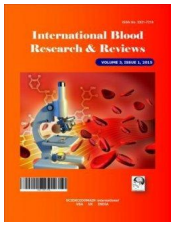

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Distribution of ABO and Rhesus Blood Groups among Voluntary Blood Donors in Enugu

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Authors' contributions

This work was carried out in collaboration between all authors. Authors NAM and OGO designed the study, wrote the protocol, managed the analysis of the study and wrote the first draft of the manuscript. Authors AMO and EBC managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: ABO and rhesus blood group study is very relevant to the blood transfusion services policy maker and clinicians. ABO and rhesus blood group are the most prevalent blood groups among so many other blood groups discovered.
Aims: The aim of this study was to find out the current distribution of ABO and Rh blood groups among the blood donors in city of Enugu.
Study Design: Two hundred and ninety randomly selected male and female blood donors were grouped according to their ABO and Rh blood group.
Place and Duration of Study: Haematology and Immunology Department, College of Medicine, Enugu State University of Science and Technology, Enugu, Enugu State, Nigeria: April 2012 to

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December 2012.
Methodology: Two hundred and ninety voluntary blood donors sample were grouped for ABO and Rhesus 'D' antigen by tile method.
Results: The result showed that blood group O and Rh 'D' positive has the highest frequency, there was no blood group AB in the study.
Conclusion: Blood group AB is completely absent in this study.

Keywords: ABO; rhesus; blood group; antigen.

1. INTRODUCTION

The International Society of Blood Transfusion (ISBT) recently recognized about thirty major blood groups and among the thirty, ABO and Rh blood groups are included [1]. ABO grouping has been shown to be the most common type of grouping. A1, A2, A1B, A2B, A2, A2B, B, B1 & O are subtypes of ABO blood group system, but some of them are very rare [2]. A very important protein plays a great role in the grouping of blood and that protein is Rh factor. If this protein is present on a particular blood type, that blood type is called positive then if absent, it is called negative [3]. In blood transfusion and organ transplant, knowledge of an individual's blood type is required so much. This is because an individual can be exposed to a blood group antigen that is not recognized by self which lead to the sensitization of the person. If somebody is sensitized, the immune system produces a specific antibody which normally binds specifically to a particular blood group antigen and antibodies against that particular antigen will be formed. These formed antibodies do bind to the antigens on the surface of transfused red blood cells which often lead to the destruction of cells [4]. The inheritance of ABO blood type depends on both parents and is controlled by single gene with three alleles; i, IA & IB. Rhesus D antigen is the second most relevant blood group system; this is due to its immunogenicity in Rh D negative individuals during pregnancy and blood transfusion [5]. The higher, the proportions of RhD negative in a population, the higher the incidence of hemolytic disease (HDN) of the new born in that population. Before the introduction of immunoprophylaxis, 1% of HDN was seen in all newborns which accounted for the death of one baby in every 2,200 births. But since the introduction of anti-D prophylaxis, death due to RhD alloimmunisation has reduced from 46 in 100,000 births to 1.6 in 100,000 births [6]. Many studies have been published on ABO blood types link with increase or decrease susceptibility to a particular disease [7,8]. Example, individual of blood group A are at greater risk for some malignancies [9]. People of blood group O are higher risk of contracting malaria and some infectious diseases, such as cholera [10]. The frequencies of A, B, O, Rh blood group phenotypes are not equal and it has been suggested that environmental factors may be responsible for it. Example, some E. coli has ABO-like antigens on their cell walls. Another one is that H antigen is chemically similar to the capsular antigens of Pneumococcus type XIV. These similarities in antigen make up sometimes confer resistance in individuals that produce the corresponding antibodies, therefore increase the susceptibility of people that their blood group matches the antigen [11]. There is relationship between the blood pH and ABO blood types and these have lead to certain disease conditions. Blood type A&O has an alkaline pH (7.40), blood type B has acidic pH (6.8) and blood type AB has neutral pH (7.00). Study carried out by United States Department of Agriculture (USDA) between 1909 and 2005 showed that population with nearly 95% alkaline blood type A/O and acidic blood type B was as a result of iron poisoning and copper deficiency. The prevalence of blood type B has increased significantly from 1960 until now, and this is observed in diabetes prevalence, which has a high correlation with type B blood [12]. Several researches have been done on relationship between ABO blood group and life span [13,14]. Due to clinical significance of ABO and Rh blood group in transfusion and compatibility, 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 blood groups among the blood donors in city of Enugu.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in the Department of Haematology and Immunology, Faculty of Medicine, Enugu State University of Science & Technology Enugu, Enugu State. Enugu State

euphemistically referred to as the "coal city" is one of the states in the eastern part of Nigeria. The state shares borders with Abia State and Imo State to the south, Ebonyi State to the east, Benue State to the northeast, Kogi State to the northwest and Anambra State to the west. Enugu State has a population of over 3.3 million people. It is also home of the Igbo of southeastern Nigeria. The city is characterized by high level of environmental sanitation, moderate planned housing, portable water supply and proper management of wastes especially in the Enugu urban.

2.2 Study Population

Two hundred and ninety voluntary blood donors are randomly selected during the National blood transfusion blood drive in the higher institutions in Enugu after given informed consent. Before carrying out the research ethical clearance approval was given by the Enugu State University of Science and Technology Teaching Hospital Ethics Committee. Forty of them were selected from Enugu State University of Science & Technology, fifty four blood donors were from Institute of Management and Technology Enugu, one hundred and thirteen blood donors were selected from Federal Cooperative College Oji River, ten of them were selected from Enugu State College of Education Technical, sixty of them were selected from Federal School of Dental Technology Enugu and thirteen blood donors were student of Ebonyi State University. This study was done from April 2012 to December 2012.

2.3 Method

Two milliliters of venous blood was collected into a plain (10 ml) container. ABO and Rhesus 'D' blood group phenotypes were determined using monoclonal anti-A, anti-B and monoclonal anti-D IgG/IgM respectively, according to procedure described by Monica Cheesbrough [15]. The principle of the test was based on the ability of the specific antisera to agglutinate red cell in the presence of the corresponding antigen. One volume of each antisera, anti A, anti B and anti D produced by Carper Laboratories in the UK was placed on a clean white tile and then mixed with a drop of 20% saline suspension of red cells at room temperature; this was then mixed carefully by gentle tilting the tile from side to side for maximum of 2 minutes. Presence of agglutination indicates the presence of the corresponding blood group. Appropriate controls of known blood groups were applied.

2.4 Statistical Method

Phenotypic frequencies were calculated and expressed as percentage. One Sample T Test was used to compare frequency distribution of ABO and Rh antigen in 20 States in Nigeria.

3. RESULTS

The two hundred and ninety voluntary blood donors selected randomly consist of 223 males and 67 females between ages 18 and 40. Table 1 showed the frequency distribution of ABO according to the sex of the donors in the following order. For male donors O > B > A (59.3% > 14.5% > 3.1%), female donors O > B > A (19.6% > 2.8% > 0.69%). Table 2 showed the distribution of the rhesus factors according to the ABO blood groups. In this study 95.9% of the donors are rhesus D positive while 4.1% are rhesus D negative. The distribution of the rhesus D positive and rhesus D negative in different blood groups occurred in the following order. Rhesus D positive O > B > A (75.9% > 16.2% > 3.8%), rhesus D negative O > B > A (3.1% > 1.0% > 0%). Table 3 showed gender distribution of the rhesus factors. Seventy three point one percent of the male blood donors were rhesus D positive while 3.8% of the males are rhesus D negative. Twenty two point eight percent of the females were rhesus D positive while 0.34% of the females are rhesus D negative. Table 4 showed the donors state of origins, ABO and rhesus blood group distribution according to the states of origins. We observed that 41.38% of the blood donors are indigene of Enugu state. Among the donors from Enugu state, the blood groups were distributed in the following order O+VE > B+VE > A+VE > O-VE > B-VE (82.5% > 7.5% > 5.8% > 2.5% > 1.7%). Table 5 showed that blood group O rhesus D positive and blood group B rhesus D positive were significant in this study ($p = .05$).

Table 1. Distribution of ABO blood group according to sex

	A	B	O
	No (%)	No (%)	No (%)
Male	9 (3.1)	42 (14.5)	172 (59.3)
Female	2 (0.7)	8 (2.8)	57 (19.6)
Total	11 (3.8)	50 (17.3)	229 (79.0)

Table 2. Distribution of rhesus status according to the ABO blood groups

ABO	RhD positive	RhD negative
	No (%)	No (%)
A	11 (3.8)	0 (0)
B	47 (16.2)	3 (1.0)
O	220 (75.9)	9 (3.1)
Total	278 (95.9)	12 (4.1)

Table 3. Distribution of rhesus status according to sex

	RhD positive	RhD negative
	No (%)	No (%)
Male	212 (73.1)	11 (3.8)
Female	66 (22.8)	1 (0.3)
Total	278 (95.9)	12 (4.1)

4. DISCUSSION

ABO and Rh blood groups are known to be very relevant in blood transfusion practice. They are also useful in population genetic studies, researching population migration patterns, as well as resolving certain medico-legal issues, particularly of disputed parentage [15]. It is, therefore, very important to have accurate information on the current distribution of these blood groups in Enugu state. The overall data of this study revealed that percentage frequencies of ABO blood group were 3.79%, 17.24%, 0% & 78.97% for blood group A, B, AB & O while 95.9% and 4.1% for rhesus D positive and negative. We observed that there is deviation between our findings and previous findings on the same subject matter from various parts of the world including Nigeria. For instance in northern part of Nigeria, Kulkarni and Colleagues reported phenotypic frequencies of 23.05%, 29.95%, 4.4% and 46.6% for A, B, AB and O blood groups respectively [16]. Bakare and Colleagues reported phenotypic frequencies of 22.9%, 21.3%, 5.9% and 50% for blood group A, B, AB and O among 7653 individuals in Ogbomoso, South-West Nigeria [17]. Adeyemo and Soboyejo also reported phenotypic frequencies of 25.3%, 16.7%, 2.7% and 55.3% for A, B, AB and O blood groups [18]. A similar study in Hungary reported blood groups phenotypic frequencies of 27.6%, 12.2%, 4.2% and 55.9% for A, B, AB and O blood groups [19]. Also another study in Kuwaiti revealed phenotypic frequencies of 16.1%, 14.0%, 2.7% and 66.8% for A, B, AB and O blood groups [20]. Another study done at Ibadan by Omotade et al. reported phenotypic frequencies of 21.6%, 21.4%, 2.8% and 54.2% for A, B, AB and O blood groups [21]. Again Iyiola et al. reported phenotypic frequencies of 18.7%, 17.6%, 5.6% and 58.1% for A, B, AB and O blood group in Ilorin, north central Nigeria [22]. In the above previous findings we observed that the pattern of distribution of blood group A, B, AB and O occurred in order of O> A>B>AB which is completely different from our findings. In this work we discovered that the following previous findings were similar to our study in the pattern of O>B>A>AB. For instance a similar study in Adamawa reported blood groups result with phenotypic frequencies of 16.5%, 21.3%,11.7% and 50.6% for blood group A, B, AB and O [23]. Another study in northern Nigeria reported phenotypic frequencies of 23.1%, 29.9%, 4.4% and 46.6% for blood group A, B, AB and O [16]. Another study in Guinea reported blood groups result with phenotypic frequencies of 22.5%, 23.9%, 4.7% and 48.9% for blood group A, B, AB and O [24]. This study also differ from report of research conducted by Yousaf et al. which revealed marginal difference between blood group B and O in Bahawalpur population at Pakistan with phenotypic frequencies of 21%, 36%, 6% and 37% for blood group A, B, AB and O [25]. Another study by Khaliq and Colleagues showed marginal difference between blood group B and O in Hazara population at Pakistan with phenotypic frequencies of 24%, 32%, 11% and 33% for blood group A, B, AB and O [26]. Our data are in line with study conducted among American Indians by Maurant et al, who found no blood group AB in his work with phenotypic frequencies of 3.9%, 1.1%, O% and 95% for blood group A, B, AB and O [27]. This study was also in consistent with previous study done in northern Nigeria which revealed that phenotypic frequencies of blood group B are on increase in Nigeria population [23].

From our finding, we discovered that percentage phenotypic frequencies of blood group O was predominant in all the parameters used in analyzing the work such as gender and state of origin. The implication of this finding is that blood group O is readily available blood in Nigeria blood banks. The higher proportion of blood group O in this study is an advantage because some research had shown that individual with blood group O had the smallest percentage of severe malaria when compared with other blood groups such as A, B & AB [28,29].The reason for less severe malaria attack seen in blood group O individuals may be due to mechanism of reduced rosettes formation by parasitized RBCs of blood group subjects as shown in the previous study [30].

Table 4. Distribution ABO & Rh according to donor's state of origin

Donor's state of origin	NO of donor according to their state of origin no (%)	A+VE	A-VE	B+VE	B-VE	O+VE	O-VE
Lagos	1 (0.34)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)
Kaduna	1 (0.34)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)
River	2 (0.69)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)
Benue	26 (8.97)	0(0.0)	0 (0.0)	9 (34.6)	0 (0.0)	16 (61.5)	1 (3.8)
Anambra	33 (11.38)	1 (3.0)	0 (0.0)	4 (12.1)	1 (3.0)	23 (69.7)	4 (12.1)
Delta	8 (2.76)	1 (12.5)	0 (0)	0 (0.0)	0 (0.0)	7 (87.7)	0 (0.0)
Imo	36 (12.41)	1 (2.8)	0 (0.0)	12 (33.3)	0 (0.0)	23 (63.9)	0 (0.0)
Akwaibom	1 (0.34)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Ogun	1 (0.34)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)
Ondo	2 (0.69)	0(0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)
Kogi	2 (0.69)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)
Enugu	120(41.38)	7 (5.8)	0 (0.0)	9(7.5)	2 (1.7)	99(82.5)	3 (2.5)
Edo	4 (1.38)	0(0.0)	0 (0.0)	1 (25.0)	0 (0.0)	3 (75.0)	0 (0.0)
Adamawa	1(0.34)	0 (0.0)	0 (0.0)	1(100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Cross River	13 (4.48)	0 (0.0)	0 (0.0)	2 (15.4)	0 (0.0)	10 (76.9)	1 (7.7)
Abia	11(3.79)	0 (0.0)	0 (0.0)	3 (27.3)	0 (0.0)	8 (72.7)	0 (0.0)
Gombe	1 (0.34)	0 (0.0)	0 (0.0)	1(100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Ebonyi	22 (7.59)	1 (4.5)	0 (0.0)	4 (18.2)	0 (0.0)	17 (77.3)	0 (0.0)
Nassarawa	3 (1.03)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)	0 (0.0)
Bayelsa	2 (0.69)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)
Total	290 (100.0)	11 (3.8)	0 (0.0)	47 (16.2)	3 (1.0)	220 (75.9)	9 (3.1)

Abbreviations: NO: Number: %: percentage, A+ VE: Blood group A rhesus D positive, A-VE: Blood group A rhesus D negative, B+VE: Blood group B rhesus D positive , B-VE: Blood group B rhesus D negative, O+VE: Blood group O rhesus D positive, O-VE: Blood group O rhesus D negative

Table 5. Frequency distribution of A+VE, B+VE, B-VE, O+VE, O-VE within 20 states

N (20)	A+VE	B+VE	B-VE	O+VE	O-VE
Mean±	1.430±	23.670±	0.235±	73.350±	1.305±
STD	3.129	34.975	0.753	34.324	3.182
T value	2.044	3.027	1.395	9.557	1.834
P value	0.055	0.007	0.179	0.000	0.082

P= .05

Also smaller proportion of donors belonging to blood group A in this study is also an advantage because research had shown that frequency of blood group A was significantly higher among people suffering from pancreatic cancer [31]. Reduced blood groups A, B and complete absent of AB in this study may be very advantageous. For instance earlier studies had shown association of oral, pancreatic, ovarian, gastric, leukemia, rectal and cervical cancers among individuals with blood groups A, AB or B [31-35]. Blood group O was highest in both male and female subjects which is consistent with previous study by Adeyemo and Colleagues [18]. This study showed a total percentage of RhD positive distribution of 95.9% and RhD negative distribution of 4.1%. Similar pattern of RhD positive and RhD negative was observed in Nigeria population and other parts of the world. For instance RhD positive of 91.4% and RhD negative of 8.6% was observed in Mandi Bahanddin (Pakistan) [36], 94% and 6% in Lagos [18], 94.4% and 5.5% in Indian [37], 95% and 5% in Germany [38], 93% and 7% in South Arabia [37], 95% and 4.8% in Ibadan [21], 96.7% and 3.2% in Portharcourt [27], 95.5% and 4.5% in Ilorin [22], 96.7% and 3.3% in Ogbomosho [17]. Study conducted by Yousaf et al. among Bahawal Pur division of Pakistan population differs from ours because the subjects in that study were exclusively RhD positive [25]. Our data on RhD distribution deviated from previous studies in some parts of Nigeria. For instance Adeyemo et al. observed that blood group O RhD positive was highest with percentage frequency of 53.3%, followed by blood group A RhD positive with percentage frequency of 23.3%, followed by blood group B RhD positive

of 14.6% and blood group AB RhD positive of 2.6% [18]. Egesie et al. also observed that blood group O RhD positive was highest with a percentage frequency of 48%, followed by group B RhD positive with percentage frequency of 22%, then followed by blood group A RhD positive with percentage frequency of 21% and blood group AB RhD positive with percentage frequency of 7% [39]. Knowledge of the distribution of ABO and Rh 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.

5. CONCLUSION

This study showed total absent of blood group AB, which is not common with previous studies in other parts of Nigeria.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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