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ORIGINAL ARTICLE

Distribution of ABO/Rh Blood Groups and Haemoglobin Phenotypes among University Students in South-West, Nigeria.

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ABSTRACT

Background: Assessing university students' blood group and hemoglobin phenotypes is vital for health policies, and premarital counseling. This study aimed at determining the distribution of Blood group and hemoglobin phenotype among university students in Southwest Nigeria

Methods: A cross-sectional study was conducted at Lead City University in South-West Nigeria from January 2018 to December 2022. Medical records of 5110 enrolled students were analyzed to assess the Blood group distribution and hemoglobin phenotype within the university population. Data encompassing demographic information and health metrics were examined for this study.

Results: In a study of 5110 participants, the mean age (was 23.57+14.89). Notably, 43.9% fall within the age bracket of 18 to 29 years, while 37.7% are below 18. A slight majority (54.1%) were female. The mean packed cell volume (PCV) was 12.9 (±1.399). Hemoglobin levels reveal most of the population (87.6%) with levels surpassing 12 g/dl. However, notable proportions exhibit anemia (12.4%). Blood group O was the most prevalent (53.6%), followed by types B (21.7%), A (20.7%), and AB (3.9%). Genotype distribution indicates a predominance of the AA genotype (73.6%), followed by AS (21.9%), AC (3.3%), and SS (0.7%), with SC (0.4%) and CC (0.1%) being relatively rare. Rhesus factor analysis shows 4.8% Rhesus negative and 95.2% positive individuals.

Conclusion: The high prevalence of sickle cell traits underscores the need for genetic counseling to address Sickle Cell Disease (SCD).

Keywords: Distribution, Blood group hemoglobin phenotype, Rhesus factor, students

INTRODUCTION

Blood groups describe characteristics of red blood cells based on substances (carbohydrates and proteins) on the cell membrane (1). The most significant classifications are the ABO and Rhesus (Rh) factor systems. The ABO system, responsible for many blood transfusion accidents, was one of the first human traits proven to follow Mendelian inheritance (2), discovered by Karl Landsteiner. (3) The Rh factor system was later defined by Weiner in 1939. (4) While there are over 400 other human antigens, most are much rarer than ABO and Rh. Blood type is determined by specific antigens on red blood cells. (1)

Blood group systems, particularly the ABO and Rh systems, are fundamental in medical science for their role in blood transfusions, organ transplants, and in understanding disease susceptibility. (5,6) The distribution of the ABO blood group varies significantly across different populations and ethnic groups. (7) Nigeria has indicated a higher prevalence of blood group O (52.93%), followed by groups A (22.77%), B (20.64%), and AB (3.66%).(8) The Rhesus factor, which can be positive or negative, also plays a critical role in medical conditions such as pregnancy and transfusion medicine. The prevalence of Rhesus negative factor varies between 5.10% and 6.01%. (9,10)

Blood type compatibility plays a critical role in organ transplantation to prevent rejection of the transplanted organ.(11) Individuals with blood group O can donate organs to recipients of any blood group (A, B, AB, or O), making them universal donors in the context of organ transplants. While Blood Group O individuals can only receive organs from donors with blood group O (12), necessitating careful matching careful matching is necessary to avoid rejection.

Hemoglobin phenotype determination is crucial for understanding genetic diversity, managing public health, and guiding reproductive choices to reduce the incidence of SCD. In Nigeria, the most common genotypes was HbAA (74.65- 78.7%), followed by Hb AS (19.6- 23.16%), Hb SS (1.5- 1.84%), Hb AC (0.20- 0.26%), and the least was Hb SC (0.04- 0.09%). (13,14)

Blood group and Rhesus factor are essential in pregnancy and maternal health, transfusion compatibility, and organ transplantation. Understanding blood group distribution is necessary for safe blood transfusions. Blood Group O Negative (O-) is the universal donor. (15) This blood type can be given to patients of any blood group, making it crucial in emergencies where the patient's blood type may not be immediately known. In Nigeria, the prevalence of Blood Group A+ were between 19.7 - 20.4%, A- 0.80- 0.97% , B+ 16.7-19.7%, B- 0.87-1.0%, AB+ 1.5- 2.2%, AB- 0.10- 0.17%, O+ 53.7- 55.6%, and O- 3.1- 3.3% (16.17). Blood group AB Positive (AB+) is known as the universal recipient, (15) can receive red blood cells from any donor, making them versatile recipients.

Rh factor compatibility between mother and fetus is crucial to avoid complications during pregnancy. (18). A Rh-negative mother carrying an Rh-positive baby is at risk of Rh incompatibility. This could lead to hemolytic disease of the newborn (HDN) (19), where the mother's immune system attacks the baby's red blood cells. Thus, counseling, early blood group, and Rh factor screening for students who will later become expectant fathers and mothers is vital. If Rh incompatibility is detected, preventive measures, such as administering Rh immunoglobulin (RhIg), can be taken to protect the health of both the mother and the baby.

In light of this context, understanding the prevalence of Blood group and hemoglobin phenotype among university students in Southwest Nigeria is crucial for informing interventions and health policies. By identifying the distribution of these conditions, stakeholders can develop strategies to promote student health and reduce the burden of

anemia, plan effective blood bank strategies, and promote premarital counseling. This study aims to fill this gap by assessing the distribution of these health issues using data from a large sample of students over five years, contributing to knowledge on student health in Nigeria and informing evidence-based recommendations for interventions.

Materials and Methods

Study Design

A descriptive, cross-sectional study was used to assess blood group phenotype and factors associated with anemia among university students in Southwest Nigeria. Medical records of 5110 enrolled students were analyzed to obtain comprehensive data for the study. The methodology employed rigorous procedures to ensure accuracy and reliability in assessing these health conditions within the university population.

Study area

The study was conducted at Lead City University, a private university in South-West Nigeria. The hospital renders both primary and secondary levels of care with the University. It is a hundred (100) bed hospital that was established in 2002. About 10,000 patients are seen per year. Services rendered include general and inpatient care, emergency services, radiological and laboratory services, public health, and obstetric care services.

Data Collection:

The primary data source for this study was the medical records of students enrolled at Lead City University. These records provided detailed information on demographic characteristics as well as health metrics. Medical records were accessed with permission from the university authorities, ensuring compliance with ethical standards and data protection regulations.

Variables:

Several variables were examined to assess university students' blood group distribution and hemoglobin phenotype. Demographic variables included age, gender, and academic status, while health metrics encompassed Packed cell volume (PCV), blood group, hemoglobin phenotype and Rhesus factor. These variables were selected based on their relevance to the study objectives and existing literature on anemia.

Data Analysis:

Data analysis was conducted using statistical software to examine the prevalence of anemia and identify associated factors among university students. Descriptive statistics were used to summarize the study population's demographic characteristics and health metrics. Chi-square tests and logistic regression analysis were employed to assess the associations between variables and the likelihood of anemia.

Ethical Considerations:

Ethical approval for the study was obtained from the Institutional Review Board of Lead City University and measures were implemented to ensure the confidentiality and anonymity of their medical records. Data were securely stored and accessed only by authorized personnel involved in the research.

Results

The population comprises 5110 individuals, with an average age of 23.57 years and a standard deviation of 14.89 years, indicating a broad age distribution. Notably, 43.9% of individuals fall within the 18-29 age range, while 37.7% are under 18 years old, underscoring a substantial adolescent presence, potentially including early university entrants. Conversely, individuals aged 69 years or older constitute a minimal 0.01%. Gender distribution reveals a slight majority of females, accounting for 54.1%, compared to males at 45.9%, portraying a female-dominated population. (Table 1)

Table 1: **Descriptive Analysis of the hematological parameters**

Variables	Categories	Frequencies	Percentages (%)
Age	< 18 years	1923	37.7
(23.57±14.89)	18-29 years	2241	43.9
	30-39 years	545	10.7
	40-49 years	277	5.4
	50-59 years	97	1.9
	60-69 years	21	0.4
	≥70 years	2	0.01
Sex	Male	2344	45.9
	Female	2766	54.1
Blood Group	A	1060	20.7
	AB	200	3.9
	B	1111	21.7
	O	2739	53.6
Rhesus	Negative (-)	245	4.8
	Positive (+)	4865	95.2
Genotype of Patients	AA	3760	73.6
	AC	169	3.3
	AS	1121	21.9
	CC	5	0.1
	SC	20	0.4
	SS	35	0.7
Total		5110	

Analysis of blood group distribution shows type O as the most prevalent at 53.6%, followed by type B (21.7%), type A (20.7%), and type AB (3.9%). This distribution aligns with global patterns, particularly in African populations where type O blood predominates. (Figure 1). Examining blood group phenotypes, the AA genotype emerges as predominant, present in 73.6% of the population, followed by AS (21.9%), AC (3.3%), SS (0.7%), SC (0.4%), and CC (0.1%). (Figure 2).

Variables	Categories	Rhesus factor		Total	X^2	P value
		Negative	Positive			
Age	< 18 years	61 (24.9%)	1269 (26.1%)	1330 (26.0%)	16.633	0.011*
	18-29 years	124 (50.6%)	2710 (55.7%)	2834 (55.5%)		
	30-39 years	27 (11.0%)	518 (10.6%)	545 (10.7%)		
	40-49 years	22 (9.0%)	255 (5.2%)	277 (5.4%)		
	50-59 years	10 (4.1%)	87 (1.8%)	97 (1.9%)		
	60-69 years	0 (0.0%)	21 (0.4%)	21 (0.4%)		
	≥70 years	1 (0.4%)	5 (0.1%)	6 (0.1%)		
Sex	Male	126 (51.4%)	2218 (45.6%)	2344 (45.9%)	3.201	0.074
	Female	119 (48.6%)	2647 (54.4%)	2766 (54.1%)		
Blood Group	A	46 (18.8%)	1014 (20.8%)	1060 (20.7%)	4.563	0.207
	AB	9 (3.7%)	191 (3.9%)	200 (3.9%)		
	B	43 (17.6%)	1068 (22.0%)	1111 (21.7%)		
	O	147 (60.0%)	2592 (53.3%)	2739 (53.6%)		
Genotype of Patients	AA	176 (71.8%)	3584 (73.7%)	3760 (73.6%)	9.278	0.098
	AC	5 (2.0%)	164 (3.4%)	169 (3.3%)		
	AS	59 (24.1%)	1062 (21.8%)	1121 (21.9%)		
	CC	1 (0.4%)	4 (0.1%)	5 0.1%		
	SC	3 (1.2%)	17 (0.3%)	20 (0.4%)		
	SS	1 (0.4%)	34 (0.7%)	35 (0.7%)		
Total		245 (100.0%)	4865 (100.0%)	5110 (100.0%)		

Rhesus factor distribution reveals 95.2% of individuals are Rhesus positive, while 4.8% are Rhesus negative. Significant differences are noted in age distribution between Rhesus negative and positive groups ($\chi^2 = 16.633$, $p = 0.011$), with Rhesus negative individuals showing slightly higher representation among those under 18 years than Rhesus positive individuals. However, no significant differences were found in gender distribution ($\chi^2 = 3.201$, $p = 0.074$), blood group distribution ($\chi^2 = 4.563$, $p = 0.207$), or genotype distribution ($\chi^2 = 9.278$, $p = 0.098$) between Rhesus positive and negative groups, except for age. (Table 2).

The age-specific trends in blood group

prevalence reveal distinctive patterns. Blood Group A emerges prominently among individuals aged 18-29 years, constituting 57.2% of this age bracket, and also shows a slight male predominance at 46.6%. In contrast, Blood Group AB demonstrates a noteworthy prevalence of 59.0% among females and a substantial presence (29.0%) among those under 18. Blood Group B displays a consistent distribution across different age groups, with a notable 3.9% showing a negative Rhesus factor. Blood Group O, meanwhile, peaks among 18-29-year-olds at 54.1% and exhibits a higher prevalence among females (53.5%) compared to males.

Among Rhesus negative participants, blood group distribution was: A- at 18% (46/245), AB- at 3.7% (9/245), B- at 17.6% (43/245), and O- at 60% (147/245). In the total population, these groups were A- at 0.9%, AB- at 0.18%, B- at 0.8%, and O- at 2.88%. Among Rhesus-positive participants, blood group distribution was: A+ at 20.8% (1014/4865), AB+ at 3.9% (191/4865), B+ at 22% (1068/4865), and O+ at 53.3% (2592/4865). In the total population, these groups were A+ at 19.8%, AB+ at 3.74%, B+ at 20.9%, and O+ at 50.7%. The significant statistical association (P = 0.048) between blood group and genotype further elucidates these relationships. Specifically, Blood Group A predominantly exhibits the AA genotype (75.3%). At the same time, Blood Group AB displays notable proportions of the AC and AS genotypes, suggesting distinct genetic predispositions associated with different blood groups. (Table 3).

Table 3: Blood group distribution across various factors

	Categories	Blood group				Total	X^2	P value
Variables		A	AB	B	O			
Age	< 18 years	272	58	274	726	1330	14.954	0.665
		(25.7%)	(29.0%)	(24.7%)	(26.5%)	(26.0%)		
	18-29 years	606	112	634	1482	2834		
		(57.2%)	(56.0%)	(57.1%)	(54.1%)	(55.5%)		
	30-39 years	105	17	114	309	545		
		(9.9%)	(8.5%)	(10.3%)	(11.3%)	(10.7%)		
	40-49 years	57	10	60	150	277		
		(5.4%)	(5.0%)	(5.4%)	(5.5%)	(5.4%)		
	50-59 years	16	1	21	59	97		
		(1.5%)	(0.5%)	(1.9%)	(2.2%)	(1.9%)		
	60-69 years	4	2	6	9	21		
		(0.4%)	(1.0%)	(0.5%)	(0.3%)	(0.4%)		
	≥70 years	0	0	2	4	6		
		(0.0%)	(0.0%)	(0.2%)	(0.1%)	(0.1%)		

Sex	Male	494	82	494	1274	2344	3.481	0.323
		(46.6%)	(41.0%)	(44.5%)	(46.5%)	(45.9%)		
	Female	566	118	617	1465	2766		
		(53.4%)	(59.0%)	(55.5%)	(53.5%)	(54.1%)		
Rhesus factor	Negative (-)	46	9	43	147	245	4.563	0.207
		(4.3%)	(4.5%)	(3.9%)	(5.4%)	(4.8%)		
	Positive (+)	1014	191	1068	2592	4865		
		(95.7%)	(95.5%)	(96.1%)	(94.6%)	(95.2%)		
Genotype of Patients	AA	798	137	795	2030	3760	25.186	0.048*
		(75.3%)	(68.5%)	(71.6%)	(74.1%)	(73.6%)		
	AC	36	13	44	76	169		
		(3.4%)	(6.5%)	(4.0%)	(2.8%)	(3.3%)		
	AS	217	47	256	601	1121		
		(20.5%)	(23.5%)	(23.0%)	(21.9%)	(21.9%)		
	CC	1	1	2	1	5		
		(0.1%)	(0.5%)	(0.2%)	(0.0%)	(0.1%)		
	SC	1	0	4	15	20		
		(0.1%)	(0.0%)	(0.4%)	(0.5%)	(0.4%)		
	SS	7	2	10	16	35		
		(0.7%)	(1.0%)	(0.9%)	(0.6%)	(0.7%)		
Total		1060	200	1111	2739	5110		
		(100.0%)	(100.0%)	(100.0%)	(100.0%)	(100.0%)		

Among individuals under 18 years old, there is a pronounced presence of AS (sickle cell trait) and SS (sickle cell disease) phenotypes, accounting for 26.7% and 42.9%, respectively. The 18-29 age group shows a significant representation of AC (55.6%), AS (53.1%), and SS (51.4%) phenotypes, indicating a high incidence of carriers and affected individuals in this demographic. Conversely, there is a decline in AS and SS phenotypes in older age groups, albeit not statistically significant (P = 0.595). Regarding gender-based comparisons, blood phenotype distributions largely mirror each other between males and females, suggesting comparable genetic trait prevalence across genders. Minor discrepancies, such as a slight male predominance in the CC genotype (60.0%), are noted but lack statistical significance (P = 0.946). Blood group A displays a slight genotype AA and AC predominance among blood groups A, AB, B, and O. Blood group AB and B have a slight CC predominance, while Blood group O displayed genotype SC predominance. This was a statistically significant association with sickle cell traits (AS and SS) (P = 0.048*), suggesting a heightened prevalence within this demographic. (Table 4).

Table 4: Blood phenotype distribution across various factors

Variables	Categories	Blood phenotype						Total	X^2	P value
		AA	AC	AS	CC	SC	SS			
Age	< 18 years	966 (25.7%)	45 (26.6%)	299 (26.7%)	1 (20.0%)	4 (20.0%)	15 (42.9%)	1330 (26.0%)	27.531	0.595
	18-29 years	2110 (56.1%)	94 (55.6%)	595 (53.1%)	4 (80.0%)	13 (65.0%)	18 (51.4%)	2834 (55.5%)		
	30-39 years	390 (10.4%)	19 (11.2%)	135 (12.0%)	0 (0.0%)	1 (5.0%)	0 (0.0%)	545 (10.7%)		
	40-49 years	205 (5.5%)	6 (3.6%)	64 (5.7%)	0 (0.0%)	2 (10.0%)	0 (0.0%)	277 (5.4%)		
	50-59 years	72 (1.9%)	5 (3.0%)	18 (1.6%)	0 (0.0%)	0 (0.0%)	2 (5.7%)	97 (1.9%)		
	60-69 years	13 (0.3%)	0 (0.0%)	8 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	21 (0.4%)		
	≥70 years	4 (0.1%)	0 (0.0%)	2 (0.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (0.1%)		
Sex	Male	1723 (45.8%)	83 (49.1%)	510 (45.5%)	3 (60.0%)	9 (45.0%)	16 (45.7%)	2344 (45.9%)	1.191	0.946
	Female	2037 (54.2%)	86 (50.9%)	611 (54.5%)	2 (40.0%)	11 (55.0%)	19 (54.3%)	2766 (54.1%)		
Blood group	A	798 (21.2%)	36 (21.3%)	217 (19.4%)	1 (20.0%)	1 (5.0%)	7 (20.0%)	1060 (20.7%)	25.186	0.048*
	AB	137 (3.6%)	13 (7.7%)	47 (4.2%)	1 (20.0%)	0 (0.0%)	2 (5.7%)	200 (3.9%)		
	B	795 (21.1%)	44 (26.0%)	256 (22.8%)	2 (40.0%)	4 (20.0%)	10 (28.6%)	1111 (21.7%)		
	O	2030 (54.0%)	76 (45.0%)	601 (53.6%)	1 (20.0%)	15 (75.0%)	16 (45.7%)	2739 (53.6%)		
Rhesus factor	Negative (-)	176 (4.7%)	5 (3.0%)	59 (5.3%)	1 (20.0%)	3 (15.0%)	1 (2.9%)	245 (4.8%)	9.278	0.098
	Positive (+)	3584 (95.3%)	164 (97.0%)	1062 (94.7%)	4 (80.0%)	17 (85.0%)	34 (97.1%)	4865 (95.2%)		
Total		3760 (100.0%)	169 (100.0%)	1121 (100.0%)	5 (100.0%)	20 (100.0%)	35 (100.0%)	5110 (100.0%)		

DISCUSSION

The analysis of blood group, hemoglobin phenotype, and Rhesus factor distribution among university students in Nigeria provides a comprehensive insight into this population's demographic and genetic characteristics. Blood group systems are essential in various medical practices, including blood transfusions, organ transplants, and susceptibility to diseases such as malaria and certain cancers (1,2). In this study, the distribution of blood groups among university students in Nigeria indicated that blood group O was the most common (53.6%), followed by blood group B (21.7%), A (20.7%), and AB (3.9%). This aligns with previous studies on blood group distribution in Nigeria and other African populations. A study (20) reported a prevalence of 59.7% for blood group O among university students in Osun State, which was slightly higher than

our finding. This discrepancy might be due to sampling differences, as the study was conducted between 2013 and 2017.

The predominance of blood group O was consistent with findings across sub-Saharan Africa, where this blood group is most prevalent. For example, research (21) among patients in Kogi State, North Central Nigeria, revealed a blood group O prevalence the same as ours (53.6%). Additionally, a study (10) reported a 54.1% prevalence of blood group O among blood donors in Benin City, supporting the high prevalence observed in various parts of Nigeria. (5) These findings are essential for blood transfusion services since individuals with blood group O are considered universal donors, especially for emergencies. (6)

On the other hand, blood group AB was the least common in this study (3.9%), similar to findings in other parts of Nigeria. A study (22) conducted in Port Harcourt found a slightly lower prevalence of blood group AB (1.3%) among patients. On the contrary, another study (23) in Ebonyi reported a prevalence of 2.8% among undergraduate students, which is closer to our results. The variations in blood group distribution, particularly for AB, may be influenced by genetic and demographic differences within the Nigerian population. Factors such as ethnicity, migration, and intermarriage among various ethnic groups in Nigeria contribute to the distribution of ABO blood types. (9) The distribution of blood groups has practical implications for transfusion services. Blood group O-negative, which was found in 2.88% of the population, poses significant challenges in resource-limited settings. Similar studies in southwestern Nigeria reported a prevalence of O-negative between 2.6% and 3.2% (16, 20), in South-south Nigeria (23,29) was 9.1%, while 1% was reported in Northern Nigeria. (25) This finding underscores the scarcity of this blood type. (10) Managing blood supplies for such rare blood groups remains a challenge, especially in emergencies where compatible donors may not be readily available.

Hemoglobin Phenotype Distribution and Sickle Cell Disease

The distribution of hemoglobin phenotypes observed in this study reflects the population's genetic diversity, with hemoglobin AA being the most prevalent phenotype (73.6%). This finding is consistent with other studies conducted across Nigeria. For instance, a study conducted in North Central Nigeria (21), reported a prevalence of 75.1% for hemoglobin AA, and another study (13) conducted in Southeast Nigeria found a similar prevalence of 74.65%. These studies highlight the predominance of hemoglobin AA, the normal hemoglobin type, across Nigeria.

The sickle cell trait (hemoglobin AS) was present in 21.9% of the participants in this study, which aligns with previous research. Research among students in Osun State (20) reported a prevalence of 23.4%, similar to another study in North Central Nigeria, which found a prevalence of 24.6%. (21) The sickle cell trait is common in Nigeria due to its selective advantage against malaria, a major public health issue in the region. (22) This high prevalence has significant public health implications, especially in terms of reproductive health and the risk of having children with sickle cell disease (SCD). (13,14)

The prevalence of hemoglobin SS in this study was 0.7%, slightly lower than reported in other Nigerian studies. For example, Azi et al. (2023) (24) found a prevalence of 0.3% among undergraduate students in Ebonyi, while Kingsley et al. (2019) (26) reported a prevalence of 2.14% among patients in a tertiary hospital in Cross River State. These differences may be attributed to regional and ethnic variations within Nigeria. Although the overall prevalence of hemoglobin SS is low, sickle cell disease remains a significant health concern in Nigeria. It is associated with high morbidity and mortality, particularly among children under five years of age. (16)

In this study, the prevalence of hemoglobin AC was 3.3%, higher than the 2.4% reported by Adeyemo et al. (2015) in Lagos. (27) Hemoglobin AC is less common than AS or SS but still carries clinical significance. Individuals with hemoglobin AC have a lower risk of malaria but may experience mild hemoglobinopathies. The higher prevalence observed in this study may reflect the diverse genetic makeup of the university population, which includes students from various parts of Nigeria. (17,30)

Rhesus Factor Distribution

The distribution of Rhesus factors in this study revealed that 4.8% of the population was Rhesus-negative, which aligns with previous studies in Nigeria. Faduyile et al. (16) reported a prevalence of 4.5% Rhesus-negative individuals in southwestern Nigeria, while another study (25) found a prevalence of 3.9% in Kano. These findings are consistent with the relatively low prevalence of Rhesus-negative individuals across African populations, which typically ranges between 3-7%. (10, 21) The scarcity of Rhesus-negative individuals presents challenges for blood transfusion services, as compatible donors for Rhesus-negative patients are often in short supply. (18) Rhesus-negative individuals are at particular risk during pregnancy if the mother is Rhesus-negative and the fetus is Rhesus-positive. This incompatibility can lead to hemolytic disease of the newborn (HDN), a potentially fatal condition where the mother's immune system attacks the fetus's red blood cells. (19) Routine screening for Rhesus factor during pregnancy is critical for preventing HDN. A study (16) emphasized the importance of early detection and intervention in cases of Rhesus incompatibility to reduce maternal and infant mortality. (10) In this study, 95.2% of the population was Rhesus-positive, which aligns with previous studies, including Ohiengbomwan et al. (2018) (20), who reported a prevalence of 95.6% Rhesus-positive in Osun State. Mazadu & Buhari (2023) (25), found 90.5% in Kano. The high prevalence of Rhesus-positive individuals in Nigeria reflects the genetic homogeneity concerning this trait. (3,4, 30,31). However, it also highlights the need to carefully manage blood supplies for the small but significant Rhesus-negative population. (28)

CONCLUSION

This study underscores the diversity of blood groups, Rhesus factors, and hemoglobin phenotypes among the student population, highlighting significant genetic influences on health. The high prevalence of type O blood and the AA genotype suggests dominant genetic trends that affect blood supply management and disease risk. Additionally, the notable presence of carriers for sickle cell traits points to potential health challenges requiring targeted interventions. Understanding these genetic distributions is crucial for informing public health strategies and improving healthcare outcomes.

We recommend implementing genetic counseling and awareness programs within educational institutions to address these genetic and health challenges. Such initiatives would educate students about their genetic profiles, enabling informed reproductive choices and reducing the incidence of genetic disorders. Additionally, regular health screenings for anemia and sickle cell disease should be incorporated into university health services to provide early detection and management, enhancing overall student health and well-being.

Limitations:

Several limitations should be considered when interpreting this study's findings. First, the cross-sectional design restricts the ability to establish causal relationships between variables. Second, conducting the study at a single university in South-West Nigeria may limit the generalizability of the findings. Additionally, reliance on medical records could introduce bias due to missing

or incomplete data. Despite these limitations, the study offers valuable insights into anemia prevalence and factors among university students, using rigorous methodology to ensure accuracy and reliability, thereby contributing to student health knowledge and informing evidence-based interventions and policies to improve health outcomes.

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