

# Frequency of A1 and A2 Subtype of Blood Group A and AB

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## Abstract

**Objective:** To assess the frequency of A1 and A2 subtype of blood group A and AB in patients presenting in a tertiary care hospital

**Methodology:** This Cross sectional study was conducted at Department of hematology, Lahore General Hospital, Lahore for 6 months i.e. 3-3-2022 to 3-9-2022. Total 235 candidates fulfilling selection criteria were selected. Using a 5cc disposable syringe and aseptic procedures, blood samples were taken and then preserved in sterile EDTA vials. The blood groups A and AB were verified using the standard ABO blood group procedure. To further differentiate between A1 and A2, samples were analysed using anti-A1 lectin. A1 was taken into consideration if agglutination with anti-A lectin occurred. The sample was classified as an A2 subgroup if the agglutination was 4+ with anti-A antisera but negative with anti-A1 lectin.

**Results:** The mean age of the patients was 18.31±6.54 years. There were 153(65.1%) males and 82(34.9%) females in this study. There were 207(88.1%) patients and 28(11.9%) donors in this study. There were 180(76.6%) patients and donors with blood group A and 55(23.4%) with blood group AB. Out of total 235 subjects of blood group A and AB, 184(78.3%) participants present with subtype A1 and 51(21.7%) with subtype A2. A1 is the main subgroup of the blood groups A and AB. Subgroup A2 constitute a significant percentage of blood group A and AB.

**Conclusion:** It is recommended that in all blood banks anti sera A1 and A2 be used for subgrouping blood group A.

**Key words:** A1, A2, Subtype, Blood group, A and AB, Tertiary care hospital

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## Introduction

Human blood is composed of cellular and fluid compartments. The cellular part consists of Red Blood Cells (RBCs), White blood cells and Platelets. Human RBCs have antigens on their membrane surface which differentiate them into different blood groups. These blood groups are mostly genetically predisposed. Until now more than 400 RBC antigens have been discovered. The most important blood groups historically and clinically are ABO and Rh blood group system.<sup>1</sup> Understanding their genetics and their immunogenic structure plays a vital role in blood transfusion safety. Most of clinicians are familiar with the fact that ABO blood group is classified into A, B, and AB blood groups but there is poor general knowledge about presence of further subgroups of O, A, B, and AB blood groups.<sup>2, 3</sup>

**Authorship Contribution:** <sup>1,3</sup>Conceived and planned the idea of the study, <sup>4</sup>final approval of the version to be published <sup>2,5</sup>drafting the work or revising it critically for important intellectual content, <sup>6</sup>Active participation in active methodology.

Our study is focused on blood group A. Blood group A has many subgroups A<sub>1</sub>, A<sub>2</sub>, A<sub>x</sub>. It has been reported that generally in case of people with blood group A 98.90% have A<sub>1</sub> subgroup and 1.0% have A<sub>2</sub> subgroup and rest is divided into other minor subgroups. Similarly in case of blood group AB, 89.70% of people have A<sub>1</sub>B subgroup and 10.30% have A<sub>2</sub>B.<sup>4</sup> In another study it was found that in cases of blood group A, 92% had A<sub>1</sub> subgroup and 8% had A<sub>2</sub> subgroup. As regards to blood group AB, 91.4% had A<sub>1</sub>B subgroup and 8.6% had A<sub>2</sub>B.<sup>5</sup> Literature from another research revealed that among the A subgroups there are 93.42% A<sub>1</sub> subgroup and 6.6% A<sub>2</sub> subgroup. In another study percentage was discovered which showed 91.6% A<sub>1</sub>B and A<sub>2</sub>B was 8.33%. Clinical importance lies in the fact that patients with blood group A<sub>2</sub> may exhibit blood transfusion reactions if transfused with A<sub>1</sub> blood group.<sup>6</sup>

This study will assess the frequency of A<sub>1</sub> and A<sub>2</sub> subtypes of blood group A and AB presenting in a tertiary care hospital. Unfortunately, there is lack of data in local literature and a need of the time to get the regional evidence regarding frequency of subtypes of blood group A and AB for the sake of more safe blood transfusion.

Funding Source: none  
 Conflict of Interest: none

Received: Mar 19, 2024  
 Accepted: July 19, 2024

## Results

This study along with determining the frequency of A<sub>1</sub> and A<sub>2</sub> subtypes will emphasize the presence of minor subgroups and enforced their detection while screening the ABO blood group. Clinicians, hematologists and para medics especially those working in blood transfusion centers will become aware of the importance of mandatory checking of subgroups A<sub>1</sub> and A<sub>2</sub> while doing blood group identification.

## Methodology

This cross sectional study was conducted at Department of hematology, Lahore General Hospital, Lahore for 6 months i.e. 3-3-2020 to 3-9-2020

Sample size of 235 cases is calculated with 95% confidence level, 3.5% margin of error and taking least expected percentage of A<sub>2</sub> subtype i.e. 8% (19) in patients with blood group A. <sup>7</sup> Non probability consecutive Sampling technique was used.

Inclusion criteria: Adult patients and healthy donors aged 14-70 years of either gender presented in tertiary care hospital with blood group A or AB were enrolled in the study.

Exclusion criteria: Patient with autoimmune blood disorders and with blood group B and O were excluded from the study.

Total 235 candidates fulfilling selection criteria were selected for the study from different departments. Demographic details of patients including name, age, gender, patients or blood donor, was also be noted. Using a 5cc disposable syringe and aseptic procedures, blood samples were taken and then preserved in sterile containers. The blood groups A and AB were verified using the standard ABO blood group procedure. To further differentiate between A<sub>1</sub> and A<sub>2</sub>, samples were analysed using anti-A<sub>1</sub> lectin. A<sub>1</sub> was taken into consideration if agglutination with anti-A lectin occurred. According to the operational criteria, a sample was classified as belonging to the A<sub>2</sub> subgroup if the agglutination was 4+ with anti-A antisera but negative with anti-A<sub>1</sub> lectin. On the proforma that is provided, all of this information was documented.

Data was entered and analyzed through SPSS 21. Frequency and percentage was calculated for qualitative variables like gender, category (patient or donor) and subtype A<sub>1</sub> & A<sub>2</sub>.

Total participants in this study were 235. The mean age of the patients was 33.18±15.84 years with minimum age of 14 years and maximum age of 70 years. There were 153(65 %) males and 82(35 %) females in this study. Out of these, there were 207 (88%) patients and 28 (12%) donors. Table I

Out of 235, 184 (78%) had subtype A<sub>1</sub> and 51 (22%) had subtype A<sub>2</sub>. Figure 1

Among the participants 235 there were 180 were of blood group A, which were divided into subtype A<sub>1</sub> (147 (80%) and subtype A<sub>2</sub> (33 (65%). Total subjects with blood group AB were 55, out of which 37 (20%) were subtype A<sub>1</sub> and 18 (35%) belonged to subtype A<sub>2</sub> (p<0.05). Distribution of blood subtype is reported in table below. Table II

Table I: Demographics of patients. (n=235)

Mean	33.18 ± 15.84
Gender	
Male	153 (65%)
Female	82 (35%)
Category	
Patient	207 (88%)
Donor	28 (12%)

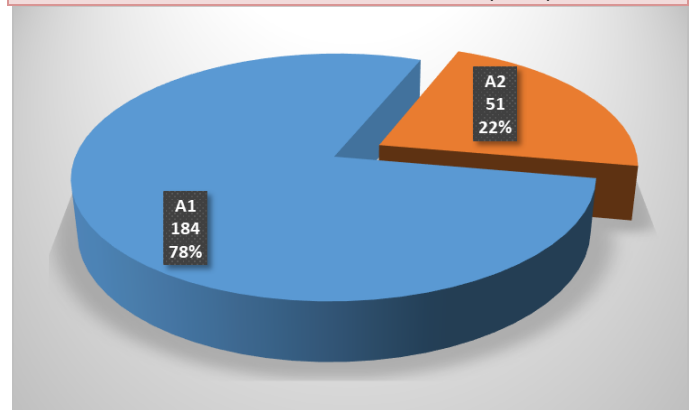


Figure 1. Distribution of subtype

## Discussion

There is significant variation in the prevalence of the common ABO phenotypes (A<sub>1</sub>, A<sub>2</sub>, B, A<sub>1</sub>B, A<sub>2</sub>B, and O) among various populations.<sup>8</sup> The A phenotype is common in Northern and Central European populations. American Indians seldom have the B phenotype, which is more common among Central Asians. From a global standpoint, blood group O represents the most widespread phenotype.<sup>9</sup> Elnour et al. detected A or AB blood types in

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100 Al Imam Al Mahdi University Faculty of Medicine students in 2015. We gathered 235 patient and donor blood samples.<sup>10</sup>

**Table II: Subtype A<sub>1</sub> & A<sub>2</sub> Stratified for Category and blood group.**

Category	Subtype		Total	P-value
	A1	A2		
n	184 (100.0%)	51 (100.0%)	235 (100%)	
Patient	160 (87.0%)	47 (92.2%)	207 (88.1%)	0.312
Donor	24 (13.0%)	4 (7.8%)	28 (11.9%)	
<i>Blood group</i>				
A	147 (80%)	33 (65%)	180 (77%)	0.023
AB	37 (20%)	18 (35%)	55 (23%)	
<i>Age (years)</i>				
18-30	24 (13.0%)	9 (17.6%)	33 (14.0%)	0.030
31-40	100 (54.3%)	35 (68.6%)	135 (57%)	
41-60	60 (32.6%)	7 (13.7%)	67 (29%)	
<i>Gender</i>				
Male	129 (70%)	24 (47%)	153 (65%)	0.002
Female	55 (30%)	27 (53%)	82 (35%)	

Elnour et al. found that 24% of the research samples belonged to group AB and 76% to group A in their study.<sup>10</sup> Similar findings were seen in our research, which included 23.4% of people with blood type AB and 76.6% of patients with blood group A. This is also consistent with earlier research conducted in Sudanese, which revealed that the A group was more common than the AB group.<sup>11,12</sup> Their population's 97% RhD antigen positivity rate is comparable to previously published Sudanese percentages.<sup>12</sup>

According to study results, A1 is the most prevalent subgroup within A group and A1 is the most prevalent subgroup within AB group; these findings are consistent with reports of similar distributions among Indian, Japanese, and South African populations, respectively.<sup>13</sup> These blood groups are significant because they may be encountered in clinical practice since anti-A1 antibodies can be found in sera of A2 groups and are more prevalent in A 2B subgroups.<sup>14,15</sup> These anti-A antibodies may lead to issues during organ transplantation, hemolytic transfusion response, and problems with blood type.<sup>16-18</sup> A separate research indicated that the A1 subgroup in the

AB group is somewhat higher than the A2 subgroup in the A group, but this difference is statistically unimportant, implying that the frequencies of the A2 and A2B subgroups in the A and AB groups are identical. This result matches Caucasian research but not Black research.<sup>19,20</sup>

Studies on the populations of Indians, Japanese, and Chinese people reported imbalances in the frequencies of A2 and A 2B in A and AB positive individuals, respectively. In contrast, our study found that in blood group A, the frequency of the A1 subgroup was 79.9%, while the frequency of the A2 subgroup was 64.7%. In group AB, on the other hand, the frequency of the A1 subtype was 20.1%, and the frequency of the A2 subtype was 35.3%, which is comparable with the studies previously mentioned.<sup>21</sup> Giriyan et al. (2017) report that 44.6% of all blood groups are A, which contains two subtypes, A1 and A2, with corresponding prevalences of 80% and 20%.<sup>4,22</sup> Over the course of two years, 20,864 donors became the subject of another investigation. Their distribution showed that within a year, from 2014 (39.45%) to 2015 (60.55%), there was an increase in the number of contributors.<sup>4</sup>

Another study's findings showed that the A group was more common in 26.2% of cases and AB in 8.2%. The prevalence of A and AB was reported to be 37.1% and 4.1% in an American research, respectively, and 41.8% and 3% in an English study.<sup>4,23</sup> In an Odisha, India survey, the prevalence of the A group was 22.3%.<sup>24</sup> The present study found that 5466 (5406 + 60) (76.20%) of donors with A antigen blood were A and 1708 (1532 + 176) (23.80%) AB. This matches a Sudanese research that found 76% A and 24% AB.<sup>10</sup>

In line with research conducted in Sudan and other regions of Southern India, the current study likewise revealed that A1 was more prevalent in the A group and A1B more common in the AB group.<sup>(25</sup> A1 and A2 are prominent subcategories within the blood type A. The increased occurrence of A2 in the AB group in Japanese persons may be attributed to the distinct manifestations of the R101 allele. In heterozygous individuals with the \*R101/\*O genotype, the R101 allele is expressed as the A1 phenotype. However, in heterozygotes with the \*R101/\*B genotype, the R101 allele is expressed as the A2 phenotype. This discrepancy leads to a greater frequency of the A2B phenotype.<sup>26</sup>

## Conclusion

The prevalence of the A1 and A2 subtypes of the blood group is notable among individuals with blood group A and AB. Transfusion of incompatible blood may result in potentially fatal transfusion-related responses. Consequently, it is crucial to apply A1 & A2 grouping in ABO type to prevent severe transfusion responses. It will result in a general enhancement of blood transfusion procedures.

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