

## Research Article

### ABO and Rhesus D Blood Groups Distribution among Students in Usmanu Danfodiyo University Sokoto, North Western Nigeria

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## Abstract

**Background:** There is ethnic variation in the prevalence of ABO and Rhesus D blood groups. This aim of this present study is to determine the distribution of ABO and Rhesus D blood group among students of African descent attending Usmanu Danfodiyo University in Sokoto North Western, Nigeria.

**Methods:** ABO and Rhesus D phenotype of 250 consecutively -recruited students of Usmanu Danfodiyo University in Sokoto North Western, Nigeria was determined using standard tube techniques based on haemagglutination principle. Seraclone Anti- A, B, AB and D reagents (Bio Rad Medical Diagnostics, Germany) was utilized.

**Results:** A total of two hundred and fifty students (250) apparently healthy students of African descent attending Usmanu Danfodiyo University in Sokoto North Western aged 18-35 years and mean age  $26 \pm 2.0$  years made up of 145 males (58.0%) and 105 female (42.0%) constituted the subjects in this case study. The distribution of the ABO blood group and Rhesus D revealed that 103 (41.2%) were group O, 68 (27.2%) were group B, 63 (25.6%) were group A and 15 (6%) were group AB. Out the 250 subjects investigated, 223 (89.2%) were Rhesus positive and 105 (10.8%) were Rhesus negative. Our finding is consistent with the general formula  $O > B \geq A > AB$  indicating a preponderance of phenotype B over A. We observed a significant difference in the distribution of O and B based on gender ( $p=0.01$ ).

**Conclusion:** The pattern of distribution of ABO blood groups among students in Sokoto is at variance with other populations particularly among Caucasians. Data derived from this study will help policy makers make evidenced -based decisions on optimum stocking of blood and blood products in Blood banks in the area, management of Haemolytic Transfusion Reaction and Haemolytic Disease of the Foetus and Newborn.

**Keywords:** ABO; Rhesus; Blood groups; Sokoto; North West; Nigeria

## Introduction

The most clinically significant human blood group system is the ABO and the Rhesus blood group systems. The clinical significance of a blood group system depend on regular occurrence of the antigens of the system on the red blood cell (RBC) membrane of a significant number of humans, the ability of the antibody of the system to cause Haemo-

lytic Transfusion Reaction (HTR) and Haemolytic Disease of the Foetus and Newborn (HDFN) [1-3].

The ABO blood group system is based on the presence of antigens A and B. Four major groups (A, B, AB and O) are available based on the presence of the A and B antigen either singly as A or B, doubling as AB or absence of both antigens as O [4-5].

Of all the Rhesus antigens (C, D, E, c and e), the D antigen is the major determinant, most immunogenic and the most clinically significant of all the Rhesus antigens. Based on the Rhesus D phenotype, individuals can be categorized as either Rhesus D positive (presence of the D antigen) or Rhesus negative (absence of the Rhesus D antigen) [6].

The prevalence of ABO and Rhesus blood groups varies from race to race. The type and stock levels of blood and blood products available in the hospital blood bank in any community should ideally closely correlate with the distribution of the clinically significant red cell antigens in the general population. The ABO and Rhesus blood group system play a significant role in civic registration, forensic studies, investigation of paternity disputes, HTR and management of HDFN. The Nigerian nation is highly diverse and has 389 ethnic groups. There is paucity of data on the prevalence of the ABO and Rhesus blood groups in Sokoto in North Western Nigeria. This aim of this present study was to determine the distribution of ABO and Rh D phenotypes among students of African descent enrolled into the Usmanu Danfodiyo University in Sokoto State in the North West geopolitical zone of Nigeria.

### Study Area

The selected area for this study is Usmanu Danfodiyo University Teaching Hospital (UDUTH) which is located in Wamakko Local Government within Sokoto Metropolitan city in Sokoto State. Sokoto State is located in the extreme Northwest of Nigeria, near the confluence of the Sokoto River and Rima River. With an annual average temperature of 28.30c (82.9 0F). Sokoto is, on the whole, a very hot area. However, maximum day time temperatures are for most of the year generally under 40 0C (104.0 0F). The warmest months are February to April when daytime temperatures can exceed 45 0C (113.0 0F). The rainy season is from May to October during which showers are a daily occurrence. There are two major seasons, wet and dry which are distinct and are characterized by high and low malarial transmission respectively. Report from the 2007 National Population Commission indicated that the State had a population of 3.6 million [7].

### Study Setting

The study was conducted in the Faculty of Medical Laboratory Science of Usmanu Danfodiyo University in collaboration with Haematology Department of Usmanu Danfodiyo University Teaching Hospital Sokoto.

### Sample Collection and Methods

Blood samples were collected by venipuncture into ethylene diamine tetracetic acid (EDTA) anticoagulated tubes and used for the determination of ABO blood and Rh D blood groups of 250 consecutively recruited subjects. Red cell phenotyping was carried out using standard

tube techniques as described by Judd [8] and Brecher [9]. The test is based on haemagglutination principle. For ABO blood grouping, a drop of Biorad Seraclone anti-A, anti-B, and anti-AB (Bio Rad Medical Diagnostics, Germany) each was placed in clean test tubes labelled 1, 2, and 3. To each tube was added a drop of 5% red blood cell suspension in saline. The contents were gently mixed together and centrifuged for 30 seconds at 1000g. The cell buttons were re-suspended and observed for agglutination. Agglutination of tested red cells constituted positive results and indicates that the red cells contain the group specific antigens. A smooth cell suspension after re-suspension followed by a microscopic confirmation constituted negative test results. For Rhesus D typing, a drop of Seraclone anti-D (RH1) blend serum (Bio Rad Medical Diagnostics, Germany) was placed in a clean labelled test tube and 1 drop of 5% RBC suspension in saline was then added and incubated at 37°C. At the end of the incubation period, the contents of the tube were mixed gently and centrifuged for 30 seconds at 1000g. Agglutination was read macroscopically and microscopically. All negative results were confirmed using the indirect antiglobulin test (IAT) procedure. The antibodies in Seraclone Anti A, B, AB and D binds to the corresponding antigen on red cells and cause an antigen-antibody reaction visible as red cell agglutination. Agglutination indicates the presence of the group specific antigen on the red cells. The four ABO blood types A, B, AB and O are defined by the presence or absences of A and B characteristics on the red cells. The absences of both A and B characteristics defines type O. The antigen characteristics A and B react with corresponding antibody Seraclone Anti A, B, and AB. The anti-D determines the Rhesus D group of subjects based on positive agglutination with anti-D (Rhesus D positive) or non- agglutination (Rhesus D negative).

### Statistical Analysis

The data collected was recorded on an Excel spreadsheet and later subjected to statistical analysis using a statistical software SPSS version 18.0. Statistical analysis included descriptive statistics of mean and bivariate analysis of t- test and chi- square. Correlation was compared using linear regression analysis. Differences were considered significant when  $p \leq 0.05$ .

### Eligibility Criteria

All consenting, consecutively recruited legal adults ( $\geq 18$  years), confirmed students of UDUS and students without a recent history of red cell transfusion were recruited into this study.

### Exclusion Criteria

The following students of UDUS who did not meet the inclusion criteria were excluded from the study (non-adult

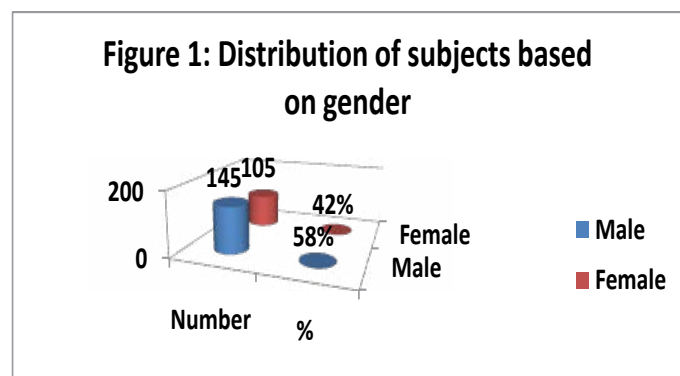
students < 18 years, non -consenting students and students who have had a red cell transfusion in the 4 months.

**Informed Consent**

Verbal informed consent was obtained from all students participating in this study, together with socio-demographic information. Ethical clearance was sought from the ethical committee of Usmanu Danfodiyo University Sokoto (UDUS), North Western, Nigeria.

**Result**

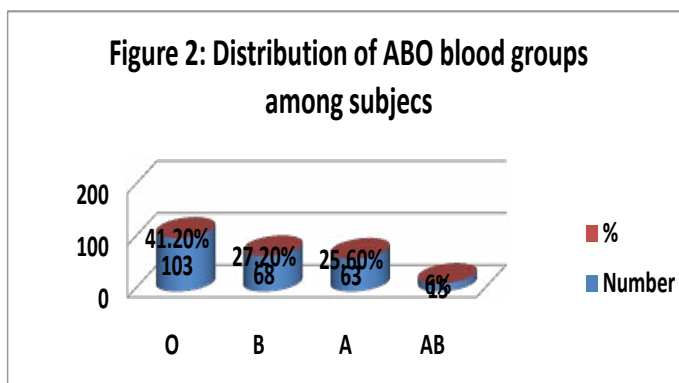
A total of two hundred and fifty students (250) apparently healthy students of African descent attending Usmanu Danfodiyo University in Sokoto North Western Nigeria aged 18-35 years with mean age 26 ± 2.0 years constituted the subjects in this case study. Subjects were made up of 145 males (58.0%) and 105 female (42.0%) Figure 1 show the distribution of the subjects based on gender. We observed a significant difference in the distribution of O and B based on the gender of students (p=0.01). Table 1 show the distribution of ABO blood group based on gender.



**Figure 1:** The distribution of the ABO blood group revealed that 103 (41.2%) were group O, 68 (27.2%) were group B, 63 (25.6%) were group A and 15 (6%) were group AB. Our finding is in line with the general formula O > B > A > AB indicating a preponderance of phenotype B over A. Figure 2 show the distribution of the ABO blood groups among subjects

**Table 1:** Distribution of ABO blood group based on gender

Gender	Group A N(%)	Group B N(%)	Group AB N(%)	Group O N(%)	p-value
Male	32 (12.8%)	38 (15.2%)	7 (2.8%)	68 (27.2%)	0.01
Female	32 (12.8%)	30 (12%)	8 (3.2%)	35 (14%)	



**Figure 2:** Out the 250 subjects investigated 223 (89.2%) were Rhesus D positive and 105 (10.8%) were Rhesus D negative. Rhesus D phenotype distribution indicated that 131 male were Rh D positive and 14 were Rh D negative. Similarly 92 female students were Rh D positive while 13 were Rhesus D negative. Table 2 shows the distribution of the Rh D blood group of students based on gender.

**Table 2:** Distribution of Rhesus D blood group among students based on gender

Gender	Rh D- positive N (%)	Rh-D negative N(%)	Total
Male	131(52.4%)	14(5.6%)	145
Female	92 (36.8%)	13(5.2%)	105

**Discussion**

The ABO blood group system is the most clinically significant human blood group system. Antibodies of the blood group system occur commonly in the plasma of individuals that lack the group specific antigens. Antibodies of the ABO blood group system has been implicated in HTR and HDFN. The Rhesus blood group system is the second most clinically significant after the ABO blood group system. The D antigen of the Rhesus blood group system is the most immunogenic and antibodies of this blood group system can cause HTR and HDFN. Previous report indicates that racial variation exists in the distribution of antigens in the ABO and Rhesus blood group system. In this present study, we observed that 41.2% of subjects were blood group O, 27.2% were blood group B, 25.6% were group A and 6% were group AB. Our finding is consistent with the general formula O > B ≥ A > AB indicating a preponderance of phenotype B over A. Our finding is consistent with a previous report by Erhabor and colleagues among blood donors in Gusau Zamfara State [10], by Akhigbe and colleagues [11] among students of Ladoke Akintola University of Technology in Ogbomosho and by Pennap and colleagues [12] among students of Nasarawa State University. Similarly our finding is also consistent with

previous result obtained among Guinean population in which the prevalence of A, B and O phenotype in the population was 14.70, 15.48, 69.83 respectively [13]. Our finding is however at variance with previous reports in other parts of Nigeria; Erhabor and colleagues [14], Jeremiah [15], Worlledge and colleagues [16], Falusi and colleagues [17], Omotade and colleagues [18], Oluwadare and Shonekan [19] and in other previous reports in other parts of Nigeria [20-21] who observed a preponderance of phenotype A over B.

In this present study we observed a higher prevalence of group O and B and Rhesus D positivity among male donors compared to females. This male gender associated higher prevalence may be due to the fact that the number of male subjects in this study was significantly higher compared to female subjects.

There are wide variations in racial distribution of ABO antigens. Our finding is also at variance with findings in some Eastern European countries where a higher proportion of group B blood (up to 40%) has been reported [4]. Also, a previous report among Americans indicates that Ethnic American Indians belong exclusively to blood group O while American Blacks generally demonstrate frequencies of O, A, B, and AB blood groups of 49%, 27%, 20% and 4%, respectively (O > A > B > AB). Also a previous study to determine the frequency of ABO and Rh blood group antigens among 4,656 neonates delivered at a private hospital in Istanbul showed that group A blood was detected most frequently followed by group O, group B, and group AB [22]. ABO distribution studies among Mauritanian population in a previous report were of the order of O > A > B [23]. In the same vein, a previous study conducted to determine the frequency of ABO and Rhesus D blood groups among a cohort of subjects in District Swat, Pakistan indicated that group B was the predominant blood group [24]. The most frequent blood group among Saudis is O-positive. The prevalence of blood group A among Saudis is significant lower than values reported among Caucasians [25]. The ABO blood group distribution among residents of Bangal, India follow a pattern (O > B > A > AB) [26]. Similarly, ABO blood group distribution study carried out in the Poonch district in Azad Jammu and Kashmir showed the same trend of prevalence similar to that observed in the general Indian subcontinent (B > or = O > A > AB) [27].

In this study we observed that group O was the most predominant ABO blood group among students in Sokoto in North Western Nigeria. Our finding is consistent with previous reports [14-18, 28-31] in different parts of Nigeria which showed that the O blood group had the highest prevalence. There is however an exception to this rule. Previous report [25] among the Gwari tribe of Abuja and the Rubuka tribe of the Plateau state in

Northern Nigeria has shown that blood group B was the predominant ABO blood group. The reason for this exception may be due to high rate of intra-communal and cousin marriages prevalent among the predominantly Muslim people of Gwari and Rubuka tribe. Muslims practice cousin marriage preferentially, and polygyny and honour marriage is allowed if the husband can support multiple wives [32-33]. The high frequency of group O observed in our study among the student of Usmanu Danfodiyo University Sokoto (UDUS) provides an advantage in terms of availability of blood for transfusions, especially in emergencies. Blood group O individual lacks ABO blood group antigens on their red cell and thus their blood can be given to people of blood groups A, B and AB. However, some level of caution has to be exercised since the plasma of some group O blood individuals are known to contain high titer of potent A and B immune haemolytic antibodies (haemolysins).

The Rhesus blood group system is the second most clinically significant red cell antigen system after the ABO blood group system. The Rhesus D antigen is the most immunogenic of all the Rhesus blood group antigens. Rhesus incompatible transfusions can have a negative implication on health [34]. In this study, we observed the prevalence of Rhesus D positive and negative of 98.8% and 1.2% respectively among our cohort of students of African descent in Sokoto. Our finding is consistent with previous reports obtained among non-Caucasians by Erhabor and colleagues [14] in the Niger Delta of Nigeria who observed that 93% of their subjects were Rhesus D positive while the remaining 7% of the study population were D negative. Egesie and co-workers [35] observed Rh-D positive and negative rates of 98% and 2% respectively among their cohort of undergraduate students in the Niger Delta of Nigeria. Similarly, 96.7% positive rate was recorded among the Ibos ethnic group of Eastern Nigeria by Ukaejiofor et al [36]. Other documented Rh-D positive rates includes; 95% by Jeremiah and coworkers [37] in Port Harcourt, 96.6% by Pramanik et al [4] in Nepal, 94% by Mwangi in Kenya [38], 93% by Bashwari et al [25] in the Eastern region of Saudi Arabia, 97.7% in West Bengal India [26], 95.94% in Guinea [13] and 92.8% by Sarhan et al [39] in Southwest of Saudi Arabia. The Rhesus blood group system is the second most important blood group system due to its immunogenicity in RhD negative individuals following exposure through blood transfusion or pregnancy [40]. Rhesus D alloantibody has been incriminated as a common cause of HDFN [41].

This percentage of Rh (D) negative observed in our study (1.2%) is significantly lower than the prevalence rate of > 14% observed among Caucasians [33-34]. There are several obstetric advantages associated with the low prevalence of D-negative in Sokoto. The risk of Rh (D) alloimmunization will be of a much smaller magnitude

than it is in most western countries where a significant proportion of the population lacks the major Rh (D) antigen. In such Rhesus D negative individuals, the chances of becoming sensitized to the D antigen following exposure either by transfusion of Rh(D) positive red cells or during pregnancy involving a Rhesus positive foetus is very high. Despite the fact that the prevalence of Rh-D negative phenotype is significantly lower among Africans compared to Caucasians, Rh D alloimmunization remains a major factor responsible for perinatal morbidity in most developing countries for several reasons; lack of universal access and unaffordability of anti-D immunoglobulin, lack of anti-D prophylaxis in Rhesus negative women who have a potentially sensitizing events during pregnancy, unavailability of prophylactic immunoglobulin D following termination of pregnancy among Rhesus D negative women and unavailability of Feto -Maternal Haemorrhage (FMH) testing following potentially sensitizing events during pregnancy.

In this present study we observed that 5.2% of our female subjects of child bearing age were Rhesus D negative. These female are potentially at risk of HDFN and HTR if they are married to Rhesus positive men and carry Rhesus D positive pregnancies or are transfused with Rhesus D incompatible units in future. This alloantibody can potentially destroy her future baby's red cell and cause Rh D haemolytic disease of the foetus and newborn (HDFN). If a pregnant woman is known to have anti-D, the Rh D genotype of the foetus can be tested by analysis of foetal DNA in maternal plasma to assess the potential risk of Rh D - associated HDFN disease [42]. One of the major advances of twentieth century medicine was to prevent this disease by stopping the formation of anti-D antibodies by D negative mothers universally with an injectable prophylactic medication called Rho(D) immune globulin [43]. The development of clinically significant red cell alloantibodies complicates transfusion therapy and pregnancy outcome particularly among pregnant women. There are several challenges associated with management of alloantibodies particularly in sub Saharan Africa; testing of pregnant women for alloantibodies is often lacking; there is absence of universal access to prophylactic immunoglobulin D for the prevention of Rh isoimmunization in Rh D- negative women coupled with the absence of cost - effective means of estimating Feto Maternal Hemorrhage (FMH) in many African settings [44].

### Competing Interests

The authors declare that they have no competing interests.

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