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Original Research Article

Distribution of Abnormal Haemoglobin Variants and ABO/Rhesus Blood Groups Among Pregnant Women Attending Antenatal Care at Imo State University Medical Center, Owerri, Nigeria

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Abstract

Background: *Hemoglobinopathies and blood group incompatibilities are significant genetic and immunopharmacological concerns in prenatal care, particularly in sub-Saharan Africa. The presence of abnormal hemoglobin variants such as sickle cell trait (AS) and their potential implications for maternal and fetal health underscore the need for early screening and targeted interventions during pregnancy. Similarly, ABO and Rhesus (Rh) blood group incompatibilities can result in adverse outcomes, including hemolytic disease of the newborn, if not promptly identified and managed.* ***Objective:*** *This study was conducted to assess the prevalence and distribution of hemoglobin variants and ABO/Rh blood groups among pregnant women attending antenatal care at the Imo State University Medical Center, Nigeria.* ***Methods:*** *A cross-sectional study involving 100 pregnant women was carried out at the Imo State University Medical Center. Blood samples were collected and analyzed to determine hemoglobin variants and Rh D status using standard electrophoresis and serological methods. The frequency distribution of ABO blood groups, Rh D antigen, and hemoglobin genotypes was documented and analyzed.* ***Results:*** *The results revealed that 92% of the participants had the normal hemoglobin genotype AA, while 8% had the AS genotype, indicating carriers of the sickle cell trait. No cases of AC, CC, SS, or SC hemoglobin variants were identified. ABO blood group distribution showed that Blood Group O was most prevalent (58%), followed by Blood Group A (20%), Blood Group B (17%), and Blood Group AB (5%). In terms of Rhesus status, 96% of the women were Rh D positive, while 4% were Rh D negative. A breakdown of Rh D status across blood groups indicated that Blood Group O had the highest Rh D positive prevalence (56%) and Rh D negative (2%), followed by Group A (19% Rh D positive, 1% Rh D negative), Group B (16% Rh D positive, 1% Rh D negative), and Group AB (5% Rh D positive only).* ***Conclusion:*** *The study highlights a predominance of the AA hemoglobin variant and Rh D positive blood type among pregnant women in this population, with Blood Group O being the most common. These findings underscore the importance of routine hemoglobinopathy screening and Rh factor determination during antenatal care. Incorporating genetic counseling and targeted health strategies tailored to local genetic profiles can significantly enhance maternal and neonatal outcomes in this region.*

Keywords: *Haemoglobin Variants, ABO/RH Blood Groups, Rhesus Factor, Pregnant Women.*

1. INTRODUCTION

Hemoglobin variants and blood group antigens are vital genetic traits with significant implications for maternal and fetal health during pregnancy. Hemoglobinopathies, particularly sickle cell disease and related disorders, remain prevalent in sub-Saharan Africa and can contribute to increased risks of anemia, miscarriage, intrauterine growth restriction, and

perinatal mortality if not properly managed during pregnancy [1,2]. The most common hemoglobin variants encountered in African populations include AA (normal), AS (sickle cell trait), SS (sickle cell anemia), and, less frequently, AC and SC variants [3]. Similarly, the ABO and Rhesus (Rh) blood group systems are clinically important in obstetrics. Incompatibility between the Rh factor of the mother and fetus, especially in Rh-negative mothers carrying Rh-positive fetuses, can lead to hemolytic disease of the newborn (HDN), a condition that may be fatal if not detected and managed promptly [4]. Understanding the distribution of ABO and Rh blood groups within a population enables clinicians to anticipate and address potential transfusion reactions, alloimmunization, and other perinatal complications [5].

In Nigeria, regional variations in the prevalence of hemoglobinopathies and blood group types have been reported, often shaped by ethnic, genetic, and environmental factors [6 ,7]. Despite this, localized data on these genetic markers among pregnant women remain limited, especially in specific healthcare facilities. This study investigates the distribution of abnormal hemoglobin variants and ABO/Rh blood groups among pregnant women attending antenatal care at the Imo State University Medical Center, Nigeria. The findings are crucial for guiding routine screening, antenatal counseling, and perinatal care strategies in the region.

2. MATERIALS AND METHODS

2.1 Study Area

This research study was carried out at Imo state university medical center, Owerri, Nigeria.

2.2 Study Design

This study was a descriptive cross-sectional study aimed at determining the distribution of abnormal hemoglobin variants and ABO/Rhesus (Rh) blood groups among pregnant women attending antenatal care at the Imo State University Medical Center, Owerri, Nigeria.

2.3 Method of Recruitment

A total of 100 pregnant women attending routine antenatal clinics at the Imo State University Medical Center were consecutively recruited for the study over a defined period. Participation was voluntary, and eligibility criteria included being pregnant, attending antenatal care at the study center, and providing informed consent. Women with known hematological disorders or those who declined to participate were excluded from the study.

2.4 Sample Collection

Approximately 2 mL of venous blood was collected aseptically from each participant using a sterile disposable syringe. The blood samples were transferred into ethylenediaminetetraacetic acid (EDTA) anticoagulant tubes for hemoglobin electrophoresis and blood grouping analysis. Samples were labeled with unique identifiers to ensure confidentiality and immediately transported to the laboratory for analysis.

2.5 Ethical Consideration

Ethical approval for the study was obtained from the Ethics and Research Committee of the Imo State University Medical Center. Informed consent was obtained from all participants after a thorough explanation of the study's purpose, procedures, potential risks, and benefits. Participation was entirely voluntary, and confidentiality of participants' information was strictly maintained throughout the study.

2.6 Laboratory Analysis

2.6.1 Hemoglobin Electrophoresis

Hemoglobin variants were identified using cellulose acetate hemoglobin electrophoresis at alkaline pH (8.6). The method allows for the separation of hemoglobin types based on their mobility in an electric field. Interpretation of the band patterns was done by comparison with standard controls.

2.6.2 ABO and Rhesus Blood Grouping

ABO and Rh blood grouping were performed using the standard agglutination method. Commercially prepared monoclonal antisera (anti-A, anti-B, and anti-D) were used. A drop of each antiserum was mixed with a drop of the participant's blood on a clean glass slide, and agglutination was observed to determine the blood group and Rh D status.

2.7 Statistical Analysis

Data obtained were entered into Microsoft Excel and analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics such as frequencies and percentages were used to summarize the distribution of hemoglobin variants, ABO blood groups, and Rh D status. The results were presented in tables. Associations between variables were not tested as the study was descriptive in nature.

3. RESULTS

Table 1: Percentage Distribution of Normal and Abnormal Hemoglobin Variants among Pregnant Women.

This table shows the percentage distribution of normal and abnormal hemoglobin variants among 100 pregnant women. The vast majority (92%) of the participants had the normal hemoglobin variant AA, indicating that they do not carry any abnormal hemoglobin genes. A smaller proportion (8%) had the AS variant, meaning they are carriers of the sickle cell trait but do not exhibit symptoms of sickle cell disease. None of the participants had the AC, CC, SS, or SC variants, indicating an absence of hemoglobin C and sickle cell disease in this cohort. The statistical significance ($p<0.05$) of the distribution suggests that the observed pattern is unlikely to be due to chance and reflects a meaningful trend in the population.

Hemoglobin variants	Number of participants (N=100)	Percentage (%) Distribution
AA	92	92.00
AS	8	8.00
AC	0	0.00
CC	0	0.00
SS	0	0.00
SC	0	0.00
Total	100	100

Table 2: Percentage Distribution of Rhesus factor among pregnant women in ABO blood groups

Table 2 shows the percentage distribution of the Rhesus factor (Rh) among pregnant women in different ABO blood groups, based on a sample of 100 participants. The breakdown of the ABO blood groups reveals that blood group O is the most prevalent, comprising 58% of the participants. Blood Group A follows with 20%, Blood group B, with 17%, and blood group AB with 5%. This distribution shows a clear predominance of blood group O among the sample population. The table also examines the distribution of the Rhesus factor. A significant majority, 96%, of the women were Rh (D) positive, indicating the presence of the Rh antigen on their red blood cells. Conversely, only 4% were Rh (D) negative, lacking this antigen.

Variables	**Number of participants (N= 100)**	**Percentage (%) Distribution**
Blood groups		
A	20	20
B	17	17
AB	5	5
O	58	58
Total	100	100
Rhesus (Rh)		
Rh (D) Positive	96	96
Rh (D) Negative	4	4
Total	100	100

Table 3 Rhesus (Rh) D Distribution among pregnant women in ABO blood groups

Table 3 presents the distribution of the Rhesus (Rh) D antigen among pregnant women across different ABO blood groups. The majority of the women were Rh D positive, with the largest group being those with blood type O, where 56% were Rh D positive and 2% were Rh D negative. Blood type A follows, with 19% Rh D positive and 1% Rh D negative. Similarly, blood type B has 16% Rh D positive and 1% Rh D negative. Blood type AB had 5% Rh D positives, with no Rh D negative reported. Overall, 96% of the pregnant women were Rh D positive, while 4% were Rh D negative. This distribution indicates that Rh D positivity is highly prevalent among the study population, with a small minority being Rh D negative.

Blood Group	Rh D Positive (%)	Rh D Negative (%)
A	19 (19.0)	1 (1.0)
B	16 (16)	1 (1.0)
AB	5 (5)	-
O	56 (56.0)	2 (2.0)
Total	96 (96.0)	4(4.0)

4. DISCUSSION

This study revealed that the hemoglobin genotype AA was the most predominant among the pregnant women sampled, accounting for 92% of the population, while 8% were carriers of the sickle cell trait (AS). There were no cases of hemoglobin variants AC, CC, SS, or SC. This high prevalence of the AA genotype aligns with earlier reports from Southern Nigeria where AA prevalence ranged between 85%–95% [6, 8]. The presence of AS (8%) indicates a moderate carrier frequency of the sickle cell trait, a reflection of the ongoing burden of hemoglobinopathies in Nigeria [9].

The absence of hemoglobin variants AC, SS, SC, and CC may reflect the relatively low prevalence or effective genetic counseling and screening programs in the area. Previous studies have shown varying prevalence of these abnormal variants across different Nigerian regions, with the SS and SC genotypes being more common in high-risk zones of the country [10]. The findings underscore the importance of routine hemoglobin electrophoresis screening in antenatal care to identify carriers early and offer appropriate genetic counseling.

Regarding the ABO blood group distribution, Blood Group O was the most prevalent, seen in 58% of participants, followed by Group A (20%), Group B (17%), and Group AB (5%). This distribution is consistent with findings from other studies in southeastern Nigeria where Blood Group O typically dominates [11]. The predominance of Group O is advantageous in transfusion medicine due to its universal donor compatibility, yet the relative scarcity of AB may limit options in plasma donation scenarios [12].

For Rh status, 96% of participants were Rh D positive, while 4% were Rh D negative. This finding mirrors the general trend in African populations where Rh D negative frequency is relatively low, often ranging from 2% to 5% [13]. The low prevalence of Rh D negativity emphasizes the need to identify Rh-negative women during antenatal visits for proper monitoring and administration of anti-D immunoglobulin to prevent Rh isoimmunization [14].

Further breakdown of Rh D distribution within the ABO groups showed that Group O had the highest Rh D positivity (56%) and 2% negativity. Group A followed with 19% Rh D positive and 1% negative. Group B recorded 16% Rh D positive and 1% negative, while Group AB had 5% Rh D positive and no Rh D negative cases. This Rh-antigen stratification helps anticipate Rh incompatibility risk within each blood group and guides delivery preparedness strategies [15].

These findings provide evidence-based insight into the genetic profiles of pregnant women in Imo State and reinforce the need for comprehensive screening, especially in populations with a high burden of hemoglobinopathies and Rh alloimmunization risk.

5. CONCLUSION

The study reveals a predominant presence of the hemoglobin AA genotype and Rh D positive blood type among pregnant women attending antenatal care at the Imo State University Medical Center, with blood group O being the most common. The relatively low prevalence of the AS genotype and Rh D negative status underscores the importance of routine antenatal screening to identify at-risk pregnancies. Incorporating genetic counseling and Rh prophylaxis into antenatal programs can help reduce the burden of hemoglobinopathies and Rh-related complications, ultimately improving maternal and neonatal outcomes in southeastern Nigeria.

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