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## ABO and Rhesus (D) Blood Group Distribution among Nigerians in Ojo Area, Lagos State, Nigeria

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### Abstract

ABO and Rhesus blood groups are known to vary from one population to another. They are the most clinically significant and prevalent blood group systems. Their relevance in blood transfusion science cannot be over emphasized. This study was designed for the purpose of updating information on the prevalence and distribution of ABO and Rh (D) blood groups among residents of Navy town, Ojo and its environs, Lagos State, Nigeria. ABO and Rhesus (D) phenotyping was carried out using standard tube techniques. Three thousand six hundred and four participants were recruited for this study. Gender distribution indicated that 2159 (59.9%) were females while 1445 (40.1%) were male. ABO blood group distribution indicated that 1868 (51.8%) were blood group O, 949 (26.3%) were blood group A, 657 (18.2%) group B and 130 (3.6%) were group AB. Of all the subjects tested, 3360 (93.3%) were Rh (D) positive while 244 (6.7%) were Rh (D) negative. The Rh D positive and Rh D negative distribution varied among the 4 ABO blood groups with O Rh D positive being the highest with 1786 (48.4%) while AB Rh D negative was the least with 6 (1.2%). The higher proportion of blood group O in this study is an advantage because blood group O blood that are negative for high titre anti A and B can potentially be transfused against ABO blood group barrier to group A, B and AB recipient. The low prevalence of Rh (D) negative blood group can also potentially reduce the incidence of Rhesus (D) - related haemolytic disease of the foetus and newborn in our environment particularly in the absence of universal access to prophylactic immunoglobulin D.

**Keywords:** ABO, Rhesus (D) blood group, Lagos, Ojo, Nigeria.

### Introduction

The ABO and Rh blood groups are among the most clinically significant blood group systems (Seeley *et al.*, 1998). Karl Landsteiner first described the ABO blood group in 1900, and it marked the beginning of blood banking and transfusion medicine (Ali *et al.*, 2005). Even after 100 years, the single most important test performed in blood banking services is the determination of ABO blood groups to avoid morbidity and mortality associated with transfusion of ABO incompatible units (Honig and Bore, 1980).

The classification of blood groups into type A, B, AB and O in ABO system as well as Rh (D) positive and Rh (D) negative in Rhesus blood group system is based on the presence or absence of group specific inherited antigenic substances on the surface of the red blood cells. The antigens may be proteins, carbohydrates, glycoproteins, glycolipids depending on the blood group system. The two significant blood group systems were discovered during early experiments with blood transfusions; the ABO group in 1901 and the Rhesus group in 1939 (Landsteiner and Weiner, 1940).

In the ABO blood group, individuals are classified into four major blood groups, A, B, AB and O, according to the presence of the antigens and agglutinins. Type A blood has type A antigens, type B blood has type B antigens, type AB blood has both types of antigens, and type O blood has neither A nor B antigens. In addition, plasma from type A blood contains type B antibodies, which act against type B antigens, whereas plasma from type B blood contains type A antibodies, which act against type A antigens. Type AB has neither type of antibody and

type O blood has both A and B antibodies (Seeley *et al.*, 1998).

The Rhesus blood group system is the second most clinically significant blood group system. The Rhesus (D) antigen is the most immunogenic of all the Rhesus antigens. This is due to its immunogenicity in Rh D negative individuals during pregnancy and blood transfusion (Pramanik and Pramanik, 2000). The higher, the proportions of Rh D negative in a population, the higher the incidence of haemolytic disease of the foetus and new born (HDFN) in that population. Before the introduction of immune-prophylaxis, 1% of HDFN was seen in all newborns which accounted for the death of one baby in every 2,000 births. But since the introduction of anti-D prophylaxis, death due to Rh (D) allo-immunization has reduced from 46 in 100,000 births to 1.6 in 100,000 births (Jeremiah, 2006).

Furthermore, the presence of Rhesus system was recognized in 1939 and it was confirmed within few years (Landsteiner and Weiner, 1940). Rhesus Blood group system emerged as the second most important blood group system due to its role in HDFN and in Rh D negative individuals in subsequent transfusions once they develop Rh antibodies (Dennis *et al.*, 1998). People are (D) positive if they have a certain Rh (D) antigen (the D antigen) on the surface of their erythrocytes, and Rh (D) negative if they do not have this Rh (D) antigen. Rhesus–D distribution also varies worldwide. Rh-D negative blood group is documented as 5.5% in South India, 5% in Nairobi, 4.8% in Nigeria, 7.3% in Lahore and 7.7% in Rawalpindi (Mwangi, 1999; Omotade *et al.*, 1999). About 95% of African – Americans are Rh (D) positive whereas indigenous Africans are virtually 100% Rh (D) positive. Rh incompatibility can pose a major problem in some pregnancies when the mother is Rh (D) negative and the foetus is Rh (D) positive (Avent, 1999). If foetal blood leaks through the placenta and mixes with the mother’s blood, the mother becomes sensitized to the Rh (D) antigen. The mother produces Rh (D) antibodies that can potentially cross the placenta and cause agglutination and haemolysis of foetal erythrocytes. This disorder is called Haemolytic disease of the foetus and newborn (HDFN), or erythroblastosis foetalis, and it may be fatal to the foetus (Dennis *et al.*, 1998).

Due to clinical significance of ABO and Rh (D) blood group in transfusion and compatibility testing, there is need for steady research to discover current status of ABO and Rhesus blood group system in our environment. This study was carried out to determine the current distribution of ABO and Rh

(D) blood groups among Nigerians in Navy town, Ojo, Lagos State, Nigeria .

## **Materials and Methods**

### **Study Area**

The study was carried out in the Medical Laboratory wing of the Nigerian Navy Reference Hospital (NNRH), Navy town, Ojo, Lagos State. The NNRH Ojo provides quality health care to naval personnel and their families at primary and secondary levels. It is the main referral hospital of the Nigerian Navy (NN). Additionally, its services are extended to members and families of Sister Services (Nigerian Army and Nigerian Airforce), the Police and other paramilitary organizations. Civilians within its neighborhood also benefit from her services as part of NN co-operate social responsibilities to the civil populace. Lagos is a conurbation in the Nigerian State. It is often regarded as the fastest growing city in Nigeria and also one of the most populous urban agglomerations in the world. (New York Times, 2014). Ojo area like other parts of Lagos metropolis is made up of a complex mix of people from various parts of Nigeria.

### **Study Design**

This prospective case study was carried out at the Medical Laboratory wing of the Nigerian Navy Reference Hospital (NNRH), Navy town, Ojo, Lagos State between June 2014 and June 2015. Participants gave verbal informed consent and were offered pre- and post-test counseling. Ethical approval was obtained from the ethical committee in the Hospital.

### **Collection of blood samples**

Blood samples were collected by venipuncture into ethylene di-amine tetracetic acid (EDTA) anti-coagulated tubes and used for the determination of ABO blood and Rh (D) blood groups among the 3604 subjects. Red cell phenotyping was carried out using standard tube techniques as described by Judd (1994) and Brecher (2002). 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 labeled 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 antigen. 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 blend serum (Bio Rad Medical Diagnostics, Germany) was placed in a clean labeled test tube and a drop of control placed in a second tube. 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 anti-globulin test (IAT) procedure (also for confirmation of weak D).

#### Statistical methods used for the analysis

The data was analyzed using Microsoft Office Excel 2007. Data were expressed as percentages and mean. A p-value of  $\leq 0.05$  constituted a statistical significance in all statistical comparisons.

#### Results

A total of 3,604 subjects were investigated in this study. Of these, 1868(51.8%) were blood group O, 949 (26.3%) were blood group A, 657 (18.2%) blood group B and 130 (3.6%) were blood group AB. Table 1 shows the percentage distribution of ABO blood groups based on gender. Gender distribution indicated that 59.9% were females while 40.1% were male. Of all the subjects tested, 3360 (93.3%) were Rh (D) positive while 244(6.7%) were Rh (D) negative. The distribution of Rh (D) group among the subjects is summarized in table 2. Table 3 shows the Rh (D) positive and Rh (D) negative distribution among the four (4) ABO blood groups. Blood group O Rh (D) positive was the predominant group 1786 (48.4%) while AB Rh (D) negative was the least predominant group 6 (0.2%).

**Table 1: Percentage distribution of ABO blood groups among the Subjects**

ABO Blood Group	N(%)	Gender	
		Male	Female
A	949 (26.3)	294 (8.2%)	655 (18.2%)
B	657 (18.2)	235 (6.5%)	422 (11.7%)
AB	130 (3.6)	88 (2.4%)	42 (1.2%)
O	1868 (51.8)	830 (40.1%)	1038 (28.8%)
<b>Grand Total</b>		1447 (40.1%)	2157 (59.9%)

**Table 2: Percentage distribution of Rhesus (D) blood groups among the subjects**

Rhesus (D) Group	N (%)
Rhesus (D) positive	3360 (93.3%)
Rhesus (D) Negative	244 (6.7%)
<b>Total</b>	3604 (100%)

**Table 3: Rhesus (D) blood group distribution among the ABO blood group**

ABO Blood Group	Rhesus (D) Positive	Rhesus (D) Negative
A	876 (24.3%)	73 (2.0%)
B	614 (17.0%)	43 (1.2%)
AB	124 (3.4%)	6 (0.2%)
O	1746 (48.4%)	122 (3.4%)
<b>Total</b>	3360 (93.3%)	244 (6.7%)

#### Discussion

The ABO blood group system is one of the most clinically important blood group systems because of the regular occurrence of antibodies of the blood group system and the ability of antibodies of the system to cause haemolytic transfusion reaction and haemolytic disease of newborn (HDN). Globally, the prevalence of ABO blood groups varies from race to race. From this study, the distribution of blood group O was the highest followed by blood group A, blood group B and blood group AB. This finding is

consistent with previous studies in other parts of Nigeria (Erhabor *et al.*, 2010; Jeremiah, 2006; Falusi *et al.*, 2000) which indicated that the prevalence of ABO blood groups followed a prevalence pattern (AB < B < A < O) among students of African descent in Port Harcourt, among students in the Niger Delta and among the Yoruba and Hausa ethnic groups, in five zones of Nigeria and in Ibadan respectively. However, our finding is however at variance with previous report among Guinean population in which the frequencies of the genes A,



B and O in the population were 14.70, 15.48 and 69.83 respectively (Loua *et al.*, 2007). In many other studies, blood group O has been found to be the most common blood group. Among the Caucasians in the United States, the distribution is type O, 47%; type A, 41%; type B, 9% and type AB, 3%. Among the Blacks in the United States, the distribution is type O, 46%; type A, 27%; type B, 20% and AB, 7% (Seeley *et al.*, 1998). Among Western Europeans 42% have group A, 9% group B, 3% group AB and the remaining 46% group O. Also, in Pakistan, blood group O is the most common (35%) followed by blood group B (33%), blood group A (23.5%) and blood group AB (8%). Thus, the segregation of the genes responsible for the ABO blood systems has always taken a particular pattern for its distribution with exceptional cases. For instance, in Nepal, where 'A' is the most common (34%) and 'O' is 1.5% (Pramanik and Pramanik, 2000). In Nigeria, in a study on 7653 individuals in Ogbomoso, Oyo State, 50% had O blood group; 22.9% had A blood group; 21.3% had blood group B and 5.9% had blood group AB (Bakare *et al.*, 2006). The higher proportion of blood group O in this study may be a potential advantage because some previous reports (Ali *et al.*, 2005; Avent, 1999) have shown that individual who are blood group O are less prone to severe malaria when compared with other blood groups (A, B & AB). The reason for less susceptibility to severe malaria attack among blood group O individuals may be due to mechanism of reduced rosettes formation by parasitized RBCs.

The Rhesus blood group system is the second most clinically significant red cell antigen system after the ABO blood group system. In this study, we observed that Rh (D) distribution also varies within any group of human population. The percentage of Rh (D) negative (6.7%) observed in our study is significantly lower than the prevalence rate of >14% Rh (D) negative phenotype observed among Caucasians (Cerny *et al.*; 2006). The risk of Rh (D) alloimmunization will be of a much smaller magnitude in our environment than it is in most Western countries where a significant proportion of the population lacks the major Rh (D) antigen. In such 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 (D) positive foetus is very high. Alloantibody D produced as a result of such immunization has serious clinical significance including HDFN and/or haemolytic transfusion reaction (HTR). Alloimmunization remains a key factor causing perinatal morbidity in most

developing nations despite the fact that the prevalence of Rh (D) negative phenotype is significantly lower among Africans compared to Caucasians. This may not be far-fetched from either one or all of the following reasons; lack of universal access and unaffordability of anti-D immunoglobulin, lack of access to anti-D prophylaxis in Rhesus (D) negative women who have a potentially sensitizing events during pregnancy (amniocentesis, cordocentesis, antepartum haemorrhage, vaginal bleeding during pregnancy, external cephalic version, abdominal trauma, intrauterine death and stillbirth, in utero therapeutic interventions, miscarriage, and therapeutic termination of pregnancy) (Erhabor *et al.*, 2013).

In this study, we observed that blood group O Rh(D) positive had the highest percentage frequency of 48.4% followed by group A Rh (D) positive with the percentage frequency of 24.3%, blood groups B Rh (D) positive was 17.0.6% and AB Rh (D) positive 3.4% respectively. Overall, the total percentage of Rh-D positive was 93.3% and that of Rh-D negative was 6.7%. This finding is consistent with previous report by Egesie and colleagues (2008) among non-Caucasians who 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 Igbo ethnic group of Eastern Nigeria (Ukajejiofor *et al.*, 1996). Other documented Rh-D positive rates includes; 95% in Port Harcourt (Jeremiah and Buseri, 2003), 96.6% in Nepal (Pramanik and Pramanik, 2000), 94% in Kenya (Mwangi, 1999), 93% in the Eastern region of Saudi Arabia (Bashwari *et al.*, 2001), 97.7% in West Bengal India (Mondal *et al.*, 2012), 95.94% in Guinea (Loua *et al.*, 2007) and 92.8% in Southwest of Saudi Arabia (Sarhan *et al.*, 2009).

### **Conclusion**

From this study, we observed that blood group O was the predominant ABO blood group. Rhesus (D) positivity was the most predominant Rhesus D blood group. The higher proportion of blood group O and Rhesus D positivity has several advantages. Firstly, blood group O blood that are negative for high titre anti A and B can potentially be transfused against ABO blood group barrier to group A, B and AB recipient thus facilitating the optimum utilization of our limited allogenic blood stock. Secondly, the low prevalence of Rh (D) negative blood group can also potentially reduce the incidence of Rhesus (D) -

related haemolytic disease of the foetus and newborn in our environment particularly in the absence of universal access to prophylactic immunoglobulin D during pregnancy particularly following a potentially sensitizing event.

Knowledge of the distribution of ABO and Rh (D) blood groups among any population provide useful information for genetic counseling, medical diagnosis, and also help in planning for future health challenges especially in blood transfusion.

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