Effect of Genetic Education on Sickle Cell Disorder screening Uptake among Secondary School Students in Ilesa- East Local Government Area

ABSTRACT

Sickle cell disease (SCD) is becoming an epidemic in Nigeria. This study aimed to evaluate the effect of genetic education with counselling on uptake of genotype screening among secondary school students (SSS).

This was a quasi experimental design of one- group pretest - posttest design. 389 SSS in grade10, 11 and 12 were randomly selected and recruited from six schools into the study. The consent of the parents and assents of SSS were taken. Data was collected with the aid of a 20 items structured self administered questionnaire, at pre and post intervention stage. Maximum score for Knowledge was 24 while that of attitude was 14. The intervention was five training sessions on genetic education, free screening, and counselling for screening volunteers. Analysis of data was done using SPSS version 17. Data was presented using descriptive and inferential statistics.

Out of the 389 students recruited only 283 questionnaires were fit for analysis. 193 (68.2%) were females; mean age was 15.5$\pm$1.23year. Most (145,51.2%) were in grade 11; and living with their parents (88.3%). There was significant improvement in the knowledge of the students post intervention (p=0.003) and mean score at posttest increased for both Knowledge (19.7) and attitude (11.7). 87.3% did genotype screening and were counseled adequately.

Findings support positive influence of genetic education on cognitive capacity of students and attitudes to screening uptake. All SSS should be allowed to offer biology and curriculum review should support inclusion of genetic education. Entrance requirements to college should include genetic testing.

Keywords: Genetic education, Sickle cell disease, Screening

INTRODUCTION

1.1 Background to the Study

Education is critical in addressing the growing burden of public health problems in developing nations. The Goal 3 of the Sustainable Developmental Goals place emphasis on the functionality of education as a requisite to achieving healthy lives and well-being across the life course (Maurice, 2015). Establishing a viable link between education and health is essential to setting policy priorities. Education empowers to make informed decision as well as dictating the behaviour of the individual, attitudes or inclination towards a specific action.

Genetic education was defined as an elucidating process which aim is to help individuals, couples, families, medical professionals and non-medical practitioners understand and adapt to the medical, psychological, familiar and reproductive implication of the genetic contribution to specific health conditions (Royal College of Midwives, 2008). Genetic education is the bedrock for genetic literacy. The basic units of human is the cell, it is composed of chromosomes on which genes are located. Gene contains deoxyribonucleic acid, the chemical basis of heredity. No two individuals are completely alike, there is a degree of variation in our genetic code that explains our uniqueness. This variation may be caused by the natural process by which the human cell is continually being replaced, or by exposure to radiation, chemical or simply by chance. Variation means the instruction dictates by the gene is incorrect so it produces a faulty protein, which may result in mutation. It is this mutation that has been identified as a major cause of disease symptoms recognized as genetic conditions. Examples of genetic conditions are, Sickle cell disease, thalassaemia, cystic fibrosis, alzheimier among others. The most familiar genetic condition to Africa is sickle cell disease caused by homozygosity for the β-globin S gene mutation (SS disease) of which technology has revealed that, it occurs when the protein valine replaced glutamic acid at the 6^{th} position of the β chain of the affected person's DNA (Langlos, Ford & Chotayat, 2008).

The UN Sustainable Development Goals emphasize non-communicable diseases as public health concerns (Hunter & Reddy, 2013), and Sickle Cell Disease (SCD) deserves recognition as a widespread non-communicable disease that can lead to serious morbidity, poor quality of life, and early mortality (CDC, 2012). SCD is reported to be the most prevalent genetic disease in the

World Health Organization's (WHO) African Region with Nigeria accounting for more than 100,000 new births yearly (CDC, 2012). Supporting this fact the WHO in 2015 affirmed that SCD is a major genetic disease in sub Saharan African and the prevalence level of 20%- 30% is recorded in Nigeria.

Despite the gaps identified by WHO in the modalities for controlling SCD by the affected countries, such as limited control programmes that have no national coverage for systematic screening of citizens for SCD and the lack of facilities to manage patients with the disorder. WHO as earmarked measures to curtail the SCD epidemic in affected countries to include; support for primary prevention through general public knowledge and genetic counselling; early detection of both traits and the disease through screening; then, management of SCD in affected persons (WHO,2015).

General public knowledge is about shaping the individual perception on any issue through impacting new knowledge (Tewksbury, Jones, Peske, Raymond, & Vig, 2000). This either reinforces the previously held perception (belief) or discards the belief because of better information. Many social factors outside of health care, of which education is key dictate the state of health of an individual. The field of population health has prided its achievement on mass education (Merzel & D'Afflitti, 2003). Eradicating diseases, morbidity or mortality is no longer restricted to the walls of the hospital. Efforts are jeared toward involving the public on health promotion techniques. One of the comprehensive approaches of health promotion is health education. Health education is about providing health information and knowledge to individuals and communities with providing skills to allow the individuals adopt healthy behaviors voluntarily. It is a combination of learning experiences designed to help individuals and communities like school to improve their health, by increasing their knowledge thus influencing their attitudes (Kumar& Preetha, 2012).

Attitudes on the other hand are formed and also changed through integration of new information available to an individual. If the new information is positive, that is, it is considered to be beneficial, it tends to make negative attitude less negative and positive attitudes are likely to become somewhat more positive, attitude of a person can be shaped majorly by the information they have and remember, if the information is forgotten it may do no good for that person, thus

the need for continuous and repeated education. Attitude influence behaviour, with a change of attitude, there will also be a change of behaviour (Ajzen, 2001). Focusing on this is essential in combating chronic disorders that cure may not be feasible. The individual with chronic disorder must be prepared to alter his/her behaviour to support healthy living and adapt to live with the changes that are favourable to his health.

Genetic Counselling and testing are effective and sustainable in reducing the spread of SCD within a given setting (Green et al., 2016; Kromberg, Wessels, & Krause, 2013; Saffi & Howard, 2015). Integrating genetic counselling and testing into routine medical care for individual remains low in Africa. The situation in Nigeria is not better off despite the fact that Nigeria contributes about 50% SCD new births to the world population of SCD (Afolayan & Jolayemi, 2011). To minimize the psychosocial consequences of delayed genetic education, it will be more beneficial to expose adolescents and young people to early genetic education and voluntary uptake of genetic testing. Early genetic counselling and testing has been recommended by the World Health Organization in 2015 to be the most cost-effective strategy for reducing the burden of haemoglobin disorders.

It has been proven that attitudinal change decreases with age, to make a lasting impact in the lifetime of an individual will be to expose him/her to the cognitive change earlier in life so that it will produce a corresponding change of attitude. It will be beneficial to train group of adolescents in school about genetic education way ahead of the time they will be deciding on who to marry, and give them the opportunity for a free genotype test so as to measure the influence of this training on the uptake of genetic screening. Hence, this study seeks to provide genetic education to in-school adolescents with the aim of ensuring their empowerment for voluntary decisions towards voluntary genetic screening for SCD.

Review of Relevant Theories

The two interrelated theories relevant to this study upon which the study is anchored are discussed which are; Theory of Reasoned Action, and, Health Belief Model.

Theory of Reasoned Action Core Assumptions and Statements

Theory of Reasoned Action was developed by Martin Fishbein and Icek Ajzen in 1975.It suggests that a person's behavior is determined by his/her intention to perform the behavior and that this intention is, in turn, a function of his/her attitude toward the behavior and his/her subjective norm. (Ajzen & Fisbein,1980; Fishbein & Ajzen 1975) The best predictor of behavior is intention. Intention is the cognitive representation of a person's readiness to perform a given behavior, and it is considered to be the immediate antecedent of behavior. This intention is determined by three things: their attitude toward the specific behavior, their subjective norms and their perceived behavioral control. The theory of planned behavior holds that only specific attitudes toward the behavior in question can be expected to predict that behavior. The students were provided with 5 sessions of repetitive training on genetic education to impact knowledge on the subject matter and ensure that they remember the information which should influence a positive attitude. In addition to measuring attitudes toward the behavior, we also need to measure people's subjective norms – their beliefs about how people they care about will view the behavior in question. The parents of the students were contacted and briefed about the study, their questions and misconception were clarified and a written consent was taken from them. Also the genetic education was presented to the students as group thus enhancing involvement and discussion. This boosted peer reinforcement by the selected students. To predict someone's intentions, knowing these beliefs can be as important as knowing the person's attitudes. Finally, perceived behavioral control influences intentions. Perceived behavioral control refers to people's perceptions of their ability to perform a given behavior. The students had prior exposure to needle prick during vaccination, so they were told that the experience of collecting blood sample for the genotype test should not hurt than that. These predictors lead to intention. This theory affirms that the more favorable the attitude and the subjective norm, and the greater the perceived control the stronger should the person's intention to perform the behavior in question which for this study is uptake of sickle cell disorder screening test.

Health Promotion Model Theoretical Propositions

Pender in 1982 proposed that prior behavior, inherited and acquired characteristics influence beliefs, affect, and enactment of health-promoting behavior (Nursing Theory, 2012). The students' education, age and parental occupation are variables that are believed to influence decision for voluntary genetic testing. Also, Persons are likely to commit to engaging in behaviors from which they anticipate deriving personally valued benefits. The students gained insight into the advantages of knowing their genotype with respect to making informed choice of intimate partner in the future. However, perceived barriers can constrain commitment to action, a mediator of behavior as well as actual behavior. Requesting the student to pay for the genetic testing may pose a barrier to actual uptake of the test, but this study provided free genetic test for all volunteers.

Likewise, perceived competence or self-efficacy to execute a given behavior increases the likelihood of commitment to action and actual performance of the behavior. Information was provided on the discomfort associated with sample collection and the student previous exposure to vaccination was captured which boost their perceived competence. Persons are more likely to commit to and engage in health-promoting behaviors when significant others model the behavior, expect the behavior to occur, and provide assistance and support to enable the behavior. Families, peers, and health care providers are important sources of interpersonal influence that can increase or decrease commitment to and engagement in health-promoting behavior. The parental consent taken and the counselling session provided to volunteers also aided the students' commitment to uptake of genetic test. The greater the commitments to a specific plan of action, the more likely health-promoting behaviors are to be maintained over

time. The students were eager to receive the result to their genotype test even during the posttest counselling session.

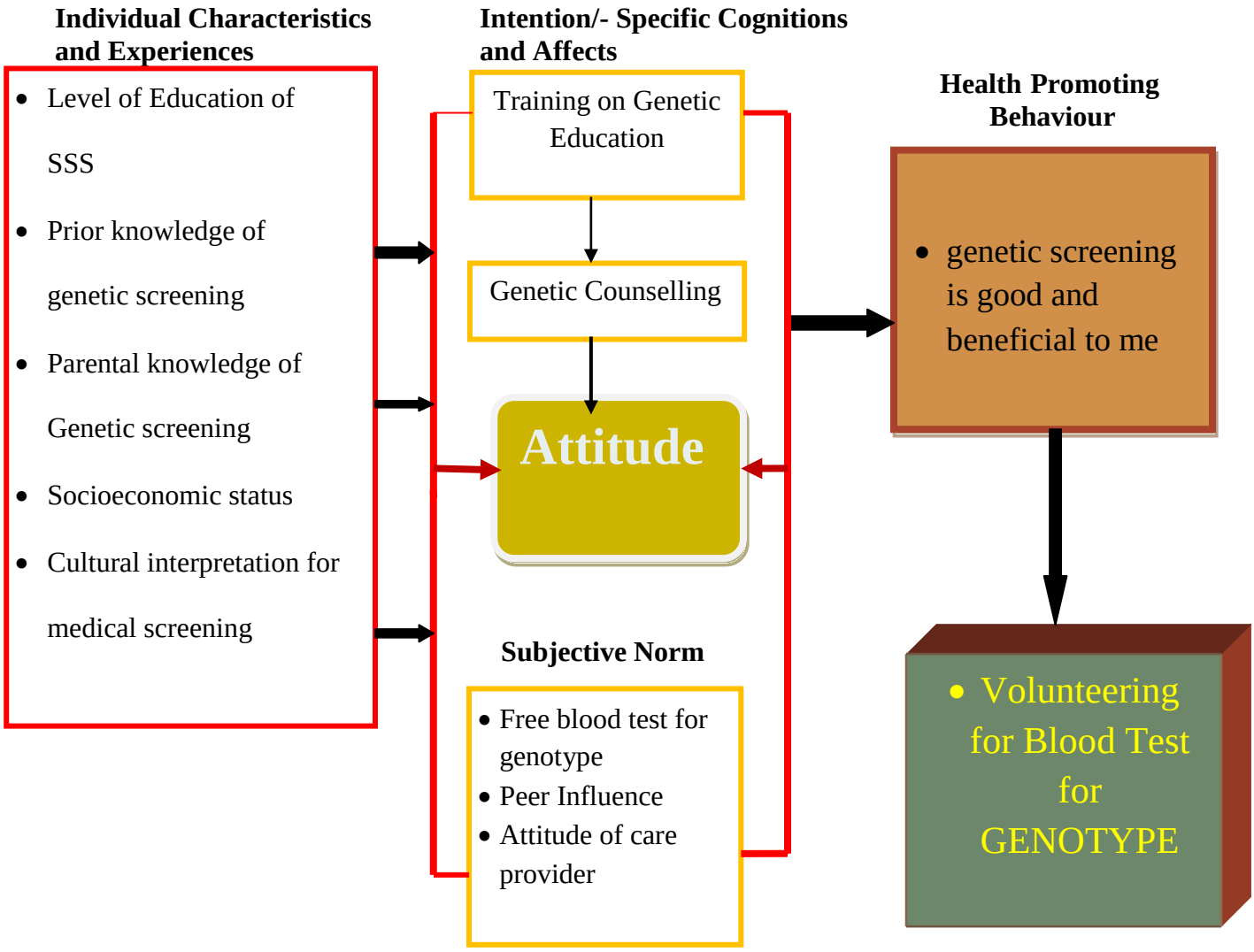


Fig 1.Diagrammatic Representation of Conceptual Framework for this Study adapted from Theory of Reasoned Action and Health Promotion Model

Research design and study setting

This study utilized a quasi- experimental design (single-subject design). This design was used to evaluate for the effectiveness of the intervention packages on the secondary school students (SSS). It was a quasi-experimental study because it lacks control group. The Osun state ministry of education based on its ethical argument only approved this design. In quasi-experimental design the degree of control is limited but interpretable results can still be obtained as this design permits comparisons. Quasi-experimental design may not rule out threat to internal validity with the same confidence as true experimental design but, it is an appropriate design when stronger design is not feasible (Portney &Watkins, 2009).

Sample size and Sampling procedure

The target populations were students of Secondary Schools grade 10 to 12 in Ilesa-East local government area that were registered at the government owned (public) secondary schools. during the period of this study (September 2016 to January 2017).

Daniel Formula for calculation of Sample size using Prevalence Rate (Naing,Winn& Rusli, 2006) was used to calculate the sample size for this study as it supports random selection of Participants where $n = \frac{Z^2 P (1-P)}{d^2}$

389 students were enrolled to allow for attrition rate of 21% as informed by the pilot study

Ethical Consideration

Ethical approval for this study was obtained from the Institute of public health, Obafemi Awolowo University, Ile-Ife with HREC No **IPHOAU/12/499.** The Osun state Ministry of education gave permission to enter the government owned schools to the principal investigator. The School principals were also informed of the study. On sighting the letter of permission from the State ministry of education the six (6) principals gave approval to assess the teachers and

students without hindrance. The consent of the parent was sought while assent was taken from students that returned signed consent form from the parent(s). Only the students that returned signed copies of both were permitted to participate in the study.

Procedure for Data Collection Five research assistants were trained to assist with data collection. Their competences were assessed at pilot study. The data was collected in five phases;

Phase 1 was the recruitment phase and it lasted for 2 weeks, as some students did not submit parental consent on time. The assent of the students that was selected with the teachers as witnesses was done at this phase. The available science teachers in each school were recruited trained using the educational package.

Phase II involved the collection of baseline data from the students through the means of self administered questionnaire which lasted for a week.

Phase III was the intervention stage when the teachers were supervised on the delivering of educational package to the students. Each of the school provided a well arranged classroom for the venue. Materials such as pictures, chalk, blackboard, biro and jotter were used. Five (5) teaching sessions was completed in each school and attendance rigorously taken. This phase lasted for 3 weeks.

Phase IV. An haematologist was made available in the school premises over a period of three days per school. The willing students that assessed the haematologist for screening were put through pre-test counselling to be able to make informed choice. Collected blood sample, were

properly labeled and transported to a laboratory that is affiliated with a state teaching hospital. Cellulose acetate electrophoresis screening method was used (Cheesbrough, 2006).

Phase V: This is the Post Intervention stage which commenced four weeks after intervention when the posttest data was collected in a single testing session to minimize temporal threat to validity (Portney & Watkins, 2009). The pre-requisite for involvement was complete attendance at the phase III of the study, for any student that was absent for any reason at any of the teaching sessions, such a student was disqualified from participating in this phase. The same questionnaire was administered to the participants to assess impact of the intervention at Phase III. Screening result was given to each student tested after a Posttest counselling session.

Study Instruments

A self administered, 20 itemed questionnaire comprising of three sections was used for data collection. In addition to the demographic data, 12 questions explored knowledge of genetic education and 8 questions focused on attitude to SCD screening. Respondents were asked to tick the most appropriate answer to the question asked. 2 marks were awarded for a correct response and 0 for a wrong option. The questionnaire was developed in English language.

Establishing Validity and Reliability of the Instrument

Validity and reliability of research instrument are important characteristics that attempt to evaluate the information solicited by the instrument (Kimberli & Westerstein, 2008). The validity of the genetic counselling guide was done through face and content validity.

The Validity of the questionnaire was also tested for face and content validity by experts in the field of nursing and heamatology who reviewed the instrument and determined that the questions satisfied the content domain of genetic counselling and testing. Content validity ensures a test is free from the influence of factors that are not relevant to the purpose of the measurement. The Face validity confirms that the instrument appears to test the Students knowledge of genetic

counselling and screening. Though the face validity is said to be subjective and scientifically weak, it is accepted as long as it is combined with content Validity (Portney & Watkins, 2009).
The test-retest method was used during the pilot study to assess the reliability of the questionnaire. The Cronbach's alpha was 0.62, which is relatively good for the internal consistency of the questionnaire. The redundant items on the questionnaire were identified and discarded at main study to increase the homogeneity of the instrument.

Statistical Analysis

Analysis of data was done through Statistical Package for Service Solution (version 17). Descriptive statistics such as frequency, proportions, mean, median, standard deviation and range was used to summarize the demographic data of the participants and their knowledge responses. Chi square was used to test the hypotheses at a significant level of $P<0.05$. The numbers of subjects that consented to genotype screening and followed through to be tested served as a measure of screening uptake.

Results

Demographic characteristics

A total of 389 students were enrolled for the study but 283 questionnaires of those who satisfied the criteria were analyzed, given a response rate of 72.8%. The gender distribution shows that there were more females 193 (68.2%), than men. The mean age was 15.5 $\pm$ (1.23) years. Majority of the students were in grade 11, (145, 51.2%) followed by grade12, (76, 26.9%) and grade 10,(62,21.9%). The highest percentage of the students were Yoruba, 269(95.1%), who live with the parents, (250, 88.3%) as shown in Table 1.

Table 1 Socio-demographic Characteristics of the Students

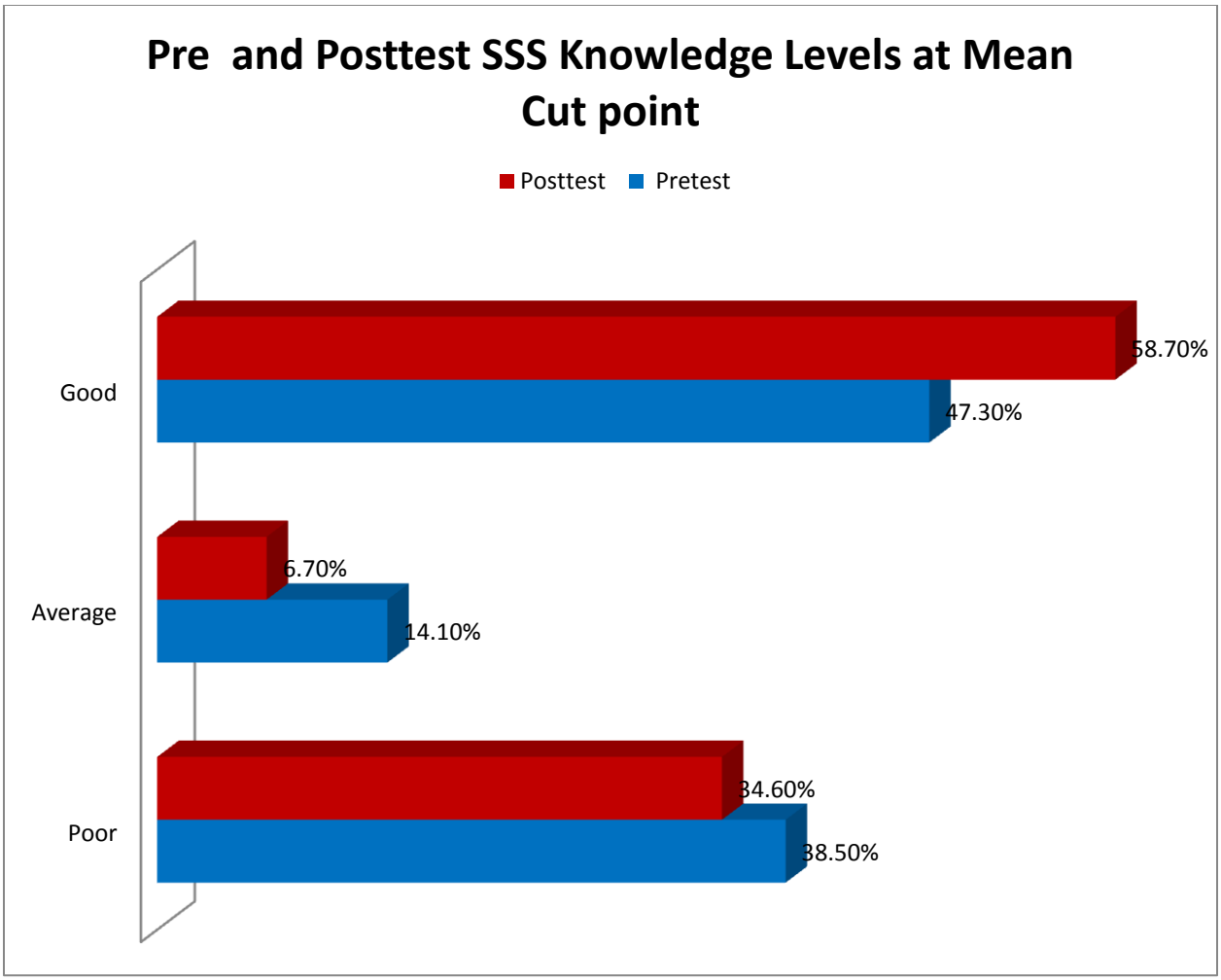
Variables	Freq (N =283)	Percentage(%)	Mean(SD)
Age			
11-15 years	133	47.0	15.5(1.23)
>15years	150	53.0	
Sex			
Male	90	31.8	
Female	193	68.2	
Religion			
Christianity	249	88.0	
Islam	34	12.0	
Current Grade			
Grade 10	62	21.9	
Grade 11	145	51.2	
Grade 12	76	26.9	
Ethnicity			
Yoruba	271	95.8	
Igbo	12	4.2	
Household Living Pattern			
Live with Parents	250	88.3	
Live with Grandparents	16	5.7	
Live with Guardian	16	5.7	
Live alone	1	0.4	
Occupation of Father			
Artisan	60	21.2	
Civil Servant	77	27.2	
Pastor	22	7.8	
Trader	75	26.5	
Farmer	42	14.8	
Dead/ Retiree	7	2.5	
Occupation of Mother			
Artisan	34	12.0	
Civil Servant	35	12.4	
Pastor	3	1.1	
Trader	206	72.8	
Farmer	5	1.8	
Birth Order			
1st	69	24.4	
2nd	66	23.3	
Middle child	148	52.3	

Assessment of Knowledge towards Genetic Education

Table 2 describes the responses of the participants towards genetic education. Knowledge was assessed by questions focusing on components of human cell, heredity and genetic disease, with prevention of genetic condition (SCD). Each response was scored by giving 2 to correct answer and 0 to the wrong answer. The scale measures knowledge for maximum score of 24 to minimum of 0 at pretest and posttest. Mean score were 16 and 19 for before and after intervention respectively. A score below the mean was considered as poor knowledge, while at mean was average knowledge and above mean as good knowledge. Out of the 283 respondents, 109 (38.5) had poor knowledge at pretest which got reduced to 98 (34.6) at posttest.fig 1.

Table 2 Responses to Genetic Education Knowledge Item

Genetic Knowledge Items	**PRETEST (N= 283)**		**POSTEST (N= 283)**	
	Yes N (%)	**No** N (%)	**Yes** N (%)	**No** N (%)
Gene comes in the form of DNA?	246 (86.9)	37 (13.1)	276 (97.5)	7 (2.5)
Genetic instruction is inherited from both parents?	248 (87.6)	35 (12.4)	258 (91.2)	25 (8.8)
A chromosome consists of 2 DNA chains?	192 (67.8)	91 (32.2)	226 (79.9)	57 (20.1)
An individual has 46 chromosomes?	72 (25.4)	211 (74.6)	226 (79.9)	57 (20.1)
A variation in a gene that creates a fault is called mutation?	92 (32.5)	191 (67.5)	192 (67.8)	91(32.2)
Genetic conditions are caused by Gene mutation?	107 (37.8)	176 (62.2)	179 (63.3)	104 (36.7)
Sickle Cell Disorder is an example of genetic condition?	249 (88.0)	34 (12.0)	274 (96.8)	9 (3.2)
Sickle Cell Disorder can be Prevented?	224 (79.2)	59 (20.8)	238 (84.1)	45 (15.9)
Person with genotype AS is a carrier of Sickle Cell Disorder?	210 (74.2)	73 (25.3)	257 (90.8)	26 (9.2)
Do carriers get sick with symptoms of Sickle Cell Disorder?	228 (80.6)	55 (19.4)	125 (44.2)	158 (55.8)
Sickle Cell Disorder can be gotten when both parents (couple) are carriers of the sickle cell gene?	179 (63.3)	104 (36.7)	241 (85.2)	42 (14.8)
Can Sickle Cell Disorder be cured?	178 (62.9)	105 (37.1)	143 (50.5)	140 (49.5)



Assessment of attitude towards Genetic Screening

Attitude towards genetic screening was assessed by asking seven questions as shown in Table 3. Each question was labeled with positive and negative attitude. A score of 2 is given to positive attitudes while 0 was given to negative attitudes with a score range of minimum 0 to maximum of 14. The mean were 11 and 12 for pretest and posttest respectively. A score below the mean cut point was classified negative attitude while score at and above the mean was positive attitude. There was a positive shift of attitude from 56.2% before to76.3% after intervention (table 4).

Table 3: Attitudes of SSS to Genotype Screening

Variables	Pretest (N= 283)		Posttest (N= 283)	
	Agree N (%)	Disagree N (%)	Agree N (%)	Disagree N (%)
Blood testing can detect sickle cell trait in an Individual	227 (80.2)	56 (19.8)	254 (89.8)	29 (10.2)
I will want to do my blood test to know my genotype	262 (92.6)	21 (7.4)	275 (97.2)	8 (2.8)
I will go ahead and marry someone if our blood tests reveal we are both Sickle cell trait carrier	27 (9.5)*	256 (90.5)	23 (8.1)*	260 (91.9)
The results of a genetic test can confirm suspected genetic condition	228 (80.6)	55 (19.4)	260 (91.9)	23 (8.1)
I must go through counselling by a health professional before my blood is taken for genetic test	230 (81.3)	53 (18.7)	256 (90.5)	27 (9.5)
I can refuse (opt out) to do the genotype test after I have been counseled	101 (35.7)	182 (64.3)	110 (38.9)	173 (61.1)
Genetic testing result should only be given to me after a counselling session	216 (76.3)	67 (23.7)	245 (86.6)	38 (13.4)

Note:* The only negatively worded question, thus disagree was the correct option and it attracted 2marks while agree was the wrong option

Table 4: Chi- square Comparison of Pre & Posttest SSS Attitude Patterns at mean cut point

Attitude Pattern	Pretest N (%)	Posttest N (%)	$\chi 2$	p-Value
Negative	124 (43.8)	67 (23.7)	25.674	0.001
Positive	159 (56.2)	216 (76.3)		

Effect of intervention on Knowledge of SSS about Genetic Education

Table 5 reveals that the genetic education intervention increased the cognitive capacity of the students at posttest, the difference was statistically significant for majority of the indices and higher mean score was recorded.

Table 5: Effect of Genetic Education on SSS Knowledge

S/NO	Variable	Pretest N (%)	Postest N (%)	X^2	P-value
1.	Gene comes in the form of DNA?	246 (86.9)	276 (97.5)	22.179	0.001
2.	Genetic instruction is inherited from both parents?	248 (87.6)	258 (91.2)	1.533	0.216
3.	A chromosome consists of 2 DNA chains?	192 (67.8)	226 (79.9)	15.132	0.001
4.	An individual has 46 chromosomes?	72 (25.4)	226 (79.9)	168.076	0.001
5.	A variation in a gene that creates a fault is called mutation?	92 (32.5)	192 (67.8)	67.880	0.001
6.	Genetic conditions are caused by Gene mutation?	107 (37.8)	179 (63.3)	39.753	0.001
7.	Sickle Cell Disorder is an example of genetic condition?	249 (88.0)	274 (96.8)	14.814	0.001
8.	Sickle Cell Disorder can be Prevented?	224 (79.2)	238 (84.1)	2.309	0.129
9.	Person with genotype AS is a carrier of Sickle Cell Disorder?	210 (74.2)	257 (90.8)	29.129	0.001
10.	Do carriers get sick with symptoms of Sickle Cell Disorder?	55 (19.4)	158 (55.8)	10.971	0.001
11.	Sickle Cell Disorder can be gotten when both parents (couple) are carriers of the sickle cell gene?	179 (63.3)	241 (85.2)	33.531	0.001
12.	Can Sickle Cell Disorder be cured?	105 (37.1)	140 (49.5)	7.837	0.005

Association of Knowledge and Attitude

The association between knowledge and attitude is presented in Table 6 which shows significant association between both scores.

Table 6: Paired t-test Comparison of HSS Knowledge at mean and Attitude Summary

	Pretest	**Posttest**		**p-value**
Variable	Mean ± SD	Mean ±SD	**t-cal**	
Knowledge Summary	16.3±3.2	19.7 ±3.0	-13.021	0.001
Attitude Score	10.7± 2.8	11.7± 2.1	-4.906	0.001

Screening uptake and Genotype Pattern of SSS

Only few (6%) of the students taught they knew their genotype before the study, with the intervention (genetic education and counselling) 247(87.3%) volunteered to be screened and there result was as presented in table7. The result was given to each student in privacy after the posttest counselling had been conducted.

Table 7: Genotype Pattern of SSS

		Pretest		**Posttest**
S/NO	VARIABLE	Frequency (n= 283) **N** (%)	VARIABLE	Frequency (n= 247) **N** (%) **Decline= 36 (12.7)**
1.	AA	11 (3.9)	AA	188 (66.4)
2.	AS	5 (1.8)	AS	49 (17.3)
3.	SS	1 (0.4)	AS	9 (3.2)
4.	Don't know	266 (94.0)	SS	1 (0.4)

Discussion

This study aimed at evaluating the effect of genetic education which in this study translates to training on genetics and counselling on uptake of screening for sickle cell disease. Result of this study showed improved knowledge of genetic education at posttest as the mean increased to 19.7 ±3.0 and the difference is significant at (p= 0.001).This corroborates the finding from a similar study conducted among youth corps in lagos, where it was reported that, there was 64.1% increased in the level of knowledge about SCD and screening at post intervention (Olatona, Odeyemi, Onajole & Asuzu,2012) The attitude to screening was positively higher (76.3%) after intervention. This is in line with the findings from similar study among african-American women of reproductive age in Pittsburgh where there was statistical significant increase in acceptance of screening for Sickle cell trait (p= <0.001) after a brief educational intervention. Furthermore, among the study participants, the uptake of screening was (87.3%) which is higher than the recorded 67% in a 20-year outcome analysis of genetic screening programs for genetic diseases in high school (Mitchell, Capua, Clow & Seriver, 1996) and also higher than 22% recorded for a similar quasi experimental study among Nigerian youth where screening was also provided for free (Olatona, Odeyemi, Onajole & Asuzu,2012). This may be as a result of bringing the haematologist into the school premises for easy accessibility and peer support among the students.\However, the school environment has been identified as ideal setting for studies on genetic education which made this current study a success(Gason,Delatycki, Metcalfe &Aitken, 2006).

Conclusion and Recommendations

The present study concludes that the SSS should be empowered with knowledge of genetic education as majority of them are confronted with challenges of making sexual and reproductive choices. Majority of the students (94%) did not know their genotype at baseline which makes them more vulnerable to wrong choice of pro-creation later in life. If we are serious about reducing the incidence of SCD in Nigeria, the following recommendations should be considered with commitment to action;

1. All students should be given the opportunity to offer human biology as a course in secondary school, so as to introduce them to the basic knowledge of genetics. Currently,

The Nigerian Secondary school curriculum is subject to the interest of the Ministry of education, biology was dropped as a compulsory subject and now reserved for students in science class only.

2. The schools should be provided with adequate number of science teachers, presently, there are not enough science teachers and the few available are not motivated to work as their salary was not paid.
3. Genetic education should be introduced into the secondary school human biology curriculum for the students to have solid foundation of genetics, and genomics.
4. Government should make efforts to sustain uninterrupted school calendar year, this can facilitate knowledge acquisition.
5. Genetic screening should be part of routine medical test for entrance into secondary school.
6. School health services should be resuscitated in all schools and trained health counselor should be part of the team, if the country is serious about reducing the incidence of Sickle cell disease.

References

Afolayan, J. A., & Jolayemi, F. T. (2011). Parental attitude to children with sickle cell disease in selected health facilities in Irepodun Local Government, Kwara State, Nigeria. *Studies on Ethno-Medicine, 5*(1), 33-40.

Ajzen I, Fishbein M. Predicting behavior from intentions. In: Ajzen I, Fishbein M, editors. Understanding attitudes and predicting social behavior. Prentice-Hall; Englewood Cliffs, NJ: 1980. pp. 46–52.

Centre for Disease Control and Prevention. (2012). Sickle Cell Disease. Retrieved from http://www.cdc.gov/globalhealth/countries/nigeria/what/scd.htm

Gustafson SL (2006) Knowledge and health beliefs of sickle cell disease and sickle cell trait: the influence on acceptance of genetic screening for sickle cell trait. A thesis presented at University of Pittsburgh 3-4.

Green, N. S., Mathur, S., Kiguli, S., Makani, J., Fashakin, V., LaRussa, P., . . . Mupere, E. (2016). Family, Community, and Health System Considerations for Reducing the Burden of Pediatric Sickle Cell Disease in Uganda Through Newborn Screening. *Global Pediatric Health, 3*, 2333794X16637767.

Howard, J., & Telfer, P. (2015). Overview of Sickle Cell Disease *Sickle Cell Disease in Clinical Practice* (pp. 3-28). London: Springer London.

Hunter, D. J., & Reddy, K. S. (2013). Noncommunicable diseases. *New England Journal of Medicine, 369*(14), 1336-1343.

Kromberg, J. G., Wessels, T.-M., & Krause, A. (2013). Roles of genetic counselors in South Africa. *Journal of genetic counseling, 22*(6), 753-761.

Maurice, J. (2015). UN set to change the world with new development goals. *The Lancet, 386*(9999), 1121-1124.

Merzel, C., & D'Afflitti, J. (2003). Reconsidering community-based health promotion: promise, performance, and potential. *American journal of public health, 93*(4), 557-574.

Olatona, F.A., Odeyemi, K.A.,Onajole A. T. & Asuzu, M.C. (2012).Attitude of Youth Corps Members to Sickle Cell Disease and its Screening in Lagos State. *Journal of Community Medicine & Health Education retrieved from https://www.omicsonline.org/effects-of-health-education-on-knowledge-and-attitude-of-youth-corps-members-to-sickle-cell-disease-and-its-screening-in-lagos-state-2161-0711.1000163.php?aid=8611*

Oyedele, E. A., Emmanuel, A., Gaji, L. D., & Ahure, D. o. E. (2015). Awareness and acceptance of premarital genotype screening among youths in a Nigerian community. *1*(1), 17-21.

Portney L.G, *Watkins* M.P (2009) Foundations of Clinical Research: Applications to Practice. 3rd ed. Upper Saddle River, NJ: Prentice-Hall Inc, Rothstein JM

Rees, D. C., Williams, T. N., & Gladwin, M. T. (2010). Sickle-cell disease. *The Lancet, 376*(9757), 2018-2031.

Tewksbury, D., Jones, J., Peske, M. W., Raymond, A., & Vig, W. (2000). The interaction of news and advocate frames: Manipulating audience perceptions of a local public policy issue. *Journalism & Mass Communication Quarterly, 77*(4), 804-829.

Wonkam, A., Ngo Bitoungui, V., & Ngogang, J. (2015). Perspectives in Genetics and Sickle Cell Disease Prevention in Africa: Beyond the Preliminary Data from Cameroon. *Public health genomics, 18*(4), 237-241.

World Health Organisation. (2015). Sickle Cell Disease Prevention and Control. Retrieved from http://www.afro.who.int/en/clusters-a-programmes/dpc/non-communicable-diseases-managementndm/programme-components/sickle-cell-disease.html

World Health Organization (2005), Department of Reproductive Health and Research. www who. int/reproductive-health. Geneva: World Health Organization; Eliminating congenital syphilis: a global health priority

World Health Organization (2006) Sickle Cell Disease Prevention and Control available on

www.afro.who.int/en/clusters-a-programmes/dpc/non-communicable-disease-managementndm/programme-components/sickle-cell-disease.html

World Health Organisation. (2015). Sickle Cell Disease Prevention and Control. Retrieved fromhttp://www.afro.who.int/en/clusters-a-programmes/dpc/non-communicable-diseases-managementndm/programme-components/sickle-cell-disease.html