

## ORIGINAL RESEARCH

# Distribution of ABO blood group antigens along with the subgroups of A and AB in a blood center of Northern India

<sup>1</sup>Dr. Irm Yasmeen, <sup>2</sup>Dr. Shazia Bashir Khatana, <sup>3</sup>Dr. Ibrar Ahmed

<sup>1</sup>Lecturer, Department of Blood Transfusion Medicine, GMC and AH Rajouri, Jammu and Kashmir, India

<sup>2</sup>Senior Resident, Department of Pathology, GMC and AH Rajouri, Jammu and Kashmir, India

<sup>3</sup>Senior Resident, Department of Pediatrics, GMC and AH Rajouri, Jammu and Kashmir, India

## Corresponding author

Dr. Ibrar Ahmed

<sup>3</sup>Senior Resident, Department of Pediatrics, GMC and AH Rajouri, Jammu and Kashmir, India

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## ABSTRACT

**Background and Objectives:** ABO blood group antigens remains the most important antigens in transfusion and transplantation due to immune genecity. Aim of this study was to determine the prevalence of ABO blood group antigens along with the subgroups of A and AB i.e A<sub>1</sub>, A<sub>2</sub>, A<sub>1</sub>B and A<sub>2</sub>B and Bombay blood group.

**Material and Methods:** This was a cross-sectional study conducted over a period of one year from April 2022 to March 2023. Blood samples were received from blood donors, blood recipients, OPD and IPD patients. The ABO blood groups and subgroup ping were determined by the antigen-antibody agglutination method by the test tube method using commercially prepared monoclonal antisera anti-A, anti-B, anti AB, anti-D, anti-A<sub>1</sub> lectin and anti-H for forward grouping. The data was presented in tabulated form.

**Results:** Out of 15527 ABO blood grouping done in the blood centre, 4164(26.8%) were blood group A, 4834 (31.13%) were blood group B, 5059(32.58%) were blood group O and 1470(9.46%) were blood group AB. Out of 4164 A blood groups, frequency of A<sub>1</sub> blood group was 94.09% (3917), and A<sub>2</sub> was 5.93%(247). Out of total 1470 AB blood groups, A<sub>1</sub>B was 85.5%(1257) and A<sub>2</sub>B was 14.48%(213). It was found that A<sub>2</sub> in AB blood group was more frequent in occurrence than A<sub>2</sub> in A blood group. The blood samples were also typed for anti-H to know the frequency of Bombay blood group. No case of bombay blood group was found during the study period.

**Conclusion:** Though subgroups of A and AB are rare but they can cause severe transfusion reactions which can be life threatening. By conducting this study in an associated hospital Blood Centre, the dangerous blood transfusion reactions occurring due to these subgroups can be avoided.

**Keywords:** Blood group, Transfusion, Antigens, Antibodies

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## INTRODUCTION

Blood is the liquid connective tissue and most essential body fluid, which is responsible for the transportation of nutrients, enzymes, and hormones throughout the body[1]. Blood is the composition of two parts, fluid part called as plasma and cellular part called as blood cells(red blood cells, white blood cells and platelets). Red blood cells (erythrocytes) are the functional components of blood responsible for the transportation of gases and nutrients throughout the human body. The RBC membrane is complex and contains numerous antigens that are made from glycol proteins and glycolipids[2]. Landsteiner ABO system of blood groups is most important for transfusion medicine. In ABO blood grouping, the individual's red blood cells (RBCs) express A, B, AB, or no antigen, and the serum, respectively, contains the

naturally occurring antibody anti-B, anti-A, no antibody, or anti-A and anti-B both. These naturally occurring antibodies in serum cause major barrier against ABO incompatible blood transfusion and organ transplantation[3]. The two major subgroups of A and AB, namely, A<sub>1</sub> or A<sub>1</sub>B and A<sub>2</sub> or A<sub>2</sub>B are differentiated on the basis of reactivity of A<sub>1</sub> cells with both anti-A and anti-A<sub>1</sub> where A<sub>2</sub> cells do not react with anti-A<sub>1</sub> lectins (*Dolichos biflorus*). Weak subgroups of A antigen in A or AB blood group can be differentiated by various immunohematological investigations[4][5]. Of individuals with A antigen, approximately 20% belong to A<sub>2</sub> while rest 80% belong to A<sub>1</sub>. Anti-A<sub>1</sub> Lectin, a cold agglutinin which destroys A<sub>1</sub> cells is clinically significant when they react at 37°C, causing transfusion reactions[6]. Other subgroups of A include A<sub>int</sub>, A<sub>3</sub>, A<sub>x</sub>, A<sub>end</sub>, and A<sub>el</sub>.

they met very rarely in transfusion medicine practices. The incidence of ABO groups varies very markedly in different races[7]. Anti A and Anti B are usually detectable within 3 to 6 months after birth[8]. these antibodies are the cause of hemolytic transfusion reactions, hemolytic disease of newborn and rejection in solid organ transplantation[9]. The prevalence of subgroups of A and AB was not known in the population of Jammu and Kashmir. So this was the first study conducted in an Associated Hospital blood centre with the aim to determine the prevalence of ABO blood group antigens along with the subgroups of A and AB i.e A<sub>1</sub>, A<sub>2</sub>, A<sub>1</sub>B and A<sub>2</sub>B.

**MATERIAL AND METHODS**

A cross-sectional study was conducted over a period of 1 year from April 2022 to March 2023 in the Department of Blood Transfusion Medicine, Government Medical College and Associated Hospital, Rajouri to assess the prevalence of ABO blood group antigens and subgroups of A and AB. Ethical clearance was obtained from the Institutional Ethical Committee. Blood samples received from blood donors, blood recipients, OPD and IPD patients

were typed for ABO and Rh grouping along with the subgroups of A and AB by standard tube as well as slide technique by using commercial available antisera (Meril, Tulip). For blood groups positive for A antigen, i.e., group A and AB, testing for subgroups was conducted with anti-A<sub>1</sub> lectin[10]. The individuals then were classified under sub-blood groups containing A<sub>1</sub> or A<sub>2</sub>. Whenever the agglutination was 4+ with anti-A antisera but negative with anti-A<sub>1</sub> lectin, the sample was considered as A<sub>2</sub> subgroup. The blood samples were also tested with anti-H to know the distribution of Bombay blood group. The data was assessed and presented in tabulated form.

**RESULTS**

A total of 15527 ABO blood grouping were done in the blood centre, 4164(26.8%) were blood group A, 4834 (31.13%) were blood group B, 5059(32.58%) were blood group O and 1470(9.46%) were blood group AB. No case of Bombay blood group was found during the study period (Table 1).

**Table 1: Distribution of ABO blood groups**

Blood group	No. of cases	%age
A	4164	26.8%
B	4834	31.13%
O	5059	32.58%
AB	1470	9.46%
Bombay (Oh)	0	0
Total	15527	100%

The most common blood group in our population was 'O' blood group (32.58%) followed by 'B' (31.13%), 'A' (26.8%) and 'AB' (9.46%). Among 4164 A blood groups, frequency of A<sub>1</sub> blood group was 94.09% (3917), and A<sub>2</sub> was 5.93% (247). Out of total 1470 AB blood groups, A<sub>1</sub>B was 85.5% (1257) and A<sub>2</sub>B was 14.48% (213). It was found that A<sub>2</sub> in AB blood group was more frequent in occurrence than A<sub>2</sub> in A blood group (Table 2).

**Table 2: Distribution of A and AB subgroups**

Blood group (no. of cases)	Subgroups	No. of cases	%age
A(4164)	A <sub>1</sub>	3917	94.09%
	A <sub>2</sub>	247	5.03%
AB(1470)	A <sub>1</sub> B	1257	85.5%
	A <sub>2</sub> B	213	14.48%

**DISCUSSION**

ABO blood group was the first blood group system discovered by Karl Landsteiner in 1900[11]. In 1902 Decasterllo and Struli discovered the fourth type AB[12,13]. Over 700 erythrocyte antigens have been reported and are organized into 35 blood group systems by International Society of Blood Transfusion[9,14]. The blood group A can be subclassified as A<sub>1</sub>, A<sub>2</sub>, and weak subgroups (AX, A<sub>3</sub>, A<sub>end</sub>, A<sub>el</sub> etc) based on red cell agglutinability and various serological reactions[15]. The present study was conducted on 15527 blood samples and showed that the prevalence of blood group O was highest with 32.58% while AB was lowest with 9.46%. Our study is consistent with the

study conducted in different regions of India showing that the blood group O is most prevalent which is followed by group B whereas AB found to be least common. Dass PK et al[16], Prabhakar S et al [17], Latoo JA et al [18], Periyavan S et al [19], Agarwal A et al[20]. The study by Nanu and Thapliyal[21] in North Indian population reports that group B was predominant. This was also reported by a study conducted in neighboring Pakistan [22]. Various studies conducted by different authors show blood group B predominance. Sidhu S [23] Pande P and Singh M [24] Devi OR and Gangadhar M [25] Subhashini AB [26]. Various studies from Pakistan also showed that blood group 'B' was predominant by Hameed A et al [27] Anees M and Mirza M [28]

Khattak I et al [29]. No case of Bombay blood group (Oh phenotype) was found in our study similar to the study conducted by Sharma DC et al [30]. Table 3 shows the comparison of ABO blood group distribution among various studies conducted in different areas is given below. In our study, A group was prevalent in 26.8% and AB in 9.46% which was comparable with the study conducted by Giriyan SS et al [6]. In a study from USA, prevalence of A and AB was found to be 37.1% and 4.1%, while in England it was found to be 41.8% and 3% respectively [31]. In a study from Odisha, India, prevalence of A group was 22.3% [32]. Present study showed that A1 was more common in A group and A1B more common in AB which was in agreement with the studies done in Sudan and parts of Southern India [16,33,34]. In present study, prevalence of A1 and A2 in 'A' blood group was found to be 94.09%

and 5.03% respectively. Prevalence of A1B and A2B in AB blood group was 85.5% and 14.48% respectively. Our results of prevalence of A2 and A2B were higher compared to the studies done by Shastry S et al [15], Bohra M et al [35], Ruhi M et al [36] but consistent with the results of the study conducted by Gopal S et al [37]. Present study showed that the prevalence of A2B in AB blood group was much more than the prevalence of A2 in A blood group which was in agreement with the other studies [15,32,38]. Table 4 showed the comparison of prevalence of A and AB subgroups among different studies. For the delivery of better blood transfusion services, it is very important to do the extended phenotyping of the population to know the prevalence of rare blood groups so that rare blood group patients can be transfused with the best compatible blood.

**Table: 3 Comparison of ABO blood group distribution among various studies**

Studies	A blood group(%age)	B blood group (%age)	O blood group(%age)	AB blood group (%age)
Saboore M et al [39]	22.42%	23.32%	51.57%	2.69%
Gopal S et al [37]	20.0%	34.4%	38.4%	7.2%
Kumar N et al [40]	21.2%	37.8%	31.8%	9.2%
Sharma DC et al [30]	22.7%	37.5%	30.8%	9%
Present study	26.8%	31.13%	32.58%	9.46%

**Table: 4 Comparison of distribution of subgroups of A and AB among different studies**

Studies	A <sub>1</sub>	A <sub>2</sub>	A <sub>1</sub> B	A <sub>2</sub> B
Saboore M et al [39]	90%	10%	66.6%	33.33%
Giriyan SS et al [6]	98.90%	1.10%	89.70%	10.30%
Elnour AM et al [33]	93.42%	6.58%	91.67%	8.33%
Chaitanya Kumar IS [38]	95.9%	4.1%	80.8%	19.2%
Gopal S et al [37]	91.6%	8.4%	83.1%	16.9%
Kumar N et al [40]	94.8%	5.1%	90.76%	9.23%
Yadav A et al [41]	91.0%	9%	84.37%	15.63%
Sharma DC et al [30]	92.0%	8.0%	91.4%	8.6%
Present study	94.09%	5.03%	85.5%	14.48%

**CONCLUSION**

Knowledge of the prevalence and distribution of ABO, Rh and Extended phenotyping of the population is very essential for effective management of the inventory of the blood centres. It should be done in each and every individual to reduce the blood transfusion reactions occurring due to minor incompatibilities. More studies should be conducted according to the geographical area of the individuals with broader representation.

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**CONFLICTS OF INTEREST**

There is no conflict of interest

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