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Frequency distribution of hemoglobin genotype, ABO and Rhesus blood groups among a cohort of pregnant women in Northern Nigeria

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Abstract

Hemoglobin variants, ABO and Rhesus blood groups are known to vary from one population to another. This study therefore sought the frequency of these indices among a cohort of pregnant women of African descent. The result will serve as a platform for instituting genetic counselling services with a view to reducing hemoglobinopathies and hemolytic diseases of newborns. One hundred and eighty two consenting pregnant women were recruited and screened for hemoglobin variants by standard alkaline cellulose acetate electrophoresis. ABO and Rhesus blood groups were determined by the hemagglutination technique. Of the 182 pregnant women screened, those with blood group O were the most prevalent (47.8%) followed by those with blood groups B (26.4%), A (19.2%) and AB (6.6%). Rhesus D antigen was positive for 86.3% and negative for 13.7% of the study population. This study reported the predominance of blood group O over the others. The prevalence of rhesus negative pregnant women was relatively very high (13.7%) compared to results from studies of unskewed populations in Nigeria. Also women with blood group B were found to be more being Rhesus negative than the others. Four types of hemoglobin genotypes were observed in this study. The most prevalent was HbAA (65.4%) followed by HbAS (32.4%) while HbSS and HbAC occurred with the same rate in the study population (1.1%). The relatively large number of rhesus negative pregnant women calls for close monitoring of pregnant women from this area because of the risk of developing moderate to severe forms of hemolytic disease of the new born. There was a low prevalence of sickle cells disease in this population (1.1%) although the prevalence of the sickle cell trait (32.4%) was above the earlier reported reference range for Nigeria. Therefore the culture of genetic counselling must be encouraged and sustained in the general population.

Key words: Pregnant Women, Blood Groups, ABO, Rhesus, Genotype, Hemoglobinopathies

Introduction

Although about 400 blood grouping antigens have been reported, ABO and Rhesus (Rh), the 1st and 4th to be discovered respectively, are the most frequently studied genetic markers in humans (Enosolease and Bazuaye, 2008). Apart from their importance in blood transfusion practice, they are useful in genetic studies of populations and also resolving medico-legal issues like disputed parentage (Enosolease and Bazuaye, 2008). Some studies have also reported their association with certain pathological conditions; for example a higher prevalence of stomach cancer among people with blood group A (Akhigbe et al., 2009) and higher vulnerability to malaria among those with hemoglobin genotype HbSS (Uzoegwu and Onuorah, 2003). Hematological studies have shown variations in different geographic locations, thus reflecting the underlying ethnic and genetic diversity of human populations (Khan et al., 2009).

Blood groups are based on antigens that are located on red blood cell (RBC) membranes and are coded by alleles on different loci on a chromosome. Individuals are divided into 4 major blood groups namely A, B, AB and O groups depending on the antigen present on their RBCs (Conteras and Lubenko 2001; Knowles and Poole, 2002). Type A blood has type A antigens and type B antibodies while type B blood has type B antigens and type A antibodies. Blood type AB has both A and B antigens and none of their antibodies while type O blood has neither A nor B antigens but both A and B antibodies. These groups are not equally distributed among humans. In most cases group O predominates followed by group A (Adeyemo and Soboyejo, 2006). The human red blood cells that carry antigen D are referred to as Rhesus positive (Rh+) while those without it are Rhesus negative (Rh-;

Conteras and Lubenko, 2001). This antigen is immunogenic inducing an immune response in 80% of D negative (D-) individuals when transfused with D-positive blood. It is also a major cause of hemolytic disease of newborns (Egesie et al., 2008). Generally only a few percentages of humans are Rh-ve. This condition has been reported to be 5.5% in South India, 5% in Nairobi, 4.8% in Nigeria and 7.7% in Rawalpindi (Adeyemo and Soboyejo, 2006). ABO and Rhesus blood groups are known to be clinically very important. Their frequencies give an insight into the underlying genetic and ethnic diversity of human population (Khan et al., 2009). Another important blood component is the hemoglobin genotypes that determine hemoglobino-pathies. Hemoglobin is the oxygen carrying pigment of the red blood cells. Defects in its genes can produce abnormal hemoglobin which leads to conditions known as hemoglobinopathies. Hemoglobin genotypes include the normal hemoglobin and the most occurring referred to as hemoglobin A (HbA) genotype and other abnormal ones like hemoglobin S (HbS), which is a variant form of hemoglobin. The variation is in the β – chain gene, causing a change in the properties of hemoglobin which results in sickling of red blood cells. Another variant is hemoglobin C (HbC), which also occurs as a result of a variation in the β-chain gene. This variant causes a mild chronic hemolytic anaemia. The heterozygous hemoglobin of most individuals is HbAA (normal), with other variants like HbAS (sickle cell trait), HbSS (sickle cell disease), HbAC (a normal gene and another that causes chronic hemolytic anemia) and HbSC (a sickle cell gene and another that causes chronic hemolytic anemia). These variants cause moderate to severe hemolytic anemia leading to high degree of morbidity and mortality (Akhigbe et al., 2009; Patel et al., 2009). Although heterozygotes are symptoms free, they present specific hematological characteristics that are useful for their identification (Erhabor et al., 2010).The World Health Organization (WHO) figures estimate that 6% of the world population is a carrier for hemoglobin disorders (Patel et al., 2009). The highest prevalence of sickle cell disorder is found among people of African or Caribbean descent and may occur among those from the Eastern Mediterrenean, Middle East, India and Pakistan (Erhabor et al., 2010).

The clinical relevance of all these is manifested in cases of incompartibility where alloantibodies cause the destruction of transfused red blood cells, cross the placenta resulting in the hemolytic disease of the newborn or result in offsprings with genetically inherited diseases like sickle cell conditions. The result of this study will therefore form the basis for providing genetic counseling services to mothers on matters that concern crucial decisions like whether or not to have more children and preparation for another pregnancy. Knowledge of the ABO blood group is crucial in blood transfusion procedures. This in turn will help reduce hemoglobinopathies and hemolytic diseases to be reflected by a drop in morbidity and mortality from such conditions in the population. Although a lot of studies have been carried out on genotype, there is dearth of published reports from Northern Nigeria on ABO and Rhesus blood group of Nigerians population. Therefore, this study was designed to investigate the ABO and Rhesus blood group of Nigerians pregnant females.

Materials and Methods

A total of 182 consenting pregnant women were selected randomly from pregnant women accessing antenatal care from a Federal Medical Center in Northern Nigeria. Using a disposable needle and syringe, 2ml of blood was collected from each participant by venipuncture and transferred into a labeled ethylenediamine tetraacetic acid (EDTA) containing bottle.

For the ABO and Rh blood group determination, a drop of blood from each subject was dropped on a clean white tile in 3 places in a row. A drop of anti A, anti B, and D (from Biotech Laboratories monoclonal, UK) was added respectively and mixed with each blood sample using glass rods. Blood groups were determined on the basis of agglutination of test serum by the respective antiserum.

Genotypes were determined using the cellulose acetate electrophoresis technique. A small quantity of blood was placed on a tile and mixed with two drops of water to lyse. With the aid of an applicator, the hemolysate was placed on the cellulose acetate paper and electrophoresced in Tris buffer solution for 15-20 minutes at 230v. Hemolysates from blood samples of known hemoglobin genotypes were run as control.

Results

One hundred and eighty two pregnant women participated in this study. Of these, 111 (60.99%) were from Keffi town while 71 (39.01%) came from the surrounding villages. The most predominant ABO blood group was group O which occurred in 87 (47.8%) of the participants while the least occurring was blood group AB which occurred in only 12 (6.6%) of the participants. On the whole 157 (86.3%) of these women were rhesus antigen positive and 25 (13.7%) were rhesus antigen negative. The normal homozygous hemoglobin gene (HbAA) was most prevalent and occurred in 119 (65.4%) of the pregnant women. (Table1).

Table 1: Distribution of genotypes, ABO and Rhesus blood groups among a cohort of pregnant women in Northern Nigeria

Blood grouping	Blood group				
	A	B	O	AB	Total
ABO grouping	35(19.2%)	48(26.4%)	87(47.8%)	12(6.6%)	182(100%)
Rh grouping Positive	32(91.4%)	39(81.3%)	75(86.2%)	11(91.7%)	157(86.3%)
Negative	03(8.6%)	09(18.7%)	12(13.8%)	01(8.3%)	25(13.7%)
Genotype	HbAA	HbAS	HbSS	HbAC	
	119	59	2	2	
	(65.4%)	(32.4%)	(1.1%)	(1.1%)	

Discussion

From this study blood group O was the most predominant group, occurring in 47.8% of the participants. It occurred about 8 times the frequency of group AB (6.6%) which occurred the least. The blood group frequencies with respect to ABO in this study can be represented as O>B>A>AB. Although the distribution of ABO blood groups varies from one population to the other, in most studies blood group O has been reported as the predominant group. For example among the Caucasians and blacks in United States it was reported as 47.0% and 46.0% respectively (Seeley et al., 1998). However, in Nepal, group A has been reported as the most prevalent (Pramanik and Pramanik, 2000) while in Pakistan, a study showed the predominance of group B (Hameed et al., 2002).

The findings from this study are in agreement with other studies in Nigeria which also reported group O as the most prevalent and group AB as the least. Bakare et al. (2006) noted group O prevalence as 50% and AB as 5.9%, while Oluwadare and Shonekan (2008) reported group O in 53% and AB in 3.9% of their participants. Group O prevalence of 55% and AB of 2.7% was reported by Adeyemo and Soboyejo (2006). Even more recent studies from other parts of Nigeria have still reported the predominance of group O over the other blood groups with group AB being the least prevalent (Akhigbe et al., 2009; Erhabor et al., 2010; Gali et al., 2010). In a study among people living with HIV and AIDS, group O was reported in 50.6% and AB in 11.7% as the most and least prevalent blood groups respectively (Abdulazeez et al., 2008). Although this is a cohort of only females and not a true representation of the general population, the blood group distribution is similar to those reports for the general population. This may imply that gender is not associated with ABO blood group distribution in a population.

The frequency of the Rhesus blood grouping antigen was found in 86.3% of the obstetric population while the remaining 13.7% were Rhesus negative. This finding agrees with studies from other parts of Nigeria which reported positivity of 96.7% (Jeremiah, 2006), 94% (Adeyomo and Soboye, 2006), 97.7% (Bakare et al., 2006), 93.2% (Akhigbe et al., 2009) and 93% (Erhabor et al., 2010). The prevalence of Rh negative in this study was relatively high because most of the Nigerian studies reported 3.2-7% in the general population (Jeremiah, 2006; Bakare et al., 2006; Adeyomo and Soboyejo, 2006; Akhigbe et al., 2009; Erhabor et al., 2010). However, even in a similar cohort it was 4.4% (Jeremiah, 2005).This is the first report of a cohort with such a high prevalence of Rhesus negative individuals. This is alarming because of its implication in the hemolytic disease of the newborns. This calls for health education programs for women of child bearing age especially as it concerns the outcome of pregnancies in a situation of Rhesus incompatibility and the inclusion of such a test at all levels of antenatal care. Women were found to be more vulnerable to being Rhesus negative if their blood group was group B (18.7%) followed by those with blood group O (13.8%) and least among those with blood groups A (8.6%) and group AB (8.3%) (Table 1).

Hemoglobin genotypes, HbAA, HbAS, HbSS, and HbAC, were reported in this population with a frequency of 65.4% 32.4%, 1.1% and 1.1%% respectively (Table 1). However, other studies in Nigeria have reported the presence of 3–6 genotypes (Jeremiah, 2005; Bakare et al., 2006; Adeyomo and Soboyejo 2006; Akhigbe et al., 2009; Erhabor et al., 2010). The normal hemoglobin (HbAA) prevalence ranges from 55-75% while the sickle cell trait (HbAS) is 20-30% in Nigeria (Adeyemo and Soboyejo, 2006; Egesie et al., 2008). Although it is within the range reported for Nigeria, the HbAA frequency in this study was lower than that observed by other researchers who reported 71.02% (Oluwadare and Shonekan, 2008) 68% (Bakare et al., 2006) 70% (Adeyemo and Soboyejo 2006), 75% (Nwaopara et al., 2009) and 66% (Egesie et al., 2008). Conversely, the prevalence of the sickle cell trait in this cohort (32.4%) was slightly above that reported for the general population in the country (Adeyemo and Soboyejo, 2006; Egesie et al., 2008).

The low prevalence of hemoglobin variants especially the HbSS which is reported to be high in Nigeria (Erhabor et al., 2010) and the very high prevalence of HbAA imply that the sickling gene pool is gradually shrinking thus lowering the occurrence of hemoglobinopathies in the populations. Probably more

people are listening to the voice of reason by the numerous genetic counselling facilities in place. While the high prevalence of Rhesus positives in the obstetrics population is clarion call for effective antenatal care and management of such women in the general population.

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