+	78	35.45
	B-	3	1.36
	AB+	22	10
	AB-	3	1.36
	O+	62	28.18
	O-	4	1.82
	Total	220	100%



**Figure 5: graphical representation of Frequency and Distribution of Occurrence of ABO and Rh in males and females**

**Discussion**

The study of blood group and its frequency in a population has a great importance because of its clinical importance not only for the blood transfusion and organ transplantation cases but also has a vital role in the field of forensics, research studies, genetics, anthropology, pathology, determining migration of races etc. (Fauduyile et. al. 2016). The knowledge of ABO and Rh blood group and its distribution across the states, country and world plays an essential role in effective management of blood bank. There is a wide variation in the frequency of occurrence of different

types of blood group from place to place in different parts of the world.

All other studies has very less number of female donors such as 0.3% in Andhra Pradesh population (Bhavani et. al. 2016), 16% in Jammu population (Gupta et. al., 2016) and 0.23% in Kumaon Region of Uttarakhand (Garg et. al., 2014) but in our study female donors has also participated almost the same percentage as that of male donors. In our study it was observed that female donors has also a significant percentage 45.45% as that of males 54.5%.

In the present study, the ABO blood group in the total sample collected from north India population showed the same prevalence of occurrence as most of the other studies conducted in India i.e. blood group O has the highest frequency followed by B then A and the least frequent is AB blood group (O (40.70%) > B (30.79%) > A (17.56%) > AB (10.95%) in the population (Bhavani et.al., 2016;. Deepthi et. al., 2015; Handoo et. al., 2014; Periyavan et. al., 2010) but in some north Indian population studies the prevalence order is different i.e. B>O>A>AB (Gupta et. al., 2016; Singh et. al., 2015; Raja et. al., 2016). According to Fauduyile et. al. 2016 there were more people with blood group A than group B among blood group donor but in our study blood group B individuals are more than the Blood group A individuals among the blood group donor.

In our study the frequency of Rh positive was 82.85% whereas Rh negative was 17.15%. Our data is consistent and are similar to the data of other studies that have been carried out in different states of India.

Rh positive group was found to be the predominant group (Deepthi et. al, 2015; Fauduyile et. al. 2016; Gupta et. al., 2016; Kaur et. al., 2016; Periyavan et. al., 2010; Raja et. al., 2016).

According to Giri et. al., 2011 amongst Rh positive male subjects, blood group B was found to be the most prevalent group (29.31%) followed by group O (27.89%), group A (26.42%) and group AB (7.75%) but in our study the most prevalent blood group was O (25.75%) followed by group B (25.38%), group A(13.26%) then group AB (10.23%). Amongst Rh-positive female subjects, blood group O was found to be the most prevalent (1.35%) followed by B (1.22%), A (0.89%) and group AB (0.50%) whereas in in this study the most prevent blood group was B (35.45%), O(28.18%), A (19.09%) and group AB (10%).

### Conclusion

The present study concludes that the most common blood group is O and the least common is AB amongst the blood donors. Regarding Rhesus blood group system, Frequency of Rh+ were greater than the Rh-frequency. In males O+ have high Frequency and in Female B+ has high frequency in north Indian Population. This information helps other studies of different geographical regions in India and mostly in the field of transplantation and forensic medicine etc. However, it is suggested that further study shall be carried out over a course of long time interval so as to get a standardized data...

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