

A Retrospective Cross-Sectional Study to Analyze ABO & Rh Blood Group Distribution Among Blood Donors, Issued Units and Seasonal Trends of Blood Donations at A Tertiary Care Hospital of Northern India

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Abstract

Background and Aim: Blood transfusion service is one of the essential components of health care system. Due to higher immunogenicity ABO and Rh blood group system are clinically significant. The aim of this study to determine the frequency of ABO and Rh blood groups among blood donors, fractions of issued units according to the blood groups and month-wise and blood group wise trend of blood donation.

Material and Method: This study was conducted at a blood bank of medical college & hospital in north India, over a period of 6 years from January 2016 to December 2021. Blood group of the blood donors was determined by commercially available standard monoclonal antisera by test tube agglutination technique accompanied by reverse grouping.

Results: Total 8656 donations occurred with mean of 1462.67 ± 395.05 during the six-years period from January 2016 to December 2021. Female donors were 183 (2.11%) and 8473 (97.88%) were males. Maximum donations and blood units were issued in September and minimum in January. The Rhesus (D) positive and Rhesus (D) negative blood donors was 94.82 and 5.18% respectively. The donors of blood group B (35.90%) are highest in number followed by donors of blood group O (33.07%), A (20.93%), and AB (10.08%).

Conclusions: This study is useful to identify the various reasons of deficiency of a particular group in a particular area and helpful in the preparedness and policy making for the improvement of blood transfusion services.

Keywords: Blood bank, ABO, Rhesus, Blood donations, Issued units.

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Introduction

In 1900 Austrian scientist Karl Landsteiner was recognized the antigens on the surface of the red blood cells and classified blood into A, B and C (later change to O) blood group.[1] After two years of this discovery in 1902 Alfred Von Decastello and Adrian Sturli discovered the fourth type - AB blood group. [2-4] Later in 1940 Landsteiner and Weiner also discovered Rhesus (D) antigen on red blood cells.[5-8] Identification of antigens on the surface of red cell was a major revolution in the history of transfusion medicine and it enlightened the path of endless possibilities in the area of Immunohematology.

Over a period of time multiple research works have been conducted out to identify the various antigens and their subgroup over red blood cells. On the bases of the reactivity of red cells with anti-A and anti-AB antibody, blood group A have been further classified as A1, A2, Aint, A3, Ax, Am, Aend, Ael, and Abantu. Red cells of blood group A agglutinated with both anti-A and anti-A1 antibody are classified as A1 whereas group A cells which react with anti-A antibody and not agglutinated with anti-A1 antibody are designated as A2. Among blood group A population A1 constitutes approximately 80% and remaining 20% is A2 blood group.[9] The occurrence of subgroups of blood group B in general population is very rare and four subgroups namely B3, Bx, Bm, and Bh have been identified.[10]

The International Society of Blood Transfusion (ISBT) Working Party for Red Cell Immunogenetics and Blood Group Terminology (ISBT WP) maintains the official record of all presently identified blood group system. Till date (June 2021) 43 blood group system have been identified which containing 345 red cell antigens. These 43 blood group system are genetically determined by 48 genes.[11] In clinical practices the utmost important blood group

system are ABO and Rhesus system, due to their higher immunogenicity than other blood group system. The antigens of ABO blood group system are under the control of three allelic genes, A, B and O and situated on the long arm of chromosome 9q.[12] In Rhesus blood group system, the presence or absence of D antigen on red cells determined by three pairs of closely linked allelic genes located on chromosome 1 and Rh-positive individuals have D antigen on the surface of red cell and Rh-negative individuals lack D antigen on red cells.[3]

ABO and Rhesus blood group antigens are present in whole population but the frequencies and distributions of specific type of blood group differ in different traces, ethnic groups amongst different populations.[13, 14] The knowledge of distribution of ABO and Rhesus (Rh) bloodgroup in local population is essential for effective management of blood bank inventory.[15] Our study reports the distribution of ABO and Rhesus blood groups among blood donors and month-wise requirement of different blood groups at a tertiary care hospital of northern India.

Materials and Methods

It was a retrospective cross-sectional study carried out at blood bank of 740 bedded medical college & hospital in north India after getting approval from Institutional Ethics Committee. Year-wise and month-wise data from January 2016 to December 2021 of all voluntary and replacement donations and issued units were collected from blood bank database.

During this study period 8656 individuals were considered medically fit as per NACO (NBTC) guidelines for blood donation.[16] The blood groups of the donated blood were determined by forward (cell grouping) and reverse (serum grouping) blood grouping using test tube agglutination method. Rh-ve

blood groups were confirmed by antiglobulin test (Du Test) and all Du positive blood were considered as Rh+ve blood group.

Data pertaining to year-wise and month-wise number of donations (both voluntary and replacement), number of issued units, ABO blood groups and Rh Blood Groups were collected from the institutional blood bank records.

Collected data was analyzed by using SPSS (version 16.0.1 of IBM, USA) and MS Excel.

Results

Total 8656 donations occurred with mean of 1462.67 ± 395.05 over the period of six years from January 2016 to December 2021 either at blood bank or at blood camps organized by

institutional blood bank at various places. Among all donors, 183 (2.11%) were females and 8473 (97.88%) were males. A total of 1995 (23.04%) were voluntary donors, out of which 98 (4.91%) were females and 1897 (95.08%) were males. Remaining 6661 (76.95%) were replacement donors comprising of 85 (1.27%) females and 6576 (98.72%) males. (Table-1) During the study period 11224 units of blood/blood product were issued with mean of 1870.67 ± 552.09 . Maximum number 1851 blood donations and 2622 units of blood and blood products were issued in year 2019 and minimum donations and issuing of blood/blood products were in 2020 that was 850 and 1173 units respectively. (Table-2)

Table 1: Yearly frequencies of voluntary and replacement donations

Years	Voluntary Donation		Replacement donations		TOTAL
	Male	Female	Male	Female	
2016	259	21	653	18	951
2017	533	38	1101	19	1691
2018	359	13	1367	26	1765
2019	301	22	1508	20	1851
2020	122	2	725	1	850
2021	323	2	1222	1	1548
TOTAL	1897	98	6576	85	8656

Table 2: Year-wise distribution of Blood donors and Issued Units

Years	Donation	Issued Units
2016	951	1105
2017	1691	2017
2018	1765	2083
2019	1851	2622
2020	850	1173
2021	1548	2224
Total	8656	11224

Month-wise distribution of blood donations and issued units revealed that highest number of blood donations and issuing of blood units were in the month of September and minimum in January. A total 1139 (13.16%) and 447 (5.16%) donations occurred in the

month of September and January respectively (p value 0.0039). The issued blood units in September 1580 (14.07%) were much higher than issued units 553 (4.92%) in month of January (p value 0.0024). (Figure-1).

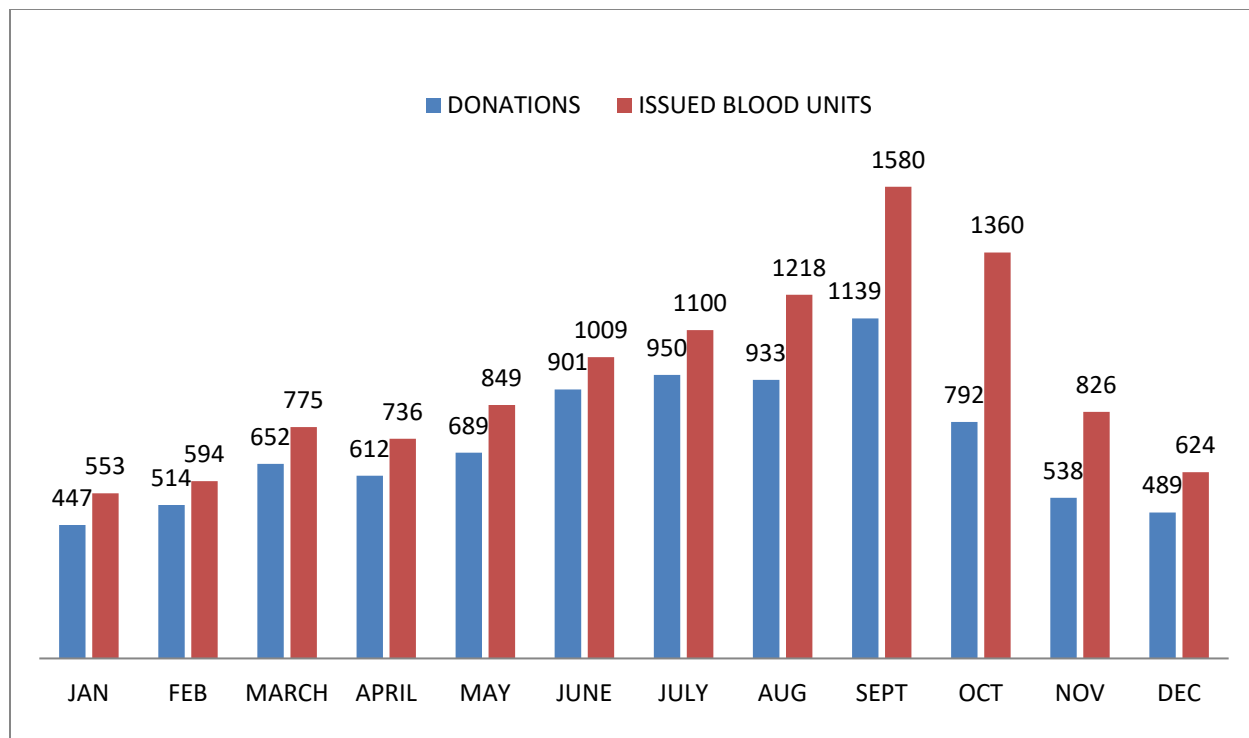


Figure 1: Month-wise frequency of blood donors and issued units

Table 3: Month-wise distribution of ABO and Rh phenotype among Blood donors

Month	DONATIONS								Total Month-wise donations
	Rh positive				Rh Negative				
	A	B	AB	O	A-	B-	AB-	O-	
January	79	161	38	155	2	4	1	7	447
February	88	210	42	146	6	13	2	7	514
March	127	234	64	190	5	14	1	17	652
April	120	210	71	178	4	14	1	14	612
May	152	225	69	203	5	15	4	16	689
June	179	263	93	329	4	17	4	12	901
July	179	369	76	276	11	16	6	17	950
August	184	305	98	300	8	15	2	21	933
September	225	385	112	349	18	19	9	22	1139
October	192	251	91	223	5	18	1	11	792
November	104	175	48	182	4	13	1	11	538
December	109	153	35	161	2	9	4	16	489
Total blood group-wise donations	1738 (20.0 7%)	2941 (33.9 8%)	837 (9.6 7%)	2692 (31.1 0%)	74 (0.8 5%)	167 (1.9 3%)	36 (0.4 1%)	171 (1.9 7%)	8656
Rh blood groups	8208(94.82%)				448(5.18%)				

Table 4: Month-wise distribution of ABO and Rh phenotype in Issued units

Month	ISSUED BLOOD UNITS								Total Month-wise donations
	Rh positive				Rh Negative				
	A	B	AB	O	A-	B-	AB-	O-	
January	140	211	65	121	2	7	1	6	553
February	129	234	34	166	8	12	2	9	594
March	157	306	83	183	13	15	1	17	775
April	150	270	89	186	5	14	7	15	736
May	213	299	91	214	5	13	4	10	849
June	240	335	93	297	8	22	4	10	1009
July	224	401	105	327	12	15	6	10	1100
August	271	466	132	302	6	13	2	26	1218
September	332	541	149	491	20	19	7	21	1580
October	284	523	117	373	8	26	4	25	1360
November	178	272	72	271	7	15	3	8	826
December	161	194	34	194	6	14	4	17	624
Total blood group-wise donations	2479 (22.1 0%)	4052 (36.1 0%)	1064 (9.48 %)	3125 (27.8 4%)	100 (0.89 %)	185 (1.65 %)	45 (0.40 %)	174 (1.55 %)	11224
Rh blood groups	10720(95.50%)				504(4.49%)				

Table 5: Sex distribution among blood donors in different studies

		Male donors (%)	Female donors (%)
Studies conducted in India	Present study	97.88	2.11
	Uttarakhand [18]	99.71	0.23
	Western Ahmedabad [17]	95.05	4.95
	AIIMS, New Delhi [19]	87.4	12.6
	Maharashtra (Loni) [20]	95.75	4.25
	Haryana [21]	94.79	5.21
	Hyderabad [21]	97.73	2.27
Studies conducted in Developing countries	Nigeria [22]	90.1	9.9
	Ghana [23]	90	10
	Burkina Faso [21]	71.2	28.8
	Togo [21]	70	30
	Iran [21]	95	5
Studies conducted in Developed countries	Great Britain [21]	45	55
	Spain [25]	50.3	49.7
	USA [24]	54.5	45.5
	Finland [24]	45	55
	Belgium [24]	54.6	45.4
	Netherlands [24]	50	50
France [24]	50	50	

Table 1: Distribution of ABO and Rh blood groups in different studies

	Study location	A	B	AB	O	Rhesus positive	Rhesus negative
Northern India	Present study (Bareilly)	20.93	35.90	10.08	33.07	94.82	5.18
	Kumaon, Uttarakhand [18]	28.70	32.07	10.53	28.70	94.49	5.51
	Lucknow [21]	21.73	39.84	9.33	29.10	95.71	4.29
	Amritsar [21]	18.01	38.06	9.62	34.31	91.28	8.72
	Jodhpur [3]	22.2	36.4	9.4	31.7	91.75	8.25
	Haryana [27]	22.90	38.83	9.54	28.70	90.72	9.28
Western India	Western Ahmedabad [17]	21.94	39.40	7.86	30.79	95.05	4.95
	Eastern Ahmedabad [28]	23.30	35.50	8.80	32.50	94.20	5.80
	Maharashtra (Loni)[20]	28.38	31.89	8.72	30.99	95.36	4.64
Eastern India	Durgapur [21]	23.90	33.60	7.70	34.80	94.70	5.30
	Ranchi [21]	22.09	35.15	8.03	34.73	96.46	3.54
Southern India	Shimoga-Malnad[30]	24.27	29.43	7.13	39.17	94.93	5.07
	Bengaluru [31]	23.85	29.95	6.37	39.82	94.2	5.8
	Chittoor [17]	18.95	25.79	7.89	47.37	90.6	8.42
	Vellore [32]	18.85	32.69	5.27	38.75	94.5	5.47
Other countries	Pakistan (Swat)[29]	27.92	32.40	10.58	29.10	90.13	9.87
	Nepal [14]	34	29	4	33	96.7	3.3
	Britain [24]	42	8	3	47	83	17
	USA [7]	41	9	4	46	85	15
	Nigeria [35]	21.60	21.40	2.80	54.20	95.20	4.80
	Iran [33]	45	11	4	40	92.40	7.60

The fraction of Rhesus (D) positive and Rhesus (D) negative blood donors were 94.82 and 5.18% respectively (p value-0.0035). In Rhesus positive blood donations, the blood group B (33.98%) donors were highest in number followed by blood group O (31.10%), A (20.07%) and AB (9.67%) donors, while in Rhesus negative blood donations, the donors of blood group O(1.97%) were maximum in number followed by blood group B(1.93%), A (0.85%) and AB (0.41%) donors.(Table-3) The commonness of blood group B (35.90%) was highest among blood donors followed by blood group O (33.07%), A (20.93%), and

AB (10.08%). A total 10720 (95.50%) units of Rh-positive blood units and 504 (4.49%) units of Rh-negative blood units were issued during study period (p value 0.0034). Among issued units of blood and blood products, blood group B was highest in number followed blood group O,A and AB in both type of Rhesus positive and Rhesus negative blood groups.(Table 4)

Discussion

It has been observed in different studies conducted in India the fractions of male donors were much higher than female donors. [17-21] Similar pattern of blood donations

were also observed in other developing countries.[21-23] Contrary to that in developed countries the fraction of both genders was comparable.[21, 24, 25] The present study is also persistently following the trend of previous studies conducted in India and in this study 97.88% donors were males and only 2.11% were female donors (**Table - 5**). Multiple factors are responsible for less significant contribution of females in blood donations in countries like India, such as cultural habits, social taboo, lack of motivation and fear of blood donation and increased deferral in female donors.[26] Greater part of female donors belonged to menstruating age groups and majority of them were found anaemic during the pre donation screening and counselling. So, they were turned down for donation. For augmentation of contribution of females in blood donation, the general health status of females needs to be improved by providing proper nutritional diet and iron supplements and eliminate the fear and misconception regarding blood donation by enlightening them with the advantages of blood donations.

The prevalence of ABO and Rh groups vary widely across different races and geographical areas of the world. In our study the donors of blood group B (35.90%) were highest in number followed by blood group O (33.07%), A(20.93%), and AB (10.08%). The findings of our study are similar to the other studies carried out in western[3, 18, 21, 27], northern [17, 20, 28] and eastern[21] part of India and Pakistan[29] as stated in **Table-6**. In southern part of India blood group O is most prevalent followed by blood group B, A and AB.[17, 30, 31, 32] In Nepal[14] and Iran[33] blood group A is most common followed by blood group O, B and AB. The studies conducted in other part of world like Britain[34], USA[7] and Nigeria[35] recommended that "O" group is most common followed by A,B, and AB. The prevalence of Rh-positive blood group is predominant in all studies conducted

in different countries including India. The fraction of Rh-negative blood group is less than 10% in all studies except studies conducted in Britain[34] and USA[7] in which the frequency of Rh-negative group is 15% and 17% respectively.

The issued blood units give an idea about the requirement of blood and blood components in that particular locality. In our study the fraction of issued units of blood group B (37.75%) were highest followed by blood group O (29.39%), A(22.98%) and AB(9.88%). The preponderance of Rh-positive blood (95.50%) in issued units was observed with minor portion contributed by Rh negative blood (4.49%).

Continuous sensitization and educational programs organized by government and NGOs about blood donation has increased the number of blood donations every year except last two years in 2020 and 2021. A sharp decline in blood donation in last two years due to COVID-19 pandemic which severely crippled every branch of health care delivery system.[36] In present study month-wise distribution of blood donation suggested that highest donations with mean(\pm SD) of 189.83 ± 69.5 were observed in September while month of January reported to have minimum donations with mean(\pm SD) of 74.5 ± 29.77 (p value 0.0039). Similar type of inclination was observed in issued units of blood and blood products. Highest blood units were issued in September(1580 with mean of 263.33 ± 97.69) and lowest were in January (553 with mean of 92.17 ± 35.51) (p value 0.0024). Most of the donations occurred during rainy season from July-October as compared to rest of the year. A total 3814(44.06%) donations occurred from July to October, it is possibly due to vector born disease like malaria[37] and dengue[38] are more prevalent in rainy season and these diseases are associated with anemia and thrombocytopenia which sometimes requires

transfusion of blood/blood components in severe cases.[39]

Conclusion

This study concludes that B blood group is most common and least common is AB among the donors in Bareilly, Uttar Pradesh, India. Rh positive is more frequent than Rh negative blood groups. The fraction of female donors is much lesser than male donors and it must be increased by improving health status of females and creating awareness about blood donation. Our study gives data about distribution of different blood groups in local population which is important for the inventory management in blood banks. Apart from that seasonal trend of blood donation and issued units are also significant in monthly stock management in blood banks. Such data is also valuable in identifying the various regions with low prevalence of a particular blood group and helpful in the preparedness and policy making for the improvement of blood transfusion services.

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