

# A1 and A2 Sub-Types of Blood Group 'A': A Reflection of their Prevalence in North Karnataka Region

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## ABSTRACT

**Introduction:** Landsteiner ABO system of blood groups is most important for transfusion medicine and has subtypes of A Antigen, A1 and A2, upon which further groups of A and AB have been classified. Of individuals with A antigen, approximately 20% belong to A2 while rest 80% belong to A1. Anti-A1 Lectin, a cold agglutinin which destroys A1 cells is clinically significant when they react at 37°C, causing transfusion reactions.

**Aim:** To assess the prevalence of A1 and A2 subgroups in the population.

**Materials and Methods:** This was two year retrospective analysis of blood groups of donors coming to the blood bank of Karnataka Institute of Medical Science, Hubli, Karnataka, India.

The data of the subgroups A and AB was analysed.

**Results:** 20,864 donors were analysed. Of 5466 (26.20%) of A group, 5406 (98.90%) belonged to A1 subgroup and only 60 (1.10%) belonged to A2 subgroup. Of 1708 donors with blood group AB, 1532 (89.70%) belonged to A1B subgroup and 176 (10.30%) belonged to A2B. It was noted that A2 in AB blood-group, as A2B, was more frequent in occurrence than presence of A2 as an A blood group. Rhesus negative frequency in these subgroups was also reported.

**Conclusion:** Having known the prevalence of A1 and A2 subgroups and incorporating them into the ABO grouping system can limit these minor, yet dangerous, transfusion incompatibilities.

**Keywords:** A and AB blood groups, Blood donation testing, Donors, RBC antigen and antibodies

## INTRODUCTION

Discovery of ABO system of blood groups by Landsteiner in 1901 marked the beginning of safe transfusion [1,2]. Till today, it is the most important blood group system in transfusion medicine [2]. There are four main blood groups enlisted in this system namely A, B, AB and O [1,3].

Subtypes of A antigen have been defined, based on which A and AB blood groups have been classified into two main subgroups each. Approximately, 20% of individuals having A antigen in blood belong to A2 and thus, forming either A2 or A2B subgroups while rest belong to A1, so as to form either A1 or A1B subgroups [3,4]. Subgroups of A antigen weaker than A2 are not frequent [2].

A1 and A2 are distinguished by the reactivity of lectin i.e., anti-A1 which occurs as a cold agglutinin and exclusively agglutinates A1 cells. About 0.4% A2 and 25% of A2B subgroups possess anti-A1. These antibodies become clinically significant if they react at 37°C destroying A1 cells [2].

The aim of our study was to assess the prevalence of A1 and A2 subgroups in the population studied and its implication in transfusion practices.

## MATERIALS AND METHODS

An analysis was performed on blood groups of donors coming to Karnataka Institute of Medical Sciences, Hospital, Hubli, blood bank. This was a retrospective study done for a period of two years; from January 2014 to December 2015. The data was collected with due and relevant permission obtained from the Head of the Department of Pathology and Blood Bank. Also, ethical clearance for the study was obtained from the Institutional Ethical Committee. The identity and the gender of the donors was not revealed in any manner in the study conducted. The blood collected from donors was typed for ABO and Rh grouping by standard tube as well as slide technique [5].

For blood groups positive for A antigen, i.e., group A and AB, further testing with anti-A1 lectin was conducted [5]. The individuals were

hence, classified under sub-blood groups containing A1 or A2. The data was tabulated and assessed.

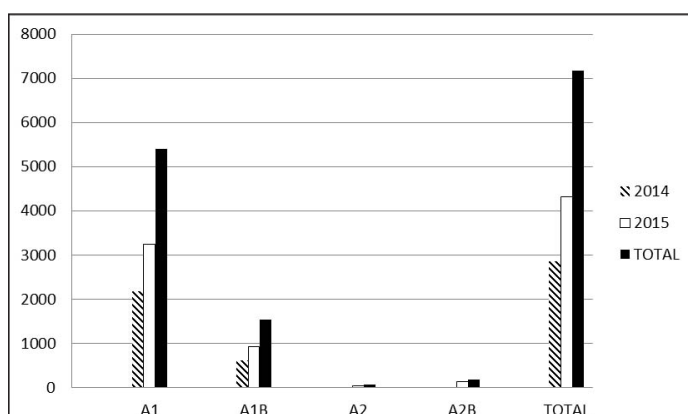
## RESULTS

ABO grouping was analysed for 20,864 donors over a period of two years. Of these, 5466 (26.20%) belonged to group A and 1708 (8.20%) belonged to group AB. Blood groups other than A and AB accounted for 13,691 (65.6%) donors.

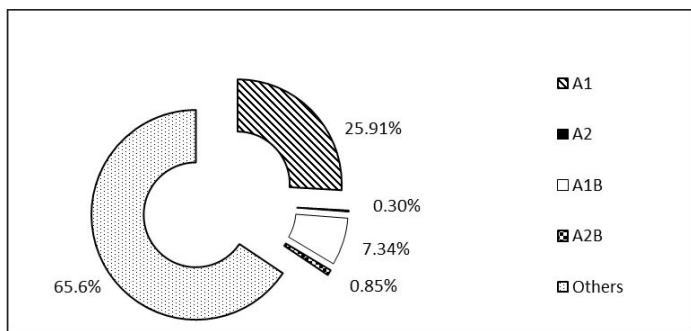
Out of the total study sample, A antigen was present in 7174 (34.4%) of the donors (A and AB blood groups). Of this, A1 antigen was present in 6938 (96.7%) donors and A2 antigen was present in 236 (3.3%) donors.

A1 and A1B sub-types were found in 5406 (75.4%) and in 1532 (21.3%) donors respectively, while A2 and A2B subtypes were found in 60 (0.8%) and 176 (2.5%) donors, respectively.

Of 5466 donors of A blood group in the two years of our study, 5406 (98.90%) belonged to A1 subtype and only 60 (1.10%) belonged to A2 subtype. Year wise distribution has been given in [Table/Fig-1].



[Table/Fig-1]: Distribution of A1 and A2 Subtypes in A and AB blood groups in two years.



[Table/Fig-2]: Percentage of blood groups in all individuals over two years.

Blood Group	Year-2014	Year-2015
A1 Positive	2093	3093
A2 Positive	30	29
A1B Positive	575	913
A2B Positive	43	130
A1 Negative	80	140
A2 Negative	1	0
A1B Negative	31	13
A2B Negative	3	0

[Table/Fig-3]: Year wise distribution of Subtypes of A and AB blood groups in study period.

On the other hand, out of 1708 donors of blood group AB, 1532 (89.70%) of the donors were classified under A1B and 176 (10.30%) donors under A2B.

In this study, it was observed that the occurrence of A2 in AB blood group as A2B was more than the occurrence of A2 in A blood group.

Out of the total individuals having A antigen in blood, 268 donors (3.73%) were found to be Rh negative. Of these, 220 (82.08%) were A1 negative, 44 (16.41%) were A1B negative, 1 (0.37%) was A2 negative and 3 (1.11%) were A2B negative.

The distribution of blood groups in all individuals is shown in [Table/Fig-2].

Out of the total 20,864 donors in two years, prevalence of A1 positive was 24.86%, A2 positive was 0.3%, A1B positive was 7.13% and A2B positive was 0.84%. Prevalence of A1 negative was 1.05%, A1B negative was 0.21%, A2B negative was 0.014% and A2 negative was 0.004%.

## DISCUSSION

ABO blood group was the first blood grouping system discovered by Landsteiner [1]. It includes different genotypes and phenotypes of A, B and O antigens. 44.6% of all blood groups are A which includes two subtypes i.e., A1 and A2 with a prevalence of 80% and 20% respectively [6].

The present study was conducted on 20,864 donors over a period of two years. Their distribution revealed increase in the number of donors within a span of one year from 2014 (39.45%) to 2015 (60.55%).

In present study, A group was prevalent in 26.2% and AB in 8.2%. 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 [7]. In a study from Odisha, India, prevalence of A group was 22.3% [3].

In present study, amongst all the donors having A antigen in the blood 5466 (5406 + 60) (76.20%) were A group and 1708 (1532 + 176) (23.80%) were AB which was almost same as a study in Sudan in which prevalence of A was 76% and AB was 24% [2]. Present study also showed that A1 was more common in A group and A1B

more common in AB which was in agreement with study done in Sudan and parts of Southern India [2,8-10].

A1 and A2 are major subgroups of blood group A. These are differentiated by the reaction of anti-A1 lectin with A1 cells. Rarely, significance of weaker variants like A2, A3 and Ax is important as they may cause haemolytic transfusion reactions [11]. A2 and A2B are rare subgroups. Individuals having these subgroups do not recognize A1 antigens as their own hence, make up specific anti A1 antibody against A1 cells. About 0.4% of A2 and 25% of A2B have anti A1 antibodies [2,12].

In present study, prevalence of A1 and A1B was 25.91% and 7.34% and A2 and A2B was 0.30% and 0.85% respectively of all donors in our blood bank. In a study done on the Muslim population of UP by Hussain R et al., the prevalence of A1 and A1B was 26.52% and 19.34% and A2 and A2B was 2.90% and 1.24% respectively [13]. Their study was similar to a study done by Ara G et al., in which prevalence of A1, A1B, A2 and A2B was 24.64%, 20.21% 3.97% and 1.60% respectively [14]. Present study showed lower values as compared to other studies done in India. A study from South India showed prevalence of A2 and A2B as 3.01% and 1.43% respectively [10]. Another study by Chaitanya Kumar IS et al., concluded that prevalence of A2 and A2B is 0.85% and 1.21% respectively [15]. In a study done by Sharma DC et al., in which A2 and A2B were found to be 8% and 8.6% respectively [16].

In present study, prevalence of A1 and A2 in A blood group was found to be 98.90% and 1.10% respectively. Prevalence of A1B and A2B in AB blood group was 89.70% and 10.30% respectively. These results were similar to the study done by Bangera IS et al., in which prevalence of A2 and A2B in groups A and AB respectively was 1.3% and 12.7% [8].

In a pilot study by Chaitanya Kumar IS et al., done in Rayalseema region, values of A2 and A2B in A and AB blood groups respectively were 4.1% and 19.2% [15]. These were higher as compared to our study. Similar studies were done by Mahapatra S et al., showed A2 and A2B as 5.8% and 31.5% and study done by Shastri S et al., which showed 1.07% A2 and 8.99% A2B respectively [3,9].

Prevalence of A1 and A2 antigens in individuals with A and AB blood groups was found to be 96.7% and 3.3% respectively in this study. This was similar to a study by Esmaili HA et al., in which A1 was 94.6% and A2 was 5.4% respectively [17]. Mahapatra S et al., concluded A1 to be 88.1% and A2 to be 11.9% of all individuals having A or AB blood group [3].

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 [2,3,8,9,15].

The prevalence of A2 and A2B along with Rh negative status is rare. In general population, A2B subtype is found in 0.9% to 1% individuals [6]. Rh negative blood groups are found in 15% of the population [16]. Considering both, the prevalence of A2B negative is 0.1%. In present study however, A2B negative was found to be 0.014%. A2 negative was found to be 0.004% among all donors during the study period [Table/Fig-3]. This aspect of transfusion medicine has not been emphasised in other studies and hence, this study helps to link the prevalence of subgroups of A antigen with Rh status of the individual and aids in precision of transfusing blood and preventing transfusion related reactions.

## LIMITATION

This study can be continued prospectively for further more years to get a comprehensive and large donor pool; from which more statistically significant analysis can be expected to be derived to more closely relate the importance of the sub types of Blood Group A.

## CONCLUSION

A1 and A2 are rare subgroups. However, they may lead to transfusion related reactions which could be lethal. By knowing the prevalence of A1 and A2 subgroups in a blood bank at tertiary care hospital, the dangerous transfusion reactions occurring due to these minor incompatibilities can be avoided. Therefore, implementation of A1 and A2 grouping in ABO typing is vital for curtailing the avoidable reactions leading to overall improvement in blood transfusion practice.

## REFERENCES

- [1] Dacie JV, Lewis SM. Practical Haematology. 9<sup>th</sup> ed. Lewis SM, Bain BJ, Bates I (eds). London. Churchill Livingstone, Harcourt Publishers Limited: 2001, pp. 444-451.
- [2] Elhour MA, Ali NY, Mohammed HA, Hummeda SA, Alshazally WA, Omer NA. Frequency of the A2-subgroup among blood group A and blood group AB among students of faculty of medicine and health sciences at Alimam Almahadi University, White Nile, Sudan. Hematol Transfus Int J. 2015;1(4):00022.
- [3] Mahapatra S, Mishra D, Sahoo D Sahoo BB. Study of prevalence of A2, A2B along with major ABO blood groups to minimize the transfusion reactions. International Journal of Scientific Research (IJSR). 2016;5(3):189-90.
- [4] Chaudhari CN, Misra RN, Nagpal AK. Transfusion in blood group A2B with anti A1 Recipient. MJAFI. 2008;64:371-72.
- [5] Macroo RN. ABO Blood Group System. In: Compendium of Transfusion Medicine. 2<sup>nd</sup> ed. New Delhi: KONGPOSH Publications Pvt Ltd, November 2009: 31-65.
- [6] Reid ME, Lomas-Francis C. The Blood Group Antigen Facts Book. 2<sup>nd</sup> ed. New York: Elsevier Academic Press, 2004. The Blood group systems and Antigens, Section II; pp. 23-24.
- [7] Gezer S, Akgün N, Akin A, Iskli A. Frequency of ABO blood groups in Eskisehir. Çocuk Sagnlgive Hastaliklan Dergisi. 1997;30:227-31.
- [8] Bangera IS, Fernandes H, Swethadri GK, Naik. Prevalence of A2 sub group in A and AB blood groups and the transfusion implications. Asian Journal of Transfusion Science. 2007;1(2):103.
- [9] Shastri S, Bhat S. Imbalance in A2 and A2B phenotype frequency of ABO group in South India. Blood Transfusion (Blood Transfus). 2010;8(4):267-70.
- [10] Das PK, Nair SC, Harris VK, Rose D, Mammen JJ, Bose YN, et al. Distribution of ABO and Rh-D blood groups among blood donors in a tertiary care centre in South India. Tropical Doctor. 2001;31(1):47-48.
- [11] Brecher ME (editor). Technical Manual. American Association of Blood Banks. 14<sup>th</sup> ed. Bethesda. Maryland; 2002.
- [12] Rudmann SV. Textbook of Blood Banking and Transfusion Medicine. 1<sup>st</sup> ed. WB Saunders, USA, Pp.73-75. 1995.
- [13] Hussain R, Fareed M, Shah A Afzal M. Prevalence and gene frequencies of A1A2BO and Rh(D) blood group alleles among some Muslim populations of North India. Egyptian Journal of Medical Human Genetics. 2013;14(1):69-76.
- [14] Ara G, Siddique YH, Afzal M. Some observations on genetic diversity and microdifferentiation processes among some populations of North India Using ABO subtypes and Rh markers. Adv Biol Res. 2011;5(5):260-66.
- [15] Chaitanya Kumar IS, Yashovardhan A, Suresh Babu B, Verma A, SreedharBabu KV, JothiBai DS. The prevalence of A2 and A2B subgroups in blood donors at a tertiary care teaching hospital blood bank of Rayalaseema region: a pilot study. [correspondence]. Journal of Clinical and Scientific Research. 2012. svimstpt.ap.nic.in/jcsr/janmar12\_files/pdf%201-1-12/Correspondence.pdf
- [16] Sharma DC, Rai S, Iyenger S, Jain B, Sao S. Prevalence and distribution of ABO and Rh-D antigens along with its subgroups and rare types in greater Gwalior region. Open Journal of Blood Diseases. 2013;3(2):69-73.
- [17] Esmaili HA, Najafzadeh J, Elmdust N. Investigating the frequency of anti-a1 antibody in individuals with a2 blood group. Urmia Medical Journal. 2015;26(6):475-81.

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