

Frequency Distribution of ABO, Rhesus Blood Groups and Haemoglobin Genotypes among Students of University of Port Harcourt, Rivers State, Nigeria

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ABSTRACT

Background: The ABO, Rhesus blood groups and Haemoglobin genotypes may vary from one population to another, and they are inherited characters. **Aim:** This study was aimed at evaluating the frequency distribution of ABO, Rhesus blood groups and haemoglobin genotypes among students of faculty of basic medical sciences of university of Port Harcourt, Rivers State, Nigeria. **Methodology:** Two milliliters (2ml) of venous blood was collected from a total of 515 students within the ages of 18-30 years and comprising of 219 males and 296 females. The blood was dispensed into ethylene diaminetetraacetic acid (EDTA) container, gently mixed and used to determine the ABO and Rhesus blood groups by the standard tile technique and the haemoglobin genotypes, using the alkaline cellulose acetate electrophoresis technique. **Result:** This study showed that the frequency of occurrence of blood groups O, A, B and AB were 64.7%, 18.4%, 15.9%, 1.0% respectively and in this order O>A>B>AB. The distribution of O+, A+, B+ and AB+ were 62.1%, 17.6%, 15.0% and 0.9% respectively (O+>A+>B+>AB+), while O-, A-, B-, and AB- were 2.5%, 0.8%, 1.0% and 0.0% respectively (O->B->A->AB-). The percentage of Rh(D) positive individuals were 95.7% and Rh(D) negative, 4.3%. The percentage frequency of blood groups A, B, AB and O among the males were 8.3%, 7.8%, 0.2% and 26.0% respectively, while the females were 10.1%, 7.8%, 0.8% and 39.0%, respectively. The frequency occurrences of 80.0%, 19.0%, 0.4%, 0.4% and 0.2% were observed for haemoglobin genotypes AA, AS, SS, AC and SC respectively. The frequency of HbAA, HbAS, HbSS, HbAC and HbSC among the males were 33.5%, 8.4%, 0.2%, 0.2% and 0.2% respectively. Percentage frequencies of 46.4% (HbAA), 10.7% (HbAS), 0.2% (HbSS), 0.2% (HbAC) and 0.0% (HbSC) were recorded among the females. **Conclusion:** This study has shown that blood group O and Rh D positive blood groups were the most common, while blood groups AB and Rh(D) negative were the least common. HbAA had the highest frequency while HbSC recorded the lowest occurrence. Generally, the percentage frequencies of HbSS, and HbSC were low, showing a low prevalence of sickle cell disease, among the students. HbAC also had a low occurrence. The knowledge of the frequency of ABO, Rhesus blood groups and haemoglobin genotypes is important in health care planning, medical diagnosis and in counseling, and will provide vital information during blood transfusion in order to prevent haemolytic transfusion reactions and death.

Key words: ABO blood groups, Rhesus blood groups, haemoglobin genotypes, Students, University of Port - Harcourt.

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INTRODUCTION

ABO Blood types were discovered by Karl Landsteiner in 1901, and he received the global prize in physiology of medicine in 1930 for this discovery [1]. ABO blood types are also present in other primates such as apes and old world monkeys (30). In human blood transfusions, it is the most important of the different blood group classification systems [2]. A mismatch in this, or any other serotype, can cause a potentially fatal adverse reaction after a transfusion, or an unwanted immune response to an organ transplant [3].

ABO system consists of four main groups – A, AB, B, and O which are determined on the basis of presence or absence of A and B antigens. These antigens are under the control of three allelic genes, A, B and O, situated on the long arm of chromosome 9q [4]. The ABO blood group antigens are the most immunogenic of all the blood group antigens followed by Rh D antigens [5]. The most common cause of death from a blood transfusion is transfusion of incompatible ABO blood type due to a clerical error. These antigens are expressed on the red blood cell surface and determine an individual's blood group [6].

The frequencies of ABO blood groups vary from one population to another. In the Caucasians in the United States, the distributions are, group O-47%, group A-41%, group B-9% and group AB-3%. Among Western Europeans, the distribution is as follows: Group O-46%, Group A-42%, Group B-3% and Group AB-3%. For blacks in the United States, the distributions are, group O-46%, group A-27%, group B-2% and group AB-7% [7]. A distribution was reported as follows ; blood group O-50%, group A-22.9%, group B-21.3%, and group AB-5.9% in Ogbomoso, Oyo State, Nigeria [8].

The Rh blood group system is the second most important blood system after the ABO blood group system. It is a human blood group system, and contains proteins on the surface of red blood cells [9]. The proteins which carry the Rh antigens are transmembrane proteins, whose structure suggests that they are ion channels [10]. The main antigens are D, C, E, c and e, which are encoded by two adjacent genes, the RHD gene which encodes the RhD protein with the D antigens (and variant) and the RHCE gene which encodes the RHCE protein with the C, E, c and antigens [11]. The Rh antigens are determined by three pairs of closely linked allelic genes located on chromosome one [12]. There is no d antigen. Lowercase “d” indicates the absence of the D antigen (the gene is usually deleted or otherwise non-functional) [12]

Antibodies to Rh antigens can be involved in hemolytic transfusion reaction and antibodies to the Rh(D) and Rh

antigens confer significant risk of haemolytic disease of the fetus and newborn [13] Rh anti bodies are IgG antibodies which are acquired through exposure to Rh-Positive blood (generally either through pregnancy or transfusion of blood products). The D antigen is the most immunogenic of all the non-ABO antigens. Approximately 80% of individuals who are D-negative and exposed to a single D-positive unit will produce an anti-D antibody. The percentage of alloimmunization is significantly reduced in patients who are actively exsanguinating [14]. All Rh antibodies except D display dosage (antibody reacts more strongly with red cells homozygous for an antigen than cells heterozygous for the antigen) (EE stronger reaction VsEe) [15].

All human populations share the same ABO and Rhesus blood group systems: although they differ in the frequencies and distributions of specific types in different races, ethnic groups and socio-economic groups or amongst different populations [16, 17]. A systematic review study in India revealed that Rh(D) positive and Rh(D) population were 94.13% and 5.87% respectively [18].

According to [19], the distribution of rhesus blood groups were as follows: Blood group O⁺ - 50.53% and O⁻ - 1.38%, blood group A⁺ - 19.69% and A⁻ - 1.09%, blood group B⁺ - 22.48% and B⁻ - 1.02%, blood group AB⁺ - 3.75% and AB⁻ - 0.06%. 94.46% were Rh(D) positive, while 3.54% were Rh(D) negative.

The distribution of Hb genotypes according Ngwengiet *al.*, 2020 was, 84.0% - HbAA, and 16.0% for HBAS. A higher % of 26.4%-HbAS and 2.9% (HbSS) among 929 participants among all age groups were reported in Cameroon [20]. The results recorded showed that out of 8,092 haemoglobin genotype tests carried out over a period of five years; 6376 (78.7%) of these were HbAA, 1580 (19.6%) HbAS, 121 (1.5%) HbSS, while HbAC and HbSC accounted for 16 (0.2%) and 4(0.04%) respectively [21].

MATERIALS AND METHODS

Study Area

The study was carried out at the faculty of basic medical sciences of university of Port Harcourt, Rivers State, Nigeria. The faculty has three departments which include: the department of nursing sciences, medical laboratory science and public health. Port Harcourt is the main city of Rivers State, located in Port Harcourt Local Government Area consisting of the former European quarters now called old GRA and New layout areas. It is located on latitude 4° 49' 27" N and longitude 7° 2' 1" E. The urban area (Port Harcourt metropolis), on the other hand is made up of the local government area itself and parts of Obio-Akpor and Eleme accordingly. Port Harcourt is highly congested, as it

is the only major city of the state. The Greater Port Harcourt region, spans eight local government areas that include: Port Harcourt, Okrika, Obio-Akpor, Ikwerre, Oyigbo, Ogu-Bolo, Etche and Eleme. Its total population was estimated at 2,000, 000 as at 2009, making it one of the largest metropolitan areas in Nigeria, but that number has greatly increased according to recent studies [22].

Study Design

This study was a cross-sectional study carried out at the faculty of basic medical sciences, University of Port Harcourt in the month of October, 2019. Questionnaires were administered to the students and they gave their informed consent before they were enrolled for the study.

Ethical Approval

Ethical approval was obtained from the chairman of University of Port Harcourt teaching hospital research ethics committee. All participants gave a written informed consent before they were enrolled for the study.

Study Population

Five hundred and fifteen (515) students within the age of 18-30 years comprising of 219 males and 296 females from the faculty of basic medical sciences, University of Port Harcourt, Nigeria were enrolled for the study.

Sample Collection

Two millilitres (2ml) of venous was collected using sterile disposable syringe. This was dispensed into ethylene diaminetetra acetic acid (EDTA) container and mixed gently. The container was labeled clearly with the participant’s number and the sample was used to determine the ABO, Rhesus blood groups and haemoglobin genotypes.

Laboratory Methods

The ABO and Rhesus blood groups were performed using the standard tile method, while the haemoglobin genotype was done using the alkaline cellulose acetate electrophoresis method.

Statistical Analysis

The statistical analysis was done using computer software’s package for social sciences (SPSS), version 21. The results were presented in descriptive statistics using frequency tables, cross tabulation and bar charts. Chi-square test for significance was used and the level of significance was set at P L 0.05.

Table 1. Frequency Distribution of ABO Blood Groups Among the Students.

ABO Blood Group	Frequency Distribution	X ²	p-Value
O	333(64.7%)		
A	95(18.4%)	7.6	0.001*
B	82(15.9%)		
AB	5(1.0%)		
Total	515		

Table 2. Frequency Distribution of Rhesus Blood Groups Among the Students.

ABO Blood Group	RhD Positive	RhD Negative	X ²	p-Value
O	320(62.1%)	13(2.5%)		
A	941(17.6%)	4(0.8%)		
B	77(15.0%)	5(1.0%)	12.8	0.001*
AB	5(0.9%)	0(0.0%)		
Total	493(95.7%)	22(4.3%)		

Table 3. ABO Blood Group Distribution in Relation to Gender.

Sex	A	B	AB	O	Total	X ²	p-Value
Male	43 (8.3%)	42 (7.8%)	1 (0.2%)	134 (26.0%)	219 (42.5%)	11.34	0.254
Female	52 (10.1%)	40 (7.8%)	4 (0.8%)	201 (39.0%)	296 (57.5%)		
Total	95 (18.4%)	82 (15.6%)	5 (1.0%)	333 (65.0%)	515 (100%)		

Table 4. ABO Blood Group Distribution in Relation to Gender.

Sex	A ⁺	A ⁻	B ⁺	B ⁻	AB ⁺	AB ⁻	O ⁺	O ⁻	Total	X ²	p-Value
Male	43 (8.3%)	0 (0.0%)	40 (7.8%)	2 (0.4%)	1 (0.2%)	0 (0.0%)	130 (25.2%)	3 (0.6%)	219 (42.5%)	12.25	0.432
Female	48 (9.3%)	4 (0.8%)	37 (7.2%)	3 (0.6%)	4 (0.8%)	0 (0.0%)	190 (36.9%)	10 (1.9%)	296 (57.5%)		
Total	91 (17.6%)	4 (0.8%)	77 (15.0%)	5 (1.0%)	5 (1.0%)	0 (0.0%)	320 (62.1%)	13 (2.5%)	515 (100%)		

Table 5. Haemoglobin Genotype Distribution Among the Students.

Haemoglobin Genotype	Frequency Distribution	X ²	p-Value
AA	412(80.0%)		
AS	98(19.0%)		
SS	2(0.4%)	1.25	0.002
AC	2(0.4%)		
SC	1(0.2%)		
Total	515		

Table 6. Haemoglobin Genotype Distribution in Relation to Gender.

Haemoglobin Genotype	Males	Females	X ²	p-Value
AA	173(33.5%)	239(46.4%)		
AS	43(8.4%)	55(10.7%)	22.35	0.738
SS	1(0.2%)	1(0.2%)		
AC	1(0.2%)	1(0.2%)		
SC	1(0.2%)	0(0.0%)		
Total	219(42.5%)	296(57.5%)		

RESULTS AND DISCUSSION

The frequency of ABO, Rhesus blood groups and haemoglobin genotypes vary from one population to another.

In this study, the frequency distribution of blood groups O, A, B and AB were 64.7%, 18.4%, 15.9% and 1.0% respectively. Blood group O had the highest frequency, followed by A, B, and then AB, which had the least frequency. Other scholars reported a frequency of 47.2%, 21.6%, 26.2% and 4.9% for groups O, A, B, and AB respectively among indigenes of federal capital territory, Abuja [23], while [24] reported a distribution of 47%, 41%, 9% and 3% for O, A, B, and AB groups respectively, in Caucasians in the United States, and 46%, 27%, 20% and 7% respectively among the African Americans.

The frequency of O⁺, A⁺, B⁺, and AB⁺ were 62.1%, 17.6%, 15.0% and 0.9% respectively, while O⁻, A⁻, B⁻ and AB⁻ were 2.5%, 0.8%, 1.0% and 0.0% respectively. O Rh(D) positive had the highest frequency, followed by A Rh(D) positive, B and the least, AB. O⁻ had the highest frequency, followed by B⁻, A⁻, while AB had zero frequency. A frequency distribution of 53.3%, 23.3%, 14.6% and 2.6% for O⁺, A⁺, B⁺, and AB⁺, respectively has been reported, while O⁻, A⁻, B⁻, and AB⁻, were 2%, 2%, 2%, and 0% respectively [25]. Generally, the percentage of Rh(D) positive individuals were 95.7% and Rh(D) negative, 4.3%. This is similar to other studies.

The percentage of Rh(D) negative is low because clinical situations may arise through Rh incompatibility.

This study also revealed that, the percentage frequency of blood groups A, B, AB and O among the males were 8.3%, 7.8%, 0.2% and 26.0% respectively, while the females were 10.1%, 7.8%, 0.8% and 39.0% respectively. Males and females of blood group O recorded the highest frequencies, followed by those of A, B and the least AB. Among all the blood groups (male and female), females had the highest frequency. [26] reported frequencies of 13%, 14%, 4% and 31% for blood groups A, B, AB and O respectively.

Percentage frequencies of 80.0%, 19.0%, 0.4% and 0.2% were observed for hemoglobin genotypes AA, AS, SS, AC, and SC respectively. HbAA had the highest frequency, followed by HbAS, HbSS, HbAC and HbSC.

The frequency of HbAA, HbAS, HbSS, HbAC and HbSC among the males were 33.5%, 8.4%, 0.2%, 0.2% and 0.2% respectively. The males of group HbAA had the highest percentage frequency, followed by group HbAS while HbSS, HbAC and HbSC had same frequency.

Percentage frequencies of 46.4% (HbAA), 10.7% (HbAS), 0.2% (HbSS), 0.2% (HbAC) and 0.0% (HbSC) were recorded among the females. The females of group HbAA had the highest percentage, followed by HbAS. HbSS and HbAC had the same frequency, while no percentage was recorded for group HbSC. Females, generally had a higher frequency than the males. [27, 28] reported percentage frequencies of 24.7% (HbAA), 7.3% (HbAS), 0.7% (HbSS), 1.3% (HbAC) and 0.7% (HbSC) respectively, among males and 45.3% (HbAA), 18.7% (HbAS), 0.7% (HbSS), 0.0% (HbAC), and 0.0% (HbSC) respectively, among the females.

CONCLUSION

The knowledge of the frequency of ABO, Rhesus blood groups and haemoglobin genotypes is important in health care planning, medical diagnosis and in counseling. It will provide vital information during blood transfusion in order to prevent haemolytic transfusion reactions and death and for easy access to rhesus negative blood for transfusion, especially during emergency.

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