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Distribution of haemoglobin variants, ABO blood group and Rhesus D among nursing students of Madonna university Nigeria

Abstract

This study evaluated the distribution of haemoglobin variants, ABO blood group and Rhesus D typing among nursing students of Madonna University Nigeria. Blood samples were collected from a total of 120 candidates within the age of 18–27years comprising of 65 female and 55 males. The haemoglobin electrophoresis method was used to determine the haemoglobin variants, while haemagglutination techniques were adopted for ABO and rhesus D typing. Results showed that blood group O, A, B and AB has a percentage occurrence of 49.23%, 21.54%, 24.62% and 4.62% for females respectively, and 56.36%, 18.18%, 14.55% and 10.91% for males respectively. The Rhesus negative and positive was 23.08% and 76.92% respectively for females, and 14.55% and 85.45% respectively for males. The haemoglobin variants; AA, AS and SS were 81.54%, 16.92% and 1.54% respectively among females and 87.27%, 10.91% and 1.82% respectively among males. For both gender, Blood group O with positive Rhesus D and AA haemoglobin variants dominated the population under study with frequency of occurrence of 38.46% for females and 49.09% for males. The findings of this study contribute to the existing pool of knowledge for health care planning and transfusion services among the target population under study.

Keywords: blood groups, haemoglobin variants, rhesus D typing, transfusion services

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Introduction

According to Apecu et al.,[1] Ugwu,[2] Karl Landsteiner (an Austrian scientist) in 1900 discovery of ABO blood group is a major breakthrough in the history of blood transfusion, which marks the beginning of wide range of discovery in the field of Immunoheamatology. In addition, in 1902 Alfred Von Decastello and Adrian Sturli discovered AB blood.[1,3,4] Several years later Rhesus (D) antigen was discovered by Landsteiner and Weiner. Apecu et al.[1] reported that blood group and Rhesus system is the most vital human blood group systems for blood transfusion. The authors further reported that other blood grouping system based on antigens exist but in clinical practices only ABO and Rhesus system are essential. Typically, the assessment of blood groups is based on inherited antigenic substances.[2] The ABO blood group system typically consists of groups A, AB, B, and O, and they are determined by the presence or absence of A and B antigens,[1] Eastlund[5] reported that these antigens are controlled by three allelic genes (viz: A, B and O) that are situated on the long arm of chromosome 9q and they are not altered by environmental factors. Olugbemi et al.[6] reported that the antigens of ABO-Rh blood group and antibodies of ABO blood group are found on the surface of red blood cell and plasma respectively. The authors further reported two antigens and two antibodies are predominantly responsible for the ABO types. Rhesus system are grouped as Rh-positive or Rh-negative based on their presence or absence on red cell surface.[1]

Beside blood groups, haemoglobin genotype is also inherited blood characters.[7] Typically disorder associated with haemoglobin usually occurs within a set of population and it tends to vary according to locality. Makani et al.[8] reported that about 700 structural hemoglobin variants are known. Of these only 2 (Hb S, Hb C) has high frequencies in African continent. As such the major haemoglobin variants are AA, AS, AC, SS and SC.[9] Jeremiah[7] also reported that sickling disorders viz: heterozygous state for haemoglobin S commonly known as sickle cell trait, the homozygous state for HbS commonly referred to as sickle cell anaemia and compound heterozygous state for HbS in addition to haemoglobin C, D, E or other structural variants are found within the human population. For instances with the human population, Sickle haemoglobin (HbS) results from a substitution of one amino acid (Valine) for another amino acid (Glutamic acid) at position six of the β-globin polypeptide chain. This substitution is caused by a single-base mutation in codon 6 within the β-globin gene on chromosome 11, where the sequence GAG occurs instead of GTG.[8] Red blood cells contain glycoproteins and glycolipids that make up the blood group antigens on their surface.[1,7] Olugbemi et al.,[6] Apecu et al.[1] opined that human blood groups depend on the functioning of glycosyltransferases (an enzymes that catalyze the formation of glycosidic bond between monosaccharides). Several studies have been carried out to assess the frequency of ABO and Rhesus blood across ethnic groups, and population and results have shown diverging phenotypic characteristics.[2] The assessment of blood group ABO, Rhesus and genotype (AA, AS, SS) provide vital information during blood transfusion services. This will be vital in preventing hemolytic transfusion reactions and death, hemolytic disease of the fetus and newborn as well as to make for easy accessibility to rhesus negative blood for transfusion especially in cases of emergency.[2] Hence this study aimed at ABO, Rhesus D typing and haemoglobin variants pattern among nursing students of Madonna University Nigeria.

Materials and methods

Sample collection

A total of 120 blood samples were collected among nursing student of Madonna University, Nigeria within the age of 18–27years comprising of 65 female and 55 males. The blood samples were

collected following venipuncture technique techniques. The blood was then dispensed into ethylenediamine tetracetic acid (EDTA) salt.

Laboratory analysis

Genotype

The blood genotype was determined using haemoglobin electrophoresis based on the method previously described by Brown[10] and has been applied by Jeremiah,[7] Onuoha et al.[9] A small amount of blood venous haemolysate was carefully placed on the cellulose acetate membrane. Then after, it was introduced into the electrophoretic tank containing Tris - EDTA - Borate buffer at pH 8.6. The samples was run for 15–20minutes in an electrophoresis machine set at an electro motive force of 160 V. control was also established by running the haemolysates of known haemoglobin variants and the results were read immediately.

Rhesus D typing

The Rhesus D typing was carried out based on the method previously described by Onuoha et al.[7,9] A drop of anti-D serum was carefully placed in a clean tube. Also, a drop of control samples was also placed on a second test tube. Then approximately 1 drop of 5% blood suspension in saline was added into the tube. The tube was incubated at 37°C for 30 minutes. After which, the tube were carefully homogenized and then centrifuged for 30 seconds then check for agglutination macroscopically. In doubts, agglutination was confirmed microscopically. In addition indirect antiglobulin test procedure was used to confirm negative results.

ABO Blood group Determination

The blood group were determined following the Red cell phenotyping method previously described by Judd,[11] Brecher,[12] and have been applied by Jeremiah.[7] A drop of anti-A, anti-B, and anti-O were carefully placed in different test tubes, and a drop of 5% red blood cell suspension in saline was added to each tube. The mixture was carefully homogenized and centrifuged for 30 seconds. Then after, the cell buttons were resuspended and agglutination was observed for positive results. Furthermore, a smooth cell suspension after resuspension followed by a microscopic confirmation constituted negative test results.

Statistical analysis

SPSS version 20 was used to carry out the statistical analysis. The data were expressed as percentage of the various categories. The resultant values were converted to chart using Microsoft excel.

Results and discussion

The percentage occurrence of various blood groups among nursing students of Madonna University Nigeria is presented in Figure 1. The blood group has a percentage of group O, A, B and AB were 49.23%, 21.54%, 24.62% and 4.62% for females respectively and 56.36%, 18.18%, 14.55% and 10.91% for males respectively. Blood grouping tend to show similar trend among the different human population. The most common trend are O>A>B>AB. This trend has been reported in some major regions of the world. For instances, Ugwu[2] reported occurrence of blood group O, A, B and AB as 47%, 41%, 9% and 3% respectively in Caucasians in the United states, 46%, 27%, 20% and 7% respectively among the African Americans. Within Africa same trend have also been reported among the rural population in southwestern Uganda,[1] Southern Ethiopia[13] and some regions in Nigeria. Sometimes, slight variation occurs between gender for blood group A and B. For instance, Olugbemi et al.[6] reported Blood group of 22.5 % (O), 7.5 %(A), 6.5 % (B) and 2 % (AB) among males, and 29 % (O), 11.5 % (A), 17.5 % (B), and 3.5 % (AB) in females among adults attended Federal Medical Centre, Lokoja, Kogi State. Olaniyan et al.[14] reported blood group of indigenes of FCT, Abuja for group A, B, AB and O as 21.6%, 26.2%, 4.9% and 47.2% respectively for all cases (male and females), 18.85, 28.8%, 5.3% and 47.1% respectively for only males, and 25.2%, 23%, 4.4% and 47.4% respectively for only females. Onuoha et al.[9] reported frequency of blood group A, B, AB and O as 20.3%, 22.7%, 3% and 54% in Yenagoa and its environs in Bayelsa state. Bamidele et al.[15] frequency of blood group A, B, AB and O as 29.4%, 15.80%, 3.2% and 51.6% among Bowen University Medical student, Nigeria. Jeremiah[7] reported frequency of blood group A, B, AB and O as 22.9%, 17.1%, 4.84% and 51.16% among students population of African descents in Port Harcourt, Nigeria. The ABO blood group influences the susceptibility of some disease condition.[14,16] Olaniyan et al.,[14] Uneke[17] opined that blood group A individuals are more at risk of contracting smallpox and developing cancer of the stomach, oesophagus and pancreas. Furthermore, Blackwell et al.[18] reported that individuals with blood group O are more susceptible to disease caused by *Escherichia coli* O157. Clarke et al.[19] reported that individuals with blood group O is about 35% likely to develop peptic ulceration than other blood group. The authors further reported that blood group O individuals more likely to suffer from duodenal than gastric ulcer. Rowe et al.[20] reported that blood group O has the tendency to protect the body against severe malaria associated with *Plasmodium falciparum* through the mechanism of reduced rosetting. Alemu and Mama[13] reported that blood group O donors are significantly more susceptible to asymptomatic malaria compared to other blood groups.

Figure 2 present the percentage occurrence of rhesus factors among nursing students of Madonna University Nigeria. The Rhesus negative and positive was 23.08% and 76.92% respectively for females and 14.55% and 85.45% for males. Typically, the frequency of Rhesus (D) negative is typically lower compare to the positive group. This trend have been reported in a rural southwestern Ugandan,[1] Nigeria[2,6,14] Ugwu[2] reported Rhesus positive (95.8%) and Rhesus negative (4.2%) among Ebonyi state University students, Nigeria. Olaniyan et al.14 reported Rh-positive (95.7%) and Rh-negative 13 (4.3%) among indigenes of FCT Abuja. Onuoha et al.[9] reported frequency of Rhesus positive (95.5%) and Rhesus negative (4.5%) in Yenagoa and its environs in Bayelsa state. Jeremiah[7] reported frequency of Rhesus positive (96.77%) and Rhesus negative (3.23%) among students population of African descents in Port Harcourt, Nigeria. AB and Rh-negative had the least frequency. Olugbemi et al.[6] also reported that gender do not significantly affect both blood group system.

Pramanik and Pramanik,[21] Sidhu[22] have reported that human share same ABO and Rhesus blood group systems; but they differs based on frequencies and distributions of specific group in different races, ethnic groups, and socio-economic groups etc. Olugbemi et al.[6] reported that when blood types are 100% genetically inherited, the environment can potentially determine which blood types in a population will be passed on more frequently to the next generation, which is done through natural selection. The percentage occurrence of genotype among nursing students of Madonna University Nigeria is presented in Figure 3. Both males and females showed similar trend. Among the various heamogoblin variants; AA, AS and SS under study the percentage occurrence were 81.54%, 16.92% and 1.54% respectively in females and 87.27%, 10.91% and 1.82% respectively in males.

The trend of the haemoglobin variants in this study is comparable to the values previously reported in different locations in Nigeria. Jeremiah[7] reported AA and AS haemoglobin variants as 80.32% and 19.68% among students of African descent in Port Harcourt. Onuoha et al.[9] reported frequency of AA, AS SS as 73.32%, 25.03 and 1.3% in Yenagoa and its environs, Bayelsa state. The lower values of SS among the population suggest that the SS gene is gradually reducing which could be due to enlightenment/ genetic counseling prior to marriage.[23–25]

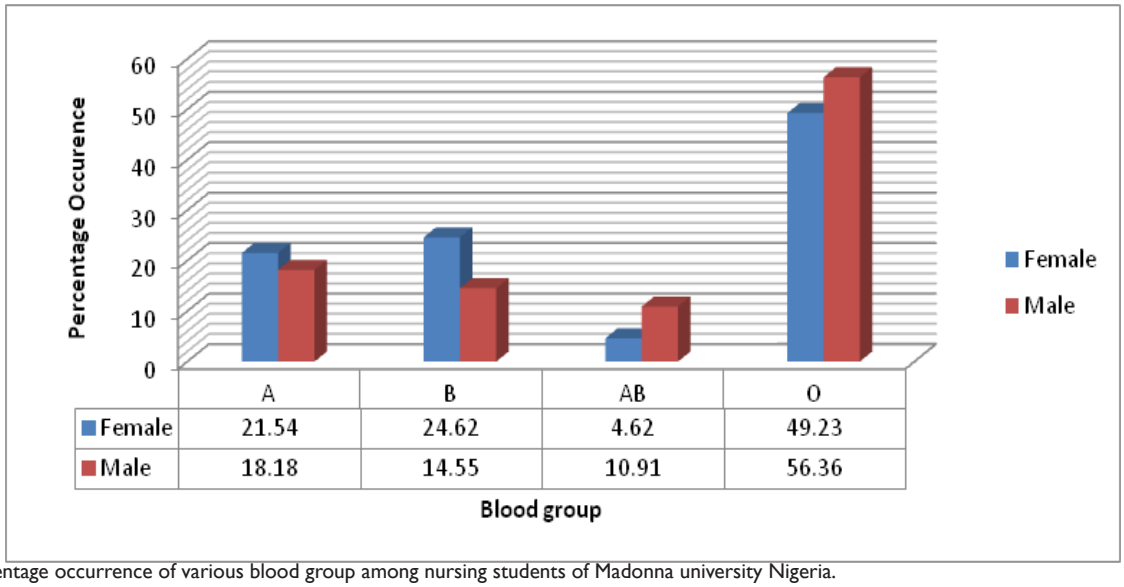

Figure 1 percentage occurrence of various blood group among nursing students of Madonna university Nigeria.

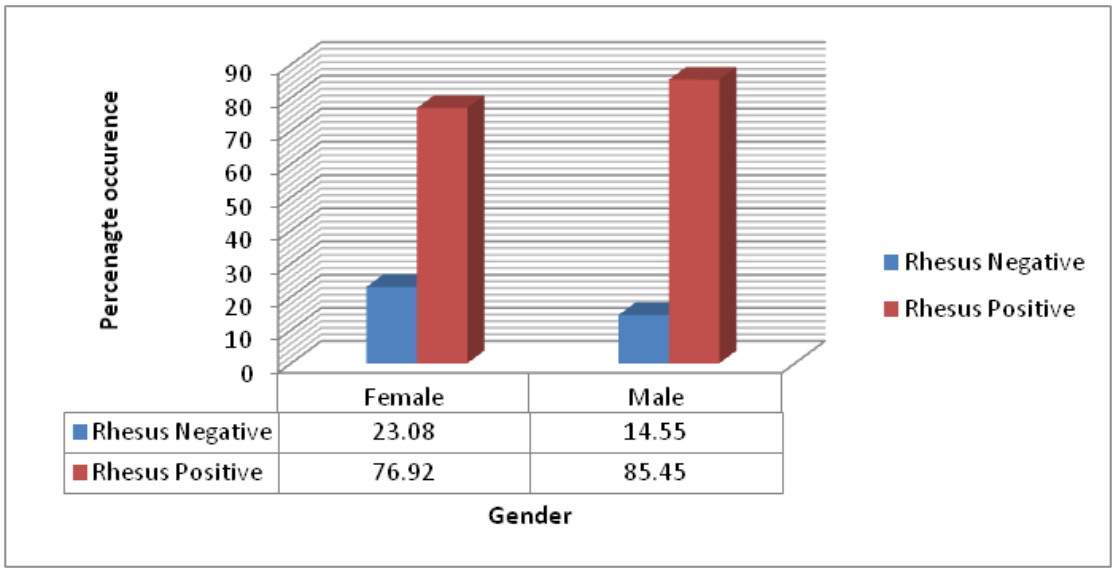

Figure 2 percentage occurrence of rhesus factors among nursing students of Madonna University Nigeria.

The percentage occurrence of blood group, rhesus and genotype among nursing students of Madonna University Nigeria is presented in Figure 4. For females and males blood group A the values were 3.08% and 5.45% respectively among individuals with negative Rhesus and AA haemoglobin variants, 15.38% and 10.91 % respectively among Rhesus positive individuals with AA genotype, and 3.08% and 1.82% respectively among Rhesus positive individuals with AS genotype. For females and males with blood group AB the values were 3.08% and 1.82% respectively among individuals with negative Rhesus and AA haemoglobin variants, 1.54% and 7.27 % respectively among Rhesus positive individuals with AA genotype, and 0% and 1.82% respectively among Rhesus positive individuals with AS genotype. Among the B blood groups Rhesus negative individuals with AA, AS and SS haemoglobin variants the percentage occurrence were 7.69%, 1.54% and 1.54% respectively in females, and 3.64%, 0.00%, 0.00% respectively in males. Furthermore, blood group B with Rhesus positive individuals having AA and AS genotype the frequency were 9.23% and 3.08% respectively for females, and 4.27% and 3.64% respectively for males.

Among the O blood groups Rhesus positive individuals with AA, AS and SS haemoglobin variants the percentage occurrence were 38.46%, 7.69% and 0% respectively in females, and 49.09%, 3.64% and 1.82% respectively in males. While the blood group O with Rhesus negative and AA haemoglobin variant, the frequency were 4.62% in females and 1.82% in males. The occurrences of the

haemoglobin variants among the various blood groups and rhesus D followed similar trend of the blood group and Rhesus D occurrence in the study area. AS such individuals with blood group O with Rhesus positive and haemoglobin variant dominated the distribution pattern. The trend of Rhesus positive individuals occirning more in Blood group O<A<B<AB is in accordance with the findings of Onuoha et al.[9] in Yenagoa and its environs, Baylesa state. Therefore, the knowledge of the various blood groups, rhesus D and genotypes is essential in diagnosis, genetic information, genetic counseling and general wellbeing of individuals.[9]

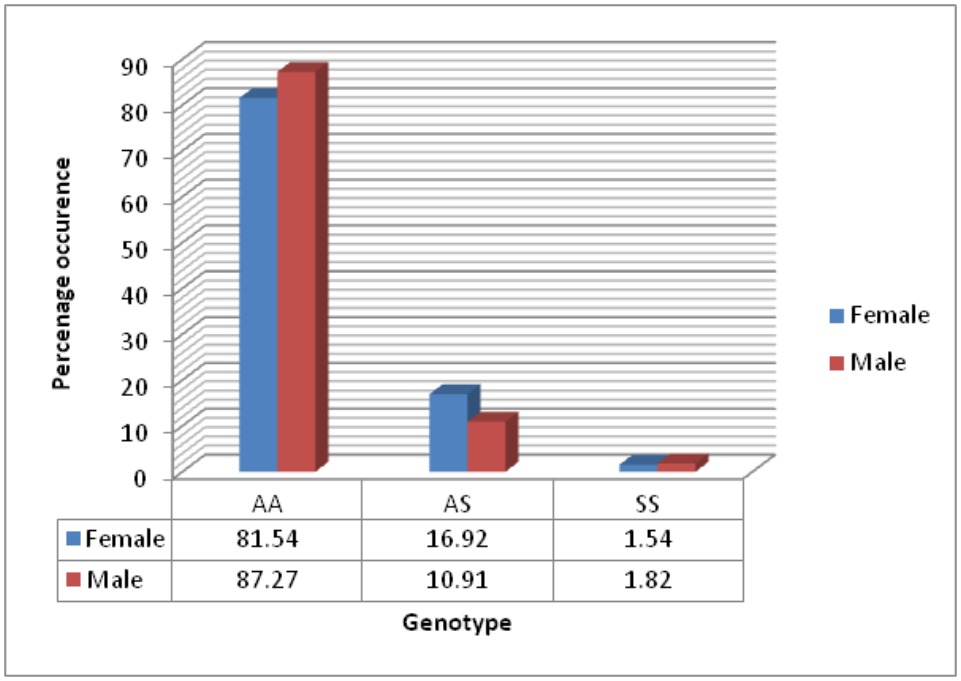

Figure 3 percentage occurrence of genotype among nursing students of Madonna university Nigeria.

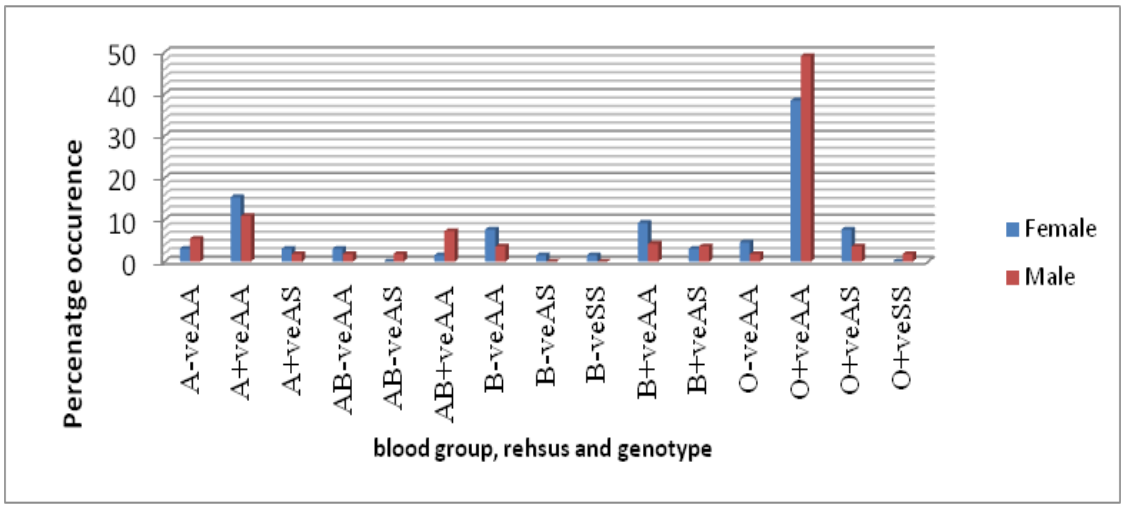

Figure 4 Percentage occurrence of blood group, rhesus and genotype among nursing students of Madonna University Nigeria.

Conclusion

Haemoglobin variants, blood group and Rhesus system is the most vital human blood group systems necessary for blood transfusion. This study found the highest prevalence rate among the A, B, AB and O was blood group O in both sex under consideration. The Rhesus D typing also showed similar trend. While AA haemoglobin variants accounts for 81.54% in females and 87.27% in males. The results generally showed that individuals with blood group O, Rhesus positive and AA genotype were more among the target population. The result of this study will be useful health care planning and management processes as well as during blood transfusion services.

Ethical consideration

Permission was obtained from the ethics committees of the Medical Laboratory Science Department of Madonna University, Elele, Nigeria. Informed consent was obtained from the patients prior to sample collections.

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None.

Conflict of interest

The authors declare that there is no conflict of interest.

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