

Comparitive Blood Group Frequency Research Article

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Abstract

The ABO blood group system is one of the most important and widely studied classification systems in human biology. First discovered by Karl Landsteiner in 1901, the ABO system classifies blood based on the presence or absence of two surface antigens—A and B—on red blood cells. The four major blood groups in this system are A, B, AB, and O, each with distinct antigenic properties and clinical relevance (Danieles,2023). In addition to ABO, the Rh system—primarily determined by the presence (Rh-positive) or absence (Rh-negative) of the D antigen—plays a vital role in transfusion compatibility and maternal-fetal health. Globally, Rh-positive individuals account for the majority of the population, with Rh positivity ranging from 85% to 95% depending on ethnicity and geography (Kaur & Singh, 2025; WHO, 2023). Rh incompatibility, particularly during pregnancy, can result in hemolytic disease of the newborn, underscoring its clinical importance. In addition to ABO, the Rh system—primarily determined by the presence (Rh-positive) or absence (Rh-negative) of the D antigen—plays a vital role in transfusion compatibility and maternal-fetal health. Globally, Rh-positive individuals account for the majority of the population, with Rh positivity ranging from 85% to 95% depending on ethnicity and geography (Kaur & Singh, 2025; WHO, 2023). Rh incompatibility, particularly during pregnancy, can result in hemolytic disease of the newborn, underscoring its clinical importance. According to the findings of results the most common blood groups is B+ and than O+ while others are rare in the population .On the others hand individual with Rh+ is 84% an 16% is Rh negative.

INTRODUCTION

Blood group systems are vital not only in clinical transfusion medicine but also in genetic research, forensic science, and anthropology. Among more than 30 recognized human blood group systems, the ABO and Rh (Rhesus) systems are the most widely studied and clinically significant. These two systems play a central role in ensuring safe

blood transfusions, managing maternal-fetal health, and understanding genetic diversity across populations (Daniels, 2023).

The ABO blood group system, discovered by Karl Landsteiner in 1901, classifies blood based on the presence or absence of two antigens—A and B—on the surface of red blood cells. Individuals with group A have A antigens and anti-B antibodies; those with group B have B antigens and anti-A antibodies; group AB has both antigens and no antibodies, making them universal plasma recipients; while group O lacks both A and B antigens but has both antibodies, making them universal red cell donors (Yamamoto & Cid, 2021).

The global distribution of ABO blood groups varies significantly—group O is most prevalent worldwide, especially in African and American populations, while group B is more frequent in South and Central Asia, and group A dominates in parts of Europe (Kaur & Singh, 2025).The four major blood groups in this system are A, B, AB, and O, each with distinct antigenic properties and clinical relevance (Daniels, 2023).

Blood group A is characterized by the presence of A antigens on the surface of red blood cells and anti-B antibodies in the plasma. It is commonly observed in populations across Europe and parts of Asia, with prevalence rates ranging from 25% to 35%, depending on the region (Yamamoto & Cid, 2021).

Blood group B, on the other hand, has B antigens and anti-A antibodies. It shows a particularly high prevalence in South Asian countries such as India and Pakistan, where it can constitute up to 35% of the population (Khan et al., 2023).

Group AB individuals possess both A and B antigens but lack both anti-A and anti-B antibodies. Although this group is the rarest globally, representing only 4–8% of most

populations, it holds special clinical significance as AB individuals are considered universal plasma donors (Kaur & Singh, 2025).

Blood group O lacks both A and B antigens but contains both anti-A and anti-B antibodies. It is the most common blood group globally, particularly dominant in Africa and the Americas, where its prevalence may exceed 40–50% (Morales & Espinoza, 2025). This research aims to compare the frequencies of A, B, AB, and O blood groups across different populations, focusing on regional trends and genetics. By understanding these patterns, the study contributes to better healthcare planning, efficient blood bank management, and deeper insights into population genetics.

The Rh system, particularly the D antigen, is the second most important in transfusion medicine. Individuals are classified as Rh-positive if they possess the D antigen and Rh-negative if they do not. The majority of the global population—about 85% to 95%—is Rh-positive, although the prevalence of Rh-negative individuals is higher in European populations compared to Asian or African groups (Morales & Espinoza, 2025; WHO, 2023). Rh incompatibility, especially between Rh-negative mothers and Rh-positive fetuses, can lead to hemolytic disease of the newborn, a serious condition requiring careful prenatal care and monitoring.

Understanding the distribution patterns of ABO and Rh blood groups is essential for public health planning, particularly in areas such as blood bank management, emergency medicine, and organ transplantation. Moreover, recent studies have also suggested associations between blood groups and disease susceptibility, including cardiovascular disorders, infectious diseases, and even COVID-19 outcomes (Zhao et al., 2021). The present study aims to compare the frequencies of ABO and Rh blood groups

across different populations based on the most recent data available from 2020 to 2025, providing insights into genetic diversity and implications for transfusion safety.

In a comprehensive meta- analysis encompassing data from January 1977 to December 2020, the ABO blood group distribution in Pakistan was reported as B (34%), O (32%), A (24%), and AB (10%), with 91% classified as Rh- positive (Iqbal & Saba, 2022). Recent localized studies further refine this picture: a 2023 cross- sectional survey in Peshawar reported B = 37.0%, O = 27.0%, A = 26.0%, AB = 10.0%, and an Rh- positivity rate of 94% (Riaz & Arif, 2024). A similar study in Lahore (March–June 2023) found O to be most common (49.3%), followed by A (27.1%), B (20.0%), and AB (3.7%), though Rh data was not detailed (Ghafoor et al., 2024)."

The present study aims to

- Determine the prevalence of each ABO blood group (A, B, AB, and O) and Rh factor (positive and negative).
- Analyze variations in blood group frequencies based on demographic variables such as gender, ethnicity, or region (if applicable).
- Provide data that can support blood bank management, transfusion services, and healthcare planning.
- Compare the findings with national and international studies to identify patterns or anomalies in blood group distribution.
- Enhance awareness about the significance of knowing blood group frequencies for clinical, forensic, and genetic studies.

MATERIAL AND METHOD

Study Design

A study is conducted to check the prevalence of ABO and Rh blood groups in LIMS college Faisalabad.

Duration of Study

The study was completed in 1 months from June, 2025 July 2025 after the approval of synopsis.

Target Population

Participants from LIMS college in Faisalabad between the Age of 20-50 years both males and females.

Sample Size

A sample size of 250 approximately and both genders are included.

Sampling Technique

The aseptic technique to collect samples by venous was used and then the test was performed by open slide agglutination method and note result after 60 seconds.

Sample Selection

Sample selection was done on the following inclusion and exclusion criteria.

Inclusion Criteria

Participants from LIMS college in Faisalabad with ages between 20-50 years.

Exclusion Criteria

Participants below the age of 20 and above 50 years were exclude

Methodology

Open Slide Method

The open slide test method was used to analyze venous blood samples from both sexes' males and females for blood grouping. Each blood sample was added, mixed with a drop of antisera anti-(A, B, D), and gently rocked for 60 seconds to watch for agglutination for agglutination

Sample Collection and Procedure

After ethical consideration and the satisfaction of the participants, we used the needle for the blood sample by using an aseptic technique putting 3 drops of blood on the slide and added with one drop of antibody antisera A, B, and D respectively. After added, mixed, and gently rocked for 60 seconds to watch for agglutination then confirmed on the microscope and noted the blood type (Group)

Blood Samples were collected by venous



Mix with specific Antisera (Anti-A, B, D)



Watch the agglutination macroscopically



Confirm agglutination on the microscope

FIGURE1/: SHOWS THE PROCEDURE FOR ABO BLOOD GROUPING

RESULTS

The first bar graph shows the overall distribution of Rh factor among a sample of 250 individuals. The two bars represent Rh-positive (Rh+) and Rh-negative (Rh-) blood types. Approximately 84% of the population is Rh-positive, while about 16% is Rh-negative.

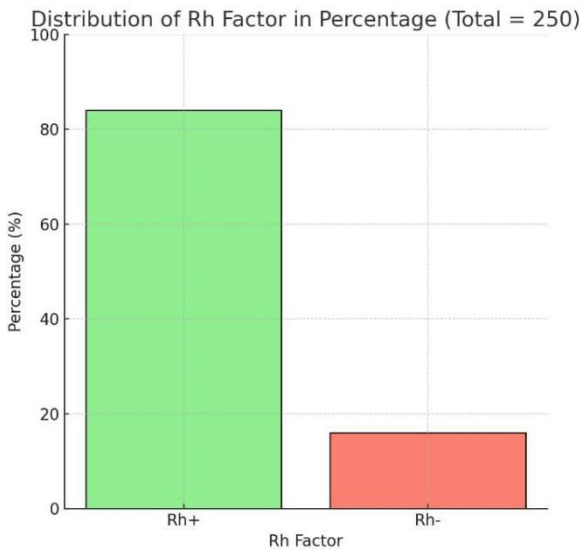
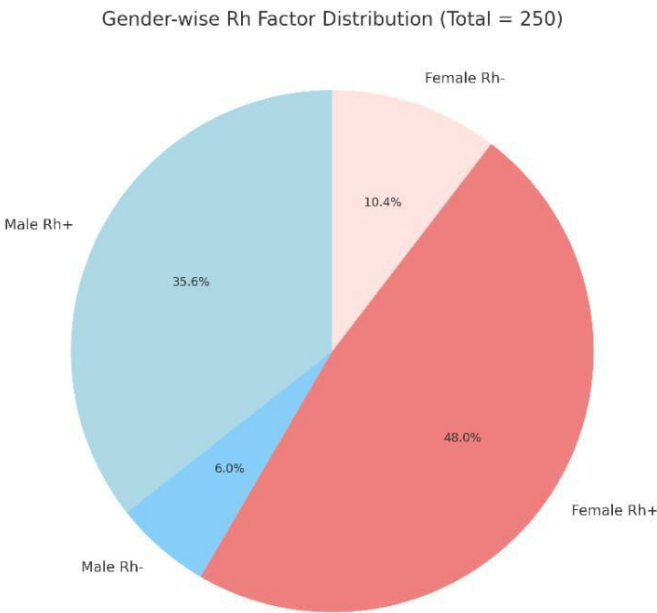


Figure 1 illustrates the distribution of the Rh factor among the study population (N = 250). The majority of individuals (84%) were found to be Rh-positive, whereas only 16% were Rh-negative. This finding aligns with global trends where Rh-positive blood groups are typically more prevalent in the general population. The high proportion of Rh-positive individuals has important implications for blood transfusion services and prenatal care, as Rh incompatibility can pose significant clinical risks.



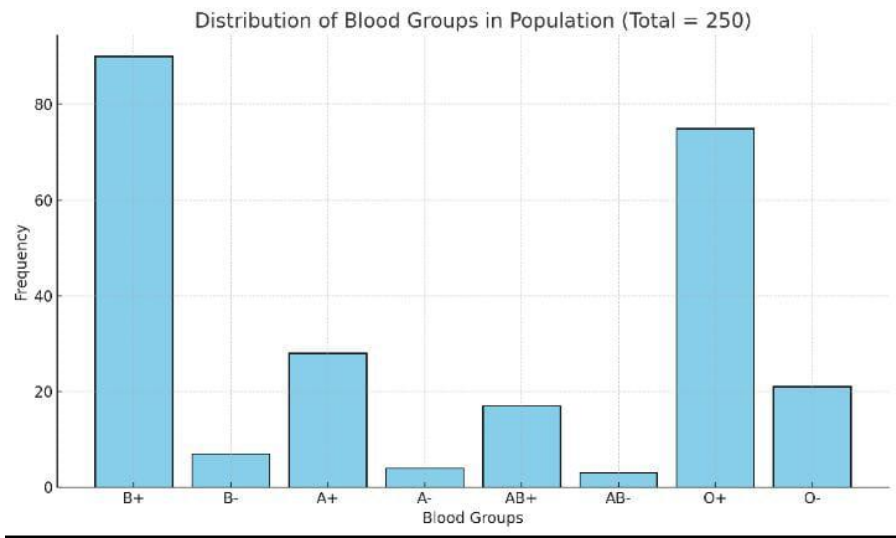
The second graph is presenting the distribution of Rh factors according to gender. It shows that 48% of the total population are Rh-positive females, 10.4% are Rh-negative females, 35.6% are Rh-positive males, and 6% are Rh-negative males

Figure 2 depicts the gender-wise distribution of the Rh factor. Among the study sample, Rh positivity was slightly higher in females (48%) compared to males (35.6%), whereas Rh negativity was also more prevalent among females (10.4%) than males (6%). This distribution suggests a slightly higher proportion of female participants in the sample

TABLE 1: GENDER WISE DISTRIBUTION OF BLOOD GROUP

MALE		FEMALE	
Rh+ve	90	Rh+ve	120
Rh_ve	14	Rh_ve	26
Total	104	Total	146

FIGURE 3 DISTRIBUTION OF ABO BLOOD GROUP IN POPULATON



The third graph shows the frequency distribution of various ABO blood groups in the same population (N = 250). The most common blood groups are B+ and O+, while rare blood groups like AB- and A- show very low frequencies. Figure 3 presents the frequency distribution of ABO blood groups within the study population. The B+ blood group was the most prevalent, followed by O+, while AB- and A- were the least common. Specifically, approximately 90 individuals had B+, and around 75 had O+. This pattern is consistent with previous reports indicating that B+ and O+ are predominant blood groups in South Asian populations. These results are critical for planning blood bank inventories and for ensuring adequate supply for transfusion demands.

TABLE 2: DISTRIBUTION OF BLOOD GROUP TOTAL PARTICIPENTS 250

A+ve	A_ve	B+ve	B_ve	AB_ve	AB_ve	O+ve	O_ve
28	4	90	7	17	3	75	21

DISCUSSION

The current study analyzed the distribution of Rh factor and ABO blood groups among a sample of 250 individuals, providing insight into population-based blood group trends, particularly within a South Asian context. The results indicate that a significant majority (84%) of the study participants were Rh-positive, while only 16% were Rh-negative. This observation is consistent with global epidemiological trends, where Rh-positive individuals tend to dominate the general population (Dean, 2005). The prevalence of Rh-positive blood types has important implications for transfusion compatibility and prenatal care. Rh incompatibility, especially in Rh-negative females bearing Rh-positive fetuses, can lead to hemolytic disease of the newborn, a serious condition if not properly managed.

The gender-wise distribution of the Rh factor further enriches the interpretation of these findings. Female participants made up a slightly higher proportion of the study population, with 48% being Rh-positive females and 10.4% Rh-negative females. In contrast, 35.6% of the population were Rh-positive males, while 6% were Rh-negative males. These results indicate a higher representation of Rh-negative and Rh-positive individuals among females. This gender imbalance may not reflect the general population precisely but remains highly relevant in clinical practice. Understanding Rh factor distribution by gender is particularly essential for obstetric services. Rh-negative women require careful monitoring during pregnancy to avoid sensitization and associated neonatal complications (Moise, 2008). The ABO blood group distribution also revealed notable patterns. The B+ blood group emerged as the most prevalent, accounting for approximately 90 individuals, followed closely by the O+ group with around 75 individuals. Other blood groups, such as AB- and A-, appeared infrequently

within the sample, highlighting their rarity in the local population. These findings align with earlier studies conducted in South Asia, where B+ and O+ blood groups are frequently reported as predominant types (Das et al., 2001). The dominance of these groups has practical significance in transfusion services, as it supports strategic planning for blood donation drives and inventory management in blood banks. Ensuring a steady supply of the most commonly required blood types is vital for effective clinical responses to emergencies and routine procedures .Furthermore, the relatively low frequency of rare blood groups like AB- and A- necessitates targeted awareness campaigns to encourage donors with these types to register with blood donation programs. Since these rare types are harder to source during emergencies, proactive strategies are essential to avoid shortages.

CONCLUSION

In summary, the study demonstrates a clear predominance of Rh-positive individuals (84%) in the population, reflecting established global and regional trends. The gender-wise breakdown further reveals a slightly higher representation of females, especially in the Rh-negative category, which carries significant clinical importance for antenatal care. Regarding ABO distribution, B+ and O+ emerged as the most common blood groups, while AB- and A- were found to be the least prevalent.

These findings have substantial implications for public health planning, particularly in blood transfusion services, maternal health programs, and emergency medical care. Blood banks must prioritize the availability of the most common blood types while also developing systems to locate and retain rare blood type donors. Additionally, the study emphasizes the importance of continued surveillance of blood

group distribution across different demographics, contributing to improved medical readiness and resource allocation.

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