



# Sickle Cell Genotype Screening among College Students: Evaluating Knowledge, Attitude, and Practice in Kwara State, Nigeria

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## *Authors' contributions*

This work was carried out in collaboration among all authors. Authors YFI, SBS and AOA developed the concept. Authors ADO and OOB designed the study. Authors AOA and ADO supervised the research. Authors ETI, JAO and SBS conducted data collection and entry. Authors YFI, OOB, and ADO performed the literature search. Authors AOA, SBS, JAO and ETI contributed to writing. All authors read and approved the final manuscript.

## *Article Information*

DOI: <https://doi.org/10.56557/jodagh/2026/v19i110560>

## *Open Peer Review History:*

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://prh.ikpress.org/review-history/14843>

## **Original Research Article**

**Received: 02/04/2026**

**Published: 07/05/2026**

## **Abstract**

**Introduction:** Sickle cell disease is endemic in Nigeria, but adoption of premarital genotype screening has been low. Considering that undergraduate students play an important role in decisions regarding reproduction, it becomes imperative to evaluate their Knowledge, Attitudes, and Practices (KAP) concerning genotype

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screening to provide information for developing school-based strategies to reduce the prevalence of sickle cell disease through genotype screening.

**Objective:** To determine the KAP and factors associated with genotype screening among undergraduate students in Ilorin, Nigeria.

**Methodology:** This was a descriptive cross-sectional study carried out on 410 students of Kwara State College of Education, Ilorin, selected through a multi-stage sampling technique. Data was obtained using a pre-tested, semi-structured, self-administered questionnaire. Data analysis was done using SPSS version 26, presenting data as frequencies and percentages. Association between socio-demographics and KAP was evaluated using chi-square test.

**Results:** Respondents comprised mostly females (58.0%) aged 19-25 years (74.1%). Awareness of genotype testing was 82.2%, 89.5% had good knowledge, while 88.8% had positive attitude. The practice level was high, with 70.5% undergoing genotype testing, majorly for medical reasons (38.1%). Sources of information on genotype testing included health care workers (38.9%) and schools (35.6%). Inability to access (35.5%) was the most significant determinant of non-adherence. Level of education ( $p=0.015$ ) and living conditions ( $p=0.024$ ) were significant determinants of knowledge, but not attitude or practice.

**Conclusion:** The knowledge and attitude towards genotype screening among the undergraduates were high, and practice was encouraged by accessibility of the service. Accessibility was the major obstacle to the uptake of the service, not cost or lack of information. It is recommended that genotype screening be integrated as a free service into school health care programs and routine health services to ensure universal premarital genotype screening.

**Keywords:** Genotype screening; knowledge; attitude; practice; sickle cell disease; undergraduates; Nigeria.

## 1. Introduction

The genotyping process is a vital activity in genetics and healthcare that entails analyzing and detecting genetic differences across diverse populations and ethnic groups. This process plays an integral role in several applications ranging from prenatal screening for genetic abnormalities, determination of disease predispositions, and research on genotype-phenotype correlations in hereditary diseases, particularly Sickle Cell Disease (SCD) (Afolabi et al., 2024). SCD is one of the serious public health problems in Nigeria, with about 2% of its newborns affected (WHO, 2024). The genotyping process is an important tool in SCD prevention through reproductive health decisions.

The prevalence of sickle cell disorder is a major public health issue that affects more than 20 million people globally and sees around 300,000 infants born each year (Adigwe et al., 2023a). According to the WHO, SCD is among the diseases that are regarded as public health priorities, particularly in sub-Saharan Africa, where the majority of global sickle cell cases originate (Dilli et al., 2024; John & John, 2020). About half to eighty percent of children in this region with sickle cell die before their fifth birthday because of issues like infection and organ failure (Adigwe et al., 2023b).

In Africa, the incidence of sickle cell ranges between 10% to 25%, with a maximum rate being reported at 40%. In Nigeria, the number of sickle cell births each year is about 150,000, and the prevalence is 20 per thousand. Mortality is very high in Nigeria, at seventy percent, among children who die before reaching five years old due to lack of treatment and proper medical attention (WHO, 2016). Nigerian hospitals record increased cases of complications like acute chest syndrome and strokes in patients with SCD (Nnodu et al., 2021). Despite this, screening and management have been inconsistent, limiting the availability of medical care (Eastburg et al., 2020). These considerations emphasize the importance of implementing screening measures and educating the general population on ways to minimize health disparities associated with SCD (Smith & Brownell, 2018; Hegemann et al., 2023).

It has been documented through studies that college students are at a key point of transition into adulthood, where their health-related decision-making could influence their future (Ibrahim et al., 2013). The need to understand attitudes and knowledge on genotype screening among college students cannot be overemphasized due to the fact that this leads to better-informed health choices, which help prepare the individuals for genetic counseling when they form families in the future. Although genotype screening is of paramount importance,

KAP among young adults and college students regarding genotype screening has been reported to be low (Adeyemo et al., 2007). According to Agofure and Danzaria, poor attitude toward premarital genotype screening was evident despite growing awareness of the importance of genotype screening in the prevention of hereditary diseases such as SCD (Agofure & Danzaria, 2020).

It is important to understand that genotype screening is an important preventative strategy through which people get an opportunity to choose their reproductive strategies and avoid the transmission of sickle cell genes. Nevertheless, its success depends largely on the Knowledge, Attitude, and Practices of young people, such as undergraduate students, because at their age, they start making life and reproductive choices. It is therefore important to evaluate the level of Knowledge, Attitude, and Practices concerning genotype screening among Nigerian undergraduate students for various reasons. Firstly, it is important to assess the level of students' knowledge about genotype screening since education campaigns may influence the prevalence rate of genetic disorders, including sickle cell disease, which is a major health issue in Nigeria (Agofure & Danzaria, 2020; Imam-Fulani, 2024; Dilli et al., 2024). Since there is a significant number of people suffering from SCD in Nigeria, it is crucial for the younger generation to know more about genotype screening.

According to Afolabi et al. (2024), and Imam-Fulani (2024), there is a significant dearth of knowledge concerning the advantages and mechanisms of premarital genotype screening among undergraduates that may hinder the efficient use of such services. Additionally, according to a study conducted among undergraduates in Nigeria, 40.5% were aware of their genotype status while 55.6% had a favorable attitude towards genotype testing (Adeyemo et al., 2007). A survey conducted in Ghana indicated that only 15.4% of respondents demonstrated good knowledge of premarital carrier screening (Sarpong et al., 2025). Moreover, studies have examined factors that affect genotype screening among undergraduate students. These factors include lack of information, stigmatization of SCD, and restricted access to genotyping facilities (Uche et al., 2017). For instance, a survey among undergraduates in Nigeria indicated that students with prior knowledge of genotype testing had a better attitude towards such tests (Adeyemo et al., 2007). In addition, a study among undergraduates in Kenya indicated that those who had gone for genotype tests exhibited favorable attitudes towards the procedure (Sammy et al., 2025).

Furthermore, a number of studies have found significant disparities in the level of awareness and knowledge about premarital genotype screening among diverse groups, implying the risk of public health consequences unless educational challenges are effectively handled (Smith & Brownell, 2018, Agofure & Danzaria, 2020; Imam-Fulani, 2024). In one study conducted in Gombe State, it was found that negative attitudes toward premarital screening was common among the participants, contradicting findings from urban areas, including Ile-Ife and Lagos, where positive attitudes were observed (Agofure & Danzaria, 2020). It is important to comprehend such differences in attitudes since it will help design effective education initiatives targeting genotype screening among students in different states in Nigeria. Also, studies have indicated that higher levels of awareness are associated with greater screening behavior, leading to a reduction in the prevalence of genetic disorders (Imam-Fulani, 2024). Interventions designed to promote positive attitudes toward genotype screening among young people can greatly prevent the development of such conditions in the future (Agofure & Danzaria, 2020; Imam-Fulani, 2024).

Additionally, the suboptimal utilization of already available health services, especially in resource-scarce environments, necessitates the immediate creation of focused educational campaigns aimed at raising awareness of relevant issues. According to Ezenwosu et al. (2021), the prevalence rate of people with little or no information on their haemoglobin genotype is alarming; however, information about one's genotype should help make well-informed decisions about reproductive health (Ezenwosu et al., 2021). Investigating the attitudes and behaviors of students towards such screening procedures will give some valuable insight into the barriers faced when trying to get involved in the process, and these findings will allow for the creation of public health campaigns addressing these issues effectively (Agofure & Danzaria, 2020; Ezenwosu et al., 2021). Hence, this study seeks to explore the current state of students' Knowledge, Attitude, and Practice regarding genotype testing at Kwara State College of Education, Ilorin, Kwara State. The results of this study will help design targeted health education programs aimed at increasing awareness of and participation in genotype screening. It was further proposed that there exists no significant association between the sociodemographic profile and the composite scores on Knowledge, Attitude, and Practices towards genotyping among the undergraduate students in Ilorin, Nigeria.

## **2. Review of Literature**

### **2.1 Empirical Framework**

#### **2.1.1 Overview of Genotype Testing**

Genotype testing forms the backbone of public health genomics. It allows early detection of genetic risks to facilitate preventive measures and individualized therapy. Across the world, technological breakthroughs in DNA sequencing have increased its application. Genotype testing uses have expanded from treating uncommon Mendelian diseases to managing prevalent ailments. Cirino et al. (2022) found that genetic testing for hypertrophic cardiomyopathy enhances long-term risk assessment and management. Similarly, Vakrinou et al. (2023) noted the cost-effectiveness of whole-genome sequencing for refractory epilepsy.

Genotype testing plays an indispensable role in addressing hemoglobinopathies in sub-Saharan Africa. This is especially true for SCD. Dilli et al. (2024) showed that premarital genotype screening programs significantly lowered the prevalence of SCD in regions with high burdens. The general community attitude towards genotype testing is positive. Munung et al. (2024) revealed that individuals in Ghana, Cameroon, and Tanzania viewed genetic tests favorably despite cost issues.

Studies on neonatal SCD screening in Nigeria suggest feasibility and clinical utility despite limitations due to poor infrastructure (Therrell et al., 2024). Specific genotype screening, such as HPV genotyping for cervical cancer screening, exemplifies how locally appropriate genetic testing results in improved outcomes (Johnson et al., 2020). Altogether, research indicates the efficacy of incorporating culturally sensitive genotype screening programs in general practice to combat hereditary diseases.

#### **2.1.2 Knowledge of Premarital Genetic Screening**

Acquisition of sufficient knowledge is essential before accepting genotype screening, but a lot still remains to be addressed among learners. The disorder is common among over 150,000 infants born in Nigeria each year, making the knowledge of students an imperative for premarital screening (Piel et al., 2017). According to findings from Imam-Fulani (2024), just 41.2% of Nigerian students had sufficient knowledge concerning SCD inheritance, and educational initiatives proved to be effective in improving the knowledge score. Similar results were observed by Agofure and Danzaria (2020), where knowledge was positively correlated with attitudes towards genotype screening among reproductive women. Thalassemia-related ignorance was equally noted among Indonesian learners by Triatin et al. (2022), calling for curriculum-based genetic knowledge dissemination on a global scale. Ezenwosu et al. (2021) emphasized the importance of community health advisors for dispelling myths and conducting screenings in schools.

#### **2.1.3 Attitude towards Genotype Screening**

Knowledge, risk perception, stigma, and culture affect attitudes. University students are crucial agents for change; however, knowledge is not equivalent to a positive attitude. Hossain et al. (2023) found that Bangladeshi university students' screening acceptability was poor despite knowledge about the disease being moderate. On the contrary, Imam-Fulani (2024) found that the willingness of Nigerian students with increased knowledge about sickle cell disease to be screened was high. Ezenwosu et al. (2021) revealed that 68% of community participants did not know their genotypes, indicating that risk perception was absent. Stigma remains a barrier to positive behavior: Ayosanmi et al. (2020) demonstrated how fear of discrimination deterred people from participating in health screenings, including genotype tests. The structural determinants of participation cannot be ignored. Rehman et al. (2024) found cost and availability of health services to be the main reasons behind students' cancer screening. Psychological barriers, such as stigma about asking for help, can be equally detrimental (Li et al., 2025).

#### **2.1.4 Practice of Genotype Screening among Students**

However, uptake of the screening among students is still low due to favorable policies. The practice is greatly enhanced by educational exposure. Galadanci et al. (2023) and Lumbe & Kibusi (2022) found higher screening willingness among students who were subjected to genotype counseling in Nigeria and Tanzania, respectively. Poor knowledge of SCD, on the other hand, results in unfavorable perceptions about people suffering from it, which in turn discourages self-screening. There is cultural endorsement of restrictive policies since 57.6% of Northern Nigerians support the ban on marriages involving incompatible genotypes (Oluwole et al., 2022). The

school-based program has been successful in ensuring high uptake of the screening among students, as demonstrated by Chen et al. (2024), who got an 89% uptake among Chinese high school students and similar success in Nigeria (Imam-Fulani, 2024).

### 2.1.5 Factors Influencing the Practice of Genotype Screening among Students

There are many factors that influence uptake. Educational efforts have proved effective in improving knowledge and practice (Chen et al., 2024; Lumbe & Kibusi, 2022). The cultural factor of fatalism and arranged marriage makes people believe that there is no need for premarital genotyping (Agofure & Danzaria, 2020). According to Imam-Fulani (2024), customized health education can help change people's perceptions by eliminating myths. There is low awareness of genotype screening among reproductive women. According to Agofure & Danzaria (2020), less than 50% of reproductive women knew about genotype screening. Availability is critical because Durrani et al. (2023) noted high uptake of genotype testing services in areas where they were subsidized and available on-campus.

## 2.2 Theoretical Framework

This study is guided by the Knowledge-Attitude-Practice (KAP) theory and the Health Belief Model (HBM). The KAP theory suggests that knowledge leads to positive attitudes, which then influence behaviors positively (Khakbaz et al., 2024). This is important because previous studies in Nigeria reveal that high SCD awareness increases the likelihood of getting screened (Oluwole & Adeyemo, 2021). Conversely, wrong information on the disease makes people unwilling to get tested (Ezenwosu et al., 2021). The HBM further explains why individuals with adequate information fail to adopt the desired health behavior (Rosenstock et al., 1988). According to the HBM, one's perception of SCD susceptibility, the severity of the condition, the benefits of getting tested, the costs involved, available cues to action, and self-confidence determine behavior (Olorunnisola & Oyerinde, 2024). For example, students who believe that they will not have children with SCD, even when they know the benefits of the procedure, will avoid screening. Thus, KAP and HBM provide an appropriate framework to assess cognitive and social psychological factors influencing genotype screening behaviors.

## 2.3 Conceptual Framework

The conceptual framework provides a visual representation of the relationships postulated between the variables under investigation (Adom et al., 2018). Genotype screening practice, operationalized as the past

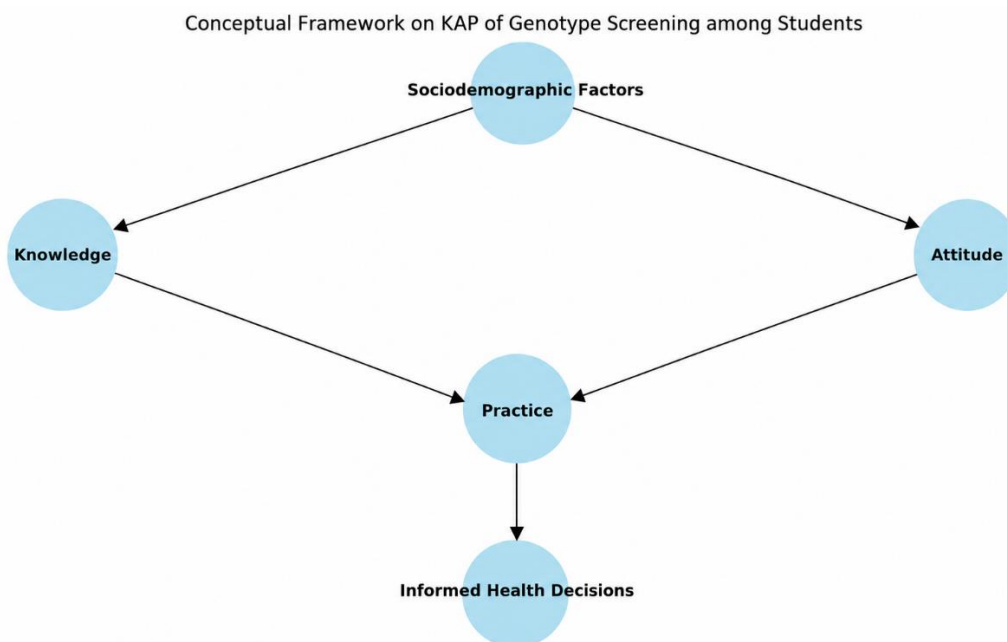


**Fig. 1. Conceptual Framework: Arrows indicating Knowledge & HBM Constructs > Attitude > Practice, with socio-demographics being the modifiers, while health education is the intervention**

experiences with screening and predisposition to engage in screening, is the outcome variable of interest. Independent variables are the student's level of knowledge regarding SCD/genotype screening and attitude towards screening, based on KAP constructs. Socio-demographic variables such as age, gender, faculty, religious affiliation, and marital intentions will modify the relationship between the independent and dependent variables. Perceived susceptibility, severity, benefits, and barriers constitute the covariates and are based on the HBM. This research conceptual framework holds that health education and screening campaigns about the basics in genetics, SCD inheritance, prevention, and free screening on campus can be a cue to action that enhances knowledge and attitude towards the practice (Fig. 1).

### 3. Methodology

#### 3.1 Study Design and Setting

The study was a descriptive cross-sectional study, employing the quantitative method of data collection. The study took place at the Kwara State College of Education, Ilorin, which is a renowned tertiary institution in Ilorin, the capital of Kwara State, Nigeria. It was founded in September 1974 with the aim of producing competent teachers in primary and secondary schools by offering various National Certificate of Education (NCE) courses in different subject fields, such as sciences, arts, and vocational education. By 2024, it was envisaged that there would be a shift towards the Kwara State University of Education (KWASUED). Located within a socially rich and intellectually dynamic community, it draws students from all corners of Nigeria, making it an ideal environment for conducting research into knowledge, attitudes, and behaviors amongst young adults. With about 7,500 students and 426 academic staff members, it has a diverse student body representing varied cultures, and its academic structure makes it an ideal target for research focused on health behaviors (Mahmud et al., 2022).

The Kwara State College of Education, Ilorin, has a health center on campus that takes care of the basic health requirements of its students and staff. This health center functions as the first point of call in terms of providing health care services for its users. These include preventive services, curative services, and promotive services. The health services include the treatment of minor illnesses, maternal and child health care services, health education, among others, while complex cases would be referred to neighboring hospitals such as the Kwara State University Teaching Hospital, Ilorin, and the University of Ilorin Teaching Hospital, Oke-oyi. The health center has its nurses, community health officers, and visiting medical practitioners who operate according to regular working hours, but are flexible to deal with emergency cases. Services offered at the health center are usually available and affordable, with a view to ensuring the welfare of members of the college and their academic productivity.

#### 3.2 Study Population

The study population comprised all full-time students of the Kwara State College of Education, Ilorin, who are currently registered for the 2025/2026 academic session. Students currently enrolled at Kwara State College of Education, Ilorin, who voluntarily consent to participate in the study and are present on the day of the survey, were included in the study. On the contrary, students who were not enrolled in the current academic year at Kwara State College of Education, Ilorin, or those who refused consent or did not attend on the survey day were not considered as part of the study.

#### 3.3 Sample Size Determination

The sample size was determined based on the proportion of students with good knowledge of premarital genotype screening from a previous study,  $= 38\% = 0.38$  (Brown et al., 2022), at 95% confidence level, and 5% margin of error. Based on the calculations using Leslie Fischer's formula for determining sample sizes in descriptive studies, a minimum of 403 respondents was required, which was adjusted to 410 for increased power. Hence, a final sample size of 410 was used for this study.

#### 3.4 Sampling Technique

For this study, a multi-stage sampling technique was adopted as follows:

### **Stage 1: Selection of Departments**

A simple random sampling technique by means of balloting without replacement was adopted in the process of selecting six departments from a total list of all the departments in the College. The selected departments were: English Education, Technical Education, Economics Education, Primary Education studies, Agricultural Education, and Geography Education. The selected departments were allocated a proportional number of respondents who would answer the questionnaire for each department.

### **Stage 2: Selection of Respondents**

This stage involves the adoption of a systematic random sampling technique where respondents from each of the selected departments were chosen based on a sample list of registered students in each of the departments. This involves determining the sampling interval,  $K^{\text{th}}$ , which is calculated as the total number of eligible students divided by the number of students needed from that department. The first respondent was randomly selected, and then subsequent selections were done systematically after every  $K^{\text{th}}$ . If the selected respondent is not available or refuses, the next one in the sampling frame is selected.

## **3.5 Instrument and Method of Data Collection**

The respondents were asked to complete a validated, pre-tested, semi-structured, and self-administered questionnaire in order to gather information regarding the level of Knowledge, Attitude, and Practice of genotype screening among them. The questionnaire was designed based on the review of the literature and was adapted according to the setting, typed legibly and consisted of 5 parts as follows:

**Section A:** Respondents' socio-demographic characteristics

**Section B:** Knowledge of genotype screening

**Section C:** Attitude towards genotype screening

**Section D:** Practice of genotype screening

**Section E:** Factors influencing the practice of genotype screening

In order to validate the questionnaire, the first version of the questionnaire was reviewed by two public health research methodology experts, and their comments and suggestions for improvement were considered. These reviews helped in making sure that all the questions posed in the questionnaire are relevant to the purpose of the study and capture the major variables associated with pre-marital genotype screening. Based on their advice, the revised version of the instrument was prepared, pretested, and used for data collection.

For the pre-test of the instrument, 41 participants from Kwara State University, Malete (equivalent to 10% of the expected sample size) participated, and the knowledge component was measured through the reliability test (Cronbach's alpha), which gave an output of 0.81. Pretesting aimed at checking the suitability of the questionnaire in terms of its structure, accuracy, readability, comprehension, and ease of administration. Feedback gained from the pretest helped make some changes to the questionnaire to eliminate any ambiguity that might arise. After analyzing and making necessary changes to the pretested questionnaire, it became the final questionnaire, which was eventually used for data collection.

During the data collection stage, two trained research assistants played a significant role as they helped in the distribution and collection of the self-administered questionnaire. Prior to conducting the data collection stage, the respondents are informed of the objective, scope, and voluntary nature of the research. Written consent is sought from those who decided to take part in the research exercise. The data collection period lasted for six weeks from February to March, 2026, and each participant receives only one copy of the questionnaire for completion.

## **3.6 Measurement of Variables and Data Processing**

Once the field data collection is done, all the questionnaires were consolidated and analyzed for any possible errors of omission and/or commission. All questionnaires are complete and accurately filled out, and were included in the data analysis. All the data were then be sorted, coded, and analyzed using the SPSS computer software. The dependent variables to be determined in this study include Knowledge, Attitude, and Practice

towards genotype testing among the respondents. On the other hand, the independent variables include socio-demographic information such as age, gender, marital status, level of education, major course, etc.

### 3.7 Analysis of Data

The questionnaires that were completed correctly were analyzed after verifying for consistency. The data were cleaned, coded, and analyzed using SPSS version 26.0 software. The descriptive statistics method, such as frequency, percentage, means, etc., was used to analyze the data. It was presented in tables and charts. The chi-square test was used to show the association between dependent and independent variables with a 95% confidence level and a p-value of less than or equal to 0.05 considered significant.

In the part concerning knowledge of genotype screening, there was the scoring and grading of responses regarding knowledge questions before analysis. This part had 14 questions, meaning that the highest score is 14. One point was given per correct answer, while no point was given for an incorrect answer. In total, the scores of knowledge responses were graded as Good Knowledge (7-14) and Poor Knowledge (0-6). The attitude of respondents towards genotype screening and its importance in preventing genetic diseases was assessed using the scoring method. Strongly Agree = 3, Agreed = 2, Disagree = 1, Strongly Disagree = 0, with the highest score being 18 and overall scores of positive attitude (9-18) or negative attitude (0-8).

## 4. Results

### 4.1 Socio-demographic Characteristics of Respondents

Table 1 indicates that most of the participants were young individuals aged between 19 and 25 years (74.1%) with a mean age of  $23 \pm 3.7$  years. Most of the participants were single (87.1%) and female (58.0%). Almost two-thirds of the study population were Muslims (64.1%), while eight out of ten were of Yoruba ethnicity (84.4%). Students were found across six departments; Agricultural Education (22.7%) and English (20.5%) departments being the most common. Almost half of the students were at NCE 2 level (45.8%). Over half were living with their parents (54.4%), whereas almost one-third were living alone (31.7%). A high awareness rate was recorded, with over four-fifths (82.2%) having heard of genotype screening. Out of the 337 respondents who had been exposed to genotype testing, Health workers emerged as the most prominent source of information regarding genotype testing, cited by more than one-third of the respondents (38.9%). Schools emerged as another dominant source of information, mentioned by more than one-third (35.6%). One-fifth of the respondents received information through mass media (20.8%), while friends were mentioned by a mere minority (4.7%) as the source of information (Fig. 2).

**Table 1. Socio-demographic characteristics of respondents**

| Variables      | Frequency (N= 410) | Percentage (%) |
|----------------|--------------------|----------------|
| Age (in years) |                    |                |
| 16 _ 18        | 54                 | 13.2           |
| 19 – 25        | 304                | 74.1           |
| 26 and above   | 52                 | 12.7           |
| Mean $\pm$ SD  | $23 \pm 3.7$       |                |
| Marital status |                    |                |
| Single         | 357                | 87.1           |
| Married        | 52                 | 12.7           |
| Divorced       | 1                  | 0.2            |
| Gender         |                    |                |
| Male           | 172                | 42.0           |
| Female         | 238                | 58.0           |
| Religion       |                    |                |
| Christianity   | 146                | 35.6           |
| Islam          | 263                | 64.1           |
| Traditional    | 1                  | 0.3            |

| Variables                   | Frequency (N= 410) | Percentage (%) |
|-----------------------------|--------------------|----------------|
| Tribe                       |                    |                |
| Yoruba                      | 346                | 84.4           |
| Hausa                       | 22                 | 5.4            |
| Igbo                        | 20                 | 4.9            |
| Fulani                      | 11                 | 2.7            |
| Others(Nupe, Ebira, Baruba) | 11                 | 2.6            |
| Course of study             |                    |                |
| English                     | 84                 | 20.5           |
| Technical Education         | 71                 | 17.3           |
| Economics                   | 41                 | 10.0           |
| Primary Education           | 78                 | 19.0           |
| Agriculture Education       | 93                 | 22.7           |
| Geography Education         | 43                 | 10.5           |
| Level of study              |                    |                |
| NCE1                        | 93                 | 22.7           |
| NCE2                        | 188                | 45.8           |
| NCE3                        | 129                | 31.5           |
| Living status               |                    |                |
| Living with parents         | 223                | 54.4           |
| Living with friends         | 57                 | 13.9           |
| Living alone                | 130                | 31.7           |
| Heard of genotype screening |                    |                |
| Yes                         | 337                | 82.2           |
| No                          | 73                 | 17.8           |

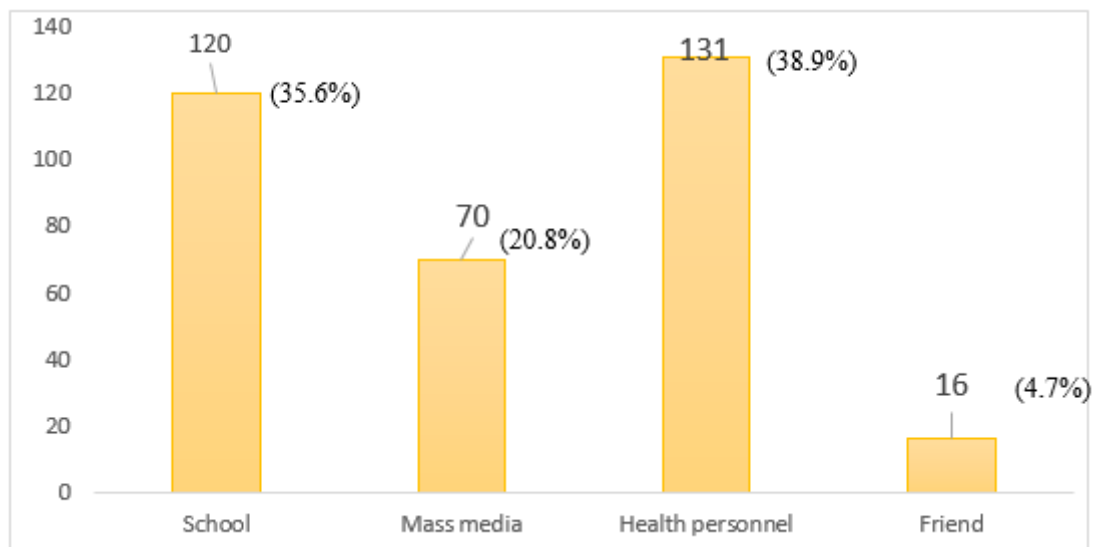


Fig. 2. Source of information on genotype screening by respondents

#### 4.2 Knowledge of Genotype Screening

Table 2 reveals that awareness regarding the importance of genotype screening was relatively high. Most participants had the right answers concerning genetic screening being indispensable when making marriage decisions (84.6%), decreasing genetic diseases' prevalence (81.0%), helping one comprehend genetic characteristics (86.3%), and the potential for transmitting genetic diseases in families (86.3%). Four out of five were also aware of the fact that a person's genotype could determine his or her risk of developing hereditary diseases (86.1%), and genetic testing methods involved DNA/blood analysis (86.3%). But there was one common misunderstanding about genetic diseases being incurable (61.7%).

**Table 2. Knowledge of genotype screening**

| Variables                                                                                                  | Yes (%)    | No (%)     |
|------------------------------------------------------------------------------------------------------------|------------|------------|
| Genetic diseases is incurable                                                                              | 253 (61.7) | 157 (38.3) |
| Genetic screening is essential to marital decision to prevent gene disorder.                               | 347 (84.6) | 63 (15.4)  |
| Health screening prevents diseases that may leads to the health issue                                      | 319 (77.8) | 91 (22.2)  |
| Genetic screening prevents genetic disorder                                                                | 325 (79.3) | 85 (20.7)  |
| Health screening prevents genetic disorder of stillbirth.                                                  | 321 (78.3) | 89 (21.7)  |
| Genotype screening prevent abnormalities in blood sample                                                   | 321 (78.3) | 89 (21.7)  |
| Genetic screening reduces the occurrence of genetic disorder                                               | 330 (80.5) | 80 (19.5)  |
| Genetic testing allows the genetic diagnosis of vulnerabilities to inherited diseases                      | 288 (70.2) | 122 (29.8) |
| Genetic testing can reduce the prevalence of genetic diseases                                              | 332 (81.0) | 78 (19.0)  |
| Genetic testing can help understand a genetic feature and its sequences                                    | 354 (86.3) | 56 (13.7)  |
| A person's genetic profile can be used to check whether they are at risk of genetic or hereditary diseases | 353 (86.1) | 57 (13.9)  |
| Genetic testing can identify specific disease that runs in the family.                                     | 341 (83.2) | 69 (16.8)  |
| Genetic diseases can be passed on in a family                                                              | 354 (86.3) | 56 (13.7)  |
| Blood test or DNA analysis is one of the methods used in genetic testing                                   | 354 (86.3) | 56 (13.7)  |

### 4.3 Attitude towards Genotype Screening

Attitudes towards genotype screening were very favorable. The majority of respondents strongly agreed that genotype screening is necessary for knowing about their genetic health status (51.0%) and that it is mandatory before marriage (54.6%). Respondents who agreed and strongly agreed that genotype screening prevents genetic abnormalities in the offspring (86.6%) and that people with information about their genotype make better decisions regarding family planning (89.2%) were numerous. However, more than half believed that it is a matter of personal choice (56.9%) and that it is too expensive (79.0%).

**Table 3. Attitude towards genotype screening**

| Variables                                                                                                                                      | SA (%)     | A (%)      | D (%)      | SD (%)    |
|------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|------------|-----------|
| Genotype screening is essential for understanding one's genetic health                                                                         | 209 (51.0) | 177 (43.2) | 20 (4.9)   | 4 (1.0)   |
| I believe that genotype screening should be mandatory before marriage                                                                          | 224 (54.6) | 159 (38.8) | 27 (6.6)   | 0 (0.0)   |
| Genotype screening is too costly and should be subsidized                                                                                      | 123 (30.0) | 201 (49.0) | 69 (16.8)  | 17 (4.1)  |
| I think that genotype screening helps prevent the birth of children with genetic disorders                                                     | 173 (42.2) | 182 (44.4) | 44 (10.7)  | 11 (2.7)  |
| I feel that genotype screening is a personal decision and should not be mandated                                                               | 95 (23.2)  | 138 (33.7) | 134 (32.7) | 43 (10.5) |
| I believe that individuals with knowledge of their genotype are more likely to make informed decisions about relationships and family planning | 183 (44.6) | 183 (44.6) | 31 (7.6)   | 13 (3.2)  |

SA – Strongly Agree

A – Agree

D – Disagree

SD – Strongly Disagree

### 4.4 Practice of Genotype Screening

Adoption of genotype screening was very high; more than two-thirds had undergone genotype testing (70.5%). Of those who were genotyped, almost one-third had done so in the last 1–2 years (28.7%). One-fifth of the study participants had undertaken genotype testing within six months prior to the survey (21.8%), in the 6–12-month period before the survey (21.8%), and over two years prior to the study (27.7%). The commonest motivation for genotype testing was medical advice (38.1%) and personal health concern (30.1%), while premarital genotyping was performed only by one-fifth of the respondents (19.0%).

**Table 4. Practice of genotype screening**

| Variables                                         | Frequency           | Percentage |
|---------------------------------------------------|---------------------|------------|
| Undergone genotype screening                      |                     |            |
| Yes                                               | 289                 | 70.5       |
| No                                                | 121                 | 29.5       |
| Time of screening                                 | n = 289             |            |
| <6 months ago                                     | 63                  | 21.8       |
| 6-12 months ago                                   | 63                  | 21.8       |
| 1-2 years ago                                     | 83                  | 28.7       |
| More than 2 years ago                             | 80                  | 27.7       |
| Main reason for undergoing genotype screening     |                     |            |
| Medical advice                                    | 110                 | 38.1       |
| Premarital screening                              | 55                  | 19.0       |
| Family planning purposes                          | 37                  | 12.8       |
| Personal health concern                           | 87                  | 30.1       |
| Main reason for not undergoing genotype screening | (multiple response) |            |
| Not interested                                    | 23                  | 19.0       |
| Don't see the need for it                         | 20                  | 16.5       |
| Lack of awareness                                 | 23                  | 19.0       |
| Financial constraints                             | 12                  | 9.9        |
| No access to screening services                   | 43                  | 35.5       |

#### 4.5 Factors Influencing the Practice of Genotype Screening

External or structural factors were also not cited by most of the participants as contributors to the process of genotyping. Fewer than half of the participants mentioned awareness of genetic diseases (42.0%) as a contributing factor, and only a quarter of the participants mentioned recommendations by health practitioners (25.6%). Only about 6.6% mentioned peer influence, while fewer than 10% mentioned culture, financial capability, availability of health care services, and family medical history. Participants showed good overall awareness of genotype screening, with a large percentage having high scores (89.5%) (See Fig. 3).

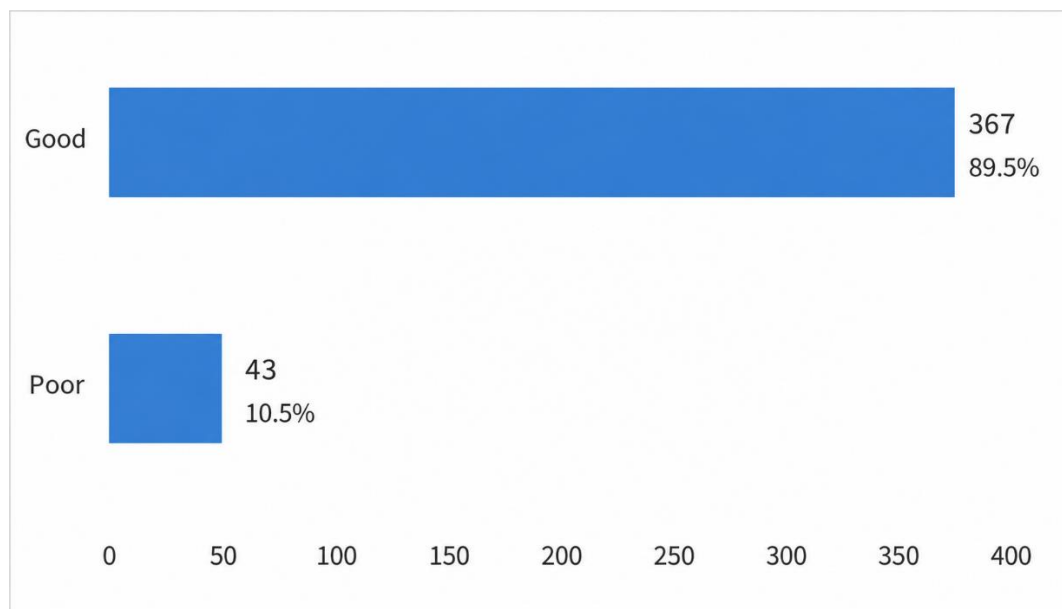
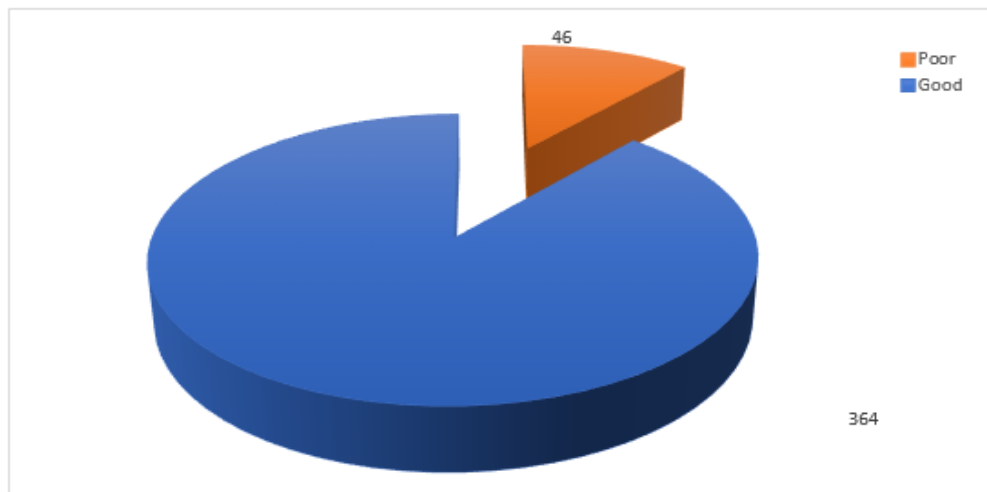
**Fig. 3. Overall score for knowledge of genotype screening**

**Table 5. Factors influencing the practice of genotype screening**

| Variables                                 | Yes (%)    | No (%)     |
|-------------------------------------------|------------|------------|
| Awareness of genetic disorders            | 172 (42.0) | 238 (58.0) |
| Recommendations from health professionals | 105 (25.6) | 305 (74.4) |
| Peer influence                            | 27 (6.6)   | 383 (93.4) |
| Cultural beliefs and practices            | 33 (8.0)   | 377 (92.0) |
| Financial capacity                        | 36 (8.8)   | 374 (91.2) |
| Availability of screening services        | 44 (10.7)  | 366 (89.3) |
| Family health history                     | 36 (8.8)   | 374 (91.2) |

#### 4.6 Association between Socio-demographics Characteristics and Knowledge of Genotype Screening

Generally, close to nine out of ten participants possessed good knowledge of genotype testing (88.8%), leaving one tenth of them with poor knowledge (11.2%). There was a statistically significant relationship between knowledge and educational level ( $p=0.015$ ), with the largest percentage of poor knowledge among NCE3 level participants (17.1%) relative to NCE1 level participants (6.5%). Similarly, there was a significant difference between living status ( $p=0.024$ ), where individuals residing with their parents showed a higher percentage of poor knowledge (14.3%) than those living alone (6.2%) or with their friends (5.3%). Age, marital status, gender, religion, and tribe had no relationship with knowledge ( $p>0.05$ ). Most respondents had a good attitude towards genotype testing (88.8%), whereas only one tenth had a poor attitude (11.2%), as illustrated in Fig. 4 below:

**Fig. 4. Attitude towards genotype screening****Table 6. Association between socio-demographics characteristics and knowledge of genotype screening**

| Variables      | Knowledge of genotype screening |            | p-value | $\chi^2$           |
|----------------|---------------------------------|------------|---------|--------------------|
|                | Poor (%)                        | Good (%)   |         |                    |
| Age (in years) |                                 |            | 0.917   | 0.173              |
| ≤18            | 5 (9.3)                         | 49 (90.7)  |         |                    |
| 19 – 25        | 33 (10.9)                       | 271 (89.1) |         |                    |
| 26 and above   | 5 (9.6)                         | 47 (90.4)  |         |                    |
| Marital status |                                 |            | 0.669   | 1.092 <sup>f</sup> |
| Single         | 39 (10.9)                       | 318 (89.1) |         |                    |
| Married        | 4 (7.7)                         | 48 (92.3)  |         |                    |
| Divorced       | 0 (0.0)                         | 1 (100.0)  |         |                    |
| Gender         |                                 |            | 0.196   | 1.674              |
| Male           | 22 (12.8)                       | 150 (87.2) |         |                    |
| Female         | 21 (8.8)                        | 217 (91.2) |         |                    |

| Variables                   | Knowledge of genotype screening |            | p-value | $\chi^2$            |
|-----------------------------|---------------------------------|------------|---------|---------------------|
|                             | Poor (%)                        | Good (%)   |         |                     |
| Religion                    |                                 |            | 0.320   | 2.295 <sup>f</sup>  |
| Christianity                | 19 (13.0)                       | 127 (87.0) |         |                     |
| Islam                       | 24 (9.1)                        | 239 (90.9) |         |                     |
| Traditional                 | 0 (0.0)                         | 1 (100.0)  |         |                     |
| Tribe                       |                                 |            | 0.731   | 1.897 <sup>f</sup>  |
| Yoruba                      | 40 (11.6)                       | 306 (88.4) |         |                     |
| Hausa                       | 2 (9.1)                         | 20 (90.9)  |         |                     |
| Igbo                        | 1 (5.0)                         | 19 (95.0)  |         |                     |
| Fulani                      | 0 (0.0)                         | 11 (100.0) |         |                     |
| Others(Nupe, Ebira, Baruba) | 0 (0.0)                         | 11 (100.0) |         |                     |
| Level of study              |                                 |            | 0.015   | 11.804 <sup>f</sup> |
| NCE1                        | 6 (6.5)                         | 87 (93.5)  |         |                     |
| NCE2                        | 15 (8.0)                        | 173 (92.0) |         |                     |
| NCE3                        | 22 (17.1)                       | 107 (82.9) |         |                     |
| Living status               |                                 |            | 0.024   | 7.443 <sup>f</sup>  |
| Living with parents         | 32 (14.3)                       | 191 (85.7) |         |                     |
| Living with friends         | 3 (5.3)                         | 54 (94.7)  |         |                     |
| Living alone                | 8 (6.2)                         | 122 (93.8) |         |                     |

<sup>f</sup> – Fisher's exact value

#### 4.7 Association between Socio-demographics Characteristics and Attitude towards Genotype Screening

The large majority of participants had a positive attitude towards genotype screening (88.8%). None of the socio-demographic factors had any significant relationship with attitude ( $p > 0.05$  for all). Positive attitude was highly prevalent among participants aged 23-35 years, females, non-Muslims, Hausa, those at post-secondary education level, and residents (86.5%-100%).

**Table 7. Association between socio-demographics characteristics and attitude towards genotype screening**

| Variables                   | Attitude towards genotype screening |            | p-value | $\chi^2$           |
|-----------------------------|-------------------------------------|------------|---------|--------------------|
|                             | Poor (%)                            | Good (%)   |         |                    |
| Age (in years)              |                                     |            | 0.708   | 0.781 <sup>f</sup> |
| ≤18                         | 7 (13.0)                            | 47 (87.0)  |         |                    |
| 19 – 25                     | 35 (11.5)                           | 269 (88.5) |         |                    |
| 26 and above                | 4 (7.7)                             | 48 (92.3)  |         |                    |
| Marital status              |                                     |            | 0.678   | 1.145 <sup>f</sup> |
| Single                      | 39 (10.9)                           | 318 (89.1) |         |                    |
| Married                     | 7 (13.5)                            | 45 (86.5)  |         |                    |
| Divorced                    | 0 (0.0)                             | 1 (100.0)  |         |                    |
| Gender                      |                                     |            | 0.391   | 0.734              |
| Male                        | 22 (12.8)                           | 150 (87.2) |         |                    |
| Female                      | 24 (10.1)                           | 214 (89.9) |         |                    |
| Religion                    |                                     |            | 0.668   | 1.018 <sup>f</sup> |
| Christianity                | 18 (12.3)                           | 128 (87.7) |         |                    |
| Islam                       | 28 (10.6)                           | 235 (89.4) |         |                    |
| Traditional                 | 0 (0.0)                             | 1 (100.0)  |         |                    |
| Tribe                       |                                     |            | 0.231   | 4.888 <sup>f</sup> |
| Yoruba                      | 38 (11.0)                           | 308 (89.0) |         |                    |
| Hausa                       | 5 (22.7)                            | 17 (77.3)  |         |                    |
| Igbo                        | 3 (15.0)                            | 17 (85.0)  |         |                    |
| Fulani                      | 0 (0.0)                             | 11 (100.0) |         |                    |
| Others(Nupe, Ebira, Baruba) | 0 (0.0)                             | 11 (100.0) |         |                    |

| Variables           | Attitude towards genotype screening |            | p-value | $\chi^2$           |
|---------------------|-------------------------------------|------------|---------|--------------------|
|                     | Poor (%)                            | Good (%)   |         |                    |
| Level of study      |                                     |            | 0.514   | 3.250 <sup>f</sup> |
| NCE1                | 6 (6.5)                             | 87 (93.5)  |         |                    |
| NCE2                | 26 (13.8)                           | 162 (86.2) |         |                    |
| NCE3                | 14 (10.9)                           | 115 (89.1) |         |                    |
| Living status       |                                     |            | 0.718   | 0.661              |
| Living with parents | 23 (10.3)                           | 200 (89.7) |         |                    |
| Living with friends | 6 (10.5)                            | 51 (89.5)  |         |                    |
| Living alone        | 17 (13.1)                           | 113 (86.9) |         |                    |

<sup>f</sup>– Fisher's exact value

#### 4.8 Association between Socio-demographics Characteristics and Practice of Genotype Screening

Over two-thirds of the participants have ever been screened for their genotype (70.5%). None of the sociodemographic characteristics was found to be significant at the  $p < 0.05$  level, although there was near statistical significance in the case of age group, where screening was more prevalent among participants aged 26 years or above (84.6%) compared to those below 26 years ( $p = 0.055$ ).

**Table 8. Association between socio-demographics characteristics and practice of genotype screening**

| Variables                   | Have undergone genotype Screening |            | p-value | $\chi^2$           |
|-----------------------------|-----------------------------------|------------|---------|--------------------|
|                             | No (%)                            | Yes (%)    |         |                    |
| Age (in years)              |                                   |            | 0.055   | 5.809              |
| ≤18                         | 18 (33.3)                         | 36 (66.7)  |         |                    |
| 19 – 25                     | 95 (31.3)                         | 209 (68.8) |         |                    |
| 26 and above                | 8 (15.4)                          | 44 (84.6)  |         |                    |
| Marital status              |                                   |            | 0.066   | 4.826 <sup>f</sup> |
| Single                      | 112 (31.4)                        | 245 (68.6) |         |                    |
| Married                     | 9 (17.3)                          | 43 (82.7)  |         |                    |
| Divorced                    | 0 (0.0)                           | 1 (100.0)  |         |                    |
| Gender                      |                                   |            | 0.250   | 1.321              |
| Male                        | 56 (32.6)                         | 116 (67.4) |         |                    |
| Female                      | 65 (27.3)                         | 173 (72.7) |         |                    |
| Religion                    |                                   |            | 0.140   | 3.540 <sup>f</sup> |
| Christianity                | 51 (34.9)                         | 95 (65.1)  |         |                    |
| Islam                       | 70 (26.6)                         | 193 (73.4) |         |                    |
| Traditional                 | 0 (0.0)                           | 1 (100.0)  |         |                    |
| Tribe                       |                                   |            | 0.088   | 7.899 <sup>f</sup> |
| Yoruba                      | 94 (27.2)                         | 252 (72.8) |         |                    |
| Hausa                       | 11 (50.0)                         | 11 (50.0)  |         |                    |
| Igbo                        | 9 (45.0)                          | 11 (55.0)  |         |                    |
| Fulani                      | 4 (36.4)                          | 7 (63.6)   |         |                    |
| Others(Nupe, Ebira, Baruba) | 3 (27.3)                          | 8 (72.7)   |         |                    |
| Level of study              |                                   |            | 0.473   | 3.531              |
| NCE1                        | 21 (22.6)                         | 72 (77.4)  |         |                    |
| NCE2                        | 59 (31.4)                         | 129 (68.6) |         |                    |
| NCE3                        | 41 (31.8)                         | 88 (68.2)  |         |                    |
| Living status               |                                   |            | 0.255   | 2.729              |
| Living with parents         | 59 (26.5)                         | 164 (73.5) |         |                    |
| Living with friends         | 21 (36.8)                         | 36 (63.2)  |         |                    |
| Living alone                | 41 (31.5)                         | 89 (68.5)  |         |                    |

<sup>f</sup>– Fisher's exact value

## 5. Discussion

### 5.1 Socio-demographic Characteristics of Respondents

This study assessed the Knowledge, Attitude, and Practice of genotype screening among students of Kwara State College of Education, Ilorin, Kwara State, Nigeria. Predominantly, the sample group was made up of younger, single females with ages ranging between 19 and 25 years (74.1%) and a mean age of  $23 \pm 3.7$ . The sample group fits the demographic structure common in Nigerian college settings and is similar to other surveys conducted in Abuja and Osun State, where most respondents were female and below the age of 25 (Cegbeyi et al., 2023; Adegboyega et al., 2024). Also, the percentage distribution of the Yoruba ethnic group (84.4%) and Muslim religion (64.1%) in this study corresponds to the cultural demography of Kwara State, which is consistent with results obtained from Al-Hikmah University, Ilorin (Imam-Fulani, 2024). Importantly, about 54.4% of the respondents live with their parents. The predominance of NCE2 students (45.8%) suggests mid-level undergraduates are most accessible for health outreach, supporting the use of institutional platforms for genotype education (Mahmud et al., 2022).

### 5.2 Knowledge of Genotype Screening

The awareness about genotype screening was relatively high because 82.2% of respondents had heard about it, while 88.8% of individuals exhibited adequate levels of overall knowledge about the procedure. Specifically, 84.6% of people knew that genotype screening is very important before marriage, while 86.3% considered this test necessary for the identification of genetic characteristics and inheritance within families. The figures mentioned above are higher compared to those among secondary school students in Gwagwalada (Abdulhameed & Yalma, 2021) but lower than statistics related to university students in Ghana (Brown et al., 2022) and Osun State (Adegboyega et al., 2024). The level of knowledge could be attributed to continuous learning during health curricular and events, because 35.6% of people identified schools as primary sources of information. However, the results of the survey also demonstrate an alarming fact – 61.7% of individuals believe that genetic diseases are incurable. The phenomenon mentioned above was described in literature as therapeutic nihilism (Durrani et al., 2023) that could be attributed to a lack of knowledge in genetics in general education programs.

### 5.3 Source of Information on Genotype Screening by Respondents

Health personnel emerged as the highest source of information (38.9%), followed by schools (35.6%), mass media (20.8%), and friends (4.7%). The high level of health personnel is consistent with the research done in Lagos, where seeking medical advice was a major reason for conducting genotype screening (Oluwole et al., 2022). While studies conducted in Gombe found that mass media accounted for the highest percentage, our results mirror those from Ilorin, where there was massive dissemination of information about hepatitis on World Hepatitis Day (Agofure & Danzaria, 2020). The high proportion of schools can be compared with Lumbe and Kibusi's (2022) quasi-experiment in Tanzania, where they found that school-based counseling increased genotype knowledge. The lowest percent attributed to peer influence (4.7%) stands in contrast to HIV screening tests carried out in U.S universities among international students from Nigeria, where peer pressure played a critical role (Ayosanmi et al., 2020).

### 5.4 Attitude towards Genotype Screening

In this study, respondents exhibited largely positive attitudes, with 88.8% showing a good attitude. Over half strongly agreed that genetic screening is important for health purposes (51.0%) and that genetic screening is necessary prior to marriage (54.6%). Also, 89.2% agreed that having knowledge about their genotypes makes for better reproductive decision-making in families. Such results are higher than those found by Agofure and Danzaria (2020) in Kumo, Gombe, but align with recently published results in Ghana, where 87% respondents support premarital screening (Sarpong et al., 2025). However, the prevalence of positive attitudes on mandatory screening contrasts with findings in Western countries' genetic testing literature, which emphasizes the principle of autonomy in this area (Cirino et al., 2022). This is attributed to the high rates of sickle cells in Nigeria and religious acceptance of premarital counseling in the region (Galadanci et al., 2023). However, 56.9% of the sample saw the screening process as a matter of personal choice, and 79.0% felt that it was too expensive.

## 5.5 Practice of Genotype Screening

Screening practices were also very high, with 70.5% having been tested previously. This is higher compared to studies done among individuals in Osun State, Nigeria (50.0%), Abuja, Nigeria (28%), and Ghana (1.2–12%). This difference might be attributed to methodological differences. Reasons such as medical advice (38.1%) and personal health concerns (30.1%) were cited as the major motivations for screening, whereas pre-marital screening motivation was cited by 19.0%. This differs from Northern Nigeria, where pre-marital screening motivates screening practices (Galadanci et al., 2023), implying that participants had opportunistic screening practices. Lack of access to screening services (35.5%) and lack of interest and awareness of the disease (19.0%) each were the major barriers for screening practices in the non-screened individuals. The prevalence of barriers due to lack of access to services differs from other sub-Saharan Africa reviews that showed barriers due to knowledge gaps (Hegemann et al., 2023; Dilli et al., 2024) but not in Bangladesh (Hossain et al., 2023).

## 5.6 Factors Influencing the Practice of Genotype Screening

There were very few structural and external variables reported as contributing to their practices. While only 42.0% reported awareness about the genetic diseases, 25.6% reported receiving suggestions from health professionals to be tested. Peer influences, cultural beliefs, and family histories were minimal, representing only 6.6%, 8.0%, and 8.8%, respectively. These results contrast sharply with the results from Thalassemia screenings in China, wherein family history was identified as a strong predictor of screening practices (Chen et al., 2024). It shows that genotype testing is still not considered part of family discussions in Nigeria. Unlike the study conducted by Ezugwu et al. (2019), which revealed that religious organizations play an influential role in influencing genetics screening in Enugu, the present research showed minimal endorsement of cultural beliefs in relation to genetics.

## 5.7 Overall Score for Knowledge of Genotype Screening

The composite score on the level of knowledge showed that 89.5% of respondents had adequate knowledge, while only 10.5% had poor knowledge. Such a high score outdoes the scores obtained by non-medical millennial individuals from Pakistan (Durrani et al., 2023) and secondary school students from Nigeria (Abdulhameed & Yalma, 2021). Such differences might be due to differences in curricula because the Colleges of Education in Kwara teach genetics and health education (Olaifa et al., 2024). Yet, 10.5% who have poor knowledge are at risk, especially considering that Nigeria's sickle cell disease births' prevalence is about 2–3% (Nnodu et al., 2021; Eastburg et al., 2020). Educational intervention among this population is essential because knowledge deficits can lead to misunderstandings, thereby compromising the process of screening (Triatin et al., 2022).

## 5.8 Association between Socio-demographic Characteristics and Knowledge of Genotype Screening

The level of study ( $p = .015$ ) and living arrangement ( $p = .024$ ) were found to be significant factors in determining knowledge. While NCE 3 respondents exhibited the highest percentage (17.1%) of poor knowledge compared to NCE 1 (6.5%), contrary to the expected trend that higher levels of study would translate into higher knowledge levels, this “senior knowledge dip” phenomenon was observed at Al-Hikmah University (Imam-Fulani, 2024) and could be attributed to the timing of genetics curricular instruction being earlier. Living with one's parents also resulted in poor knowledge (14.3%) compared to living independently (6.2%), probably due to independent students being more proactive in seeking out health-related information. This contradicts the findings by Khakbaz et al. (2024), which revealed that family support positively influenced cancer screening knowledge in Iran, indicating the importance of cultural context. There was no significant relationship between age, gender, religion, and tribe, unlike Ghana, where female participants had better knowledge (Brown et al., 2022).

## 5.9 Association between Socio-demographic Characteristics and Attitude towards Genotype Screening

None of the socio-demographic factors tested had a significant relationship with attitude ( $p > .05$  in all cases). Positive attitudes were above 86% for all subgroups, suggesting social acceptance despite the age, gender, or

religious differences of the respondents. This consistency is in stark contrast to sickle cell attitude studies in Lagos, in which female and older participants showed higher levels of positivity (Oluwole et al., 2022). Lack of any predictive socio-demographic variables means that attitude formation among these young people has to do with the education that all have received in school, just like what Li et al. (2025) found among Chinese university students

### **5.10 Association between Socio-demographic Characteristics and Practice of Genotype Screening**

While no variable attained significance, age almost did ( $p = .055$ ), because 84.6% of those aged  $\geq 26$  years got screened compared to 66.7–68.8% of other age categories. This contrasts with Adigwe's (2022) findings in which older, unmarried individuals in Abuja were more likely to get screened, attributable to impending marriages. These insignificant relationships contrast with Osun State, in which a person's course of study and religion predicted screening (Adegboyega et al., 2024), yet conform to Sarpong et al.'s (2025) research in Ghana showing poor demographic prediction of practice. This lack of a significant relationship despite the 70.5% adoption rate suggests that when screening is conducted opportunistically, such as on World Hepatitis Day, demographic barriers do not matter. This corroborates WHO's recommendation for 2024 for opportunistic testing at established public health events (Therrell et al., 2024). Nevertheless, those who failed to screen (29.5%) should not be disregarded as their barrier was a lack of access (35.5%), not attitude or knowledge.

In summary, from this study, it is evident that the students in Ilorin exhibited high levels of knowledge, positive attitudes, and surprisingly high levels of practice concerning genotype screening; mostly through health system interventions, unlike previous studies conducted in Nigeria, where there was a large gap between knowledge and practice (Adesina et al., 2022). It appears as though accessibility has been the main mediator here, and that the null hypothesis cannot be tested with current analyses, since knowledge and attitude alone are not sufficient. This means that future programs will need to involve schools and health care providers to counter the “incurable disease” belief, while addressing issues related to affordability and accessibility. Considering the high prevalence of sickle cell disease in Nigeria (Adigwe et al., 2023a), it is important that knowledge and positive attitudes be used in premarital genotype screening to achieve elimination in 2030.

### **6. Limitations, Mitigation Measures and Suggestions for Future Studies**

This study has some limitations. It was carried out in only one college of education in Ilorin, restricting generalization of findings to the entire population of Nigerian undergraduate students, especially those studying in universities or private schools. The cross-sectional design does not enable causal inference among Knowledge, Attitude, and Practices, and the latter is prone to recall or social desirability bias. The quantitative method employed did not consider cultural and religious factors that affect decision-making in premarital screening.

For limited generalizability, future multicenter studies incorporating various higher institutions within different geopolitical zones in Nigeria are recommended. In order to establish causation, longitudinal methods can be adopted for future research. For bias reduction, future research should involve verification of genotype cards along with self-reporting and should include qualitative dimensions. Future researchers must also ensure the provision of adequate funding, extended data collection periods, and consider the use of adequately trained research assistants to improve data quality and reduce resource-related constraints.

Additional research is needed to investigate how screening for genotypes can be combined with other maternal healthcare activities, like prenatal care and reproductive health services, to see if combining services increases screening among younger generations. There should be an investigation into the effectiveness of men's involvement when making screening decisions. This will help explain the lack of interest in conducting premarital genotypes even though most women participate. Research on mobile Health (mHealth) reminders, peer education in schools, and inclusion in community health insurance schemes for genetic services could generate data that can inform future interventions. Lastly, there is a need for research on the stigma and discrimination against persons with sickle cell trait or disease within schools and marriage domains.

### **7. Conclusion**

The study aimed at investigating the Knowledge, Attitudes, and Practices regarding genotype testing among undergraduate students in Ilorin, Nigeria, and the factors that influence their adoption. The results showed high

levels of awareness and satisfactory knowledge about genotype testing, with the participants demonstrating a very good understanding of the importance of genotype testing in making decisions on marriage and preventing genetic diseases. Participants displayed highly positive attitudes towards genotype testing, with many of them strongly supporting the need for compulsory genotype testing before marriage and realizing the significance of the process for family planning. The practice rate of genotype testing was quite high, which was mostly due to advice from healthcare practitioners and personal reasons rather than premarital intentions. However, unavailability of the service was the main determinant factor in the non-adoption of genotype testing, even more so than awareness and cost. The level of study and place of residence influenced the knowledge score, but socio-demographic variables did not predict attitude and practice. Despite being unable to reject the null hypothesis, which suggested no relationship between Knowledge, Attitude, and Practice, the study found that adequate knowledge and attitude are insufficient without appropriate access to facilities for genotype screening. Generally, the findings demonstrate that knowledge and attitude towards genotype screening among undergraduate students in Ilorin are adequate. The major limitation is the unavailability of facilities for genotype screening in the city.

## 8. Recommendations

For effective translation from high knowledge level and favorable attitude to genotypes screening to practice, screening activities need to be systematically introduced into tertiary institution health programs, especially as part of health promotional activities within the school environment. The Ministry of Health at both state and federal levels, together with Colleges of Education, needs to set up free or affordable on-campus genotype screening units to solve the problem of lack of accessibility to screening facilities identified as one major obstacle in practicing genotyping. As indicated by health professionals and schools as sources of information, capacity building of health workers in schools and inclusion of genetics education into general studies curriculum are recommended to rectify misinformation about genetic conditions such as the perception that diseases arising from genes cannot be cured. In addition, religious and traditional organizations need to be brought on board as stakeholders in the implementation of genotype screening prior to marriage as proposed in previous studies on ethical issues.

## Consent and Methods of Protection of Human Subjects

Informed consent was obtained from all the participants before engaging them in the study. This included providing information on the aim, objectives, process, benefits, and even risks involved in the research in the form of an information sheet that was distributed to all the eligible participants. Participants were given the chance to ask questions about things that they were not sure of. Those who agreed to participate in the study also signed a consent form indicating that they were aware of their rights, including withdrawing from the study. The consent forms were separated from the anonymous questionnaire and put in a cabinet that is secured with a lock and can only be accessed through the computer that is password-protected by the principal investigator. Confidentiality was observed during data collection and processing, as well as in all processes of conducting the research.

## Ethical Approval

Permission for conducting this study was granted by the Ethical Review Committee of the Kwara State Ministry of Health, with permission number ERC/MOH/2026/02/597. There was no use of any form of pressure, temptation, or undue influence in gaining consent from the students. Consent was obtained from the participants before they took part in the study. Moreover, they were fully informed that they can withdraw from the study at any time and face no consequences whatsoever as far as the withdrawal is concerned. There were absolutely no risks associated with taking part in the study, and the benefits of the study were worth much more than the risks involved. The present study complies with the requirements of the Helsinki Declaration. Information about all the respondents were kept strictly confidential and anonymous throughout the study process.

## Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

## Competing Interests

Authors have declared that no competing interests exist.

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