

Comparative ABO blood group and rhesus factor distribution between homogenous and heterogenous populations in South Eastern Nigeria



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ABSTRACT

Background: The ABO blood group and Rhesus (Rh) factor remain the most important blood group in transfusion medicine. Knowledge of ABO and rhesus blood group distribution within a population is indispensable for transfusion medicine, clinical and marriage counselling.

Aims and Objectives: The objectives of this study were to provide data and compare the pattern of ABO and rhesus blood group distribution between a homogenous and a heterogenous population. **Material and Methods:** Blood was collected from 352 University students representing a heterogenous population and 235 primary school pupils in a local community representing homogenous population. The ABO and rhesus blood groups were determined using white tile and agglutination methods. **Results:** Among the 352 and 235 individuals studied in UNN and HFNP, blood groups O had the highest frequency with 54.80% and 51.06% respectively while blood group AB had the least frequency of 4.50% and 3.40% in UNN and HFNP respectively. Rhesus positive had the highest frequency of 88.63% and 95.33% while rhesus negative had the frequencies of 11.35% and 4.68% in UNN and HFNP respectively. Rhesus negative was highest among females in UNN 26 (7.37%) while males had the highest rhesus negative 7 (2.98%) in HFNP. In both study populations, there was no significant difference in ABO and rhesus blood group distribution between the males and females ($P > 0.05$). **Conclusions:** A homogenous population is associated with low prevalence of rhesus negative compared to a heterogenous population.

Key words: ABO; Rhesus factor; Blood transfusion

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INTRODUCTION

The discovery of ABO blood groups and rhesus factor (Rh) has been a tremendous breakthrough in transfusion and clinical medicine. Four principal blood groups are recognized and include A, B, AB, and O¹ while rhesus factor can be positive or negative in each individual. The ABO and rhesus blood group systems vary in distribution according to ethnicity, races, socio-economic groups and populations² but remains the same during one's lifetime.

Although 100% heritable, environment potentially can play a role in determining the blood type in a population that will be transmitted more frequently to the next generation through natural selection.³

ABO and rhesus blood groups are the most clinically important of all blood groups since their discovery in 1901 and 1939 respectively.⁴ They are of utmost importance in transfusion medicine particularly but not limited to haemolytic transfusion reactions and haemolytic disease

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of the newborn.⁴ They are applied in studies of human population genetics, forensic studies, clinical studies, and blood transfusion.^{5,6} Knowledge of ABO and rhesus blood group distribution in a particular area is crucial for effective management of blood bank⁶ and in medical counselling.

Clinically, ABO blood groups have been associated with certain ailments and disorders. ABO play vital role in immunohaematology, and other human ailments such as neoplastic, cardiovascular and infectious disorders.⁷ With respect to pancreatic cancer, blood group A has been found to be more prone to pancreatic cancer than blood groups B, AB, and O.⁸ In addition, individuals with non-O blood group have increased risk of developing gastric cancer^{9,10}, lung cancer¹¹, and arterial and venous thromboembolic diseases.¹² Similarly, 9% of cardiovascular deaths have been suggested to be as a result of having a non-O blood type.¹³

In Chinese population, it has been found that men with blood type B had a lower risk of developing gastrointestinal and bladder cancers when compared to those with blood group A, on the other hand, those with AB blood group have a high risk of having liver cancer.¹⁴ In Iraq, blood pressure and levels of some body fluids like glucose and cholesterol have been found to be higher in patients with blood group O with a trend decreasing from A, B, and AB.¹⁵ Individuals with blood group O also have higher risk of suffering from malaria and some other infectious diseases such as cholera¹⁶, while individuals with blood group A have been found to have a reduced risk for Congenital Heart Disease (CHD).¹⁷

Problems with rhesus factor arises when an rhesus negative person receives an rhesus positive blood in transfusion. Such condition also occur when a woman with rhesus negative blood type carries a foetus with rhesus positive blood¹⁸ resulting inhaemolytic disease of the newborn (HDN) or erythroblastosis foetalis.¹⁹

The frequency of rhesus positive and rhesus negative in some countries have been found to correlate positively and negatively respectively with the incidence of some health disorders in the countries.^{20,21} The higher the prevalence of rhesus negative among females in a population, the higher the occurrence of haemolytic disease of the newborn in the given population.²² Individuals with rhesus negative blood type are more prone to allergic, digestive, heart, haematological, immunity, mental health and neurological problems.²⁰

The knowledge of ABO and rhesus blood groups have been applied in Nigeria mainly in blood transfusion and marriage counselling. However, with a body of published works on association of ABO blood groups

and rhesusnegative blood types with some diseases and disorders, knowledge of ABO and rhesus blood group distribution in a particular population could be extended to include selection to reduce or eliminate the incidence of cardiovascular diseases, diabetes, cancer, mental illnesses and some other disorders which some family lineages have been associated with for a number of generations.

Distribution of ABO and rhesus blood groups have been studied in different parts of Nigeria. However, except for Falusi *et al*²³ who studied ABO and rhesus blood groups among different ethnic groups in Nigeria and Olaniyan *et al*³ who studied ABO and rhesus factor among indigenes of the Federal Capital Territory, all other studies in Nigeria were among University Students or patients in University Teaching Hospitals^{24,25,26,5,4,27,28,29,30} which constitutes heterogenous populations. There is no study in Nigeria to the best of our knowledge that compared ABO and rhesus blood group distribution between a heterogenous and homogenous populations to ascertain the trend of ABO and rhesus blood types between them. In addition, there has never been a known record of ABO blood group and rhesus factor distribution in OnichaIgboeze in Ebonyi State, neither do such data existed in University of Nigeria, Nsukka in Enugu State. The objectives of this study therefore were to provide data and compare the ABO and rhesus blood group distribution between a homogenous population (population of close relatives – OnichaIgboeze) and a heterogenous population (population of individuals with no blood relationship – University of Nigeria, Nsukka).

MATERIALS AND METHODS

Students of University of Nigeria Nsukka (UNN) in Enugu State and pupils of Holy Family Nursery and Primary (HFNP) OnichaIgboeze in Ebonyi State were used for the study. Students of UNN comprised adults from 17 years and above and represents a heterogenous population while HFNP comprised young individuals aged from 6-14 years from within OnichaIgboeze and represents a homogenous population. A total of 587 individuals comprising 352 from UNN and 235 from HFNP participated in the study. The study started after obtaining ethical approval of the Research and Ethical Committee, Bishop Shanahan Hospital, Nsukka.

Blood samples were collected from each individual by venipuncture method using a disposable 2ml syringe and emptied into an Ethylene Diamine Tetra Acetic Acid (EDTA) anticoagulant bottle. Each bottle was labelled properly and transported to Bioscope Diagnostic and Research Laboratory Services, Trinity Plaza, No. 9 Odenigbo Road, Nsukka, Enugu State for analysis.

The ABO and rhesus blood groups were determined using a clean white tile and antisera. A drop of blood from each student was placed into three different spots on white tile. A drop of each blood antisera was placed on each of the drop of blood, and the blood group and rhesus factor determined after observing the agglutination of the blood samples. Agglutination of blood cells in anti-A serum indicated blood group A and agglutination of blood cell in anti-B serum indicated blood group B. Agglutination of cell in both anti- A and anti- B sera indicated blood group AB. The agglutination of blood cell in anti-D serum indicated rhesus positive (+) and no agglutination indicated rhesus negative (-).

The distribution of ABO blood groups and rhesus factor were expressed in numbers and percentages. The data was analyzed using the Statistical Package for Social Science (SPSS) version 20.0. Significant difference was determined at $P < 0.05$.

RESULTS

Distribution of ABO blood groups in the study populations

Among the 352 students in UNN and 235 pupils in HFNP, blood groups O had the highest frequency with 54.80%

Blood groups	Number Examined (%)	Gender	
		Male	Female
A	104 (29.50)	42 (40.4)	62 (59.6)
B	39 (11.10)	12 (30.8)	27 (69.2)
AB	16 (4.50)	8 (50.0)	8 (50.0)
O	193 (54.80)	68 (35.2)	125 (64.8)
Total	352 (100)	130 (36.9)	222 (63.1)

Blood groups	Number examined (%)	Gender	
		Male (%)	Female (%)
A	59 (25.11)	31 (52.54)	28 (47.46)
B	48 (20.43)	22 (45.83)	26 (54.17)
AB	8 (3.40)	3 (37.50)	5 (62.5)
O	120 (51.06)	46 (38.33)	74 (61.67)
Total	235 (100)	102	133

	UNN		HFNP	
	Males (%)	Females (%)	Males (%)	Females (%)
Rh+ve	116 (32.95)	196 (55.68)	95 (40.43)	129 (54.90)
Rh-ve	14 (3.98)	26 (7.37)	7 (2.98)	4 (1.70)

in UNN and 51.06% in HFNP. On the other hand, blood group AB had the least frequency with 4.50% in UNN and 3.40% in HFNP (Tables 1 and 2). There was no significant difference in the distribution of blood groups between the male and female in the two populations ($P > 0.05$). The trend of ABO blood groups in the two populations are $O > A > B > AB$. Blood group B in HFNP is almost double the percentage in UNN (20.43%, 11.10%) but the rest are similar in proportion in the populations (Table 1 and 2).

Rhesus factor distribution in the study areas

In the two study populations, rhesus positive had the highest frequency (88.63% in UNN; 95.33% in HFNP) while rhesus negative had the least frequency (11.35% in UNN; 4.68% in HFNP). The trend of rhesus negative among the ABO blood groups was $O > A > B > AB$ in UNN while in HFNP the trend was $B > O > A > AB$. In UNN, females had the highest number of persons with rhesus negative 26 (7.37%) while males had the highest number of pupils with rhesus negative 7 (2.98%) in HFNP (Table 3). Comparing rhesus factor distribution for each blood group between the two populations, blood groups O and AB had equal percentage distributions of rhesus positive in the two populations while rhesus negative is seven times in blood group A (2.8%) in UNN than blood group A (0.4%) in HFNP (Table 4). The proportion of rhesus factor in each study population are as shown in Figure 1. In both study populations, there was no significant difference in rhesus factor distribution between the males and females ($P > 0.05$).

DISCUSSIONS

In both populations studied, blood group O had the highest distribution while blood group AB had the least occurrence. These observations are in agreement with²⁴ in Lagos, Jeremiah²⁵ in Port Harcourt, and Olaniyan et al³ and Medugu et al²⁹ who found blood group O and AB to be the highest and least prevalence respectively among indigenes of Federal Capital Territory (FCT), Abuja and Federal Medical Center Yola respectively, and Sagirolu et al³¹ who observed similar trend in Turkey. Similar studies in Nigeria by Musa et al²⁸, Ugwu³⁰, Enosolease and Bazuzye⁵, Egesie et al²⁶ and Bamidele et al⁴ reported same in Teaching Hospitals in Sokoto, Ebonyi, Benin, Niger Delta University and Bowen University respectively. The high prevalence of blood group O means that blood

Table 4: Distribution of Rhesus Factors among the Blood Groups

Study population	Blood group	Rh+ (%)	Rh- (%)
HFNP	A	58 (24.7)	1 (0.4)
	B	42 (17.9)	6 (2.6)
	AB	8 (3.4)	0 (0)
	O	116 (49.4)	4 (1.7)
UNN	A	94 (26.7)	10 (2.8)
	B	32 (9.1)	7 (2.0)
	AB	12 (3.4)	4 (1.1)
	O	174 (49.4)	19 (5.4)

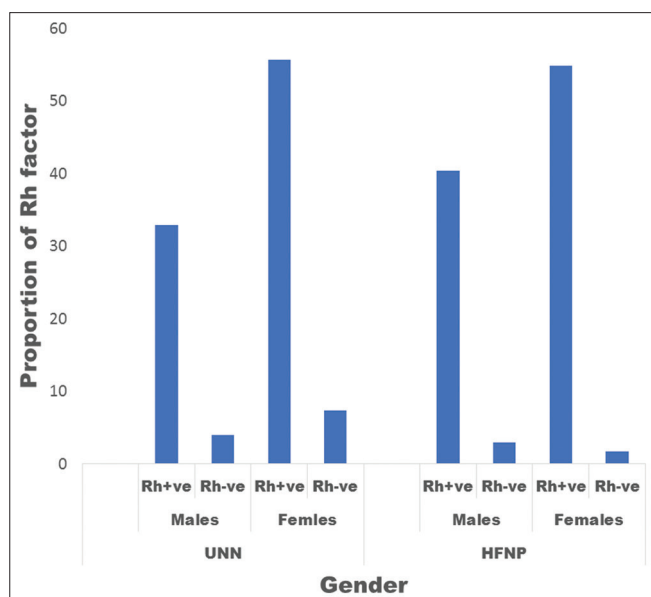


Figure 1: Proportion of Rhesus factors in each of the study populations

group O has a selective advantage and will be passed on to the subsequent generations more than the three remaining blood groups.

The trend of ABO blood groups distribution in the two populations were O > A > B > AB. This trend was similarly reported by other researchers across Nigeria^{24,25,26,5,4,29,30} and Sagiroglu et al³¹ in Turkey. However, this observation contradicts the findings of Olaniyan et al³ in FCT Nigeria and Musa et al²⁸ in Sokoto both of who found blood group B to be more prevalence than blood group A among the populations studied.

Rhesus positive had the highest prevalence in the two populations studied and accounted for 88.65% and 95.32% of the total individuals studied in UNN and HFNP respectively. The high prevalence of rhesus positive observed in this study is in agreement with²⁴ who observed 94% in Lagos, Jeremiah²⁵ who observed 96.77% in Port Harcourt, Olaniyan et al³ who observed 95.7% in FCT, Medugu et al²⁹ who observed 97.1% in Yola, 96.46% observed by²⁸ in Sokoto, Ugwu³⁰ who observed 95.9% in Ebonyi, and Egesie et al²⁶ and Bamidele et al⁴

who observed 98% and 93.7% in Niger Delta University and Bowen University respectively. Rhesus positive has a selective advantage and will be passed on to the subsequent generations more frequently than rhesus negative

In UNN, the prevalence of rhesus negative is higher in females (7.37%) than in males (3.98%) while in HFNP, the prevalence of rhesus negative is higher in males (2.98%) than in females (1.7%). The higher prevalence of rhesus negative among the females in UNN is in agreement with Olaniyan et al³ and Ugwu³⁰ who observed similar trend in FCT and Ebonyi State University respectively. On the other hand, the high prevalence of rhesus negative among the males in HFNP is in consonance with the observation of Bamidele et al⁴ in Bowen University. The high prevalence of rhesus negative among the females in UNN compared to HFNP implies that the chances of the haemolytic disease of the newborn will be higher in UNN than in HFNP; this was speculated by Kumar and Regan²². The high prevalence of rhesus negative in UNN could be attributed to the heterogeneity of the population while the low prevalence of rhesus negative in HFNP and among the females could be attributed to the homogeneity of the population. The people of OnichaIgbogee where HFNP are located form a local homogenous population that intermarry and has a high regard for marriage selection governed by family and society norms.

The prevalence of rhesus negative among the blood groups showed striking variations between the two populations. In UNN, blood group O had the highest prevalence of rhesus negative followed by A, B and AB in that order. The high prevalence of rhesus negative among individuals with blood group O in UNN is in accordance with the findings of Medugu et al²⁹ in Yola, Musa et al²⁸ in Sokoto, and Ugwu³⁰ in Ebonyi but contradicts that of Bamidele et al⁴ who observed equal prevalence of rhesus negative among blood groups A, B, and O in Bowen University, Egesie et al²⁶ who observed equal distribution of rhesus negative between blood group A and O in Niger Delta University, and Olaniyan et al³ who observed the highest prevalence of rhesus negative in blood group A in FCT. The high prevalence of rhesus negative in blood group O in UNN might be attributed to the heterogeneity of the studied population. In addition, the high prevalence of rhesus negative in individuals with blood group O in the population is evident since individuals with blood group O constituted more than half of the studied population.

In HFNP, the distribution of rhesus negative among the blood groups followed a different trend with blood group B having the highest prevalence followed by blood groups O and A. This pattern contradicted all other findings in Nigeria and might be attributed to the homogenous nature of the studied population. The low prevalence of

rhesus negative among blood group A in HFNP suggests that the population in OnichaIgboeze is less prone to the various cancers and disorders associated with blood group A and rhesus negative however, this needs further research to be confirmed. In HFNP, no rhesus negative was observed in blood group AB. This is in consonance with Olaniyan *et al*³, Egesie *et al*²⁶, and Bamidele *et al*⁴ who observed the same in FCT, Niger Delta University, and Bowen University respectively. The low prevalence of rhesus negative in blood group O which constituted 51.06% of the studied population and even lower than in blood group B which constituted only 20.43% of the studied population in HFNP suggests that homogenous population is associated with low prevalence of rhesus negative. This could be due to intermarriage and marriage selection within the population.

CONCLUSION

In conclusion, a homogenous population is associated with low prevalence of rhesus negative compared to a heterogenous population. Similarly, the low level of rhesus negative in homogenous population implies that the prevalence of haemolytic disease of the newborn will be low compared to a heterogenous population. In addition, blood group O in general has the highest prevalence in every population while blood group AB has the least prevalence in every population. The blood groups of local homogenous populations are healthier than that of heterogenous population due to low prevalence of rhesus negative. These observations have clinical implications for blood transfusion, management of blood banks and marriage counselling.

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IEO- Conceived and designed the work, prepared the manuscript; **OPU-** Conceived and designed the work, prepared the manuscript; **EVM-** Conducted the field and lab work; **IEU-** Conducted the field and lab work; **IJO-** Sourced for literature and statistically analyzed and interpreted the data; **SCE-** Conducted the lab work and proof read the manuscript.

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