

Detection of ABO And Rhesus Phenotyping Prevalence among Volunteer Blood Donors Attended Tertiary Care Hospital Blood Bank

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Abstract

Background:ABO and Rhesus-types antigens are particularly important for blood transfusion due to clinical implications as, hemolytic anemias, transfusion reaction, and erythroblastosis are caused by antibodies reacting with antigens. **Objectives:** The aim detection of ABO And Rhesus Phenotyping prevalence among Volunteer Blood Donors who attended tertiary care Hospital blood banks.**Method:**ABO and Rhesus phenotyping tests were performed on blood samples drawn from the donors by an accepted standard laboratory procedure for ABO and Rhesus types. **Results:**The study covered 995 blood donors aged 18-28 is the lowest age which is 44.4% and >78 is the peak age having a 33.3% of group donors. The percentage of gender shows that Male donors are predominant at 68.3% compared to donor females are only 31.7% of all. In the present study, we noticed that the donor's blood was enrolled in 995. 680 males and 315 females. The observation found blood group O was highest at 47.7% then followed by next of A at 25.8%, B at 22.5%, and AB at 3.9% presented. The percentage of Rhesus phenotyping of blood donors was 90.5% Rhesus-positive and Rhesus-negative 9.5%. **Conclusion:**The greatest common blood type is O and the least common is AB. Where the Rhesus D was 90.5% positive and 9.5% Rhesus D negative.

Keywords:ABO and Rhesus blood type, Phenotyping, Blood donor, Blood bank, and Transfusion medicine.

Introduction

The antigens type found in red blood cells (RBCs) is determined through RBC phenotyping. All patients who need blood transfusions have their ABO/Rh types determined during the "type and screen" procedure. The most clinically considerable blood type system, the ABO blood grouping system, was invented by Karl Landsteiner in 1900. (Woldu *et al.*, 2022) Four blood A, B, and O group antigens have been identified as A, B, AB, and O.(Halawani and Arjan, no date)

Blood groups play a significant role during transfusions and are determined by the presence of surface antigens in RBCs. (Kumar *et al.*, 2018) The human types A, B, and O is a common example of multi allelism since it has three alleles, A, B, and O, and its phenotypes might be A, B, O, or AB. The inheritance of genes on chromosome 9 that convert glycosyl transferases that transfer oligosaccharide residues to (H) antigen, resulting in the formation of group A & B antigens, whereas O persons lack such activity, determines the

specific composition of the blood A, B, and O systems. (Anifowoshe *et al.*, 2017)

Plasma and serum from people with blood group A contain antigen (A) and anti-B antibodies. Group O blood lacks both A and B antigens but contains both types of antibodies in the plasma, whereas group B blood possesses (B) antigens with - A antibodies in the plasma. (Gonnade *et al.*, 2017)

Rhesus blood type: Rh grouping is determined by the presence or lack of D antigen on the surface of RBC since Rh is composed of D antigen. Glycoproteins and glycolipids with genetic control make up blood-type antigens. (ManAlemu and Mama, 2016) The Rh blood group system is the second most important in terms of clinical importance. RhD, RhC, RhE, Rhc, and Rhe are the most significant of the more than 50 antigens connected to the Rh blood type system. (Tariq *et al.*, 2022) Most cases of alloimmunization following blood transfusions and pregnancy are caused by the five most prevalent ones, D, C, E, c, and e. (Makroo *et al.*, 2014) which have been related to hemolytic disorders in both fetal and newborn humans. Due to the strong immunogenicity of D antigen in clinical settings, it can either be (D) Rh positive or (D) Rh negative. 85% of White people and 92% of Black people experience D+ve frequent incidence. The majority of D- individuals will immediately create anti-(D) when unprotected from D+, Red blood cell hemolysis transported by the anti-(D) is known as (alloimmune hemolytic disorder). There is less immunogenic activity in other Rh antigens, such as C, c, E, and e. Once the appropriate antibody has been created, they become important for in-patient care. Although some IgM antibodies also react with anti-human globulin at (37°C), D and E antibodies are primarily IgG in composition. (Mbalibulhaet *et al.*, 2022)

Distribution of blood system: Globally and among nations, there are variations in the distribution of ABO and Rh D typing blood. For the efficient management of blood bank records, as well as for resolving medicolegal issues like uncertain paternity, conducting human genetic studies, and studying population immigration patterns, information on the ABO distribution Rh D blood type and their allele frequencies worldwide is helpful. (Sigamani and Gajulapalli, 2022)

A, B, O, and Rh in transfusions medicine: A blood bank's main responsibility is to provide patients with adequate care for their safe and compatible blood or blood component units. (Owaidahet *et al.*, 2020) Patients with chronic illnesses need blood transfusions on a regular basis. Blood transfusion therapy was made more challenging by the emergence of erythrocyte alloantibodies. Thus, the immunological status of each patient has a significant role in the emergence of alloantibodies, particularly in situations where blood is transfused between individuals with diverse ancestries. The main objective of transfusion therapy is to prevent alloimmunization, an immunological reaction that develops after transfusion against foreign RBC antigens. (Elmobarket *et al.*, 2019) The prevalence and antigenicity of various antigens determine the frequency of incidence of related antibodies. Alloantibodies to low/intermediate frequency antigens through high antigenicity are more prevalent than antibodies to high-occurrence antigens. Therefore, it is essential for safe transfusion to include blood typing, antibody identification, cross-matching, antibody screening, and red cell morphologies. (Prinja and Narain, 2020)

Data from 1 429 996 donors was examined from 112 studies by 23 Indian federations. The general distribution of the blood groups A, B, O, and AB is (23%, 34%, 34%, and (8)18%,

respectively. RhD positivity and negativity are represented by percentages of (94)13% and (5) 87%, respectively.(Patidar and Dhiman, 2021)

Available data that shows ABO And Rhesus Phenotyping prevalence among Volunteer Blood Donors who attended tertiary care Hospital blood banks is the most important information need all aspects of transfusion medicine as well as to know the age groups, especially young males and females prior to transfusion, the goal of this study is to detect the prevalence of ABO and Rh typing in order to give the patient the most compatible blood as soon as possible when are required and to avoid the risk of hemolytic transfusion reactions.

Problem Statement

The city of Mohali, which is a part of the Punjab state in northern India, has a diversified population with a range of racial and genetic origins. Understanding the local blood donor population and its potential impact on transfusion services requires research into the ABO prevalence and Rh blood types in this area. This study is aimed at shedding light on the distribution of blood types among blood donors in Mohali, Punjab, by analyzing the detection of the prevalence of ABO and Rh blood types in a tertiary care hospital situation. In order to guarantee a safe and suitable blood supply for patients in need, the results of this study can be used to improve inventory management, optimize blood transfusion procedures, and direct donor recruitment strategies.

Objectives

To seek out the detection of ABO And Rhesus Phenotyping prevalence among Volunteer Blood Donors who attended tertiary care Hospital blood banks.

- To determine the prevalence and distribution of different blood types among blood donors.
- To find out the demographical distribution of (ABO & Rh) phenotyping

To provide information on the distribution of blood types (ABO & Rh D) Phenotyping.

Materials and Methods

Study area, design and target population: This was a retrospective study conducted at the Blood Bank tertiary care hospital in Mohali, Punjab. All donors who donate at tertiary care Hospital Blood Bank in Mohali, Punjab, were involved in the study population.

Sampling and Sample Size: A sample of blood donors who attended the tertiary care hospital over a predetermined time period to donate blood voluntarily were involved in the study. All eligible blood donors who satisfied the inclusion criteria were studied using convenience sampling.

Inclusion and exclusion criteria: As per the SOPs available in the blood bank, the study's inclusion criteria were as follows:

1. All blood donors must be over the age of 18 years old.
2. All blood donors who don't have a prolonged chronic medical condition.
3. Totally blood donors weighing above (45) kilograms.
4. Altogether blood contributors with hemoglobin levels above 12.5 g/dl.

The elimination criteria were the follows:

1. Volunteers Blood donors with a blood contribution occurrence of less than three months.
2. Blood donors who are taking medication.
3. Blood Donors who have just and freshly undergone surgery.

Laboratory investigations procedure: The study presented ABO and Rh D type blood distribution are carried out by whole donors of blood who accepted successfully to donate for one year period attended at the hospital blood bank for donating purpose as a health donor volunteers. The collection of blood was taken for replacement and volunteers were donors at the area of blood donation blood bank. Perhaps after a donation of blood, the blood type was

determined through Cell grouping (forward blood typing) and Serum typing (Reverse blood typing) which was done by tiles heam agglutination method and tube method by using the available commercial standard operating manual procedure as instructed by manufacture. The A, B, AB, and D and the human mixed pooled of known ABO cells are prepared daily at the department blood bank. Lastly, blood type is designated to donors if both forward group and reverse group are identified by using fully automated equipment (Ortho Innova, Atovue, Ortho clinical diagnostics limited). Rhesus D negative blood types are confirmed by using Indirect Anti-globulin Technique (IAT) after all recorded results of blood donors. And other procedures are done routinely by performing ABD reverse diluent cassettes on fully automated equipment The Hardy-Weinberg equilibrium of measurable genetics was used to estimate allelic frequency.

The technique also estimated the maximum probability ratio under the statement that the ABO blood groups system is determined in three alleles, a single gene called A, B, & O, and that A & B are autosomal dominant over the O gene & co-dominant with each other. We calculate

the expected phenotypic frequencies of blood groups based on the allelic frequency results. Chi-square tests were used to assess the independence & goodness of suitability for gene & genotype frequencies.

Data collection procedures and statistical analysis: Demographic information about the donor, such as age, and gender, was achieved from Blood Bank registering log books. The collected data on ABO and Rh blood types were accumulated and analyzed using appropriate statistical methods of SPSS version 20.0 using Chi-square test significance of descriptive statistics, such as frequencies and percentages, were calculated for detection of ABO And Rhesus Phenotyping prevalence among Volunteer Blood Donors who attended tertiary care Hospital blood banks. the qualitative data were expressed in the form of mean and standard deviation.

Results

The study covered 995 blood donors aged 18-28 is the lowest age which is 44.4% and >78 is the peak age h 33.3% of the age among the group donors (Table 1, Figure1).

Table 1: This is showing percentage of age wise ABO samples collected to check the prevalence of the ABO and Rh-Phenotyping for the purpose

Age Group	Percentage
18-28	44.4
29-38	55.6
39-48	66.7
49-58	77.8
59-68	88.9
>78	33.3

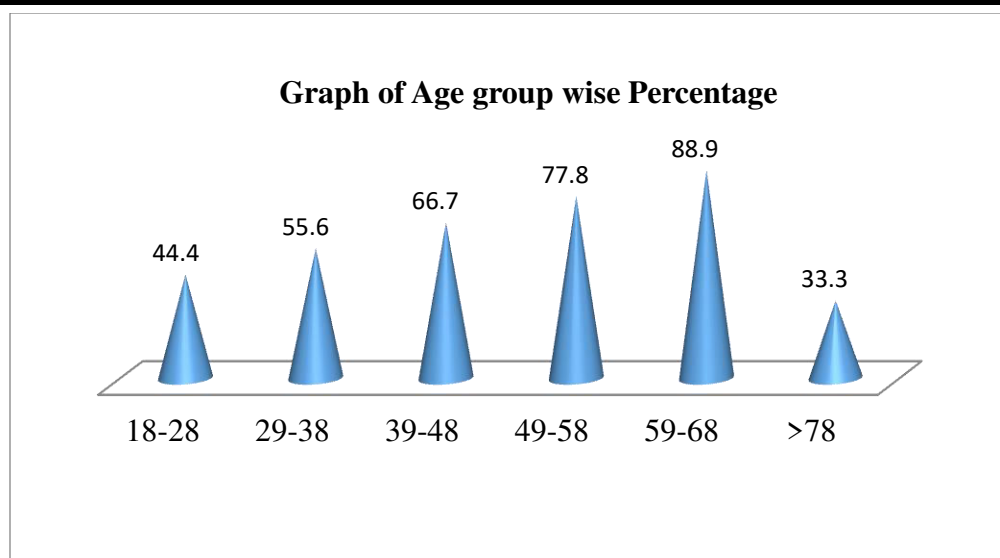


Figure 1: Figure showing percentage of age wise ABO samples collected to check the prevalence of the ABO and Rh-Phenotyping for the purpose.

The percentage gender shows that Male donors are predominant for 68.3% compared to Female donors only 31.7% of all. (Table 2, Figure 2).

Table 2: This is the frequency table of the percentage of Gender wise ABO volunteer blood donors to check the prevalence of ABO and Rh- typing.

Gender	Number	Percent
Male	315	31.7
Female	680	68.3
Total	995	100.0

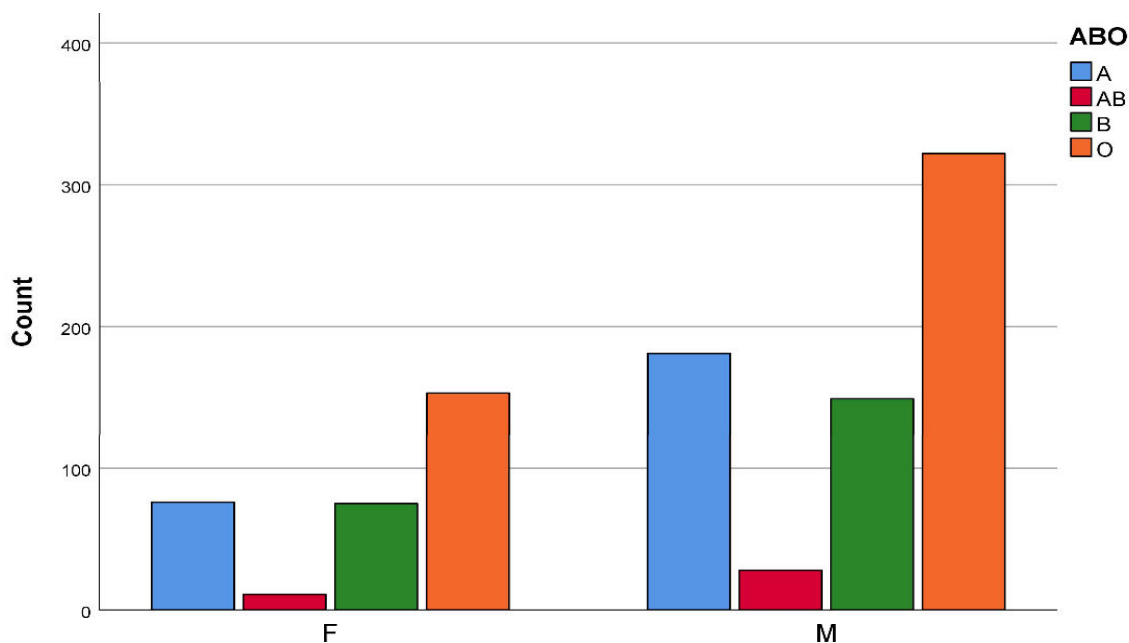


Figure 2: This bar figure presents the gender of ABO blood donors' participants

In the present study, we noticed that number of the donor's blood was enrolled 995. 680 males and 315 females. The observation found that blood group O was highest at 47.7% than followed by next of A at 25.8%, B at 22.5%, and AB at 3.9% presented in (Table 3, Figure3).

Table 3: This is the frequency table of the percentage of ABO blood grouping among the blood donors.

Gender	Number	Percent
A	257	25.8
AB	39	3.9
B	224	22.5
O	475	47.7
Total	995	100.0

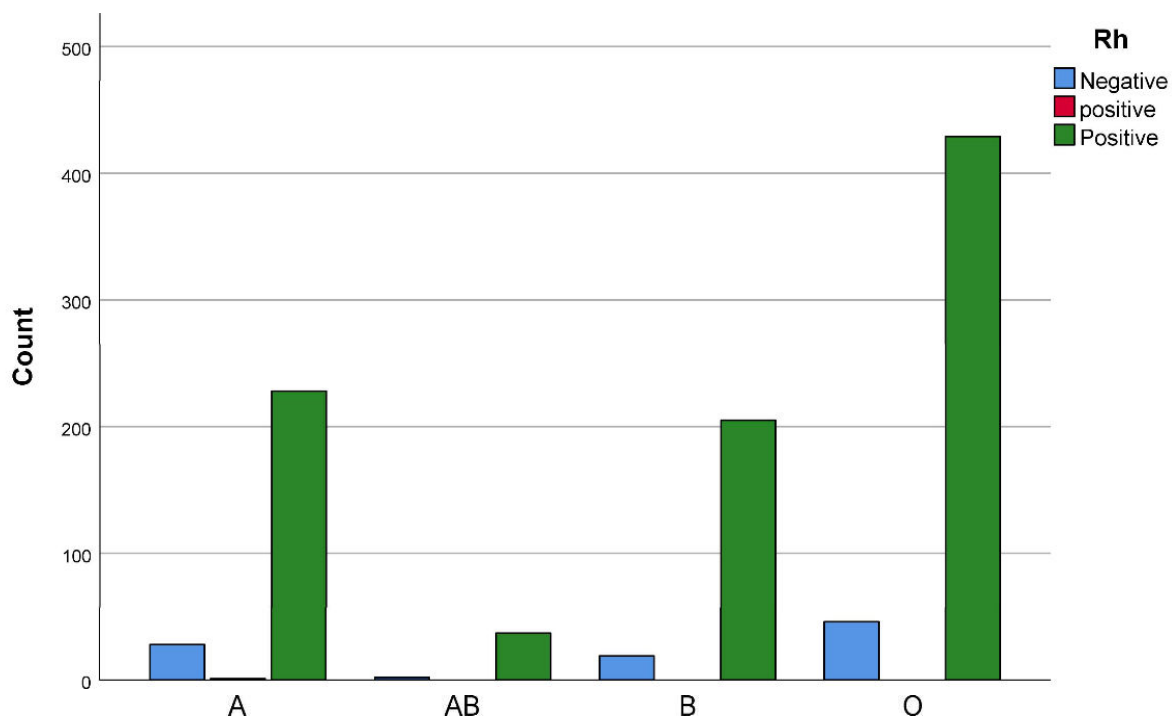


Figure 3: This bar figure presents ABO and Rh blood types among the blood donation for that purpose.

The percentage of Rhesus phenotyping of the donors blood was 90.5% Rh- positive and Rh- was 9.5%. presented in (Table 4, Figure 4).

Table 4: This is the frequency table of the percentage of Rh- blood type among blood donors.

Gender	Number	Percent
Rh Negative	95	9.5
Rh Positive	899	90.5
Total	995	100.0

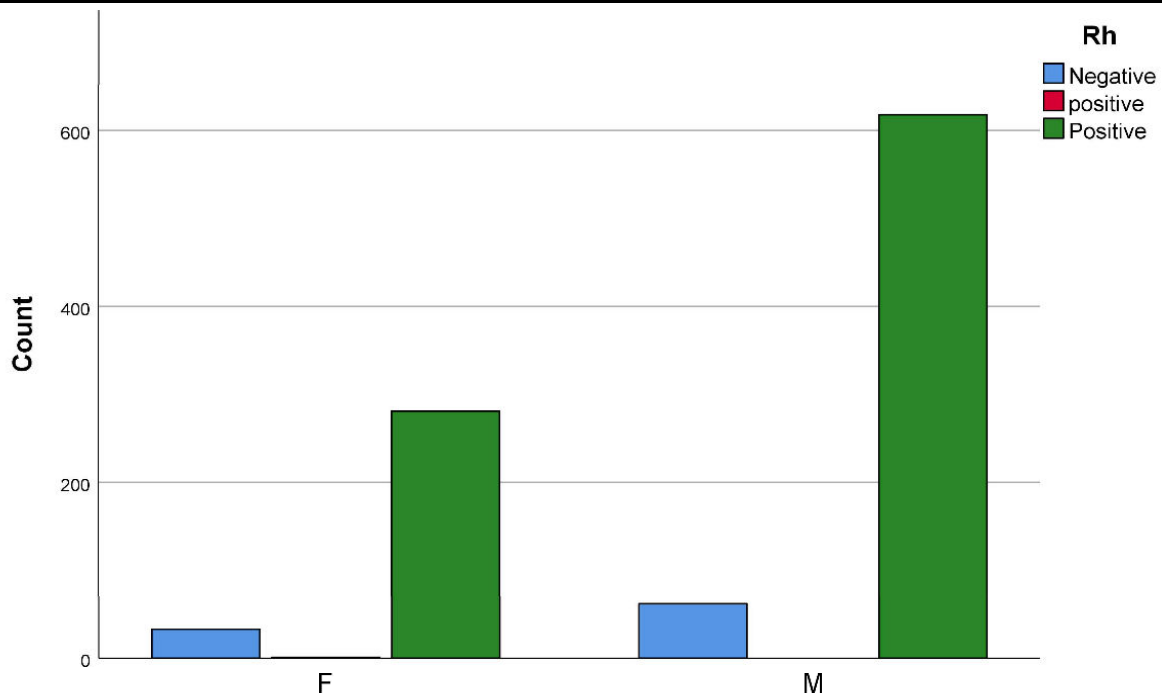


Figure 4: This bar Figure shows the percentage of gender and Rh- blood type among blood donors.

For the Rhesus phenotyping (Rh-ph) blood type it is presented in (Table 5, Figure 5) accordingly. Additionally, the number of donors for each blood type may change over time due to factors such as population demographics, medical advances, and public health campaigns.

Table 5: This is the frequency table that shows the percentage of Rhesus phenotyping of blood sample

Rhesus phenotype	Number	Percent
C-c-E-e+	3	.3
C-c+E-e+	152	15.3
C-c+E+e-	26	2.6
C-c+E+e+	115	11.6
C+c-E-e+	223	22.4
C+c-E+e+	4	.4
C+c+E-e-	2	.2
C+c+E-e+	299	30.1
C+c+E+e-	1	.1
C+c+E+e+	170	17.1
Total	995	100.0

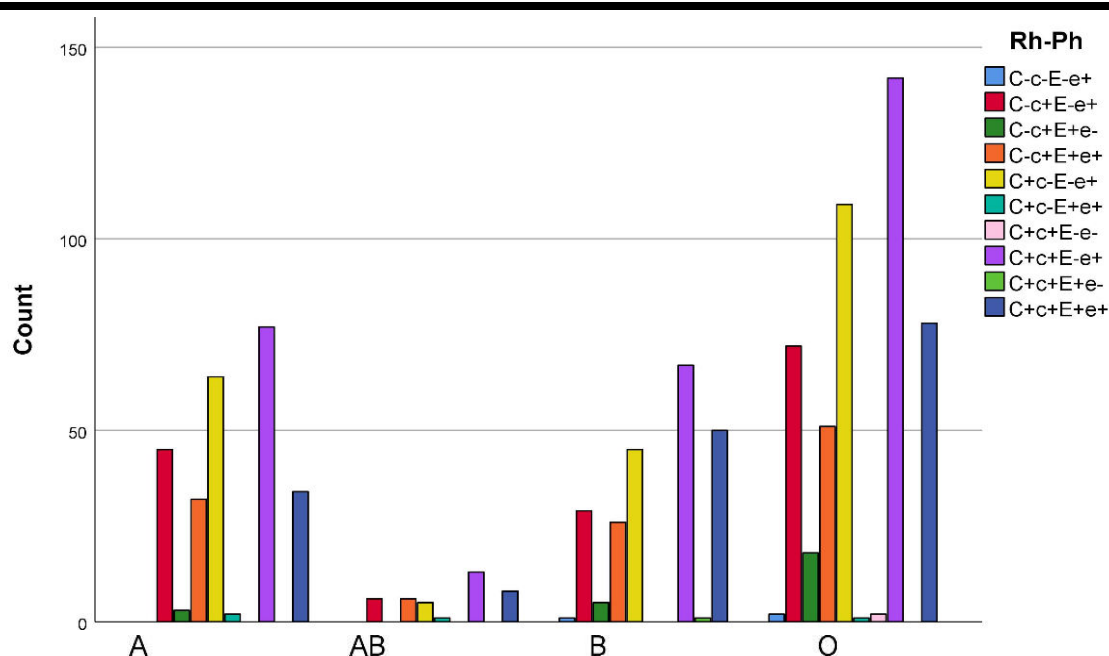


Figure 5: This bar Figure presents ABO and Rh phenotyping among the blood donors volunteers

Discussion

This study obtained 995 participants of volunteers' blood donors of different ages as shown in (Table 1 and Figure 1) above. In terms of gender were Males 680 and Females 315. (Table 2, Figure 2) concerned with the prevalence of ABO and Rh genders. There are differences in prevalence frequency distribution in the percentage of blood type ABO and Rh blood types among the participant donors as presented on (Table 3 and 4) respectively figures. As shown the highest prevalence frequency of blood types ABO among blood donors was O for 475 = 47.7%, which the high distribution among donors is followed by A which is 257 = 25.8%, blood type B is 224 = 22.5% and AB blood type 39 = 3.9% accordingly.

Various research studies have shown the O blood type were the greatest common group of blood and the AB blood type were the lowest common group of blood in different area and population. For example, in the

Ladakh population of India. (Mohd Murtaza et al, 2020) the distribution blood type O = 34.29%, A= 29.65%, B= 29.28% and AB= 6.76%.

On review paper conducted in India present the Distribution of ABO and Rh blood type as follows: A, B, O, and AB blood kind in India is 23.16%, 34.10%, 34.56%, and 8.18% respectively (ISBT, 2021 Gopal K et al) likewise in the study in Chengalpattu of South India shown the phenotype frequency of blood group O = 39.17% was the highest and AB blood group was the least in 7.88%. (Karthik Sigamani et al).

However, the result from central Gujarat India shows different result as follow: blood group B was the most common at 35.96% and the blood group AB was the least 8.43%. (Barot et al, 2020). The finding from the North India study presents the blood group B donors are highest in numbers 35.90%, followed by blood group O = 33.07%, A= 20.93%, and AB= 10.08%. as

presented (Bhardwaj et al, 2022). Another study from the North part of India shows the B blood group was the commonest prevalent in donors 34.84%, next by the O blood group 29.75%, A= 21.50%, and 13.91% AB blood group. (Tulika Chandra et al,2012). Also in Delhi India, shown the result as blood group A=23.88%, B=37.38%, AB= 9.97%, and O = 29.27%. (Sanjay Kumar et al,2023)

The study done by Daljit Kaur shows that blood types A, B, O, and AB were 22.6,23.4% for A blood type, B blood type 37.8,35.6%, O equal 29.5,29.5% and AB equal to 10.1,11.4% respectively, with the Rh D are observed 95.4% positive and 5.5% Rh D negative.

Due to the study presented by (Swelem et al 2018) reported that the percentage prevalence rate of Blood type AOB and AB are as flowing 39.4% blood type A, 25.9% for blood type O, 24.1% B blood type and AB blood carry 10.9% respectively. The case percentage of Rh negative is 14.4% and Rh D is 85.6%. this subject shows that blood group A is highest than other groups by the following with O, B, and AB respectively.

The subject research (Qutaiba K.J, 2022) shows that blood group A phenotyping is more accountable for 82.054%, B phenotype is 46.439%, AB phenotype 12.792%, and O phenotype is 34.547% respectively. This presented the highest number of total phenotyping in the blood type A phenotype. On the side of Rh phenotype, the Rh D positive shown is more prevalent in all studies done in different geographical places worldwide followed by the Rh negative in all reference cases of the research done among the various subject of researchers.

Conclusions

The present subject comes to the conclusion that the highest common blood type is the O group and the common least is the AB type among the donors in the Mohali region. Where the Rh D was 90.5% positive and 9.5% Rh D negative. In tertiary care hospital blood banks like the one in Mohali, Punjab, it is crucial for transfusion medicine to take into account the incidence of ABO and Rhesus phenotypes among blood donors. With the help of this information, blood banks may improve patient care in Mohali and elsewhere by changing their procedures, enhancing blood transfusion safety, and more. For improving our understanding of blood group distribution patterns and their clinical implications in transfusion medicine, further study in this field is essential, as well as the application of modern technologies and best practices. Additionally, a population's blood group prevalence can be significantly influenced by factors like genetic, ethnic, geographic, and sociodemographic factors. Blood banks must take these factors into consideration when managing blood supplies and developing donor recruitment strategies

Ethical Consideration

The Chandigarh University Research and Publication Committee approved the use of blood bank data after seeking approval from the hospital management. The blood donors also received information about the trial in return for their verbal agreement. Respondents and management were expected to disclose data and information, maintain confidentiality, and abide by norms of ethics in order for the study to achieve its goals.

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