



Trends in  
**Medical Research**

ISSN 1819-3587



Academic  
Journals Inc.

[www.academicjournals.com](http://www.academicjournals.com)

## Prevalence of Haemoglobin Variants, ABO and Rhesus Blood Groups in Ladoke Akintola University of Technology, Ogbomoso, Nigeria

<sup>1</sup>R.E. Akhigbe, <sup>1</sup>S.F. Ige, <sup>1</sup>A.O. Afolabi, <sup>1</sup>O.M. Azeez,

<sup>2</sup>G.J. Adegunlola and <sup>3</sup>J.O. Bamidele

<sup>1</sup>Department of Physiology,

<sup>2</sup>Department of Biochemistry,

<sup>3</sup>Department of Community Medicine, College of Health Sciences,  
Ladoke Akintola University of Technology, Oyo State, Nigeria

**Abstract:** In view of the association of various haemoglobin genotypes and blood groups with different pathological conditions and the risk of alloimmunization from allogeneic blood transfusion seen in patients with sickle cell disease, the incidence of haemoglobin variants, ABO and Rhesus (Rh) blood groups in Ladoke Akintola University of Technology (LAUTECH), Nigeria, was assessed. This is a retrospective study using medical records of 1122 students (between 18-25 years old) of LAUTECH. Out of the 1122 students, 71.03% were HbAA, 22.19% HbAS, 5.26% HbAC, 0.54% HbSS, 0.80% HbSC and 0.18% HbCC. No incidence of HbSS, HbSC and HbCC in male. The frequencies of A, B, AB and O blood groups were 21.30, 22.73, 2.85 and 53.12%, respectively. The 93.32% were Rhesus positive (Rh<sup>+</sup>), while the remaining 6.68% were Rhesus negative (Rh<sup>-</sup>). Results from this study show a low prevalence of abnormal haemoglobin variants. Blood group O was most predominant, while blood group AB was least dominant. In conclusion, this study shows that there is a decline in the prevalence of haemoglobinopathies in the studied area. Also, routine haemolysin test should be conducted on every group O blood before blood transfusion to reduce the risk of transfusion reaction since some group O blood, which is the predominant blood group, is known to contain immune haemolytic antibodies.

**Key words:** Haemoglobin genotype, haemoglobin variant, blood group

### INTRODUCTION

Haemoglobin is the oxygen-carrying pigment of the Red Blood Cells (RBCs). It is a chromoprotein that contains four heme groups, which are the pigment-containing part and globin, the protein part. A molecule of haemoglobin contains four polypeptides globin chains:  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\delta$  chains. Haemoglobin genotypes are inherited characters determined by different combinations of these chains. They include Hb AA, HbAS, HbAC, HbSC, HbSD, HbSE and HbSS. HbS differs from HbA by the substitution of valine, a neutral amino acids at position 6 in the  $\beta$ -chains, while HbC differs from HbA by the substitution of lysine, a basic amino acid, for glutamic acid at position 6 in the  $\beta$ -chains (Weatherall, 2001; Okpala *et al.*, 2002; Hoffbrand *et al.*, 2006). Haemoglobinopathies are inherited disorders of haemoglobin, which are genetically transmitted and are due to a single mutant gene. They are due to genetic mutation leading to structural variation in the peptide chain of the globin

**Corresponding Author:** R.E. Akhigbe, P.O. Box 944, Ilorin, Kwara State, Nigeria

portion of haemoglobin. Haemoglobinopathies are the commonest genetic disorder of 7% of the world's population being carriers (Weatherall, 2001). Statistics show that about 300,000 children are born with Sickle Cell Disease (SCD) worldwide annually (Okpala *et al.*, 2002). Haemoglobinopathies include HbAS, HbAC, HbSC, HbSD, HbSE and HbSS.

Blood groups are groups of antigens that are located on the red cell membranes and are coded by alleles at different loci on a chromosome. Although, about 400 blood grouping antigens have been reported, ABO and Rh which were the 1st and 4th to be discovered respectively, are the most important. The ABO system derives its importance from the fact that A and B are strongly antigenic and anti A and anti B occur naturally in the serum of persons lacking the corresponding antigen, these antibodies being capable of producing hemolysis *in vivo*. Individuals are divided into four major blood groups: A, B, AB and O, depending on the antigens present on RBC (Pramanik and Pramanik, 2000; Conteras and Lubenko, 2001). An individual of type A blood group raises anti-B antibodies against B-blood group RBCs if transfused with blood from B group, with resultant lysis of the RBCs. This is due to the presence of isoantibodies against nonself blood group antigen. The same happens for B and O blood groups. AB does not have an anti-A and anti-B isoantibodies because A and B antigens are present on the RBC and are both self antigens.

The human RBCs that contain antigen D are known as rhesus positive (Rh<sup>+</sup>), while those without antigen D in their RBCs are rhesus negative (Rh<sup>-</sup>) (Conteras and Lubenko, 2001; Knowles and Poole, 2002). The D-antigen is immunogenic and induces an immune response in 80% of D-negative individuals when transfused with 200 mL of D-positive blood (Mollison *et al.*, 1997). This also occurs in pregnancy resulting in haemolytic disease of the newborn, HDN (Knowles and Poole, 2002).

Many studies have associated abnormal haemoglobin and blood group systems with different disease condition in different parts of the world. Studies have revealed that dominant homozygotes (HbAA) are more susceptible to plasmodial parasite infection than sickle heterozygotes (HbAS), while recessive homozygotes (HbSS) are most vulnerable to malaria than the other two members of genotypic groups (Uzoegwu and Onwurah, 2003).

Studies also showed that stomach cancer have a higher prevalence rate among group A population than the rest ABO blood groups (You *et al.*, 2000). Similarly, results of a research study in Yola, Nigeria, showed that blood group AB recorded the highest rate of HIV-2 infection and the least prevalence of HIV-1 whereas seroprevalence of HIV sero-type was significantly higher among rhesus D positive subjects than their rhesus D negative counterparts (Abdulazeez *et al.*, 2008).

Since, haemoglobin genotypes, ABO and Rh blood groups have been associated with different pathological conditions, it is necessary to know the prevalence of haemoglobin genotypes and blood groups. Several studies in different regions across the globe have revealed variations in the incidence of abnormal haemoglobin variants, ABO and Rh blood groups.

This study was designed to assess the changing trends in the prevalence of haemoglobin genotypes, ABO and Rh blood groups for database purposes using LAUTECH, Ogbomoso, Nigeria, as the studied area.

## **MATERIALS AND METHODS**

### **Study Area**

The study was carried out in Ogbomoso, Oyo State, Nigeria. The study was conducted in Ladoke Akintola University of Technology Medical Centre.

### Selection of Subjects

The participants were mainly students of the university. A total of 1122 subjects, which included 573 males and 549 females of comparable age range, between 18 and 25 years, were selected. The medical records of these students were used. The Medical and Ethical Committee of the LAUTECH Medical Centre approved the research study.

## RESULTS AND DISCUSSION

Hb genotypes AA, AS, AC, SS, SC and CC were seen in the study population and their incidences were 71.03, 22.19, 5.26, 0.54, 0.80 and 0.18%, respectively. No incidence of SS, SC and CC in male (Table 1), thus showing sex-specific prevalence of SS, SC and CC in female.

Blood group O was found to be the most frequent (53.12%) among the study population, while blood group AB was least prevalent (2.85%). The prevalence of blood group A and B were 21.03 and 22.73%, respectively (Table 2). The gene frequencies with respect to ABO can be shown as: O>B>A>AB.

In Rhesus blood grouping, 93.32% of the study population was Rh<sup>+</sup>, while the remaining 6.68% was Rh<sup>-</sup> (Table 2).

With respect to both ABO and Rhesus blood grouping systems, the prevalence of blood group A<sup>+</sup>, A<sup>-</sup>, B<sup>+</sup>, B<sup>-</sup>, AB<sup>+</sup>, AB<sup>-</sup>, O<sup>+</sup> and O<sup>-</sup> were 20.05, 1.25, 20.86, 1.87, 2.58, 0.27, 49.82 and 3%, respectively with blood group O<sup>+</sup> most prevalent (49.82%) and AB least prevalent (0.27%). The gene frequencies with respect to ABO and Rhesus systems can be shown as: O<sup>+</sup> > B<sup>+</sup> > A<sup>+</sup> > AB<sup>+</sup> > O<sup>-</sup> > B<sup>-</sup> > A<sup>-</sup> > AB<sup>-</sup> (Table 3). These gene frequencies with respect to ABO and Rhesus systems were similar as for only ABO system. Gender had no significant effect on the incidence of ABO and rhesus blood group systems (Table 2, 3).

Several studies have shown the prevalence of HbSS among the black population. Sinou (2003), reported the incidence of HbSS in Africa to be 1-10%, while that of HbAS was 15-30.5%. He also reported the prevalence of HbAS in West Africa and Nigeria to be 5 and 40.5%, respectively.

Table 1: Prevalence of haemoglobinopathy genes among students in Ogbomoso, Nigeria

Gender/Hb genotype	AA	AS	AC	SS	SC	CC	Total
Male	407.00	141.00	25.00	-	-	-	573
Female	390.00	108.00	34.00	6.00	9.00	2.00	549
Total	797.00	249.00	59.00	6.00	9.00	2.00	1122
Percentage	71.03	22.19	5.26	0.54	0.80	0.18	

Table 2: Distribution of blood antigens in the study population

Gender/blood group	ABO blood group				Total	Rhesus factor		Total
	A	B	AB	O		Rh <sup>+</sup>	Rh <sup>-</sup>	
Male	121.00	136.00	17.00	299.00	573	540.00	33.00	573
Female	118.00	119.00	15.00	297.00	549	507.00	42.00	549
Total	239.00	255.00	32.00	596.00	1122	1047.00	75.00	1122
Percentage	21.30	22.73	2.85	53.12		93.32	6.68	

Table 3: Prevalence of various blood groups (ABO and Rh) in the study population

Gender/blood group	A <sup>+</sup>	A <sup>-</sup>	B <sup>+</sup>	B <sup>-</sup>	AB <sup>+</sup>	AB <sup>-</sup>	O <sup>+</sup>	O <sup>-</sup>	Total
Male	116.00	5.00	128.00	8.00	15.00	2.00	281.00	18	573
Female	109.00	9.00	106.00	13.00	14.00	1.00	278.00	19	549
Total	225.00	14.00	234.00	21.00	29.00	3.00	559.00	37	1122
Percentage	20.05	1.25	20.86	1.87	2.58	0.27	49.82	3	

In this study, the frequencies of HbAA, HbAS and HbAC were 71.03, 22.19 and 5.26%, respectively. The HbSS, HbSC and HbCC did not occur in male among the participants of this study. However, among the female participants, the prevalence of HbSS was 0.54%, HbSC was 0.80% and HbCC was 0.18%.

Results of this study are similar to previous studies (Moormann *et al.*, 2003; Zacheaus, 2006), where the incidence of HbSS was zero. It is also in consonance with previous studies that reported the prevalence of HbSS, HbSC and HbCC to be 3, 2 and 0.3%, respectively (Bakare *et al.*, 2004). A study also reported the prevalence of HbSS and HbAC to be 4 and 1%, respectively (Nwafor and Bamigo, 2001). Similar results were reported where the incidence of AA, AS, AC, SS, SC and CC were 69.35, 36.94, 0.12, 3.54, 0.02 and 0.01%, respectively (Uzoegwu and Onwurah, 2003). The low prevalence of abnormal haemoglobin variants observed in this study and in previous studies (Moormann *et al.*, 2003; Zacheaus, 2006) show that the prevalence of sickle cell gene is reducing in Nigeria and in Africa.

The prevalence of HbAS in this study is similar to the values of Sinou (2003). The decline in the incidence of haemoglobinopathies seen in this study may be associated to increased awareness of the sickle cell anaemia, increased response of people to genotyping prior marriage and childbearing, increased prenatal diagnosis of genetic haemoglobin disorders and improved socio-economic conditions. The sex-specific prevalence of HbSS, HbSC and HbCC in female could suggest that inheriting the homozygous state for HbSS, HCC and in combination, HbSC, is sex-linked.

The incidence of ABO blood groups reported by many researchers in different parts of the world has shown some inconsistencies, however the prevalence of Rhesus antigens has been consistent.

The results from this study shows that blood antigen O predominate those of all other blood antigens. This is in agreement with previous reports (Geatner *et al.*, 1994; Uzoegwu and Onwurah, 2003; Zacheaus, 2006; Odokuma *et al.*, 2007; Lova *et al.*, 2007; Abdulazeez *et al.*, 2008; Epid *et al.*, 2008). However, this is not in agreement with some studies that showed that blood antigen B predominates (Hameed *et al.*, 2002; Mohammed *et al.*, 2004). Blood group AB exhibited the least incidence in this study. This is in agreement with all previous studies cited. The results from this study showed that the frequencies of ABO system is in the order of O > B > A > AB as reported in previous studies (Mwangi, 1999). However, this is not in consonance with some other studies that reported the frequencies of ABO blood system in the order of O > A > B > AB (Geatner *et al.*, 1994; Zacheaus, 2006; Odokuma *et al.*, 2007).

The results of the study may suggest that there is a positive correlation between the prevalence of ABO blood group and geographic location.

The incidence of Rhesus D antigen in this study was 93.32%. This is in agreement with all previous studies cited. The low incidence of Rhesus negative antigen observed in this population (6.68) is an interesting finding as low Rhesus negative incidence among females in the study population could permit only very limited Rhesus-mismatched marriages among couples, which could generate less haemolytic disease of newborn associated with such marriages. In this study, gender shows no influence on ABO and Rhesus blood groups.

## **CONCLUSION AND RECOMMENDATION**

Results from this study shows that blood group O is predominant over other blood groups, while AB remains the least prevalent and Rh<sup>+</sup> significantly preponderant. Since, some

group O blood is known to contain immune haemolytic antibodies, routine haemolysin test should be conducted on every group O blood before blood transfusion to reduce the risk of transfusion reaction.

Since, blood groups and haemoglobin genotypes have been reported by many researchers in different parts of the world as factors predisposing some pathological conditions, further study on the association between blood group, haemoglobin genotype and disease conditions is therefore recommended.

#### **ACKNOWLEDGMENTS**

The co-operation of all members of staff of LAUTECH Medical Centre, especially Dr. Adegbosin (Medical Director, LAUTECH Medical Centre) and Mr. Ayano Amao Taiwo (Chief Laboratory Scientist, LAUTECH Medical Centre) is much appreciated.

#### **REFERENCES**

- Abdulazeez, A.A., E.B. Alo and S.N. Rebecca, 2008. Carriage rate of human immunodeficiency virus (HIV) infection among different ABO and Rhesus blood groups in Adamawa State Nigeria. *Biomedical Res.*, 19: 41-44.
- Bakare, A.A., M.A. Azeez and J.O. Agbolade, 2004. Gene frequencies of ABO and Rhesus blood groups and hemoglobin variants in Ogbomoso, South-West, Nigeria. *Global J. Med. Sci.*, 3: 17-22.
- Conteras, M. and A. Lubenko, 2001. Immunohaematology: Introduction. In: *Postgraduate Haematology*, Hoffbrand, A.V., S.M. Lewis and E.G.D. Tuddenham (Eds.). 4th Edn., Arnold Publishers, London, UK., pp: 165-181.
- Epid, T.T., C.D. Nwani and N.P. Ugorji, 2008. Prevalence of malaria in blood donors in Abakaliki Metropolis. Nigeria. *Sci. Res. Essays*, 3: 162-164.
- Geatner, H., J. Lyko and S. Lyko, 1994. The antigens ABO and Rh(D) in Nigeria population. *Handard Medicus*, 37: 81-91.
- Hameed, A., H. Wajahat, A. Janbaz, R. Fazli and Q. Javed Anver, 2002. Prevalence of phenotypes and genes of ABO and rhesus (Rh) blood groups in Faisalabad, Pakistan. *Pak. J. Biol. Sci.*, 5: 722-724.
- Hoffbrand, A.V., P.A.H. Moss and J.E. Petit, 2006. Genetic Disorders of Haemoglobin: *Essential Haematology*. 5th Edn., Blackwell Publishing Ltd., UK., pp: 72-93.
- Knowles, S. and G. Poole, 2002. Human Blood Group Systems. In: *Practical Transfusion Medicine*. 1st Edn., Blackwell Science, London, UK., pp: 24-31.
- Lova, A., M.R. Lamal, N.Y. Haba and M. Camara, 2007. Frequency of blood groups ABO and rhesus D in the Guinea population. *Transfus Clin. Biol.*, 14: 435-439.
- Mohammed, S.K., S. Fazli, T. Faheem and M.K. Birjees *et al.*, 2004. Prevalence of blood groups and Rh factor in Bannu region (NWFP) Pakistan. *Pak. J. Med. Res.*, 43: 1-3.
- Mollison, P.L., C.P. Engelfriet and M. Contreras, 1997. *Blood Transfusion in Clinical Medicine*. Blackwell Science, England,.
- Moormann, A.M., P.E. Emburry, J. Opondo, O.P. Sumba, J.H. Ouma, J.W. Kazura and C.C. John, 2003. Frequencies of sickle cell trait and glucose-6-dehydrogenase deficiency differ in highland and nearby lowland malaria-endemic areas of Kenya. *Trans. R. Soc. Trop Med. Hyg.*, 97: 513-514.
- Mwangi, J., 1999. Blood group distribution in an urban population of patient targeted blood donors. *East Afr. Med. J.*, 76: 615-618.

- Nwafor, A. and B.M. Bamigo, 2001. A comparison of measured and predicted hemoglobin genotype in a Nigerian population in Bonny, Rivers State, Nigeria. *J. Applied Sci. Environ. Manage.*, 5: 79-81.
- Odokuma, E.I., A.C. Okolo and P.C. Aloamaka, 2007. Distribution of ABO and Rhesus Blood groups in Abraka. Frequency of blood groups ABO and rhesus D in the Guinea population. *Nig. J. Physiol. Sci.*, 22: 89-91.
- Okpala, I., V. Thomas, N. Westierdale, T. Jegede and K. Ray *et al.*, 2002. Comprehensive care of sickle cell disease. *Eur. J. Haematol.*, 68: 157-162.
- Pramanik, T. and S. Pramanik, 2000. Distribution of ABO and Rh blood groups in Nepalese medical students: A report. *East Mediterr. Health J.*, 6: 156-158.
- Sinou, M.T., 2003. Antenatal screening of sickle cell disease. 8th postgraduate course for training in Reproductive Medicine and Reproductive Biology, Cameroon. [http://www.gfmer.ch/Endo/PGC\\_network/antenatal\\_screening\\_sickle\\_cell\\_Tchana.htm](http://www.gfmer.ch/Endo/PGC_network/antenatal_screening_sickle_cell_Tchana.htm).
- Uzoegwu, P.N. and A.E. Onwurah, 2003. Prevalence of hemoglobinopathy and malaria diseases in the population of old Aguata Division, Anambra State, Nigeria. *Biokemistri*, 15: 57-66.
- Weatherall, D.J., 2001. Genetic Disorders of Haemoglobin. In: *Post-graduate Haematology 4th Edn.*, Hoffbrand, A.V., S.M. Lewis and E.G.D. Tuddenham (Eds.). Arnold Publishers, London, UK., pp: 91-119.
- You, W.C., J.L. Ma, W. Liu, M.H. Gant and Y.S. Chang *et al.*, 2000. Blood type and family cancer history in relation to precancerous gastric lesions. *Int. J. Epidemiol.*, 29: 405-407.
- Zaccheaus, A.J., 2006. Abnormal haemoglobin variants, ABO and Rh groups among student of African descent in Portharcourt. *Africa Health Sci.*, 6: 177-181.