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Research Article

Prevalence Of Elevated Abo Antibody Titres And Their Association With Donor Characteristics: Implications For Non Identical Abo Transfusion.

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Abstract: ***Background:*** Introduction: The ABO blood group system, discovered by Karl Landsteiner in 1901, remains the most significant blood group system in transfusion medicine due to its strong immunogenicity and widespread distribution in human populations. ***Aim:*** To assess the levels of anti-A and anti-B antibody titers and identify the most suitable donor profiles for safer non-identical ABO transfusions based on the antibody titer data. ***Methodology:*** This is a descriptive cross-sectional study that was conducted in 400, Group "ABO" blood donors in the Department of Immuno- Haematology and Transfusion Medicine, S.P. Medical College and Associated Group of P.B.M. Hospitals, Bikaner, fulfilling the laid down donor selection criteria from 1st December 2025 to 31st May 2026. ***Result:*** Group O donors had higher IgG anti-A and anti-B titres, while age, sex, Rh type, donor type and donation history were not reliable predictors of elevated IgM titres. CONCLUSION: Direct screening for high-titre ABO antibodies, particularly in group O donors, and locally validated cut-offs may improve transfusion safety when plasma-containing components are transfused across ABO barriers.

Keywords: ABO Isoagglutinins, High-Titre Antibodies, Transfusion Safety.

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INTRODUCTION

The ABO blood group system, discovered by Karl Landsteiner in 1901, remains the most significant blood group system in transfusion medicine due to its strong immunogenicity and widespread distribution in human populations. Blood components with a minimum amount of ABO-incompatible plasma or "low titre" Group O whole blood should be utilized in the absence of ABO-compatible blood products1.The measurement of anti-A and anti-B antibody titres is crucial for several reasons. However, with the evolution of transfusion medicine, attention has extended to ABO isoagglutinins due to their immediate clinical significance. High anti-A or anti-B titres are associated with increased risk of HTRs, which can manifest as haemolysis, renal failure, disseminated intravascular coagulation, or even death2,3. Levels of anti-A and anti-B antibodies appear to be influenced by environmental factors. Changes in the characteristics of these antibodies result from immunisation, pregnancy, or incompatible transfusions, especially in plasma incompatible platelet transfusions.

The possibility of a haemolytic reaction can be reduced by transfusion of Group O blood that has low titres of anti-A and anti-B, especially in immunized patients. The distribution and titres of anti-A and anti-B antibodies are known to vary among different populations and ethnic groups. Studies conducted in various regions of India and abroad have reported significant heterogeneity in antibody titres, influenced by genetic factors4, environmental exposures, infectious diseases, and nutritional status. Most existing studies have focused on ABO blood group distribution or Rh typing, with limited data on isoagglutinin titres and their clinical implications in this region.Understanding the regional variations in anti-A and anti-B titres is important for establishing safe transfusion practices, especially considering the increasing demand for blood components and plasma-based therapies5,6. It also aids in formulating protocols for donor screening, plasma donation, and managing transfusion reactions effectively.

While the importance of antibody titres is well recognized, standardisation of measurement techniques and establishment of cut-off levels remain challenging.7 In India, the absence of uniform guidelines for anti-A and anti-B titre screening in blood donors further complicates transfusion safety. The National Blood Transfusion Council (NBTC) recommends certain thresholds, but these are not mandatory and vary across centres.8 Consequently, there is a pressing need for region-specific studies that evaluate antibody titres, their distribution, and associated risk factors in local populations.There is no consensus on critical ABO antibody titres to guide transfusion and transplant decisions. To mitigate ABO incompatibilities, implementation of ABO titre measurement can favour a reduction in transfusion reactions in non-group O recipients.9 The specific objectives include determining the distribution of ABO blood groups within the donor population, measuring the titres of anti-A and anti-B antibodies in individual donors, analysing the correlation between these antibody titres and demographic variables such as age and gender, and establishing baseline data to inform and improve safe transfusion practices in the region.The need for this study stems from the

critical role that anti-A and anti-B agglutinin titres play in ensuring the safety and compatibility of blood transfusions, by estimating these titres among blood donors in Western Rajasthan, India.

AIM

To assess the levels of anti-A and anti-B antibody titers and identify the most suitable donor profiles for safer non-identical ABO transfusions based on the antibody titer data.

MATERIALS AND METHODS

This is a descriptive cross-sectional study that was conducted in 400, Group "ABO" blood donors in the Department of Immuno-Haematology and Transfusion Medicine, S.P. Medical College and Associated Group of P.B.M. Hospitals, Bikaner, fulfilling the laid down donor selection criteria from 1st December 2025 to 31st May 2026. Ethical Approval was obtained from the ethical committee of S.P. Medical College and Associated Group of P.B.M. Hospitals, Bikaner. The sample size was calculated based on a previous study40 that reported that, overall prevalence of ABO Anti-A and Anti-B Agglutinin Titers among Blood Donors in India 46% per 1000 populations. 95% level of confidence and Error rate set at 0.5 levels. The age group to be included in the study is 18–60 years.Inclusion criteria included Donors who fulfilled the eligibility criteria as per the Drugs and Cosmetics Act, 1940 and Rules, 194550 will be included in the study after getting the written informed consent.Exclusion criteria involved AB blood group donors, donors with irregular red cell antibodies, those reactive for HIV, Hepatitis B, Hepatitis C, malaria, and syphilis, and those who had not given consent were excluded from the study. Confidentiality: Donor confidentiality was maintained throughout the study, adhering to relevant guidelines for data protection and anonymity.

The sample size was calculated based on a previous study40 that reported that, overall prevalence of ABO Anti-A and Anti-B Agglutinin Titers among Blood Donors in India 46% per 1000 populations. 95% level of confidence and Error rate set at 0.5 levels.

$$n=Z2\ P(1-P)/d2$$

Where,
n = sample size,
Z = Z statistic for a level of confidence, for the level of confidence of 95%, which is conventional, Z value is 1.96.
P = expected prevalence or proportion (in proportion of one; if 46%, P = 0.46),
d = precision (in proportion of one; if 50%, d = 0.5).
n = 1.96 x 1.96 x 0.46 x (1 – 0.46)/0.52 n=382

Sampling Technique: Simple Random Sampling.

RESULTS

Table 1: Donor type and donation history distribution

Donor type	First-time n (%)	Repeat n (%)	Total n (%)
Replacement	20 (50.0)	20 (50.0)	40 (10.0)
Voluntary	183 (50.8)	177 (49.2)	360 (90.0)
Total	**203 (50.8)**	**197 (49.2)**	**400 (100.0)**

The donor population showed predominance of voluntary donors (360, 90.0%), while replacement donors constituted 40 (10.0%); first-time and repeat donors remained nearly balanced.

Table 2: Distribution of ABO blood groups across age and sex groups

Age group	A n (%)	B n (%)	O n (%)	Total n (%)
18-30	31 (19.3)	59 (36.6)	71 (44.1)	161 (40.2)
31-40	27 (22.9)	44 (37.3)	47 (39.8)	118 (29.5)
41-50	21 (25.0)	24 (28.6)	39 (46.4)	84 (21.0)
51-60	7 (18.9)	15 (40.5)	15 (40.5)	37 (9.2)
Total	**86 (21.5)**	**142 (35.5)**	**172 (43.0)**	**400 (100.0)**
Sex	**A n (%)**	**B n (%)**	**O n (%)**	**Total n (%)**
Female	10 (27.8)	13 (36.1)	13 (36.1)	36 (9.0)
Male	76 (20.9)	129 (35.4)	159 (43.7)	364 (91.0)
Total	**86 (21.5)**	**142 (35.5)**	**172 (43.0)**	**400 (100.0)**

Blood group O was the most common group in every age category.
The male predominance was observed across all ABO groups.

Table 3: Distribution of Rh type across age groups and sex

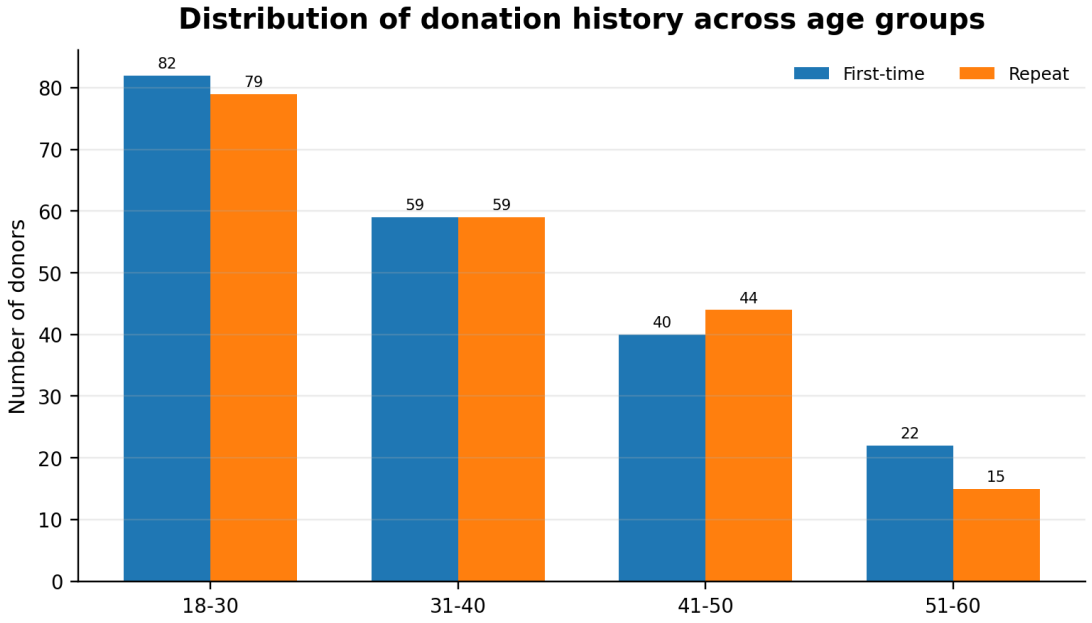
Age group	Rh Negative n (%)	Rh Positive n (%)	Total n (%)
18-30	9 (5.6)	152 (94.4)	161 (40.2)
31-40	5 (4.2)	113 (95.8)	118 (29.5)
41-50	5 (6.0)	79 (94.0)	84 (21.0)
51-60	3 (8.1)	34 (91.9)	37 (9.2)
Total	**22 (5.5)**	**378 (94.5)**	**400 (100.0)**
SEX	**Rh Negative n (%)**	**Rh Positive n (%)**	**Total n (%)**
Female	2 (5.6)	34 (94.4)	36 (9.0)
Male	20 (5.5)	344 (94.5)	364 (91.0)
Total	**22 (5.5)**	**378 (94.5)**	**400 (100.0)**

Rh-positive donors predominated in every age group.
Rh-positive status was almost equally predominant among males and females.

Table 4:Distribution of donor type across age groups and sex

Age group	First-time n (%)	Repeat n (%)	Total n (%)
18-30	82 (50.9)	79 (49.1)	161 (40.2)
31-40	59 (50.0)	59 (50.0)	118 (29.5)
41-50	40 (47.6)	44 (52.4)	84 (21.0)
51-60	22 (59.5)	15 (40.5)	37 (9.2)
Total	**203 (50.8)**	**197 (49.2)**	**400 (100.0)**
Sex	**Replacement n (%)**	**Voluntary n (%)**	**Total n (%)**
Female	4 (11.1)	32 (88.9)	36 (9.0)
Male	36 (9.9)	328 (90.1)	364 (91.0)
Total	**40 (10.0)**	**360 (90.0)**	**400 (100.0)**

Voluntary donors predominated across all age groups, while replacement donors constituted approximately 10% within each age group. Voluntary donors predominated among both males and females, while replacement donors constituted approximately 10% in each sex category.



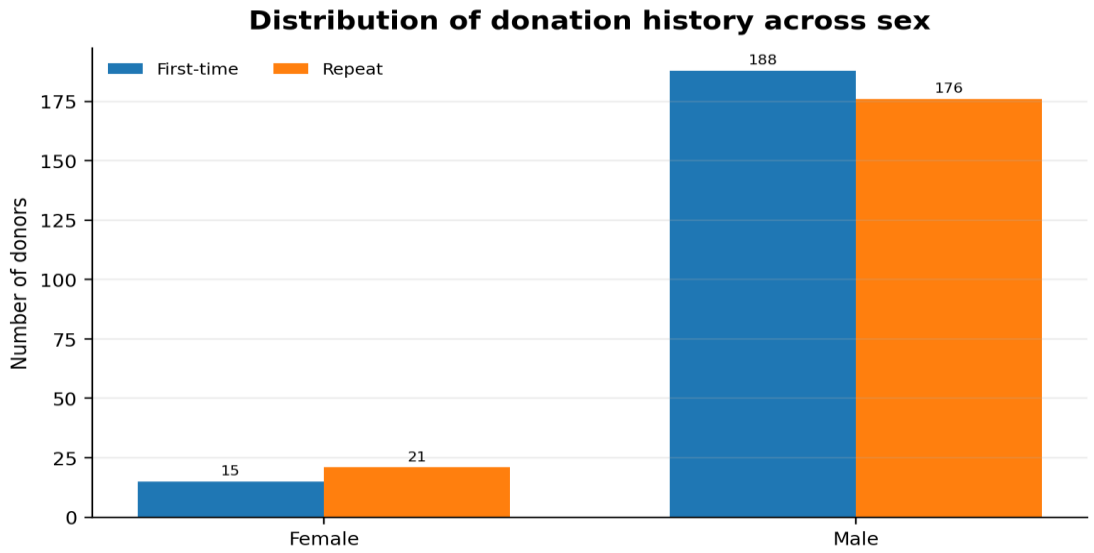


Figure 1,2: Distribution of donation history across age groups and sex

First-time and repeat donations were nearly balanced across the study population
First-time donation was slightly more common among males, while repeat donation was proportionately higher among females.

Table 5: Cross-tabulation of blood group and donor type

Blood group	Replacement n (%)	Voluntary n (%)	Total n (%)
A	9 (10.5)	77 (89.5)	86 (21.5)
B	14 (9.9)	128 (90.1)	142 (35.5)
O	17 (9.9)	155 (90.1)	172 (43.0)
Total	**40 (10.0)**	**360 (90.0)**	**400 (100.0)**

Voluntary donation predominated across A, B, and O blood groups, while replacement donors constituted approximately 10% within each ABO group.

Table 6: Cross-tabulation of blood group and donation history

Blood group	First-time n (%)	Repeat n (%)	Total n (%)
A	44 (51.2)	42 (48.8)	86 (21.5)
B	73 (51.4)	69 (48.6)	142 (35.5)
O	86 (50.0)	86 (50.0)	172 (43.0)
Total	**203 (50.8)**	**197 (49.2)**	**400 (100.0)**

Donation history showed a near-even distribution within each ABO blood group.

Table 7: Prevalence of elevated Anti-A and Anti-B titres

Antibody type	Elevated titre cut-off	Frequency	Percentage (%)
Anti-A IgM	>=64	63/314	20.1
Anti-A IgG	>=128	107/314	34.1
Anti-B IgM	>=64	16/258	6.2
Anti-B IgG	>=128	96/258	37.2
Any elevated titre	IgM >=64 or IgG >=128	182/400	45.5

Elevated titre was defined as IgM >=64 and IgG >=128 for descriptive analysis.
Overall, 182 of 400 donors (45.5%) had at least one elevated Anti-A or Anti-B titre according to the defined cut-off.

Table8: Elevated titre profile among group O donors

Pattern	Cut-off	Frequency	Percentage of group O (%)
Anti-A IgM	>=64	35/172	20.3
Anti-A IgG	>=128	106/172	61.6
Anti-B IgM	>=64	6/172	3.5
Anti-B IgG	>=128	96/172	55.8
Any elevated titre in group O	IgM >=64 or IgG >=128	143/172	83.1
No elevated titre in group O	-	29/172	16.9

The denominator for each antibody is the number of group O donors with available titre data; total group O donors n=172. Among group O donors, any elevated titre was observed in 143 of 172 donors (83.1%). Elevated IgG titres were more frequent than elevated IgM titres in group O donors.

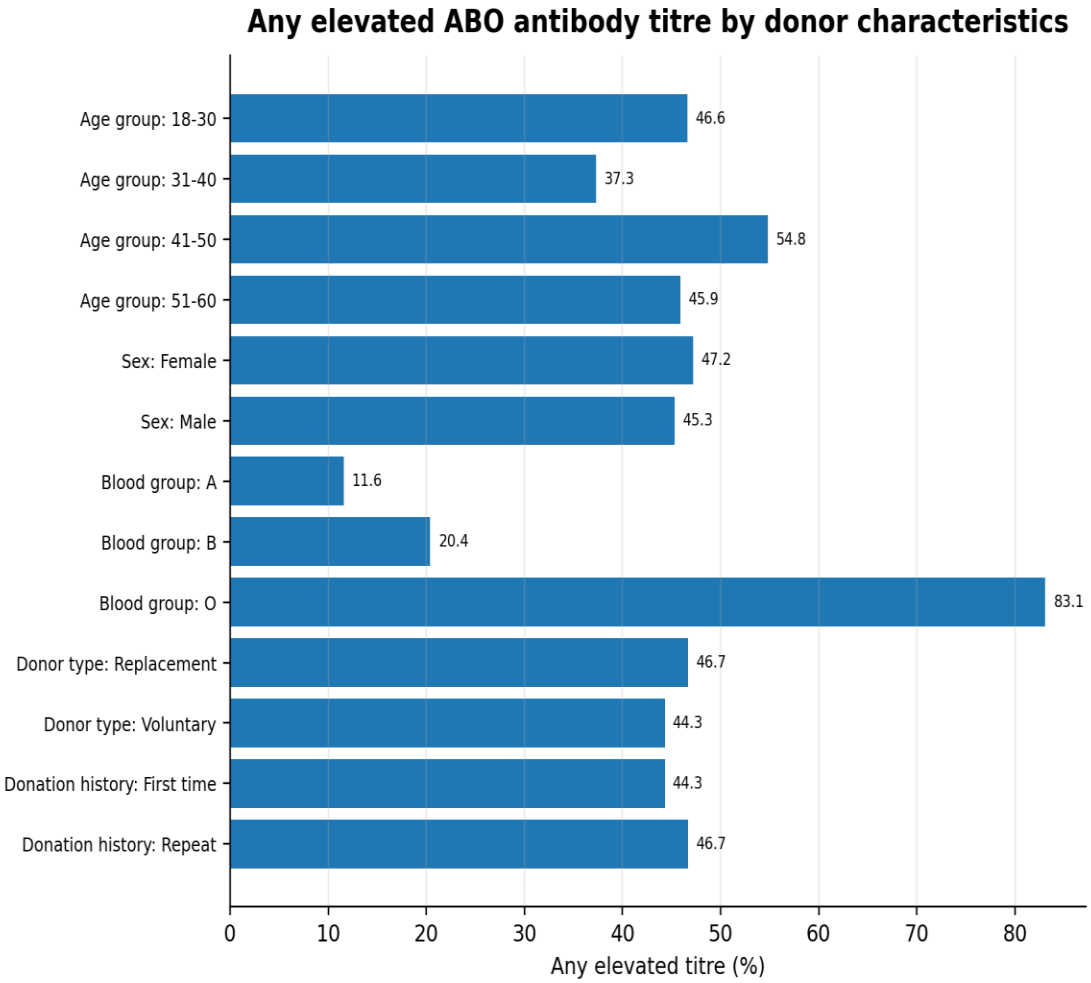


Figure 3: Association of donor characteristics with any elevated ABO antibody titre

Chi-square test was used. Any elevated titre was defined as Anti-A/Anti-B IgM >=64 or Anti-A/Anti-B IgG >=128.
Blood group showed a statistically significant association with elevated titre status ($p<0.001$), mainly due to the high prevalence of elevated IgG titres among group O donors. Age, sex, donor type and donation history were not significantly associated with any elevated titre.

DISCUSSION

The present study evaluated anti-A and anti-B IgM and IgG agglutinin titres among 400 blood donors at a tertiary care blood centre in Western Rajasthan. The present study assessed the demographic profile, ABO/Rh distribution, donor profile, blood-group-wise antibody titres, elevated-titre burden and correlation between anti-A and anti-B titres in ABO blood group donors. The principal findings were predominance of group O donors, lower IgM elevated-titre frequency than many tube-based reports, substantially higher IgG anti-A and anti-B titres among group O donors, and a significant positive correlation between group O anti-A and anti-B IgM titres. These findings are important because group O components may be used across the ABO barrier in urgent transfusion settings, where passively transfused isoagglutinins can cause hemolysis.

No statistically significant association was observed between age category and elevated IgM titre in group A, group B or group O donors. This differs from Ravikanth et al.10, Tendulkar et al.11 and França et al12., who reported higher titres in younger donors or lower titres in older donors. In the present study, younger donors contributed more elevated-titre cases mainly because they were the largest donor group, not because age independently predicted titre elevation.

Sex, Rh type, donor type and donation history did not reliably identify elevated-titre donors. Thus, demographic selection cannot replace direct antibody testing when group O plasma-containing components are intended for ABO non-identical transfusion. The findings are relevant for transfusion of group O whole blood, platelet concentrates and other plasma-containing components to non-O recipients. Passive transfusion of ABO-incompatible plasma may cause haemolysis when donor antibodies are high. Screening plateletpheresis or group O donors for high-titre ABO antibodies has been proposed as a practical risk-reduction strategy.

An institutional strategy may include maintaining a low-titre donor registry, preferentially issuing ABO-identical platelets, and using tested low-titre group O components when ABO-identical products are unavailable. Since the present method is NEO Iris microplate/SPRCA, local validation of titre cut-offs is necessary before adopting thresholds from tube-based literature.13,14,15 The present findings were compared with Indian and international studies evaluating ABO isoagglutinin titres. Because study populations, laboratory methods and definitions of high titre differ, the comparison is descriptive rather than a direct equivalence between methods.16,17

The present study reproduces the broad pattern reported in the JCDR article and other reports: group O donors often show a higher immunohaematological risk profile, elevated anti-A tends to be more common than elevated anti-B in group O donors, and group B donors may show higher anti-A than group A donors show anti-B. However, the absolute prevalence of elevated IgM titres was lower in the present study than in several published reports. This may reflect regional factors and method-related differences18.

The lack of a significant age association in the present study differs from Tendulkar et al11. and França et al12., but supports the practical conclusion that age alone should not be used as a surrogate for low-titre status. The separate SPRCA-based IgG analysis is a distinctive addition and highlights a risk domain not captured in IgM-only screening studies.

CONCLUSION

The study demonstrates that group O donors in Western Rajasthan have a substantial burden of elevated ABO agglutinin titres, particularly IgG anti-A and IgG anti-B. IgM titres were generally low to moderate, but IgG titres among group O donors were markedly higher than those in corresponding non-O groups.A method-specific institutional low-titre donor registry, especially for group O donors, may improve transfusion safety during platelet, plasma and whole-blood transfusion across ABO barriers.

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