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Haemoglobin types, knowledge, attitude and perception of sickle cell anaemia among indigenes of Yahe; a rural community of Cross River State, Nigeria

Akpan, P.A.*, Etura, J.E. and Odey, R.N.
Department of Haematology and Blood Transfusion Science, Faculty of Medical Laboratory Science, University of Calabar, P.O. Box 1115, Calabar, Nigeria.
Author for Correspondence*: apu0520@unical.edu.ng/+2348027321305/ ORCID number: 0000-0002-4571-8804. https://dx.doi.org/10.4314/sokjmls.v8i2.5

Abstract
Sickle cell anaemia (SCA) is a genetic blood disorder affecting millions of people worldwide and it remains a major public health concern in Nigeria. The frequencies of carriers usually dictate the prevalence of sickle cell anaemia hence the incidence can be drastically reduced if the population in different communities have the knowledge of the genotype combinations that produce individuals with SCA. This study assessed the distribution of haemoglobin types and the knowledge, attitude, and perception about sickle cell anaemia in Yahe, a rural community in Cross River State, Nigeria. Following ethical approval from the Cross River State Ministry of Health and informed consent from participants, a structured questionnaire was pre-tested and used to collect data on knowledge, attitude, and perception of sickle cell anaemia among two hundred indigenes of Yahe aged eighteen years and above. Knowledge, attitude, and perception were graded based on standard systems. Haemoglobin types were determined by cellulose acetate electrophoresis at pH 8.6. Chi-square was used to analyze data and the p-value was considered significant at $p < 0.05$. The study subjects comprised of 81 males and 119 females. Sixty-seven of the respondents were aged 18–25 years, 137 were married while 94 had only primary level of education. Distribution of haemoglobin types showed that 65% were AA, 34% were AS while 1% were SS. Among the 200 respondents, 56.5%, 38.0%, and 11.0% had poor, fair, and good knowledge respectively. While 77.5% had a negative attitude, 83.5% had a negative perception. Age and educational level significantly (P=0.001) influenced knowledge, attitude, and perception of indigenes of Yahe towards sickle cell anaemia. It is recommended that more awareness campaigns should be undertaken in rural areas where the knowledge and attitude about sickle cell anaemia is still poor.

Keywords: Haemoglobin, sickle cell anaemia, knowledge, attitude, perception, rural

Introduction
Sickle cell anaemia (SCA) is a genetic blood disorder affecting millions of people worldwide (Piel *et al.,* 2013). It is caused by a single nucleotide polymorphism in the beta-globin gene (HBB), resulting in a substitution of valine for glutamic acid at the sixth position of the beta-globin protein (Thein, 2013), thus producing haemoglobin S (HbS) instead of the normal haemoglobin (HbA). This mutation causes haemoglobin to form long, rigid chains that distort the shape of red blood cells, under certain conditions, giving them a sickle-like appearance, which leads to various clinical manifestations (Steinberg, 2008). The abnormal red cells can block blood vessels, leading to pain, organ damage, and an increased risk of infections (Kato *et al.,* 2018). The disease is inherited in an autosomal recessive pattern, meaning that an individual must inherit two copies of the mutated gene, one from each parent, to develop the disease (Weatherall, 2010). Carriers of a single copy of the mutated gene are said to be carriers of the sickle cell trait (Hb AS), which is generally a benign condition, although it can cause complications in certain situations, such as high altitude or extreme physical exertion (Steinberg and Sebastiani, 2012). Sickle cell anaemia is

more prevalent in certain populations including those of African, Middle Eastern, Indian, and Mediterranean descent. In the United States, the disease primarily affects African Americans, with an estimated 100,000 individuals living with SCA and another 2.5 million carrying the sickle cell trait allele (CDC, 2023). The severity of SCA varies widely, with some individuals experiencing mild symptoms and others suffering from life-threatening complications. Common symptoms include anaemia, fatigue, pain crises, and organ damage, particularly in the lungs, kidneys, and spleen (Hassell, 2010). Treatment options for SCA include pain management, blood transfusions, and bone marrow transplantation as well as management of symptoms and the prevention of complications, although these therapies are not curative and may have significant risks and side effects (Ware *et al.,* 2017). Pain management is a critical aspect of care, and individuals with SCA may require hospitalization for severe episodes of pain. Hydroxyurea, a medication that increases the production of HbF, can reduce the frequency of and severity of pain episodes and other complications (Agrawal *et al*., 2014). Gene therapy, which involves replacing the mutated HBB gene with a healthy copy, is a promising area of research, although it is still being developed (Cavazzana *et al.,* 2019). Despite advances in treatment, the average life expectancy for individuals with SCA is significantly reduced when compared with the general population. The disease is associated with a high risk of mortality, particularly in childhood (Quinn *et al.,* 2010).

Despite significant efforts to improve the diagnosis and management of sickle cell anaemia in Nigeria, the disease continues to be associated with significant morbidity and mortality. According to a study by Adegoke *et al*. (2021), sickle cell anaemia is associated with a high burden of pain, infections, and organ damage, which can significantly reduce the quality of life of affected individuals. Furthermore, the high cost of treatment, limited access to healthcare facilities, and lack of awareness about the disease among the general public are major challenges in the management of sickle cell anaemia in Nigeria (Galadanci *et al.,* 2014). These factors can lead to delayed diagnosis, inadequate treatment, and poor outcomes for affected individuals. Sickle cell anaemia remains a major public health concern in Nigeria, where it is estimated that 24% of the population are carriers of the mutant gene with over 150,000 infants born with the disease each year (Galadanci *et al*., 2014; WHO, 2021). The frequencies of carriers usually dictate the prevalence of sickle cell anaemia by birth. The incidence of sickle cell anaemia can be drastically reduced if the population in different communities have the knowledge of the genotype combinations that produce individuals with SCA. Hence, this study assessed the distribution of haemoglobin types and the knowledge, attitude, and perception about sickle cell anaemia in Yahe, a rural community in Cross River State, Nigeria.

Materials and Methods

Study area and design: The study was conducted in Yahe Community, Yala Local Government Area, Cross River State, Nigeria. A cross-sectional study design was adopted for this research.

Ethical consideration/informed consent: Ethical clearance was obtained from the Research Ethics Committee of the Ministry of Health, Cross River State. Detailed explanations of the purpose, objectives, risks, and benefits of the study were made to prospective subjects in English as well as their native language and the confidentiality of their responses to administered questionnaire was assured after which consent was obtained. The respondent's right to refuse or withdraw from participating in the interview was fully maintained.

Study subjects: A total of two hundred (200) male and female indigenes of Yahe community aged 18 years and above were enrolled in this study based on convenience sampling method. Indigenes of Yahe who gave consent and volunteered to participate were included while those who did not consent were excluded.

Data and sample collection: A face-to-face verbal interview was conducted in English and Yala native language and the responses of the study

subjects were filled out on a structured questionnaire. Three milliliters of venous blood samples were drawn aseptically from each participant via venepuncture using a disposable plastic syringe into EDTA-anticoagulated tubes and labelled with the name, gender, and unique identification number. The samples were temporarily stored in a cold flask packed with ice prior to their transfer to the Haematology laboratory of University of Calabar Teaching Hospital where they were analyzed.

Sample analysis

Haemoglobin typing by Cellulose Acetate Electrophoresis at alkaline pH (8.6).

Principle: At alkaline pH, haemoglobin is a negatively charged protein and when subjected to electrophoresis will migrate toward the anode (positive electrode), with its variants separating at different rates due to differences in their surface electrical charges as determined by their amino acid composition. Structural variants that have a change in the charge on the surface of the molecule at alkaline pH will separate from Hb A.

Procedure: The samples were washed, and the packed red cells lysed with the haemolysing agent (water). With the power supply disconnected, the electrophoresis tank was prepared by placing equal amounts of Tris Borate EDTA (TEB) buffer in each of the outer buffer compartments. Two wet chamber wicks were then placed one along each divider/bridge support ensuring that they make good contact with the buffer. The cellulose acetate paper was soaked by lowering it slowly into a reservoir of buffer and left for about 30 minutes prior to use. Five milliliters each of the control and the haemolysate were filled accordingly on the well-plate. The cellulose acetate strip was removed from the buffer and blotted twice between two layers of clean blotting paper. The applicator was loaded by depressing the tips into the sample wells twice and applied to the cellulose acetate paper. The cellulose acetate paper was placed across the bridges ensuring that they make good contact with the buffer, and electrophoresed at 350 V for 15 min. After 15 min electrophoresis, the electrophoretic mobilities of the haemoglobin variants were observed and results were recorded.

Data/Statistical analysis: Two hundred valid questionnaires were subjected to statistical analysis. Information collected from the questionnaire included sociodemographic parameters, knowledge, attitude, and perception toward sickle cell anaemia. The section on knowledge included questions on etiology, clinical manifestations, and treatment of SCA. Each of the 10 questions in the knowledge section was scored as 1 for "Yes" response or 0 for "No/I don't know" response to give a total knowledge score of 10. Scores between 0 and 3 were considered poor knowledge, between 4 and 6 fair knowledge, and between 7 and 10 good knowledge. The section on attitude consisted of 11 questions, each of the 11 questions were scored from 1-5 as "Negative Attitude" and from 6-11 as "Positive Attitude". The section on perception included 10 questions, where 1-5 were scored as "Negative Perception" and 6-10 as "Positive Perception". Grading for knowledge and perception is based on a system developed by Therese *et al. (*2019) while that of attitude is based on a system by Adigwe *et al*. (2022). Chi-square was used to analyze data on Statistical Package for the Social Sciences (SPSS) version 22.0 software. The p-value was considered significant at $p < 0.05$ and the results are presented in tables.

Results

This study was designed to determine the frequency of haemoglobin types, as well as the knowledge, attitude, and perception towards sickle cell anaemia among indigenes of Yahe, Yala Local Government Area, Cross River State. A total of 200 subjects participated in the study comprising 81 (40.5%) males and 119 (59.5%) females. Sixty-seven (33.5%) of the respondents were within the age range of 18–25 years, 137 (68.5%) were married while 94 (47.0%) had only primary level of education. Table 1 shows the distribution of haemoglobin types; of the 200 participants, 130 (65%) were AA, 68 (34%) were AS while 2 (1%) were SS. Table 2 presents the level of knowledge, attitude, and perception of sickle cell anaemia among indigenes of Yahe. Among the 200 respondents, 56.5%, 38.0%, and 11.0% had poor, fair, and good knowledge respectively. The mean knowledge score was 3.08 ± 1.92, indicating a fair general knowledge of participants. One hundred and fifty-five

(77.5%) respondents had a negative attitude while 45 (22.5%) had a positive attitude towards sickle cell anaemia. The mean attitude score was 4.0 ± 2.03, indicating a negative attitude by participants. Similarly, 167 (83.5%) of the respondents had a negative perception while 33 (16.5%) had a positive perception. The mean perception score was 3.9 + 1.73, indicating a negative perception by participants.

Table 3 presents the influence of age and education on respondents' knowledge about sickle cell anaemia. Forty-five (67.2%) of respondents who were within the age group of 18-25 years had fair knowledge, 11(16.4%) had good knowledge and 11 (16.4%) had poor knowledge. For respondents aged 26-32 years, 60.9% had fair knowledge and 39.1% had poor knowledge. For those aged 33-39 years, 92.1% had poor knowledge and 7.9% had fair knowledge. All (100%) respondents aged above 40 years, had poor knowledge about sickle cell anaemia. The influence of age on knowledge about sickle cell anaemia was found to be statistically significant (P=0.001). All eighteen (100%) subjects who had no formal education as well as 94 (100%) with a primary level of education, had poor knowledge about sickle cell anaemia, Furthermore, 75 (98.7%) of the study population with secondary level had fair knowledge while 12 (91.7%) of those who had attained a tertiary level of education, had good knowledge about sickle cell anaemia. Educational level was observed to significantly (P=0.001) influence the knowledge about sickle cell anaemia.

In table 4, the influence of age and education on the attitude of indigenes of Yahe to sickle cell anaemia is presented. Thirty-one (46.3%) of those between the ages of 18-25 years had a positive attitude while 36 (53.7%) had a negative attitude. Among those aged 26-32 years, a positive attitude was reported for 16 (34.8%) with 30 (65.2%) having a negative attitude. Thirty-seven (97.4%) of those aged 33-39 years as well as 100% of those above 40 years, had a negative attitude towards sickle cell anaemia. Again, 100% of those who had tertiary education and 47.4% of secondary school leavers, had a positive attitude while 100% of primary school leavers and those without formal education, had a negative attitude towards sickle cell anaemia. The influence of age and education on the attitude of Yahe indigenes towards sickle cell anaemia was found to be statistically significant (P=0.001). Table 5 shows the influence of age and education on respondents' perception of sickle cell anaemia. For those between the ages of 18-25 years, 34.3% had a positive perception while 65.7% had a negative perception. Among those aged 26-32 years, 82.6% had a negative perception of SCA with only 17.4% having a positive perception. Similarly, 94.7% of those aged 33-39 had a negative perception in contrast to 5.3% with a positive perception. One hundred per cent (100%) of those above 40 years, had a negative perception of sickle cell anaemia. Eighteen (100%) of those with no formal education, 98.9% of primary school leavers, 72.4% of secondary school leavers and 8.3% of those with tertiary education had a negative perception while their counterparts with a positive perception made up 0%, 1.1%, 27.6% and 91.7% respectively. Perception of SCA was observed to be significantly influenced (P=0.001) by age and educational status.

Table 1: Haemoglobin types among indigenes of Yahe Community

Haemoglobin Type	Frequency	Percentage (%)
HbAA	130	65.0
HbAS	68	34.0
HbSS	2	1.0

Table 2: Level of knowledge, attitude and perception of sickle cell anaemia among indigenes of Yahe

Variable	Frequency
Level of knowledge	
0-3 (Poor)	113 (56.5%)
4-6 (Fair)	76 (38.0%)
7-10 (Good)	11 (5.5%)
Mean knowledge score	3.08 ± 1.92
Attitude	
0-5 (Negative)	155 (77.5%)
6-11 (Positive)	45 (22.5%)
Mean attitude score	4.0 + 2.03
Perception	
0-5 (Negative)	167 (83.5%)
6-10 (Positive)	33 (16.5%)
Mean perception score	3.9 + 1.73

Table 3: Influence of age and education on knowledge about sickle cell anaemia among indigenes of Yahe

Variable	Number Enrolled (N=200)	Frequency (%)	Level Of Knowledge (%)			P-Value
			Poor	Fair	Good	
Age group (Years)						
	67	33.5	11 (16.4)	45 (67.2)	11 (16.4)	
18-25	46	23.0	18 (39.1)	28 (60.9)	0 (0.0)	
26-32	38	19.0	35 (92.1)	3 (7.9)	0 (0.0)	*0.001
33-39	25	12.5	25 (100.0)	0 (0.0)	0 (0.0)	
40-46	15	7.5	15 (100.0)	0 (0.0)	0 (0.0)	
47-54	9	4.5	9 (100.0)	0 (0.0)	0 (0.0)	
>55			**113 (56.5)**	**76 (38.0)**	**11 (5.5)**	
Total						
Educational level						
	18	9.0	18 (100.0)	0 (0.0)	0 (0.0)	
No formal	94	47.0	94 (100.0)	0 (0.0)	0 (0.0)	
Primary	76	38.0	1 (1.3)	75 (98.7)	0 (0.0)	*0.001
Secondary	12	6.0	0 (0.0)	1 (8.3)	11 (91.7)	
Tertiary			**113 (56.5)**	**76 (38.0)**	**11 (5.5)**	
Total						

Table 4: Influence of age and education on attitude towards sickle cell anaemia among indigenes of Yahe

Variable	Number Enrolled (N=200)	Frequency (%)	Level Of Attitude (%)		P-Value
			Positive	Negative	
Age group (Years)	67	33.5	31 (46.3)	36 (53.7)	
18-25	46	23.0	16 (34.8)	30 (65.2)	
26-32	38	19.0	1 (2.6)	37 (97.4)	
33-39	25	12.5	0 (0.0)	25 (100.0)	*0.001
40-46	15	7.5	0 (0.0)	15 (100.0)	
47-54	9	4.5	0 (0.0)	9 (100.0)	
>55			**48**	**152**	
Total					
Educational level					
No formal	18	9.0	0 (0.0)	18 (100.0)	*0.001
Primary	94	47.0	0 (0.0)	94 (100.0)	
Secondary	76	38.0	36 (47.4)	40 (52.6)	
Tertiary	12	6.0	12 (100)	0 (0.0)	
Total			**48**	**152**	

Table 5: Influence of age and education on the perception of sickle cell anaemia among indigenes of Yahe

Variable	Number Enrolled (N=200)	Frequency (%)	Level of Perception (%)		P-Value
			Positive	Negative	
Age group (Years)	67	33.5	23 (34.3)	44 (65.7)	
18-25	46	23.0	8 (17.4)	38 (82.6)	
26-32	38	19.0	2 (5.3)	36 (94.7)	
33-39	25	12.5	0 (0.0)	25 (100.0)	*0.001
40-46	15	7.5	0 (0.0)	15 (100.0)	
47-54	9	4.5	0 (0.0)	9 (100.0)	
>55			**33**	**167**	
Total					
Educational level					
No formal	18	9.0	0 (0.0)	18 (100.0)	
Primary	94	47.0	1 (1.1)	93 (98.9)	
Secondary	76	38.0	21 (27.6)	55 (72.4)	*0.001
Tertiary	12	6.0	11 (91.7)	1 (8.3)	
Total			**33**	**167**	

Discussion

The distribution of haemoglobin types and the knowledge, attitude and perception of sickle cell anaemia among indigenes of Yahe, a rural community in Yala Local Government Area, Cross River State, Nigeria was assessed in this study. More females consented to participate in the study. This may be due to the role of nurturing women play in the family hence they may be more concerned about issues relating to the health and well-being of the family as well as the community at large. Furthermore, the males may have been busy at work to provide for the family as suggested by Tusuubira *et al*. (2018). About one-third of the study subjects were young adults (18-25 years). This group participated probably due to their level of education and understanding of the study objectives. Almost half of the study participants had only primary level of education. This is not surprising since Yahe is a rural community and most of its educated indigenes may be resident in urban areas. Educational status has been linked with rural-urban migration (Ali, 2010; Liao *et al*., 2021). The predominant Hb type in Yahe community is HbAA which is comparable to the distribution in most localities in Cross River State and indeed Nigeria (Nubila *et al*., 2013; Eledo *et al*., 2018; Akaba *et al*., 2019). The frequency of HbSS is one percent in the study area and this implies that the incidence of sickle cell anaemia is quite low. However, the frequency of thirty-four per cent for the heterozygous HbAS is a cause for concern as there is the possibility of mating and marriage between members of the community which will increase the probability of producing offspring with sickle cell anaemia. Again, it is likely that the indigenes of Yahe pair with individuals from other communities hence the incidence of HbSS is very low among them. It has been observed that the distribution of haemoglobin types in a particular population may change over time due to factors such as population growth, migration, and healthcare interventions (Williams and Weatherall, 2012; Piel *et al*., 2014).

More than half (56.5%) of the indigenes of Yahe had poor knowledge about sickle cell anaemia with only 5.5% having good knowledge. Again, more than seventy per cent of them had a negative attitude and poor perception towards sickle cell anaemia. This implies that this rural community is yet to be educated about the disease and the poor knowledge can be linked to the age and level of education of the indigenes as expressed in Table 3. It is worthy of note that respondents of the youngest age group (18-25 years) were the only ones who had a good knowledge of sickle cell anaemia thus there is hope for better awareness among the upcoming generation in the Yahe community. It is particularly worrisome that all indigenes aged 40 and above had poor knowledge about sickle cell anaemia. This could have negative implications if members of this group are still getting married and producing offspring. The poor level of knowledge can also be traced to those with no formal and primary level of education. Secondary education was only able to confer a fair level of knowledge while a good level of knowledge is linked to a tertiary level of education. One study reported a fair general knowledge among university students in Nigeria (Uche *et al*., 2017) while another reported a high level of awareness among university graduates with a small proportion having good knowledge and this was linked to those who studied courses in the Medical Sciences (Adewoyin *et al*., 2015). Despite the relatively high awareness of the disease in the general population, a significant knowledge gap has been identified among the study population. It can be deduced that although education may enhance the general knowledge about sickle cell anaemia, it is specific education on the subject matter that will impart good and right knowledge hence deliberate and targeted public health education is still a need particularly in rural communities.

The attitude and perception of the indigenes of Yahe towards sickle cell anaemia was observed to be generally negative and linked to age as well as their level of education. Almost half of the subjects aged 18-32 years had a positive attitude along with 34.8% of those aged 26-32 years. In contrast, 97.4% of those aged 33-39 years and all aged 40 years and above had a negative attitude towards sickle cell anaemia. Again, all subjects with primary school or no formal schooling had a negative attitude while all tertiary institution graduates had a positive attitude. Those subjects who had secondary level of education were

divided almost equally in terms of a positive or negative attitude. More than half (65.7%) of Yahe indigenes who were aged between 18 and 25 years had a negative perception, and the frequency was observed to increase with age. A negative perception was also observed among those with secondary level of education and below; almost all (91.7%) with tertiary level of education had a positive perception of sickle cell anaemia. These findings show that age and educational status are important factors which influence the perception of sickle cell anaemia among the indigenes of Yahe community. Age and level of education have been reported to influence knowledge and attitude towards sickle cell disease (Olakunle *et al*., 2013; Arthur and Koffuor, 2022).

Conclusion and Recommendation

This study has shown that the distribution of Haemoglobin types in Yahe, a rural community in Cross River State, Nigeria was 65.0%, 34.0% and 1.0% for HbAA, HbAS and HbSS respectively. It was also observed that most indigenes had poor knowledge as well as negative attitude and perception of sickle cell anaemia, which was greatly influenced by age and educational level. It is recommended that more awareness campaigns should be undertaken in rural areas where the knowledge and attitude about sickle cell anaemia is still poor.

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