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BLOOD GROUP FREQUENCY DISPARITIES BETWEEN PATIENTS AND HEALTHY BLOOD DONORS IN A TERTIARY CARE HOSPITAL: MYTH OR REALITY?

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ABSTRACT:
ABO blood groups have been linked to various diseases, influenced by both environmental factors and genetics. Aim of this study was to investigate significant disparities in blood group frequencies between patients and healthy blood donors and to explore the underlying reasons for these differences. This cross-sectional retrospective study was done for a period of two years at a tertiary care centre in eastern India on patients and healthy blood donors. ABO and RhD blood groups were determined using column agglutination technique for blood donors and conventional test-tube technique for patients. Z-score was calculated to compare the two populations on the basis of blood groups. Chi-square test for independence was calculated to correlate the presence of A and B antigens with disease status of the populations. A p-value of <0.05 was considered statistically significant. Out of 75,817 participants, 31,586 (41.66%) were blood donors and 44,231 (58.34%) were patients. Most common blood group among both populations was B (blood donors=36.45%, patients= 37.64%), least common was AB (blood donors=8.88%, patients= 7.76%). Frequencies of all blood groups were almost similar in both populations. Correlation between RhD blood group and disease status of the populations was statistically significant. Result of comparison between only A antigen with only B antigen and the populations was statistically significant so was the presence of RhD antigen. Frequencies of blood groups and their associations with diseases in tertiary healthcare settings are vital for guiding clinical assessments and interventions, and optimizing blood stock management through targeted donor recruitment strategies.

KEY WORDS: ABO, Blood group frequencies, Healthy blood donors, Patients, RhD

INTRODUCTION:

Blood groups are categorized based on the presence or absence of specific antigens on the surface of red blood cells. [1] Studies on blood group distribution within a population or region are crucial for several reasons, including optimizing blood transfusion services, improving organ transplantation outcomes, and aiding in forensic and legal cases. Additionally, certain diseases show a higher prevalence among individuals with specific blood types, making this information vital for targeted healthcare strategies.

Since the discovery of the ABO blood group system, numerous studies have explored the relationship between different ABO blood types and a variety of diseases. [2]

Blood groups have a genetic basis, which is why certain diseases are more prevalent among specific blood types. For instance, ischemic heart disease is more common in individuals with blood group A, while ovarian cancer is more frequently observed in those with blood group B. [3,4] Gastric ulcers tend to be more common in people with blood group O. [5] Interestingly, individuals with blood group O also have a lower risk of developing squamous cell carcinoma and basal cell carcinoma. [6]

It has been observed that the distribution of blood groups among individuals with certain diseases varies significantly. This variation may be attributed to the presence of ABO antigens, which are found in blood groups A, B, and AB but are absent in group O, or due to genetic differences at the ABO locus. [7-9] Environmental factors and host genetics also play a crucial role in the development of these diseases. Therefore, studies on blood group frequency distribution are valuable tools for understanding the prevalence of specific diseases in different regions, contributing to more effective clinical research and public health strategies.

On the other hand, blood donor demographics might be shaped by factors such as community awareness, outreach programs, and inherent willingness to donate, which may not necessarily reflect the general population's blood group distribution.

There has been ongoing debate about whether the observed differences in blood group frequencies between patients and blood donors are merely coincidental or indicative of a deeper, systemic pattern. This study aims to investigate the blood group frequencies among patients and blood donors in a tertiary care hospital, examining whether significant disparities exist and exploring the underlying reasons for any observed differences. By providing a detailed analysis, we hope to contribute to the ongoing discourse on this subject, offering insights that can improve blood bank management and enhance patient care in tertiary healthcare settings.

MATERIALS AND METHODS:

1.1 Study setting and design: This was a cross sectional retrospective observational study conducted at the Department of Transfusion Medicine and Blood Bank of an apex tertiary care centre in Eastern India for a period of 24 months, from January 2022 to December 2023. Study population was divided into two groups:

1.1.1 Healthy blood donors: This group included the whole blood donors of A, B, O and AB blood groups screened according to Standards of Blood banking and Drug and Cosmetics act 1940. [10,11] Those donors who were positive for transfusion transmitted infections (HIV 1 and 2, HBV, HCV, Syphilis and Malaria) and positive indirect antiglobulin test (IAT) were excluded from the study

1.1.2 Patients: This group included all the patients whose blood group testing was performed in the central laboratory of our tertiary care centre.

1.2 Sample collection:

1.2.1. Healthy blood donors: Blood collected in pilot tubes (from diversion pouch) during blood donation was used for the testing. No extra blood sample was collected from the donors.

1.2.2. Patients: Blood sample collection was done according the central laboratory's standard operating procedures (SOP) in EDTA vacutainers.

1.3 Immunohematology:

1.3.1. Healthy Blood Donors: 1% red cell suspension was prepared in low ionic strength solution (LISS). For determination of blood group, forward and reverse group was performed on ABO gel cards (BIORAD). IAT was performed on each donor sample. All these procedures were performed by column agglutination technique (CAT) and according to manufacturer's instructions.

1.3.2. Patients: 5% red cell suspension was prepared in 0.9% normal saline. For determination of blood group, forward and reverse group was performed by conventional test tube technique (CTT). In case of any ABO discrepancy, the particular blood sample was sent to the blood centre for resolving the discrepancy.

Ethical approval:

All the participants who gave consent to participate in the present study were included. The study was approved by the institutional review board (IRB) and the institutional ethics committee (IEC) [AIIMS/Pat/IEC/2022/1096].

Statistical analysis:

Data was entered in an MS excel sheet. Numerical values and percentages were calculated. Statistical analysis was performed using SPSS software (Version 25.0.0.0, Chicago, USA). To compare the two study populations on the basis of different ABO and RhD blood groups, z-score was calculated. To find out the correlation between the presence or absence of blood group antigens and the two study populations, chi-square test was performed. In both the cases, p-value was also calculated. P-value of less than 0.05 was considered as statistically significant.

RESULTS:

A total of 75,817 participants were included in the study of which 31,586 (41.66%) were healthy blood donors and 44,231 (58.34%) were patients. 61,026 (80.5%) were males while 14,791 (19.5%) were females. Majority of participants belonged to age group of under 30 years. Demographic characteristics of the participants has been shown in table 1.

As illustrated in figure 1, B [28,161 (37.1%)] was the most common while AB [6,238 (8.2%)] was the least common ABO blood group (figure 1[a]). RhD antigen was present in 72,670 (95.8%) of the participants (figure 1[b]).

z-score was calculated to compare both the healthy blood donor and patient populations on the basis of different ABO and RhD blood groups. The association was found to be not clinically significant for A ($p=0.2891$), B ($p=0.5028$), O ($p=0.4532$) and AB ($p=0.3841$) blood groups. However, a clinically significant association was found for RhD blood groups ($p=<0.00001$). the association has been illustrated in table 2.

In order to find out an association between presence or absence of A and B antigens with the two populations, chi-square test for independence was calculated which has been shown in table 3.

There was no significant association between the presence or absence of either A ($p=0.1866$) or B ($p=0.6956$) or both A and B ($p=0.4509$) antigens with the populations. However, when presence of only A antigen was compared with the presence of only B antigens, the association was clinically significant ($p=0.0255$). Similarly, the presence and absence of RhD antigens had clinically significant association with the study populations ($p<0.00001$).

DISCUSSION:

In the context of a tertiary care hospital, which typically serves as a referral centre for specialized medical care, the comparison of blood group frequencies between patients and blood donors becomes particularly relevant. These hospitals often cater to a diverse patient population with varied medical needs, necessitating a well-stocked blood bank that can meet urgent and specific blood type requirements.

Gender distribution in healthcare access in India and many developing countries often reveals significant disparities. Kapoor et al in their study in four different cities in India for a period of one year found out that overall male to female ratio was 1.69 and for Bihar was 2.37. [12] The present study had somewhat similar observation with gender ratio as 2.12 (table 1). They excluded the obstetrics and gynaecology patients, but our study included those patients. However, blood donor gender ratio in our study was found to be 71.29 (table 1) which was nearly comparable to an observation of 72.67 by Agnihotri et al. [13]

Analysing the blood group distribution in this setting can highlight potential mismatches between supply and demand, guiding efforts to recruit donors with underrepresented blood types.

ABO and RhD blood group distribution among patients in India has not been studied much as compared to whole blood donors. On patients with hemoglobinopathies screened at a tertiary care centre in eastern part of India, Mondal et al observed the most common blood group to be O (35.8%) followed by B (34.87%) and A (22.65%) while the least common blood group was AB (6.68%) with RhD frequency of 97.7%. [14] Our study had the observation of most common blood group as B (37.64%), followed by O (34.31%), A (20.29%) and AB (7.76%) (figure 1[a]) while RhD frequency was 96.65% (figure 1[b]).

Previous studies have shown the distribution of ABO and RhD blood groups among blood donors from overall India and observed the frequencies of A, B, O, AB and RhD as 23.16%, 34.1%, 34.56%, 8.18% and 95.77% respectively. [15,16] Our study had the similar observations as frequencies of A, B, O, AB and RhD blood groups were 21.61%, 36.45%, 33.05%, 8.88% and 94.73% respectively (figure 1[a] and [b]). This observation suggests that the frequencies of ABO and RhD blood group are almost similar in both blood donor and patient population.

To examine the relationship between blood groups and health status in the studied populations, z-scores were calculated. The p-values for blood groups A, B, AB, and O (table 2) revealed no significant differences between healthy blood donors and patients. This suggests that the ABO blood group likely does not play a significant role in determining disease status within this population. However, a very low p-value (<0.0001) for the RhD blood group indicates a strong and statistically significant association between RhD status and disease status (table 2). This finding suggests that RhD positivity or negativity may significantly influence health outcomes, potentially affecting susceptibility to certain diseases or conditions.

In order to investigate the relationship between blood group antigens (A and B) and disease status, a chi-square test for independence was conducted. The results showed no statistically significant association between the presence or absence of both A and B antigens and the populations studied (table 3). However, when comparing the presence of only A or only B antigen, the result was statistically significant (table 3). This suggests that one antigen may present a different level of disease risk compared to the other. Additionally, the comparison of RhD antigen presence or absence was also statistically significant (table 3), indicating that RhD status could be an important factor in health outcomes. This warrants further investigation and may have clinical relevance in assessments or interventions.

A key strength of the study was its robust sample size. However, a limitation was the inability to correlate blood groups with specific diseases, as has been done in previous studies, to identify potential changes in historical trends suggesting such relationships.

Tables:

Table 1. Participants' Demographics

Gender		
	Healthy Blood Donor[n (%)]	**Patient [n (%)]**
Male	30958 (98.02%)	30068 (67.98%)
Female	628 (1.98%)	14163 (32.02%)
Total	31586	44231
Age Group		
	Healthy Blood Donor [n (%)]	**Patient [n (%)]**

0-17 Years	0 (0%)	12442 (28.13%)
18-30 years	19416 (61.47%)	8223 (18.59%)
31-59 Years	12142 (38.44%)	16635 (37.61%)
≥ 60 Years	28 (0.09%)	6931 (15.67%)
Total	31586	44231

Table 2: Comparison between Healthy Blood Donors and Patients according To ABO and RhD Blood Groups

Blood Group	z-score	p-value
A	1.0599	0.2891
B	-0.675	0.5028
O	-0.7539	0.4532
AB	0.8671	0.3843
RhD	-13.0718	<0.00001

Table 3: Comparison between Healthy Blood Donors and Patients according to presence or absence of ABO and RhD antigens

Blood group Antigen	Chi-square	p-Value
A+B+AB/O	0.5684	0.4509
A+AB/O	1.7439	0.1866
B+AB/O	0.1531	0.6956
A+AB/B+AB	5.2027	0.0225
RhD Positive/RhD Negative	170.8714	<0.00001

Figures:

Figure1[a]: ABO Blood group of participants

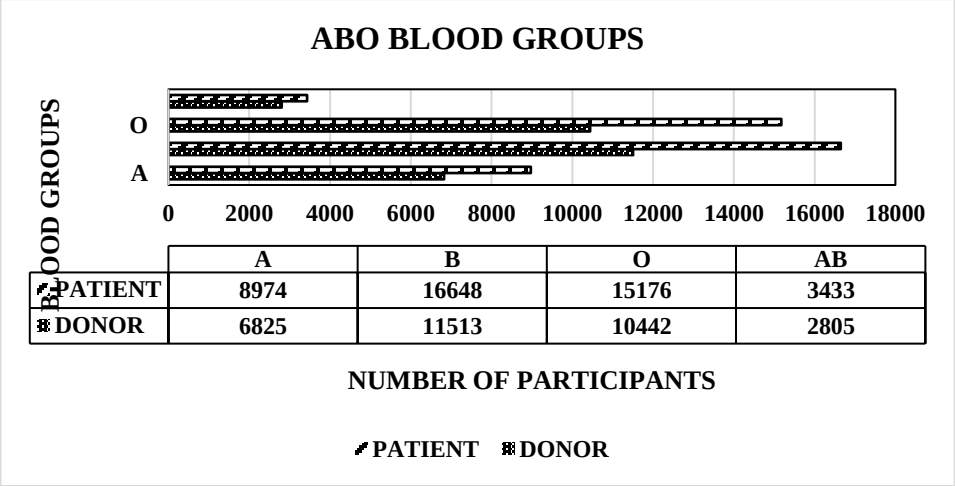
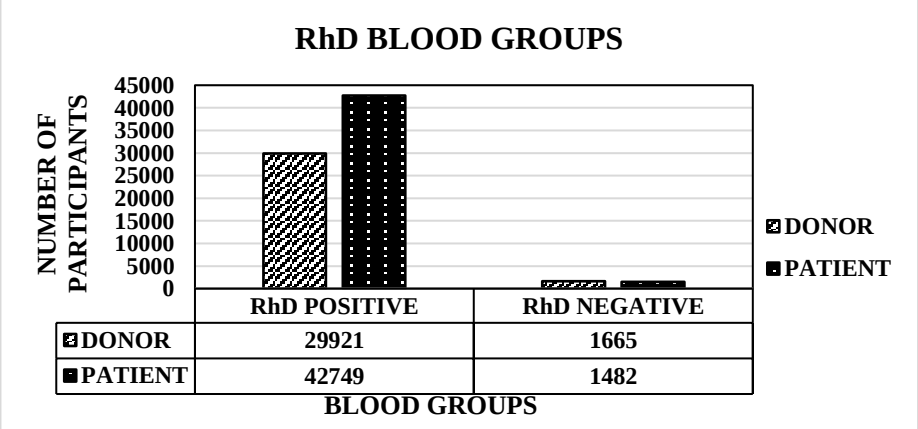


Figure 1[b]: RhD blood group of participants



CONCLUSION:

The study highlights several important findings related to the distribution of blood groups and their potential association with health status in a tertiary care hospital setting. RhD status, along with specific ABO antigens, should be further investigated for their potential impact on health outcomes. These findings could play a crucial role in shaping clinical assessments and interventions, while also informing strategies for managing blood bank supplies and recruiting donors with underrepresented blood types in hospital settings.

CONFLICTS OF INTEREST: None

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