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Distribution pattern of abo and rhesus blood group among voluntary blood donors in Abakaliki

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Abstract

ABO and Rhesus (Rh) blood group antigens are hereditary characters and are useful in population genetic studies, in resolving medico-legal issues and more importantly in compatibility test in blood transfusion practice. The aim of this work is to determine the distribution pattern of ABO and Rh (D) blood group among voluntary blood donors in Abakaliki. Blood groups and rhesus were tested in 500 subjects comprising of 446 male donors and 54 female donors. Cell and serum grouping technique was carried out using standard procedures respectively. The overall distribution of ABO cell and serum grouping, and Rh (D) groups result shows that A, B, AB and O are 87(17%), 63(13%), 5(1%) and 345(69%) respectively. For the Rh group, 473 (95%) of the donors were Rh (D) positive and 27(5%) were Rh D negative. The reduction in number of female donors is due to religious belief of some, menstrual flow, fear of needle prick, Low PCV etc. In Conclusion, this work could help health institutions to identify where they can obtain blood products necessary for medical interventions. Moreover, this piece of information contributes to the knowledge of the genetic structure of the Abakaliki population which could have significant implications in different fields of biomedicine.

Keywords: ABO; Rhesus; Blood; Voluntary; Donors; Group.

1. Introduction

Blood is the most essential body fluid, which is responsible for the transportation of nutrients, enzymes, and hormones throughout the body (Tesfaye et al., 2014). Primarily, the blood has a fluid part called plasma and blood cells (white blood cells, red blood cells (RBC), and platelets). Of the cells, the RBC membrane is complex and contains numerous antigens that are made from glycoproteins and glycolipids (Dzieczkowski et al., 1998) Based on the surface of RBC antigens, more than 100 blood group systems have been identified. However, the ABO and Rh blood group antigens are the most commonly used blood group antigens in a clinical setup and are used to avoid transfusion reactions and maternal death (Egesie et al., 2008).

The ABO blood groups were the first human blood group system that was discovered by Karl Landsteiner. The ABO antigens are controlled by 3 allelic genes placed on the long arm of chromosome 9q and are mainly responsible for the RBC membrane structural integrity and transportation of molecules through membranes (Jahanpour et al., 2017). The ABO blood group is commonly tested for transfusion of blood and its components, organ transplantation, genetic studies, and forensic determinations, as well as for medico-legal issues like paternity testing.

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In 1941, Landsteiner and Weiner discovered the Rhesus (Rh) blood grouping system (Firkin et al., 1989). The Rh blood group is a multi-antigen system expressed by 3 pairs of closely linked allelic genes located on chromosome 1, which consists of more than 50 antigen expressions. However, the major Rh antigens of medical importance are D, C, E, c, and e (Behra et al., 2013). An individual who has the Rh-D antigen is called Rh-D positive, while those lacking the antigen are called Rh-D negative. When a Rh-D negative person is transfused with Rh-D positive blood or a Rh-D negative mother is carrying a Rh-D positive fetus, the antigen will be recognized as a foreign particle by the immune system, which produces an antibody, resulting in a hemolytic transfusion reaction and hemolytic disease in the fetus and newborn(Suresh et al., 2015).

Knowledge of ABO and Rh blood group distribution will help to reduce maternal mortality rates through effective management of blood bank inventory. Blood bank access will also provide a safe and sufficient supply of blood, reducing the number of preventable disease deaths through effective management of blood bank inventory. Besides, the distribution of ABO and Rh-D blood groups varies in different populations (races, ethnic groups, and socio-economic classes).

Therefore, the aim of this study is to determine the distribution of ABO blood group alleles among voluntary blood donors in Abakaliki, ebonyi state.

1.1 Study design

The experiment was a prospective study of the pattern and distribution of ABO blood group among voluntary blood donors involving a prompt analysis of fresh collected serum from the donors.

1.2 Study area

This study was designed and carried out in Abakaliki, Ebonyi state, Nigeria. Abakaliki is the state capital. Ebonyi is an agrarian state in south easthern Nigeria. The subjects for the study were recruited from the state capital (Abakaliki). Which is predorminated majorly by farmers, with few civil servants and businessmen. Foods such as yam, cassava, rice, potatoes etc are major food crops and oil palm as a major cash crop. The state has lots of resort places such as Uburu salt lake and Ndibe beach etc. The people speak Igbo and English language.

1.3 Study population

A total of 500 apparently healthy subjects aged 18 - 40 and out of which 398 were male and 102 were female were recruited from different parts of Abakaliki for the study. The participants were selected based on their willingness to participate in the study.

1.4 Selection Criteria

1.4.1 Inclusion criteria

Voluntary and replacement blood donors that is, blood donated replaced blood utilized by family and friends were included in the study.

1.4.2 Exclusion

Donors with any form of illness and those that do not conform to the standard criteria set out for the blood donation were excluded from the study.

1.4.3 Sample collection and processing

A total of 2.5ml of blood was collected, and transferred into a dry plain container using a 5ml syringe needle following the standard techniques. The samples were spun at 12000xg for 3 minutes to obtain the serum and immediately proceeded for blood group identification.

2. Laboratory Analysis

2.1 Methods

Cell grouping using tube technique

2.1.1 Principle

Red cells from the specimen are reacted with reagent antisera (anti-A and anti-B). Agglutination of red cells indicates presence of corresponding antigen (agglutinogen) on red cells.(Peggy Jensen, 2003)

2.1.2 Procedure

- Six tubes were labeled from one to six and arranged in a rack.
- One drop of anti-A serum was added to tube 1, one drop of anti-B serum was added to tube 2 and one drop of anti AB serum was added to tube 3.
- One drop each of 2% red cell suspension of patient's cell was added to tube 1, 2 and 3.
- Two drops of patient serum was added in each of the tubes 4, 5 and 6.
- To tube 4, 1 drop of 2% suspension of group A red cells was added, To tube 5, 1 drop of 2% group B cells was added and in tube 6, 1 drop of 2% group O cells was added.
- 6 .The contents of all the tubes were mixed properly by shaking the rack.
- The tubes were allowed to stand at room temperature for two hours.
- The tubes were centrifuged at 3000g for 5 minutes after 5 minutes incubation.
- After centrifugation, the cells were re-suspended by tapping the bottom of the tubes.
- The results were then read microscopically. (Peggy Jensen, 2003)

2.2 Method: Serum grouping (Reverse method)

2.2.1 Principle

Patient's serum is tested for the presence of ABO antibodies. The patient's serum is mixed with known red cells in a test tube. A specified number of drops of patient serum are placed into each of three properly labeled tubes. (Peggy Jensen, 2003).

2.2.2 Procedure

- Allow unknown blood sample stand for some time and separate the serum.
- Add 2 drops of unknown serum in 3 different test tubes.
- Add 1 drop of 3-5% cell suspension of known blood of A, B and O group into these test tubes.
- Centrifuge at 3000rpm for five minutes.
- Look for agglutination either with naked eye or under the microscope.(Peggy Jensen, 2003)

2.3 Statistical analysis

Simple percentage distribution and table were used to represent the result. Phenotypical frequency were calculated and expressed as percentage. Statistical analysis was performed with the aid of Statistical Programme for Social Sciences (SPSS) version 20.0. $P< 0.05$ was considered as significant.

3. Results

A total of 500 samples was used comprising of 446 Males and 54 females. Amongs this, a total of 21 donors were less than 18 years of age, all representing the male gender as seen in table A total of 479 donors were above the 18 years bracket. Amongst this, 425 were males and 54 females as seen in Table 1. The males forming the majority of donors. Blood group A donors were 87(17%) of which 75(17%) were Males and 12(22%) were females. A total of 63(13%) donors were blood group B, having 54(12%) males and 9(17%) females. Blood group AB donors were 5(1%) in total, all of which were Males. A total of blood group O donors were 345(69%), of which 312(70%) were males and 33(61%).

Table 1 Age Group of The Blood Donors

Age group	Total n (%)	Male n (%)	Female n (%)	p-value
<18 years (non adult)	21 (4)	21 (5)	0 (0)	<0.001
>18 years(adult)	479 (96)	425 (95)	54 (100)	
Total	500 (100)	446 (100)	54 (100)	

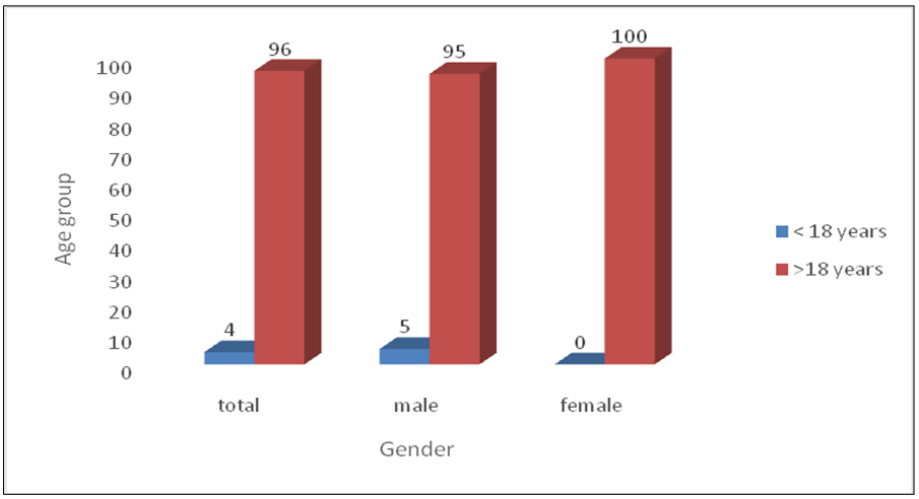

Figure 1 Distribution of Age group of Donors

The frequency of ABO blood groups in 500 donors shows that the most prevalent blood group was O, followed by A, B and AB as the least common group (Table 3).

For the Rh antigen, A total of 473(95%) were Rh D positive, of which 422(95%) were males and 51(94%) were females. 24(5%) male donors were Rh D negative while 3(6%) of the donors were Rh D negative females, summing up a total of 27(5%) Rh D negative donors as seen in Table 3. A total of 83(18%) donors were A Rh D positive while a limited number of 4(15%) were A Rh D negative as shown in Table 4. B Rh D positive donors were 63(13%) in total while no number was recorded for the rhesus negative of same blood group type as seen in Table 3. AB Rh D positive donors were 5(1%) in total with no number recorded for their Rh D negative counterpart. A total of 322(68%) O Rh D positive donors were recorded while 23(85%) of the donors were O Rh D negative as shown in Table 2

Among the Rh- positive donors, Blood group O was the commonest (68%) followed by blood group A (18%), B(13%) and group AB(1%). Among the Rh-negative donors, Blood group O was prevalent (85%) followed by blood group A (15%) as non was recorded for both blood group B and AB donors respectively.

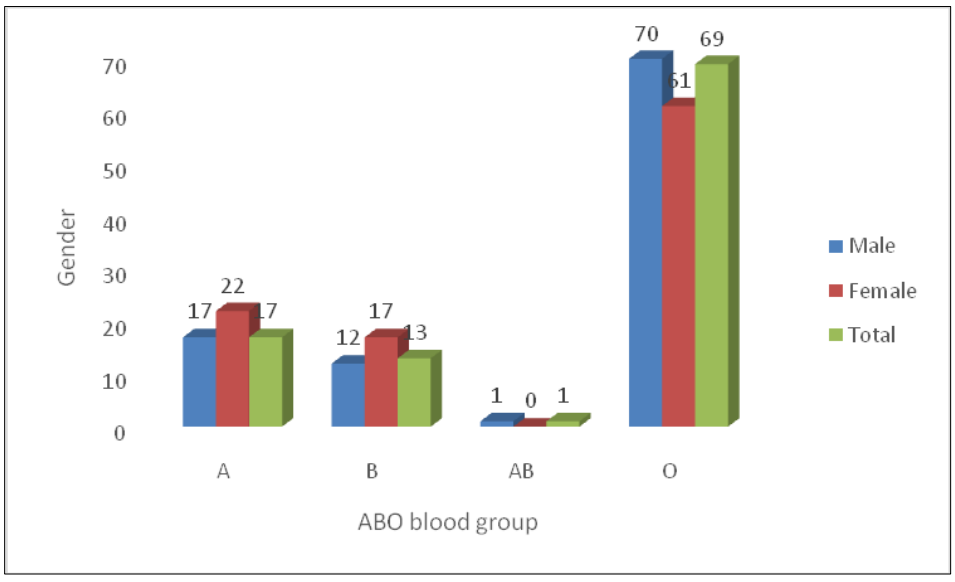

Figure 2 Distribution of Blood type among Genders

Table 2 Distribution of Rhesus (D) factors among the blood donors according to gender

Rhesus Group	Total n (%)	Male n (%)	Female n (%)	p-value
Rh 'D' Positive	473 (95)	422 (95)	51 (94)	<0.001
Rh 'D' Negative	27 (5)	24 (5)	3 (6)	
Total	500 (100)	446 (100)	54 (100)	

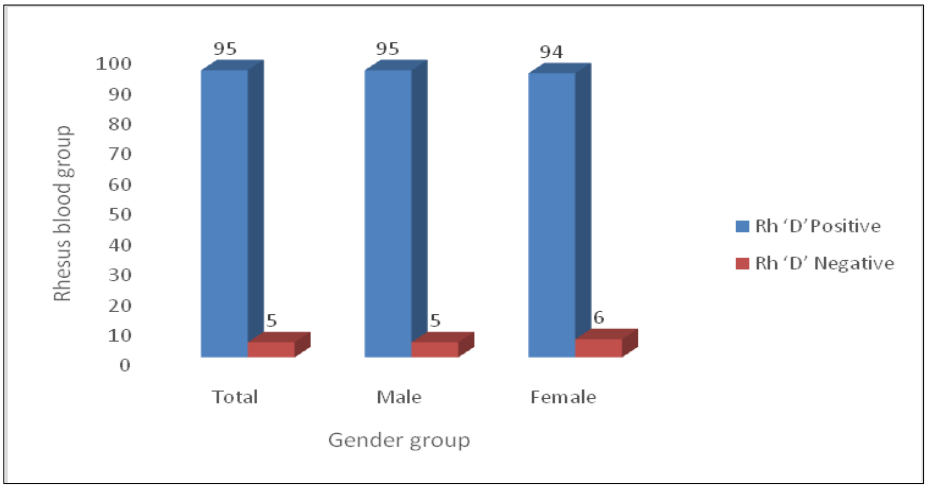

Figure 3 Distribution of Rhesus factor among Donors

Table 3 Distribution of Rhesus (D) factors among the different ABO blood groups

Blood group	Rh 'D' Positive n (%)	Rh 'D' Negative n (%)	p-value
A	83 (18)	4 (15)	0.014
B	63 (13)	0 (0)	
AB	5 (1)	0 (0)	
O	322 (68)	23 (85)	

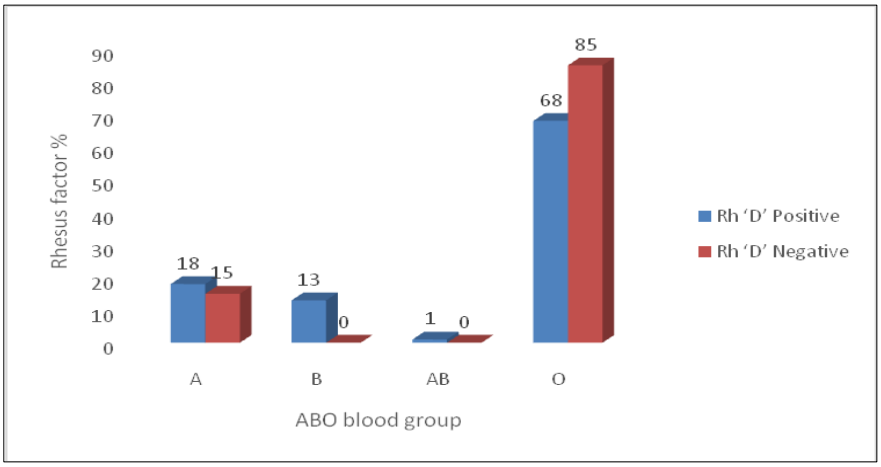

Figure 4 Distribution of Rhesus (D) factors among the different ABO blood groups

4. Discussion

Blood groups and Rh antigen are hereditary. Gene for ABO antigens is on the 9th chromosome and Rh antigen gene is on the 1st chromosome. The distribution of ABO blood group varies regionally, ethically and from one population to another (Webert *et al*., 2004).

The findings of this present study shows that the blood group O occurs most frequently among the donors and blood group AB is the least common in Abakaliki, Nigeria.

Knowledge of the distribution of ABO and Rhesus blood groups is an important element in determining the direction of recruitment of voluntary blood donors as required in each region and for effective management of blood banks inventory, be it at a facility of a small local transfusion service or regional or national transfusion services.

This study reveals that Rhesus (D) negativity has the lowest distribution among the donors which is similar to other studies conducted on other African continent. The identification of Rhesus blood system is important to prevent erythroblastosis fetalis, which commonly arises when a Rhesus negative mother carries Rhesus positive fetus.

In this study there was a significant difference ($p<0.05$) distribution of donors among the ABO blood groups by gender. A higher proportion of Rhesus (D) negative was found among the male donors. The dominance of male over female in blood donation exercise can be attributed to the fact that in an African context there is a general belief that men are healthier than women (Tagny *et al.,* 2010) and thus are more suitable for blood donation. Women in menstruating age group lose blood every month and are anemic, so unfit for blood donation and are eliminated by the pre-donation screening exercise. Other obstetrical factors including pregnancy and breastfeeding render them further from donating blood.

The sequence of ABO distribution among the rural population in Abakaliki is; O > A > B > AB. While the frequency of Rhesus (D) negative is very low in rural Abakaliki and is mainly among males. Further, males are the predominant blood donors in the region. The blood bank services in Abakaliki need to develop innovative strategies targeting female donors. This is likely to boost stocks for the blood bank in the region. Similar studies should be undertaken for the other regions of the country to establish the blood group distribution. Collectively these studies would provide the national blood bank services with information critical for supply forecasting and blood inventory management.

5. Conclusion

With a sample of 500 donors, it is established that among the various ABO and Rh-D blood groups in the Abakaliki state of Nigeria, group O is the commonest, and the occurrence of blood groups A and B is nearly equal; although blood group A is slightly higher. The frequency of Rh-negative is, although slightly higher in the present series than that in the previous studies in other parts of Nigeria, was strikingly lower than the Caucasian population. This work could help health institutions to identify where they can obtain blood products necessary for medical interventions.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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