International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Distribution of ABO, Rhesus Blood Groups, and Genotype among Students of Federal University Wukari, Taraba State, Nigeria

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Abstract: ***The ABO and Rhesus blood group systems are globally recognized as the most pivotal blood groups that areused in blood grouping and medical transfusion purposes. The ABO and Rhesus blood groupshas shown to genetically vary across different populations of the world. This present study aims to provides essential information on the distribution of ABO, Rhesus blood groups, and genotypes among students at the Federal University Wukari, Taraba State, Nigeria. A total of 547 student data were randomly collected from the records unit of the university clinic, comprising 332 males and 213 females. The result shows variation in the percentage frequency distribution among the students. Blood group O had the highest percentage frequency (52.8%), group B had a frequency of 23.4%, group A was 19.7%, while blood group AB had the least percentage frequency (4.0%). Variations were also seen in the Rhesus distribution, as the total percentage frequency of Rhesus - positive individuals was 98.2%, while those of Rhesus - negative individuals was 1.8%. The genotype distribution among 277 students on the other hand, varied in the order of AA>AS>SS, with percentage values of 75.8%, 23.8%, and 0.4%, respectively. Additionally, this study gives vital information concerning the management of blood banks and sustainable healthcare services in the community.***

Keywords: ABO, Rhesus, Genotype, Wukari, Taraba State

1. Introduction

The ABO and Rhesus (Rh) blood group systems are globally recognized as the most clinically relevant in blood groups in blood groups determination and transfusion medicine (Olubayode *et al.*, 2013; Anifowoshe *et al.*, 2017). This is because fatalities due to blood transfusion incompatibility and haemolytic disease of the newborn (HDN) have greatly reduced since the revolutionary discovery of the ABO and rhesus blood groups system in the 1901 and 1940 by Karl Landsteiner and Landsteiner and Wiener (Landsteiner & Weiner, 1940). However, many underserved rural communities in Nigeria are yet to fully access the benefits of this medical innovation even in the 21st Century, as demand for transfusable blood and related products far outweighs supply (Jahanpour *et al*., 2017). Furthermore, lack of readily available data on the distribution and frequency of blood groups of individuals in the affected communities makes it difficult for medical personals to recruit compatible donors during emergency situations. Getting a suitable match for patients with rare blood groups could be a matter of life and death, when not attended to in a timely fashion.

The human ABO blood group is a typical example of a multi - allelic trait that has been classified into four major blood groups, namely A, B, AB, and O, based on presence or absence of surface antigens and agglutinins on the red blood cells (RBCs) (Yamamoto *et. al*., 1990; Adeyemo & Soboyejo, 2006; Anifowoshe *et al.*, 2017). Blood group A individuals have agglutinin antigen A and naturally occurring IgM anti - B antibodies in their blood serum; group B individuals have B antigen and anti - A antibodies; group AB individuals have both A and B antigens with neither anti - A nor anti - B antibodies. In contrast, blood group O individuals have no antigen but contain both Anti - A and Anti - B antibodies (Yamamoto *et. al*., 1990; Seeley *et al.*, 1998).

Rh blood group or Rhesus blood group is second in clinical importance after the ABO blood groups system. It is highly polymorphicin the sense that it's known to have at least forty - four different antigens, of which the most significant is the presence or absence of the RhD antigen on the RBCs surfaces (Dennis *et al.*, 1998; Garba *et al., 2016*). When testing for the Rhesus D antigen, an individual is either classified as Rhesus - positive (RhD^+) or Rhesus - negative (RhD^-).

It is worthy of note that investigative accounts of the distribution of the two blood groups have been reported for various populations globally. These reported frequencies of the ABO and Rh blood groups have consistently highlighted the genetic variations that exist in different geographical locations of the globe, thus reflecting the underlying genetic and ethnic diversity in human populations (Garratty*et. al*., 2004; Anifowoshe*et al.*, 2017). For instance, in Australia, blood group O is reported to be about 49%, group A is 38%, group B is 10%, and group AB is 3%. Also, in Canada, group O is about 46%, group A is 42%, group B is 9%, and group AB is 3% (Olubayode *et al.*, 2013). Comparable studies from Nigeria show a high degree of congruence with those of Australia, Canada, and other Nations of the world. The ABO distribution and gene frequencies from Ogbomosho, Oyo state Nigeria, indicates that 50% of the population are blood group O individuals, 22.9% to are group A, 21.3% are group B and 5.9% are blood group AB (Olubayode *et al.*, 2013). InIlorin, North Central Nigeria, available data indicates blood group O individuals to be 58.13%, group A to be 18.67%, group B to be 17.62% and group AB 5.59% respectively. Likewise, a compilation of data from numerous studies from across Nigeria by

Anifowoshe *et al*. (2017) is seen to follow the same order, i. e., O> A > B > AB (52.93%, 22.77%, 20.64% and 3.66%). These patterns are also corroborated by data from the United States of America (O, 46.6%; A, 37.1%; B, 12.2%; and AB, 4.1%). In addition, Countries such as Mauritania, Morocco, Cameroun, Tunisia, Ethiopia, and Iran reflect the same order of O > A > B > AB (Garratty *et. al*., 2004; Hamed *et. al*., 2012; Anifowoshe *et al*., 2017). The Rh blood groups on the other hand has demonstrated to be highly variable worldwide, as nearly 100% of indigenous African are known to be Rh^+ (Nigeria: 94.9% (Anifowoshe *et al*., 2017), Ethiopia: 92.06% (Tesfaye *et. al*., 2015), and Madagascar: 98.9% (Randriamanantany *et. al*., 2012)).95.71% of Northern Indiansand 90.3% of North American Indian in US are reported to be RhD^+ (Chandra *et. al*., 2012; Garratty *et. al*., 2004), thus highlighting once more the genetic diversity of the humans ABO and Rh blood groups.

The aim of this study is to investigate the phenotypic variation and frequency distribution of the ABO blood groups, Rhesus blood group and genotypic variations of the ABO blood groups from student's medical laboratory records across five Faculties of Federal University Wukari, Taraba State, Nigeria, using a retrospective approach. We expect to find variations in the distribution of ABO, Rh (D) blood groups and Genotypes. We also expect to find a small percentage of Students with the Sickle cell haemoglobin (Hb^S), as the sickle cell homozygotes (Hb^SHb^S) and heterozygotes (Hb^AHb^S) are expected to be found in the gene poll of malaria endemic areas such as Wukari, Taraba State (Anifowoshe *et al*., 2017). Lastly, there is currently no data pattern of distribution and frequencies ABO, Rh (D) blood groups and genotypes for the area as this is study is the first of its kind with regards to these genetic traits.

2. Materials and Method

The study was conducted at Federal University Wukari, Taraba State, Nigeria using secondary data. A total of 547 students' medical laboratory data were collected from the Records Unit of the University Health Centre. Three hundred and twenty - nine (329) were males and two hundred and eighteen (218) were females. Of the 547 students' data sampled, only277 students had genotype data.

Data analysis

The collected data were analyzed using simple statistical percentages performed using SPPS version 23 software, and results visualization as displayed using tables and charts was done on Microsoft Excel version 2016.

3. Result

A total of 547 students ABO and Rhesus blood groups laboratory records were analyzed to determine the percentage frequency distribution of blood groups A, B, AB, and O as shown in Table 1. Significant differences can be seen among the blood group phenotypes, with blood group O having the highest frequency across the five sampled Faculties (Table 1). Two distinct patterns of blood groups distributions can be observed in Table 1, group 1 comprises Faculties EDU, ALS, and HMS with O>A>B>AB; and group 2 comprises PAS and COH with O>B>A>AB. Although blood group O phenotype is the prevalent blood group in both males and females, significant phenotypic differences can be observed between males and females, as a higher percentage of females have blood group B phenotype than males (Table 2).

Rhesus positive (RhD^+) blood group was observed to be the prevalent phenotype in the five Faculties sampled in the present study (Table 3). It is noteworthy that no Rhesus negative (RhD^-) phenotype (Table 3) was recorded in theCollege of Health (COH). The same pattern is observable among males and females (Figure 1). The Rhesus positive (RhD^+) is observed to be the dominant phenotype among studies of Federal University Wukari, Taraba State, Nigeria.

The genotypic distribution could not be determined for majority of the 547 students' data analyzed because only 59 students had genotype records. Forty - five (45) students were AA, thirteen (13) were AS while one (1) was SS, with percentage values of 76.3%, 22% and 1.7% respectively (Figure 2). In the Facultyof Education (EDU), of the 35 students with genotype records, 27were AA, and 8were AS with percentage values of 77.1% and 22.9%. The Faculty of Agriculture and Life Sciences (ALS) had 36AA out of 53 students while 17 students were AS with percentage values of 67.9% and 32.1%. In Humanities and Management Sciences (HMS) 116 students' records were analyzed, of which 92 were AA and 24 were AS with percentage values of 79.3% and 20.7%. The College of Health (COH) on the other hand had 10 AA and 4 AS with the percentage values of 71.4% and 28.6%. Figures 3 shows the summary of the genotypic distribution of blood groups in males and females among students of Federal University Wukari, Taraba State, Nigeria.

Table 1: Phenotypic distribution of ABO blood groups across five Faculties of Federal University Wukari, Taraba State, Nigeria

	ABO blood groups				Total
Faculty[a]	A (%)	B (%)	AB (%)	O (%)	
PAS	28 (26.2)	23 (21.5)	3 (2.8)	53 (49.5)	107
EDU	6 (16.7)	8 (22.2)	0 (0.0)	22 (81.1)	36
ALS	17 (17.2)	25 (25.3)	7 (7.1)	50 (50.5)	99
HMS	52 (17.9)	70 (24.1)	12 (4.1)	157 (54.0)	291
COH	5 (35.7)	2 (14.3)	0 (0.0)	7 (50.0)	14
Total	108 (19.7)	128 (23.4)	22 (4.0)	289 (52.9)	547

[a]Pure and Applied Sciences (PAS) while Education (EDU), Agriculture and Life Sciences (ALS), Humanities and Management Sciences (HMS) and College of Health (COH).

Table 2: Phenotypic distribution of ABO blood groups among males and females of Federal University Wukari, Taraba State, Nigeria

	ABO blood groups				Total
Gender	A (%)	B (%)	AB (%)	O (%)	
Male	62 (18.8)	72 (21.9)	17 (5.2)	178 (54.1)	329
Female	46 (21.1)	56 (35.7)	5 (2.3)	111 (50.9)	218
Total	108 (19.7)	128 (23.4)	22 (4.0)	289 (52.8)	547

Table 3: Phenotypic distribution of Rhesus blood groups across five Faculties of Federal University Wukari, Taraba State, Nigeria

Faculty[a]	RhD^+ (%)	RhD^- (%)	Total
PAS	105 (97.2)	3 (2.8)	108
EDU	32 (94.1)	2 (5.9)	34
ALS	97 (97.0)	3 (3.0)	100
HMS	289 (99.3)	2 (0.7)	291
COH	14 (100)	0 (0.0)	14
Total	537 (98.2)	10 (1.8)	547

[a] Pure and Applied Sciences (PAS) while Education (EDU), Agriculture and Life Sciences (ALS), Humanities and Management Sciences (HMS) and College of Health (COH).

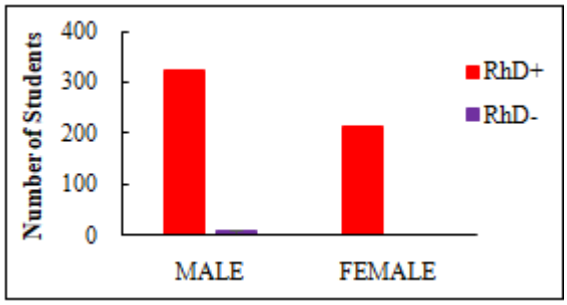

Figure 1: Phenotypic distribution of Rhesus blood groups among males and females of Federal University Wukari, Taraba State, Nigeria

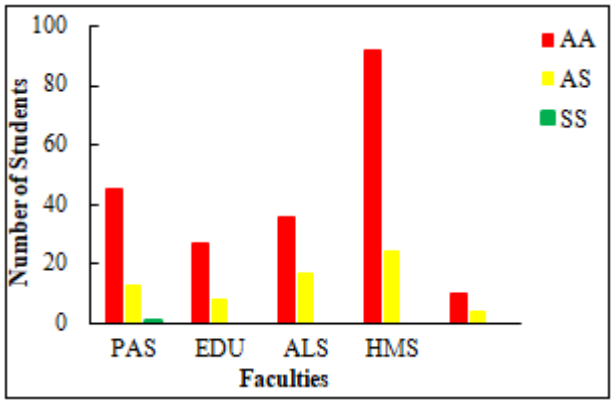

Figure 2: Genotypic distribution of ABO blood groups across five Faculties of Federal University Wukari, Taraba State, Nigeria

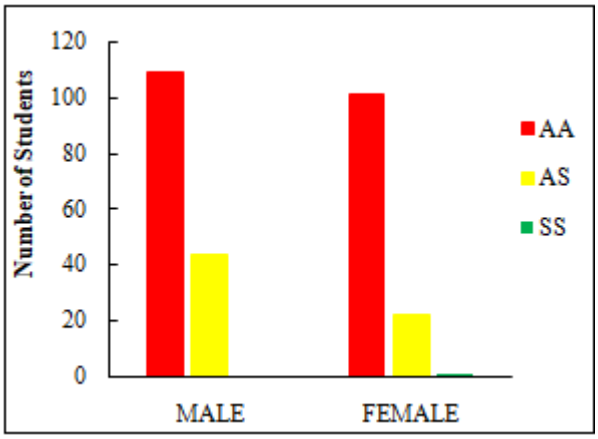

Figure 3: Genotypic distribution of ABO blood groups among males and females of Federal University Wukari, Taraba State, Nigeria

4. Discussion

The primary aim of this study was to investigate the phenotypic and genotypic variation and the frequency distributions of the ABO blood group, and frequency distribution of Rhesus blood group of students across five Faculties of Federal University Wukari, Taraba State, Nigeria, from student's medical laboratory records. Numerous workers have previously reported that remarkable variations exist in the frequency distribution of the humanABO and Rhesus blood groups, thus highlighting the genetic and evolutionary diversity of different populations globally (Pramanik *et al*., 2000 and Sidhu 2003; Garratty *et. al*., 2004; Adeyemo & Soboyejo, 2006; Olubayode *et. al*., 2013; Anifowoshe *et al.*, 2017). Variations in frequencies and distributions of specific types of blood groups in different nations, tribes, demographic and amongst diverse population have equally been reported (Pramanik *et. a*l., 2000; Sidhu, 2003). Furthermore, there is accumulating evidence in support of wide variations among racial groups in the distribution of the ABO antigens even though, the antigen remains constant throughout life (Enosolease and Bazuaye, 2008; Anifowoshe *et al.*, 2017).

In this study, out of the total sample size of five hundred and forty - seven students (547) students records of Federal University Wukari, Taraba State, two hundred and eighty - nine (289) were blood group O with a percentage frequency of 52.8%. One hundred and twenty - eight (128) were blood group B with a frequencyof 23.4%, one hundred and eight were A (108) with a frequency of 19.7%, and twenty - two (22) were AB with frequency of 4.0% respectively. We observed the following order of O>B>A>AB as the prevalent pattern in our result, which is congruent with earlier reports fromMakurdi, Benue State Nigeria and among indigenous of Ijaw of Nigeria (Eru *et al.*, 2014; Adienbo *et al.*, 2010). On the contrary, results from other studies show a different from what commonly observed, such as the pattern of ABO distribution is seen as O>A>B>AB (Garba *et al.*, 2016; Adeyemo *et al.*, 2006; Olubayode *et al.*, 2013), this pattern was also observed in our results from the Faculty of Pure and Applied Sciences (PAS) and College of Health (COH) (see Table 1). Furthermore, Ahmed in 2009 reported patterns in the order ofB>O>A>AB withpercentage values of 93%, 66%, 47% and15% respectively. According to our result, blood group O had a frequency of 52.80% and was the most frequently encountered phenotype across the faculties studied. On the other hand, blood group AB was the least encountered phenotype with a frequency of 4.0%. The findings are consistent with reports from previous studies done in other Nigerian populations, where the blood group O is observed to be the predominantblood group in comparison to the less frequency blood group AB (Anifowoshe *et al.*, 2017; Olubayode *et al.*, 2013and Olaniyan *et al.*, 2013). The variations that have been observed in various populations, with regards to ABO blood group frequency distribution have been attributed to both genetic and biogeographical factors. Furthermore, the prevalence of blood group O as observed from result could have positive health consequences, as this blood group phenotype has been demonstrated to confer protection against malaria parasite. Studies indicate the erythrocytes of individuals with blood group O may potentially prevent

rosette formation by Plasmodium falciparum (Rowe et. al., 2009; Tekeste & Petros, 2010). Therefore, the prevalence of blood group O phenotype could be beneficial in a malaria endemic area such as Wukari.

Results of the Rhesus blood distribution in the current study indicates that RhD positive phenotype to be the dominant Rhesus blood group phenotype, with a percentage value of 98.2% (Table 3 and Figure 1). The RhD negative seem to be a rare phenotype as it was recorded in only 10 out of 547 students (1.8%) (see Table 3 and Figure 1). Our results corroborate findings from comparable studies by Eru *et al.* (2014) and Egesie *et al.* (2012). However, the prevalence of RhD+ was observed in males (60.3%) and less in females (39.7%), see Figure 1. The Rhesus negative phenotype in females is advantageous because prevalence of Rhesus negative females in any given population could lead to clinical complications of fetomaternal hemorrhage resulting in the haemolytic disease of the newborn (HDN), miscarriages and irreversible sensitization reaction of the mother, due to Rh incompatibility (Anifowoshe *et al.*, 2017; Olubayode *et al.*, 2013*;* Olaniyan *et al.*, 2013).

The result of the distribution of Haemoglobin genotype among student 277 students across the five faculties of Federal University Wukari, indicate that 210 students were AA (75.8%), 66 were AS (23.8%), and 1female student was found to be SS (0.4%), see Figure 2 and 3. This result corroborates those of a previous study carried out at Imo State University by Okoroiwu *et al. (*2015), where the distribution of AA and AS were 74.6% and 25.4%, with zero occurrences of SS genotype. The proportion of AA was significantly higher than that of AS in this study, which congruent with that of Nwafor & Banigo (2001), where AA ranged from 55 to 75% and the sickle cell trait range from 20 to 30%.

5. Conclusion

The result of this study indicates that blood group O and RhD positive are the most frequently encountered blood groups and the HbAA genotype was the predominant genotype among students across the faculties sampled. The significance of these results is invaluable to effective blood bank management, easy access to information for timely donor recruitment, and important knowledge about the health benefits of the prevalence of certain blood group phenotypes in the population could aid the proper allocation of resources and sustainable Health care delivery in the target community.

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