EFFECTS OF HAEMATOLOGIC EDUCATION ON KNOWLEDGE, ATTITUDE AND MANAGEMENT OF SICKLE CELL DISEASE AMONG IN-SCHOOL ADOLESCENTS IN IBADAN METROPOLIS, NIGERIA

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CERTIFICATION

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DEDICATION

This project is dedicated to God Almighty, the Author and Finisher of my faith for His love, mercy and faithfulness. Also to my loving husband, Engr Oladimeji Bhadmus, my excellent children, Olumide, Olamide, Ayomide and Aramide. Also, to my mother Mrs Victoria Efunreni Faseyitan and my late father, Deacon Daniel Adebayo Faseyitan.

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ABSTRACT

Sickle Cell Disease (SCD) is a major health challenge with serious consequences on individuals, family and particularly adolescents living with the disease. Previous studies focused largely on prevalence and social relations with carriers, while little attention had been placed on haematologic education to boost the general scientific knowledge of adolescents about the inheritance of SCD as a means of reducing the prevalence. This study, therefore, was carried out to determine the effect of haematologic education on knowledge, attitude to and management of SCD among in-school adolescents in Ibadan metropolis, Nigeria. The moderating effects of gender and religion were also examined.

Health Belief Model provided the framework, while the pretest-posttest control group quasi experimental design of 2x2x3 factorial matrix was adopted. Two Local Government Areas (LGAs) out of the five in Ibadan Metropolis were randomly selected. Two public co-educational secondary schools were randomly selected from each LGA. An intact class of Junior Secondary School II students was randomly selected from each of the selected schools. The schools were randomly assigned to Haematologic Education and control groups, while treatment lasted eight weeks. Instruments used were Haematologic Education guide, SCD Knowledge (r=0.81), Attitude towards SCD (r=0.83) and SCD Management Skills (r=0.80) scales. Data were analysed using descriptive statistics and Analysis of Covariance at 0.05 level of significance.

Majority of the participants were female (54.6%) with a mean age of 10.7±2.8 years. There were significant main effects of treatment on knowledge ($F_{(1,204)}$=95.29; partial η^2=0.32), attitude ($F_{(1,204)}$=126.09; partial η^2=0.85) and management skills of SCD ($F_{(1,204)}$=139.45; partial η^2=0.41). The participants in Haematologic Education group obtained higher mean score in SCD knowledge- 56.88; attitude- 51.42; management skills- 32.28 than those in the control group; knowledge- 40.85; attitude- 15.79; management skills-19.15. There was a significant main effect of gender on SCD management skills ($F_{(1,204)}$= 10.50; partial η^2=0.05) in favour of female from the treatment group but none on knowledge and attitude. There was a significant main effect of religion on knowledge of SCD ($F_{(1,204)}$= 8.39; partial η^2=0.30) in favour of christians but none on attitude and management skill. There were two-way interaction effects of treatment and gender ($F_{(1,204)}$= 5.42 ; partial η^2=0.03 as well as treatment and religion $F_{(1,204)}$= 5.63; partial η^2=0.03) on SCD management skill in favour of female Christian from haematologic education group but none on knowledge and attitude to SCD. The two-way interaction effect of religion and gender as well as the three-way interaction effect were not significant.

Haematologic education enhanced the knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan metropolis, Nigeria. Therefore, haematologic education should be included in health education curriculum for secondary schools.

Keywords: Sickle cell disease, Haematologic education, In-school adolescents, Inheritance of sickle cell disease, Health education

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INTRODUCTION

Background to the study

Blood is essential for proper functioning of the body system in order to cope with normal daily living and whenever anything is wrong with blood, it can affect the total health of the individual. It makes up about seven percent of the weight of the human body. Blood is a constantly circulating fluid that provide the body with nutrition, oxygen and help in waste removal from the body. It is composed of plasma and formed elements. Plasma consists of albumin, globulins, fibrinogen, salts, lipids and glucose. Formed elements are red blood cells which carry oxygen to tissues in the body, white blood cells which fight infections and platelets which help in clotting. Heamatologic diseases interfere seriously with the ability of the composition of blood to function properly (American Society of Haematology, 2018). These diseases affect the production of blood and its components such as blood cells, blood proteins, bone marrow, haemoglobin and blood vessels which can either be inherited, due to side effects of drugs or lack of certain nutrients in the body. Blood is made up of different parts and each part has a unique function Heamatologic diseases include anaemia, thrombophilia, haemophilia, haemoglobinopathies, blood cancers, lymphoma and myeloma (AMH, 2016).

Diseases affecting the white blood cells include a form of cancer in the lymph system, this makes white blood cells to become malignant, spreading and multiplying abnormally either inside the bone marrow or in the circulating blood in the body. Diseases of platelets may be in form of an infection somewhere in the body which may spread into the blood causing a bigger form of the infection or a blood clot may form inside a blood vessel. This may dislodge and move to any vital organ in the body leading to occurrence of other serious problems. Some of the diseases of red blood cells include excessive red blood cells which can cause headache and pletora which is a rare red complexion or inadequate red blood cells which could be due to blood loss or haemoglobin deficiency called heamoglobinopathy (Macon, Solan and Lamoreux, 2017). Haemoglobinopathy is a group of blood disorders in which there is abnormal production or structure of heamoglobin. It is a genetic disease. Of all genetic disorders to which man is known to be liable, there is probably no other that presents a collection of problems and challenges quite comparable to sickle cell disease because of its chronicity and resistance to therapy. It is seen as a major global haemoglobinopathy (Olubiyi, Umar, Ajiboye, Olubiyi and Abioye, 2015).

Red blood cells deliver haemoglobin throughout the body, ensuring that the body tissues have the oxygen they need for life and proper functioning. Sickle cell disease (SCD) is a chronic hereditary disorder which affects the red blood cells and it is a major public health problem. It is a lifelong ailment arising from the inheritance of sickled haemoglobin from both parents. It is one of the most common hereditary diseases occurring world-wide with serious complications that may affect any organ or system of the human body (Mulumba and Wilson, 2015). The disease also has social, physical, psychological and economic implication on the affected child and the family. The United Nations General Assembly (2008) and the World Health Organization (WHO) (2010) recognised SCD as a global public health concern. SCD is a genetic haematologic disorder affecting red blood cells as a result of the presence of an abnormal formation of haemoglobin. Haemoglobin (Hb) is the molecule in the red blood cells that transports oxygen from the lungs to the tissues of the body and gives the red blood cells the red colour. SCD is characterised by abnormal sickle cell-shaped red blood cells and is caused by inheriting two abnormal haemoglobin genes, one from each parent.

The abnormality seen in the haemoglobin occurs when there is mutation in both copies of the β-globin gene, a major subunit of haemoglobin. Sickle haemoglobin (HbS) is a structural variant of normal adult haemoglobin (HbA). The disease is characterised by severe haemolysis, recurrent illness, trauma, high morbidity and mortality rate. SCD limits the oxygenating role of haemoglobin resulting in damaging or sickling of the red blood cells (Chakravorty and Williams, 2015). Individuals with only one mutated gene and one normal copy are known as sickle cell carriers because they have the trait of SCD. Sickle cell trait carriers are healthy and will not develop SCD but can pass the ‘S’ gene to their children. Adequate knowledge of the disease, especially among the adolescents can reduce its multiplication.

Sickle cell disease affects millions of people throughout the world with 3 to 7% of the population living with the disease. There is between 20 and 25 million people living with sickle globally out of which between 10 and 15 million live in Africa where mortality rates for those under age 5 range from between 50% to 80% (Aygun and Odame, 2012). Centre for Disease Control and Prevention (2015) emphasised that the disease is particularly common among those whose ancestors come from sub-Saharan Africa, Spanish speaking regions in the Western Hemisphere and Mediterranean countries such as Turkey, Greece and Italy. Sickle cell disease affects about 100,000 Americans most of whom are of Black origin and 1 in 2,000 live births

with sickle cell disease in United Kingdom (Sickle Cell Disease Global, Research and Screening, 2013).

In the Sub-Sahara Africa, 2% of all children born have SCD (Makani, Cox, Soak, Komba, Oruo and Mwantemi, 2011). The United Nations Population Fund (UNFPA) (2008) reported that in Africa, 444,000 babies have sickling disease. It is estimated that 75–85% of children born with SCD are born in Africa. West Africa with the population of 5 million has 90% of all cases of SCD in the world. Nigeria, which is the most populous sub-Saharan African country was ranked first as the sickle cell endemic country in the world with 2 to 3% of the population living with SCD. World Health Organisation, (W. H. O) (2006) confirmed that Nigeria has the largest population of people with SCD as 20 out of 1000 births or 1 in 50 babies are affected which is about 150,000 births annually and this accounts for almost one third of the 444,000 babies born yearly with major haemoglobin disease worldwide. In the report by Falusi (2013), 24%, that is 40 million Nigerians or 1 in 4 people are carriers of the 'S' gene and this number exceeds the total population of every other affected African country. In Western Nigeria, the population of people living with SCD is about 2.4% (Taiwo, Oloyede and Dosunmu, 2011).

WHO (2006) established that sickle cell disease results from a substitution of valine leading to replacement of glutamic acid, an amino acid that is situated in the 6^{th} position of the beta globin chain in the hemoglobin molecule. People with this disease make a different form of haemoglobin called haemoglobin 'S' (Rees, Williams and Gladwin, 2010). Normal red blood cells with haemoglobin'A' are round in shape, move smoothly and continuously through the blood vessels whereas in individuals with SCD, the normally round red blood cells which are pliable become crescent or half-moon (sickle) shaped cells that are rigid and easily destructible. The red blood cells in persons with this disease survive in the circulation for about 15 to 20 days instead of the normal 120 days. The sickle cells are destroyed very quickly resulting in anaemia which can be mild or severe. The accumulation of the sickled red blood cells can also block the blood vessels leading to lack of oxygen which can also cause a lot of harm to the tissues and organs in the affected area of the body (Adeyanju, 2010; National Human Genome Research Institute (NHGRI), 2010).

The type of haemoglobin gene which a person has inherited from his or her parents determines the type of adult haemoglobin. Inheritance of gene HbS from each parent results in the disease (HbSS) which means that both parents are carriers of haemoglobin 'S'. Sickling

decreases the cell's flexibility and results in various complications commonly associated with the term 'sickle cell crisis' which is used to describe several independent acute conditions occurring in people with sickle cell disease. The complications of sickle cell disease are life-threatening as the disease affects multiple parts of the body with the symptoms such as fatigue, yellowish discoloration of the eyes, shortness of breath, serious infections, damage to vital organs, stroke, kidney damage, respiratory problems, bone marrow failure, cognitive impairment, motivational delay in children as well as maternal and foetal morbidity and mortality (National Heart, Lung and Blood Institute, 2014). The high mortality and morbidity associated with SCD produce grief and permanent anxiety, pain, frustration, poor quality of life to the family and a large drain on the national health expenditure (Durotoye, Salaudeen, Babatunde, Bosch and Ajayi, 2013).

Sickle cell disease has economic implication for the affected child and the family. Recurrent sickle cell crises interfere with the life of the individual living with SCD, especially with regard to education and the social and psychological effects. Social effects include unbalanced stature, limitation in activities, missed schools and repeated hospitalisation. Vaso-occlusion occurs when the sickle red blood cells obstruct blood vessels resulting in total or inadequate blood supply to the affected organs. Pain crises caused by vaso-occlusion are the trademark of SCD and affects most people with the disease. Pains and symptoms persist throughout the life of individuals living with the disease (Olatunya, Ogundare and Aderiye, 2015; Kofi, Egunjobi and Akinyanju, 2010). Psychological effects include anxiety, depression, withdrawal, aggression, poor relationship, poor school performance, reduced quality of life and neurocognitive impairment.

Multiplication of sickle cell disorder has been possible due to Nigerians' flair for many children. Unfortunately, the issue of malaria infection has complicated and worsened the issue. Carriers of sickle cell trait can withstand attack of malaria but there is high mortality of 50% to 90% of children with SCD due to plasmodium falciparum infection in developing countries. Enhanced phagocytosis occurs in haemoglobin S carriers, destroying malarial infested blood cells than in individuals with HbAA thus making the available people with genotype 'AS' live because they are not greatly affected by malaria, they intermarry and makes majority become carrier of sickle cell. The carriers increase and this makes the prevention of SCD more difficult (Center for Disease Control (CDC), 2007). It has been established that about 24% of the entire population in Nigeria, that is, 1 in 4 adults carry the sickle cell trait (Sickle Cell Hope Alive

(SCHAF), 2015). The adolescents' knowledge about the inheritance can help to reduce the high prevalence of the disease especially in Oyo State.

Adolescence is a period between childhood and adulthood and it constitutes a significant population group especially in developing countries.It is closely associated with teenage years. It is considered as one of the crucial periods of life between childhood and adulthood that is accompanied by a rapid increase in the rate of physical growth and cognitive development. It is also the period when young people gain 50% of their adult weight, more than 20% of their adult height and 50% of their adult skeletal mass but in adolescents living with sickle cell disease, they are slow in growth with small stature and delayed puberty which may cause psychological problems. This delay in puberty may be a problem of self-esteem, socialisation and negative thoughts (Williams-Smith, 2015; Erin, 2011). Adolescence is the risk factor in SCD. There are about 1.2 billion adolescents worldwide, making up 18% which constitute one-fifth of the world population. Sub-Sahara Africa is the only region of the world in which the number of adolescents continue to grow significantly and nearly 90% of adolescents live in developing countries to which Nigeria belong (W.H.O, 2015; United Nations Population Fund (UNFPA), 2011).

According to Nandanwar and Kamdi (2013), adolescents living with sickle cell disease may have impaired growth of retarded physical growth and development characterised by stunted growth, delay in skeletal age and shorter height. Katibi (2008) confirmed that physical deformities in adolescents suffering from SCD include frontal bossing, protruding abdomen and long, slender extremities which may cause discontent with their stature. These result in social problems for the adolescents living with SCD which may cause other healthier people to develop change in attitude either positively or negatively towards them.

Difficulty in living with SCD becomes more noticeable as the sufferers reach adolescence. They get tired easily during exercise and this may result in feelings of despair, hopelessness and social isolation. They may have hard time to adjust up to normal development, compromised interpersonal relationship with family and peers, missed opportunity of the school environment and peers, dropping out of school, fears, anxieties, hatred for parents and desire to hide the illness to avoid judgment. Frequent hospitalisation affects the parents and other siblings as more time that is devoted to the sick child always affect family relationship (Olagunju, Olaogun, Afolabi and Adereti, 2014). Psychosocial problems affecting adolescents with SCD and their families generally develop from the effect of pain and other SCD symptoms on their

daily lives. Moreover, people's attitude towards the adolescents with the disease can also lead to social and psychological problems. Adolescents living with SCD are at high risk of school absenteeism and this is a significant problem as it may increase problems with school achievement. The social effects of missed school, limitations in activities, pain crises and repeated hospitalisation can also cause distress as they have a greater risk of unsuccessful school performance than their healthy peers (Adegoke and Kuteyi, 2012). Acute pain which is the hallmark of SCD is the main cause of hospitalisation for people with SCD. SCD pain crises also lead to depression, anxiety and other mental problems which are also associated with the decreased capacity to cope with pain. Anie, Dasgupta, Ezenduka, Anardo and Emodi, (2007) confirmed that about half of people living with SCD in Nigeria have depressive feelings.

Knowledge is the information, understanding and skills that an individual acquires through education or experience by perceiving, discovering or learning (Gbefwi, 2004). It is also the representation of facts and concepts that are organised for future use. In the context of this research work, haematologic education is viewed as the understanding of the nature of sickle cell disease, signs and symptoms, inheritance, complications and its management in relation to prevention of triggers of crises in the affected individual. Knowledge of sickle cell disease will be most beneficial to adolescents during their school-going years as schools lay a country's foundation on a host of issues including health. The schools are the main venue to increase knowledge and discuss various health problems with experienced health educators as most of the adolescents spend a large proportion of their day in school. What is learnt at this impressionable stage of life in terms of knowledge and attitude has a lasting impact on the entire life span of the individual (WHO, 2007; Leena, Ravi and Abbay, 2005).

Knowledge about SCD should start early in life. Falusi (2013) stressed that knowledge of SCD should start early in life before children reach the age of 14. There is a notion that the younger the learner is, the better the learning ability (Kalesanwo, 2007). Studies have established that the knowledge of sickle cell disorder is low among secondary school students (Olanrewaju, Enwerem, Adebimpe and Olugbenga-Bello, 2013). Assessing adolescents' knowledge about SCD would aid in planning the most effective educational approaches to improve knowledge about SCD and its management as regards the prevention of triggers of crises.

Attitude is a psychological construct which expresses one's disposition towards an issue. It is also a way of thinking, a way of looking at things and a point of view or frame of mind.

Attitude is learned through experience and observation which may influence behaviour. Behaviour can be inferred from disposition to situations. In other words, knowledge about an issue may determine the attitude towards it which in turn influences the behaviour (Odelola, Adisa and Akintaro, 2013). Some people think that the disease can be as a result of affliction from evil spirits and gods. The myths and misconceptions about the disorder has made people from Yoruba to call such children 'Abiku' among the Yoruba speaking areas or 'Ogbanje" among the Igbo people which means repeated cycles of birth, death and reincarnation (Adeyemi and Adekanle, 2009, Asakitipki, 2008). The mates of such children in the school who have this idea may have unkind and negative attitude towards the adolescents living with SCD and this in turn may have psychological and social effects on them.

The negative attitude and perceptions of non-sufferers towards affected persons especially attitude to symptoms like jaundice, leg ulcers, short or small stature and also to the erroneous causes of sickle cell disorders as evil spirit, gods or curse may add to their problems. Some of the school mates of the adolescents living with SCD have negative attitude towards them and may not want to associate, study, play or invite them to social gathering as they may be ashamed of them; their families also believe in the secrecy of the disease. The negative attitude and unkind behaviours towards adolescents living with SCD is not helping their schooling experience. Studies carried out by Olarewaju, Enwerem, Adebimpe and Olugbenga-Bello (2013) revealed that the attitude of young people towards people living with SCD is negative.

SCD is a life-long disease, however, it can be managed. In the context of this study, management is the knowledge of actions that needs to be taken to ensure that there is no aggravation of health status of people living with sickle cell disease and this is based on the avoidance of the triggers of crises such as infections, especially malaria, over exposure to extreme humidity of coldness, hot weather and rigorous exercise. The primary aim of the knowledge of management is to reduce the pain and discomfort being experienced by adolescents living with the disease in order to carry on with normal living, improve the quality of life and reduce their burden of social and psychological trauma. The knowledge of the management can as well encourage positive attitude towards people living with sickle cell disease as they may be able to assist willingly during the crisis stage. Fowora (2016) found out in his study that knowledge of management can help minimise the complications of SCD, thereby increasing the quality of life, reduce psychosocial and psychological problems and can

encourage positive attitude towards adolescents living with sickle cell disease. Prompt attention is also needed in case of crises. Federal Ministry of Health (2012), in its guidelines for the management of SCD in Nigeria recommended education on SCD.

Reports showed that SCD was a well-known disorder in West Africa and the natives had several local names for the disease before it was discovered in America (Reid and Rodgers, 2007). In Africa, beliefs and traditional practices are relevant in SCD. Beliefs are usually influenced by religious values which influences health behaviour. Anie, Egunjobi and Akinyanju, (2010) opined that religion has significant role on attitude especially in Nigeria. Religion is also significant in the attitude of parents whose children have SCD. Highly religious people may have positive attitude towards them and are likely to show more love and care as they may perceive the disease as an act of God or destiny while low religious people may not (Afolayan and Jolayemi, 2011).

Most people in Nigeria believe in the ancestral deities, gods, witchcraft and evil spirit as causes of SCD and they feel that they can appease the spirit by seeking the assistance of religious leaders for prayers or traditional healers who may prescribe or perform appropriate rituals. Afolayan and Jolayemi (2011) and Anie, Egunjobi and Akinyanju (2010) reported that Africans generally, most especially Nigerians engaged in more religious activities more than the Carribeans and people from United Kingdom when it comes to the issue of SCD. Erinosho (2005) explained that scientific knowledge would affect the attitude of people towards the adolescents living with SCD instead of the mystical belief that SCD is caused by evil machinations, punishment from God or being abandoned by God.

SCD affects males and females but it was noted that there is increased morbidity, crises and greater pain attacks in males than females. Affected females have slightly higher foetal hemoglobin levels which may be protective. It was concluded that the basis for this differences could lie in the observation that nitric oxide bioavailability and responsiveness are reduced in males whereas estrogen facilitate nitric oxide production and limit its consumption in females. Nitric acid dilates blood vessels and increases the easy flow of blood (Gladwin, Schechter, Ognibene, Coles and Reiter, 2003). Also, the onset of puberty may be delayed in both boys and girls with SCD, more noticeable in adolescent males than females and pregnancy in sickle cell disease is at very high risk as maternal and foetal complications are higher (Ilesanmi, 2014).

Haematologic education deals with education to prevent, diagnose, treat and investigate malignant and non-malignant blood diseases with particular emphasis on SCD (American Society of Hematology (ASH), 2008). It is for Clinicians, Trainees, Educators and people living with blood diseases. It is a form of health education which is a teaching-learning process directed at a learner to acquire knowledge and develop positive attitude and skill or practice for the wellbeing of himself and others. It is one of the best ways to impact knowledge. According to Moronkola (2012), health education is a process by which health information is successfully impacted in such a way that the recipient is motivated and equipped to make use of the information for the improvement, maintenance and protection of health. It is a form of learning in which knowledge, skills and habits of a group of people are transferred from one generation to the next through teaching which can take place in a school setting depending on the target population and the type of strategy the educator wants to adopt. It builds students' knowledge and positive attitude about health and motivates students. ASH (2015) confirmed that it has taken a number of steps to increase education and awareness about SCD. A typical health education is the haematologic education as an intervention to increase the knowledge, encourage positive attitude towards adolescents living with SCD and its management in relation to prevention of triggers of crises.

Understanding knowledge about sickle cell inheritance, its health implications as well as behaviour towards individual with SCD among secondary school students is important. Olanrewaju, Enwerem, Adebimpe and Olugbenga-Bello (2013) and Olakunle, Kenneth, Olalekan and Adenike (2013) recommended that if SCD control strategies must yield any significant results, there is need to raise awareness about SCD especially among students in secondary institutions. Haematologic education for the public and within the formal education sector is generally lacking, thereby leaving the population largely uninformed. Lack of information and education about the disease has encouraged the multiplication of SCD, myths, misconceptions, negative attitude towards the adolescents suffering from SCD and its management. There is need for improved SCD education. Owolabi, Alabi, Olusoji, Alabi and Otu (2011) emphasised this.

Ibadan, the capital of Oyo State, is a cosmopolitan town and it is one of the largest and most populous urban centres in Nigeria. Ibadan Metropolis consists of five local governments namely: Ibadan North, Ibadan North-East, Ibadan North-West, Ibadan South-East and Ibadan

South-West. Ibadan has 5.5% of its population living with SCD and 25% of the population are of genotype HbAS; that is, carriers of 'S' gene (Sickle Cell Hope Alive Foundation (SCHAF) 2015).

Adequate knowledge about the inheritance of the disease can reduce the prevalence and prevent SCD when adolescents are able to have a choice of future partners that will not result in having children living with SCD and in addition, people who are living with SCD, can live a meaningful and reduced-crisis life with support from people around them, most especially, their school mates. Therefore, understanding knowledge about sickle cell inheritance, its health implications, management as well as attitude towards individual with SCD particularly among in-school adolescents is important.

Statement of the Problem

Sickle cell disease is a major public health challenge and is usually blamed on poor sensitisation. The prevalence of SCD is high in Nigeria with the largest population of people living with sickle cell disease globally: 20 per 1000 births or 1 in 50 births (WHO, 2006: Emechebe, Onyire, Orgi, and Achigbu, 2017). WHO (2010), in its 63rd World Health Assembly concluded that Nigeria may likely see a very large increase in the number of newborns with SCD from 91,000 to 106,100 in year 2010 to 140,800 in 2050 but which has now reached over 150,000. This showed predictive progressive increase. Ibadan has 5.5% of its population with SCD (Nabila, Ukaejiofo, Nubila and Azeez, 2013). Haematologic education is a preventive strategy in reduction of prevalence of sickle cell disease. There is need for both prevention and control of SCD in Nigeria. Furthermore, the number of carrier is also large, 40 million Nigerians carry sickle cell trait (SCHAF, 2015). This translates to 1 in 4 adult Nigerians are carriers. Knowledge about the inheritance of sickle cell disease may reduce intermarriage between carriers and also reduce the prevalence and multiplication of the disease when adolescents are able to have a choice of future partners that will not result in having children living with SCD as some people still hide under the commitment of love alone to choose their future partners. Adolescents not only constitute a formidable demographic force but also make up the next generation of parents, workers and leaders. Falusi (2013) stressed that SCD is one of the problematic issues in the country and advocated that adolescents should have adequate information about SCD before they reach the age of 14 years. Moreover, SCD contribute to

neonatal, infant and child mortality in Nigeria and this undermines the attainment of Sustainable Developmental Goals. It causes 9 to 16% under-five mortality as 100,000 infants die each year as a result SCD (Olatunya, Ogundare and Aderiye, 2015).

Haematologic education especially among secondary school students could constitute an important variable that influences attitude of the adolescents. Anie, Egunjobi and Akinyanju (2010) also concluded that there is need to make healthy people know about the disease, dispel rumors, myths, misconceptions and encourage positive attitude towards the adolescents living with SCD in order to assist them to live a life devoid of unkind attitude to reduce social and psychological problems. There have been several studies on SCD but most of these works are descriptive in nature. Adewuyi (2000) studied knowledge and attitude towards SCD while Adegoke and Kuteyi (2012) worked on psychosocial burden of SCD but little research effort have been directed towards experimental work on how to improve knowledge, attitude and management of SCD as regards prevention of triggers of crises especially among secondary schools students as Nigeria has the highest number of people living with SCD. Therefore, this study examined the effects of haematologic education intervention on knowledge, attitude and management of sickle cell disease as regards prevention of triggers of crisis among in-school adolescents in Ibadan Metropolis, Oyo State, Nigeria.

Objective of the Study

The main objective of this study was to find out the effect of haematologic education on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis.

Specific Objectives of the Study

The study achieved the following objectives:

1. Determined the knowledge, attitude and management of in-school adolescents in Ibadan Metropolis towards sickle cell disease.

2. Examined the main effect of haematologic education on knowledge, attitude and management of sickle cell disease among in-school adolescents students in Ibadan Metropolis, Oyo State.

3. Found out the moderating effect of gender on knowledge, attitude and management of sickle cell disease among adolescents in Ibadan Metropolis, Oyo State.

4. Found out the moderating effect of religion on knowledge, attitude and management of sickle cell disease among adolescents in Ibadan Metropolis, Oyo State.

5. Established the interaction effect of treatment and gender on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.

6. Determined the interaction effect of treatment and religion on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.

7. Investigated the interaction effect of gender and religion on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.

8. Determined the interaction effect of treatment, gender and religion on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.

Research Questions

The study found answers to the following research questions:

1. Do in-school adolescents in Ibadan Metropolis have knowledge of sickle cell disease?

2. What are some myths and misconceptions about SCD among in-school adolescents?

Hypotheses

The following hypotheses were tested:

1. There will be no significant main effect of treatment on:

   a. Knowledge

   b. Attitude

   c. Management of sickle cell disease disease among in-school adolescents in Ibadan Metropolis, Oyo State.

2. There will be no significant main effect of gender on:

   a. Knowledge

   b. Attitude

c. Management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.

3. There will be no significant main effect of religion on:
   a. Knowledge
   b. Attitude
   c. Management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.
4. There will be no significant interaction effect of treatment and gender on;
   a. Knowledge
   b. Attitude
   c. Management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.
5. There will be no significant interaction effect of treatment and religion on;
   a. Knowledge
   b. Attitude
   c. Management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.
6. There will be no significant interaction effect of gender and religion on:
   a. Knowledge
   b. Attitude
   c. Management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.
7. There will be no significant interaction effect of treatment, gender and religion on:
   a. Knowledge
   b. Attitude

c. Management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State.

Delimitation of the study

The study was delimited to the following:

1. Randomised pre-test-post-test control group quasi experimental research design.
2. All public junior secondary school adolescents in Ibadan Metropolis.
3. Students in JSS 2
4. Dependent variable of knowledge, attitude and management of sickle cell disease.
5. Independent variable of haematologic education.
6. Multistage sampling procedure (simple random sampling technique, purposive sampling technique, total enumeration and use of volunteers)
7. Self-developed and validated questionnaire as instrument for data collection.
8. Haematologic disease training package and self developed questionnaire for training and data collection
9. Eight weeks of training programme
10. Descriptive statistics of frequency counts, pie chart and percentages to analyze the demographic attribute of the respondents and to provide answers to the research questions while Multivariate Analysis of Covariance (MANCOVA) was used to test the hypotheses at 0.05 alpha level.
11. 10 trained research assistants

Limitation of the study

These were the limitations encountered in the course of the study:

There was subject mortality. Also, the researcher did not have control over some extraneous variables such as obtaining information from books or electronic media on topics related to the study.

Significance of the Study

The findings of this study may be of immense help in reducing the multiplication and prevalence of sickle cell disease as the knowledge acquired may prompt these adolescents to inform their parents about the importance of genotype testing and this may lead to safe choice of their future partners in order to avoid having children with sickle cell disease. It may also influence the beliefs and create worthy positive attitude of in-school adolescents towards people living with sickle cell disease as well as the management of the disease as regards the prevention of triggers of sickle cell crises.

The findings of this study revealed the effectiveness of haematologic education intervention in improving knowledge, attitude and management of SCD. It may also serve as reference for other researchers who may wish to carry out related studies. Also, it may aid in planning the most effective educational approaches to improve the knowledge of adolescents about SCD. The adolescents who participated in this study may serve as peer educators to those who did not participate and by extension, to their families and the nation at large.

Furthermore, it is hoped that the findings of this study when presented to the Ministry of Education may institute SCD-friendly school policies. Findings of this study may expose the importance of periodic engagement of professional health personnels to schools and enlighten the adolescents more on sickle cell disease. The findings of the study may be of immerse value for future public health program pratitioners who wish to develop prevention program for sickle cell disease.

Operational Definition of Terms

In-school adolescents: Boys and girls between the ages of 9 and 14 years currently in public junior secondary school in Oyo State.

Knowledge of Sickle Cell Disease: This is how well informed an adolescent is about the nature of sickle cell disease.

Attitude to sickle cell disease: This implies the individual disposition towards sickle cell disease.

Management of sickle cell disease: This is the knowledge of actions that needs to be taken to ensure there is no aggravation of health status of people living with sickle cell disease as regards the prevention of triggers of crises.

Haematologic education: This is a carefully planned packaged teaching on blood diseases with emphasis on sickle cell disease intended to bring about scientific knowledge, positive attitude and management of sickle cell disease.

Sickling: This is distortion or alteration of red blood cells in sickle cell disease.

Sickle Cell Crisis: Episodes of severe pain that begins suddenly and lasts several hours to several days in people living with sickle cell disease.

Haemoglobin A (HbA): Haemoglobin is normal red blood cells composed of two alpha globin and two beta globin normally produced by children and adults.

Haemoglobin S (HbS): This is an inherited blood disorder as a result of the production of sickle cell-shaped red blood cells.

Vaso-occlusion: This is the obstruction of small blood vessles anywhere in the body by the deformed red blood cells leading to painful episodes.

Triggers of sickle cell crises: These are avoidable actions that aid the occurrence of sickle cell crises.

CHAPTER TWO
REVIEW OF LITERATURE

This chapter will review relevant literatures from various sources under the following sub-headings:

1. **Conceptual framework for the study**
2. **Theoretical Framework for the study (**Health Belief Model)
3. **Theoretical Review**
   a. Concept of heamatologic diseases
   b. Overview and Concept of sickle cell disease
      (i) Concept of sickle cell disease
      (ii) Origin and History of sickle cell disease
      (iii) Causes of sickle cell disease
      (iv) Pattern of inheritance
      (v) Classification of sickle cell disease
      (vi) Signs, Symptoms and Complications of sickle cell disease
      (vii) Diagnosis of sickle cell disease
      (vii) Prevention of sickle cell disease
   c. Myths and misconceptions about sickle cell disease
   d. Prevalence of sickle cell disease in Nigeria
   e. Adolescents and Sickle Cell Disease
   f. Knowledge of sickle cell disease among adolescents in Niger
   g. Public attitude towards people living with sickle cell disease in Nigeria
   h. Management of sickle cell disease
4. **Empirical Literature Review on SCD**
   (i) Knowledge of adolescents on SCD
   (ii) Attitude of adolescents towards people living with SCD
   (iii) Management of sickle cell disease
   (iii) Effect of sickle cell education on knowledge among adolescents.
   (iv) Effect of sickle cell education on attitude among adolescents.
   (v) Effect of sickle cell education on management of sickle cell disease among adolescents.

5. Appraisal of Literature

Conceptual Framework for the study

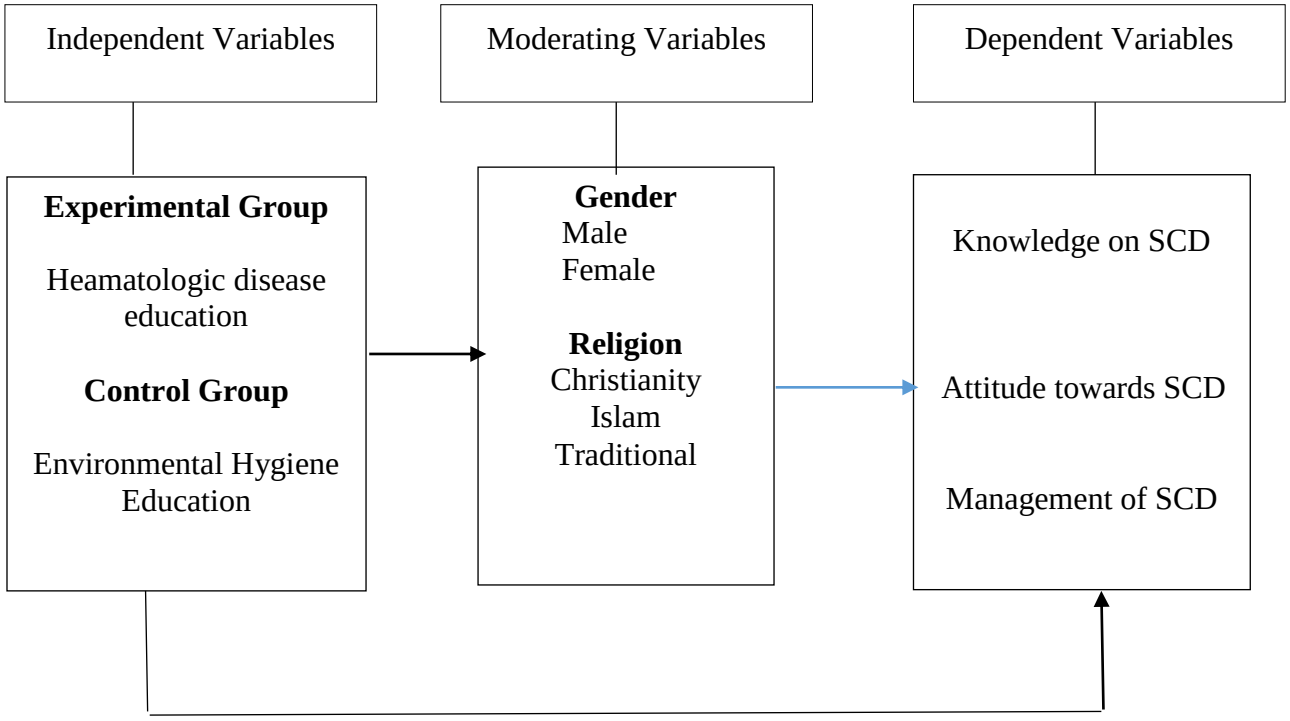


Fig 1.1 Conceptual Framework

Source: Self-developed for the study

The conceptual framework is self-developed and it was structured in a way to check the effect of haematologic education on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis. The independent variables that will be manipulated in the study will be expressed at two levels, haematologic education (experimental) and environmental hygiene education (control). The factors that may affect the outcome of the treatment and that can be observed and measured (moderating variables) are gender which will be measured at two levels (male and female) and religion at three levels (Christianity, Islam and Traditional. The dependent variables will be knowledge, attitude and management of SCD. Haematologic education among other things will give correct information on the nature, causes, pattern of inheritance, what brought about the signs and symptoms and management. The haematologic education will also give facts and dispel myths and misconceptions about sickle cell disease. This study will examine the effect of haematologic education on knowledge, attitude

and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

Theoretical Framework of the Study

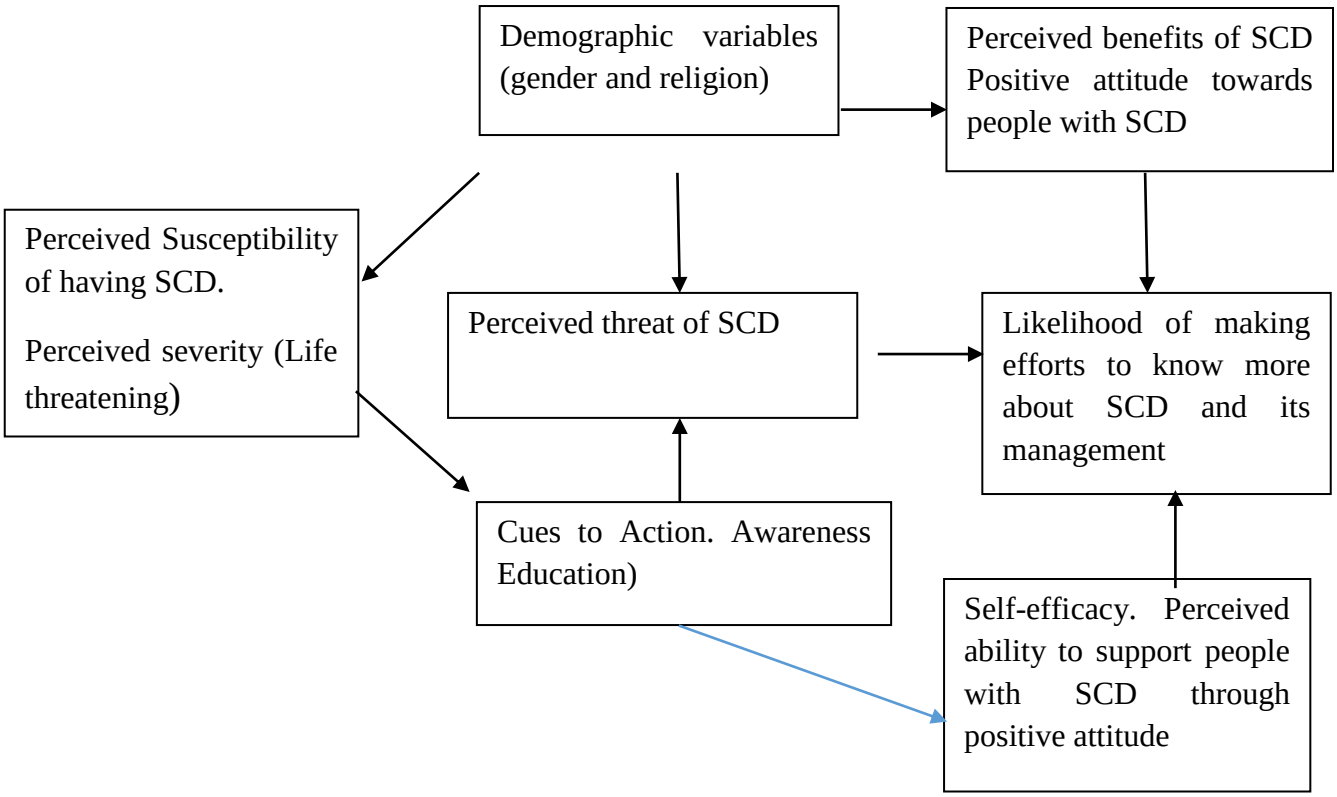


Fig. 2.2: Health Belief Model. Source: Glanz, 2002

Rosenstock was the first to introduce the Health Belief Model (HBM) in 1950s, in an effort to explain the lack of participation in preventive health behaviour. The original model included four general constructs: perceived susceptibility, seriousness, benefits and barrier. Common health motivation and confidence were later included (Guvenc, Akyuz and Acikel, 2011).The HBM is generally used to demonstrate why people change or continue particular health behaviour (James, Pobee, Otidine, Brown and Joshi, 2012). The HBM is a value expectancy model, meaning that behaviour depends on the individuals' expectancies concerning the outcomes of a given action and the perceived values attached to those outcomes. The HBM uses a cognitive approach with the goal to recognise patterns of health behaviours. It is one of the

oldest and most extensively used models where theory has been modified from the behavioural sciences to address health problems (Guvenc, Akyuz and Acikel, 2011).

The basic assumption of the HBM is that people with better information make better health decisions with each step in the decision making process dependent on the previous decision or beliefs. According to the HBM, a person must believe that he/she is susceptible to a condition, the condition is serious, there is a successful intervention for the condition and can overcome all barriers to using the intervention. The HBM proposes that there are six general contributions to one's health beliefs; perceived susceptibility or the risk of developing the disease followed by perceived threats or severity of the disease, perceived benefits from the health behaviour outcome and perceived barriers preventing the health behaviour. Health motivation or cues to action follows and then, self-efficacy or belief in one's ability to carry out the health behaviour as it affects an individual's acting on a health belief (Danis, Buchanan and Green, 2013; Guvenc et al, 2011; James, Pobee, Otidine, Brown and Joshi, 2012; Mahmoodi, Safari, and Samadi, 2011; Wong, Wong, Chan, Feng, Wai and Yea, 2013).

Perceived susceptibility refers to a person's own perception of the probability of encountering a situation that would be detrimental to their health. Perceived seriousness is an indicator of the understanding of the severity of the disease. Perceived benefits are things done to prevent the disease or cope with the illness through effective management. Perceived barriers refer to features of the prevention or intervention approaches that may be viewed as inconvenient, expensive, unpleasant, painful or upsetting (Guvenc et al, 2011).

In this study, perceived susceptibility refers to an individual's likelihood to have sickle cell disease. The SCD knowledge and awareness can influence the person's belief of what actually is SCD, life threatening state of the disease, the effects, attitude attached to SCD and the management may influence perceived severity. According to HBM, if the person believes that he or she is likely to have SCD and consider the severity of having it then there is the likelihood that the person will make an effort to seek education which will result in improved knowledge and the likelihood that people will make an effort to seek education also depends on the determination to overcome the barriers associated with these interventions. Also if the cost of having SCD is known against the benefits of the behaviour that produces the SCD, there is every tendency that one will seek knowledge so as to avoid SCD. Cues to action refer to awareness about SCD and this can be through education. Education influences the person's perception of

the threat. Finally, the person has to feel confident that he or she has the ability to carry out the behaviour. HBM is instrumental because not only does it enhance health behaviour but it also influences intervention programs by recognising possible preliminary factor of health behaviour that can be changed.

Theoretical Review

Concept of Haematologic Diseases

Haematologic diseases are diseases that affect the production of blood and its components such as blood cells, blood proteins, bone marrow, haemoglobin and blood vessels which can either be inherited, due to side effects of drugs or lack of certain nutrients in the body. In other words, haematologic diseases are blood disorders. Blood is composed of plasma and formed elements. Plasma is the substance that is present in the blood and it consists of albumin, globulins, fibrinogen, salts, lipids and glucose. Formed elements are red blood cells which carry oxygen to tissues in the body, white blood cells which fight infections and platelets which help in clotting of blood. Haematologic diseases interfere seriously with the ability of the composition of blood to function properly and prevent the individual to cope with normal daily living (American Society of Heamatology, 2018).

Diseases affecting the white blood cells include a form of cancer in the lymphatic system, this makes white blood cells to become malignant, spreading and multiplying abnormally either inside the bone marrow or in the circulating blood in the body. Diseases of platelets may be in form of an infection somewhere in the body which may spread into the blood causing a bigger form of the infection or a blood clot may form inside a blood vessel, this may dislodge and move to any vital organ in the body leading to occurrence of other serious problems. Some of the diseases of red blood cells include inadequate red blood cells which could be due to blood loss or haemoglobin deficiency called haemoglobinopathy. (MedlinePlus, 2016; Metha, 2011). Haemoglobinopathy is a group of blood disorders in which there is abnormal production or structure of hemoglobin. It is a genetic disease. Of all genetic disorders to which man is known to be liable, there is probably no other that presents a collection of problems and challenges quite comparable to sickle cell disease because of its chronicity and resistance to therapy. It is seen as

a major global haemoglobinopathy (Macon, Solan and Lamoreux, 2017; Olubiyi, Umar, Ajiboye, Olubiyi and Abioye, 2015).

Concept and Nature of Sickle Cell Disease

The term sickle cell disease (SCD) describes a group of inherited red blood cell disorders (Meier and Miller, 2012). People with SCD have abnormal haemoglobin, called haemoglobin 'S' or sickle haemoglobin, in their red blood cells (Ashley-Koch, Yang and Olney, 2010). Haemoglobin is a protein in red blood cells that carries oxygen throughout the body. "Inherited" means that the disease is passed by genes from parents to their children. SCD is not contagious. A person cannot catch it like a cold or infection from someone else. People who have SCD inherit two abnormal haemoglobin genes, one from each parent. In all forms of SCD, at least one of the two abnormal genes causes a person's body to make haemoglobin S. When a person has two haemoglobin 'S' genes, Haemoglobin SS, the disease is called sickle cell anaemia. This is the most common and often most severe kind of SCD. The abnormal form of haemoglobin S is an example of a single mutation in the gene responsible for haemoglobin synthesis (WHO, 2006).

Haematologic diseases are diseases that affect the production of blood and its components such as blood cells, blood proteins, bone marrow, haemoglobin and blood vessels which can either be inherited, due to side effects of drugs or lack of certain nutrients in the body. In other words, haematologic diseases are blood disorders. Of all genetic disorders to which man is known to be liable, there is probably no other that presents a collection of problems and challenges quite comparable to sickle cell disease because of its chronicity and resistance to therapy. It is seen as a major global haemoglobinopathy (Olubiyi, Umar, Ajiboye, Olubiyi and Abioye, 2013; Aygum and Odame, 2012; Aliyu, Kato, Taylor, Babadoko, Mamman and Gordeuk, 2008; Weatherall, 2011; Modell and Darlison, 2008).

SCD is an inherited disorder of haemoglobin that has a worldwide impact on health and longevity. It is characterized by lifelong haemolytic anaemia and a wide variety of painful and debilitating vaso-occlusive events (Jenrette and Murdaugh, 2008). The complications of sickle cell disease can cause psychological problems for the sufferer coupled with erroneous belief that the disease is caused by evil spirit making some non- sufferers to have negative attitude towards

them. The prevention of SCD is when the parents with sickle trait or SCD do not marry each other. The implication is that individual should know their genotype.

Origin and History of Sickle Cell Disease

Peculiar elongated and sickle-shaped' is how sickle cells were first described in 1904 by intern Ernest Edward Irons when examining the blood of Walter Clement Noel, a 20-year-old first-year dental student from a wealthy Black family in Grenada. Noel had been admitted to the Chicago Presbyterian Hospital suffering from anaemia and was readmitted several times over the next three years before completing his studies (Herrick, 1910). Nothing more was known about that patient until a medical historian, Dr. Todd Savitt, visited Chicago with the intention of locating the original patient's docket. Remarkably he was successful and published a fascinating account, from which it was discovered that the patient's name was Walter Clement Noel, born on June 21, 1884 and that he lived on the DuQuesne Estate in the north of the island. After qualifying as a dentist in Chicago, he returned to Grenada and had a successful dental practice in the capital before dying of the acute chest syndrome on May 2, 1916 at the age of 32 years (Savitt & Goldberg, 1989; Ballas, Gupta and Adams- Graves, 2012).

Iron's supervising physician, James B. Herrick, wrote a paper published in 1910 in the Archives of Internal Medicine documenting the first known case of sickle cell disease in the United States (Serjeant, 2010). Although this was the first known case of SCD in the United States, elements of the disease had been recognised earlier. African medical literature reported this condition in the 1870s, when it was known in some areas as "ogbanjes" (children who come and go) because of the very high infant mortality rate caused by this condition. There are reports of the condition tracking back to 1670 in one Ghanaian family. While sickle cell disease primarily affects persons of African descent, it is also present in Portuguese, Spanish, French Corsicans, Sardinians, Sicilians, mainland Italians, Greeks, Turks and Cypriots. Sickle cell disease also appears in Middle Eastern countries and Asia. Linus Pauling and colleagues were the first to demonstrate that sickle cell disease occurs as a result of an abnormality in the red blood cell in 1949. This historical finding was the first time a genetic disease was linked to a mutation of a specific protein (Ballas, 2010). The origin of the mutation that led to the sickle-cell gene derived from at least four independent mutational events, three in Africa and a fourth in either Saudi Arabia or central India. These independent events occurred between 3,000 and 6,000 generations ago, about 70-150,000 years. The Memphis physician, Lemuel Diggs, a prolific

researcher into sickle cell disease, first introduced the distinction between sickle cell disease and trait in 1933, although it took some years until 1949 when the genetic characteristics were elucidated by Neel and Beet. 1949 was the year when Linus Pauling described the unusual chemical behaviour of haemoglobin 'S' and attributed this to an abnormality in the molecule itself. The actual molecular change in HbS was described in the late 1950s by Vernon Ingram. The late 1940s and early 1950s saw further understanding in the link between malaria and sickle cell disease. In 1954, the introduction of haemoglobin electrophoresis allowed the discovery of particular subtypes, such as HbSC disease. November 15, 2010 marks 100 years since the first formal description of sickle cell disease by Dr. James Herrick, a cardiologist in Chicago (Herrick, 1910; Sergeant, 2010).

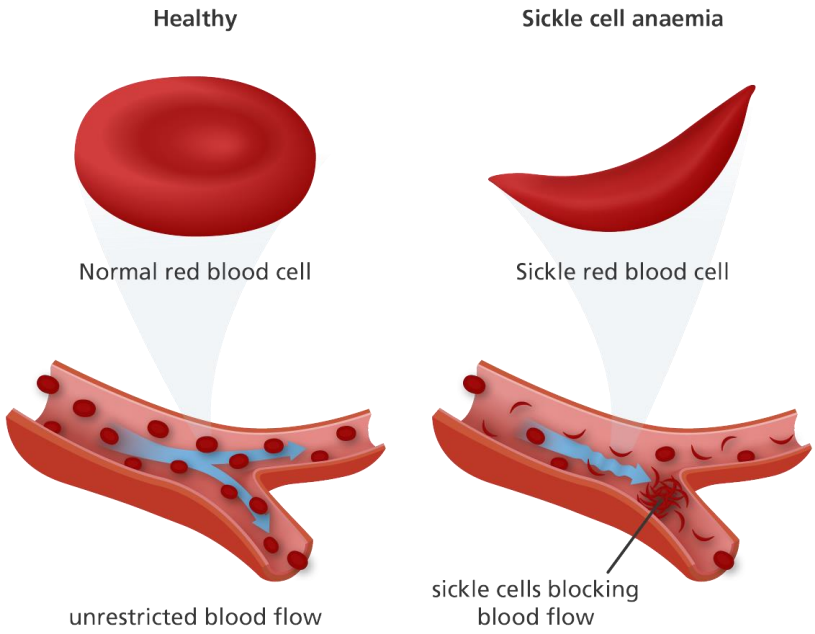


Fig 2.0: Diagram showing Normal and Abnormal Red Blood Cells

Source: Wikipedia, 2014

Fig 2.0 showing the difference between a normal red blood cell and a sickle cell with abnormal (sickle) haemoglobin

Top left image shows normal red blood cells flowing freely in a blood vessel. Bottom left image shows a cross-section of a normal red blood cell with normal haemoglobin. Top right shows abnormal, sickle red blood cells blocking blood flow in a blood vessel. Bottom right image shows a cross-section of a sickle cell with abnormal (sickle) haemoglobin forming abnormal stiff rods.

Causes of Sickle Cell Disease

The main cause of sickle cell disease is the inheritance of the S gene from the parents. The presence of the double S gene leads to sickling of the red blood cells and signs and symptoms of cickle cell disease.

The healthy adult haemoglobin (HbA) molecule is made of two α globin chains and two β globin chains that bind oxygen in erythrocytes for transport throughout the body. Mutations within the genes which code for the α or β globin protein subunits can result in an imbalance of globins that disrupt the function and oxygen binding ability of red blood cells. Characteristics of SCD are a result of the unique properties of the haemoglobin molecules, leading to vaso-occlusion and haemolytic aneamia. In HbS, a single point mutation results in a glutamic acid replacing valine.

Sickle-cell disease is caused by an abnormality of haemoglobin, the red protein in red blood cells that carries oxygen from the lungs to the tissues of the body. The red blood cells of persons with this disorder survive in the circulation for only 15 to 20 days instead of the normal 120 days (Adeyanju, 2010). This results in anaemia which can be mild or severe. These red blood cells have tendency to lose their normal round shape and become rigid and deformed with sickle cell-shaped. These pointed and elongated cells are not always pliable enough to squeeze through small blood vessels as normal red blood cells leading to blockage of such blood vessels (Adeyanju, 2010). This causes deprivation of blood circulation to the surrounding tissue causing pain and tissue damage. There are other kinds of complication which vary from individuals. These are the results of mutant sickle cell haemoglobin within the red blood cells. Haemoglobin is the protein in RBCs that carries oxygen. It is made up of two alpha chains and two beta chains. These are made by the alpha and beta genes. The four main types of sickle cell anaemia are caused by different mutations in these genes. Sickle haemoglobin (HbS) results from a substitution of one amino acid (Valine) for another amino acid (Glutamic acid) at position six of the -globin polypeptide chain. This substitution is caused by a single-base mutation in codon 6 within the -globin gene on chromosome 11.

Due to the abnormal amino acid in the -globin chain, HbS forms long, insoluble polymers when deoxygenated, and the red blood cells (RBCs) containing HbS deform and form a ‘sickle’ shape. It was previously thought that the clinical consequences were simply due to this abnormal, rigid sickle red blood cell occluding small blood vessels however, there is increasing evidence that the pathogenesis of the various clinical events, both acute and chronic, results from a series

of complex mechanisms which are not limited to the red blood cells (Annie and Green, 2015). These relate to concentration of HbS and other haemoglobin variants such as HbF (fetal haemoglobin) within the cell which reduces its ability to polymerise, disturbances in the red cell membrane making the cell less responsive to oxidant stress and altered membrane lipids resulting in increased rigidity.

The result is that there is abnormal cell-free haemoglobin, which circulates in plasma, this results in vaso-constriction, increased adhesiveness of erythrocytes, leukocytes, endothelial cells and platelet aggregation. The disease occurs due to a mutation of the beta globin gene of heamoglobin, causing a substitution of the glutamic amino acid for valine at position 6 of the beta chain, thereby producing an abnormal haemoglobin, called haemoglobin S (HbS), instead of normal haemoglobin, haemoglobin A (HbA).With modified physicochemical characteristics, the molecules of haemoglobin S suffer polymerisation and precipitation, leading to a change in form, a deformity of red blood cells which become sickle-shaped. In this case, the viscosity of the blood increases due to the formation of tactoids.

Pattern of Inheritance and Classification of Sickle Cell Disease

Everyone has two copies of the haemoglobin gene in every cell in their body (apart from eggs and sperm), one from the mother and one from the father. When eggs and sperm are made, only one of the two genes goes into each egg or sperm cell. This is because when the egg and sperm come together to form a new baby, this new person has two genes in every cell in their body as well. The genes the baby gets will therefore depend on the genes carried by the parents. Sickle cell anaemia is called a recessive condition because individual must have two copies of the sickle haemoglobin gene to have the disorder. Sickle haemoglobin is often shortened to S or HbS. If the individual has only one copy of the sickle haemoglobin along with one copy of the more usual haemoglobin (A or HbA), this means Sickle Cell Trait. This is not an illness but means that person is a carrier of the gene and can pass it on to the children. If one or both couples know the types of haemoglobin they have, they will know the different possible combinations of genes that their offspring could inherit. Only when both parents are HbAA and/or HbSS will all the children inherit the same combination of genes and be sure whether the child will be affected or not (Sickle Cell Society, 2014)

Understanding Chance

To help one to think about chance it can be useful to use things that we are all used to. When a woman has a baby there is a one in two (50%) chance that the baby will be a girl and a one in two (50%) chance that the baby will be a boy. Although over the whole population there are almost exactly equal numbers of men and women, within any family there may be all girls, all boys or a mixture of both. The one in two chances apply to each pregnancy afresh. The one in two chances informs that nature will choose one out of two different possibilities. If the chance is one in four, there are four different possibilities and the outcome will be one of these.

The lines coming in to each baby show that one gene has come from the mother and one gene has come from the father. The diagrams show the following combinations of parents and the types of children they can have:

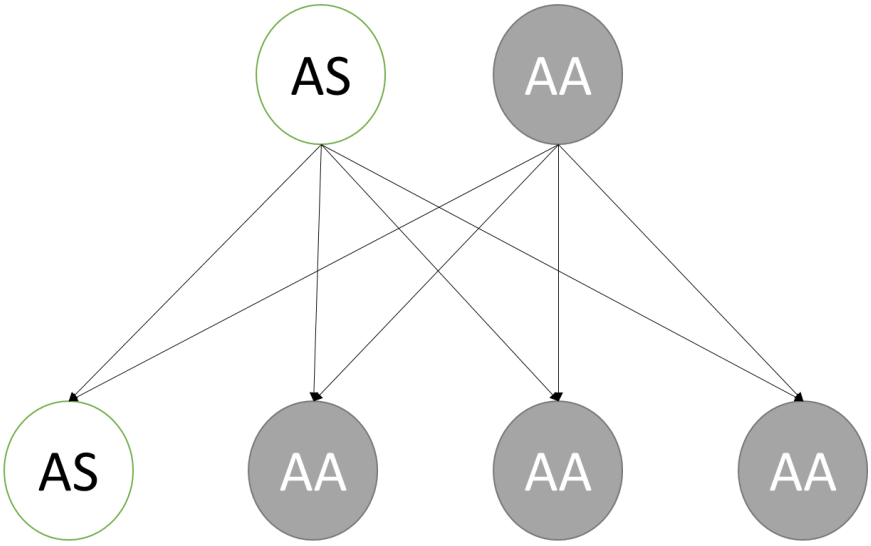


Fig 2.4 AS and AA (Self developed)

In line with Fig 2.4, if one parent has sickle cell trait (HbAS) and the other carry the normal haemoglobin (HbAA), then none of the children will have sickle cell disease. There is a one in two (50%) chance that any given child will get one copy of the HbS gene and therefore have the sickle cell trait. It is equally likely that any given child will get two HbA genes and be completely unaffected.

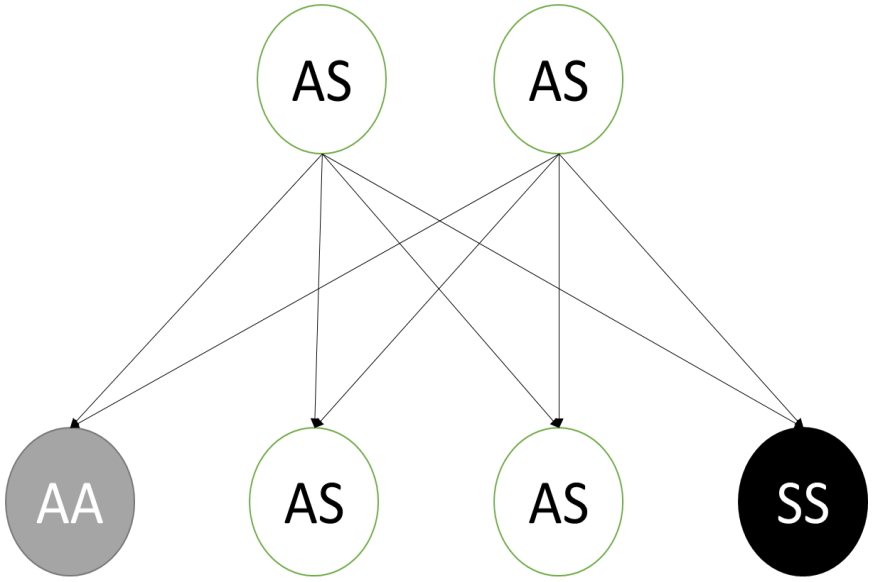


Fig 2.5 AS and AS (Self developed)

According to Fig 2.5, if both parents have sickle cell trait (HbAS), there is a one in four (25%) chance that any given child could be born with sickle cell anaemia. There is also 25% chance that any given child could be completely unaffected. There is a one in two (50%) chance that any given child will have the sickle cell trait.

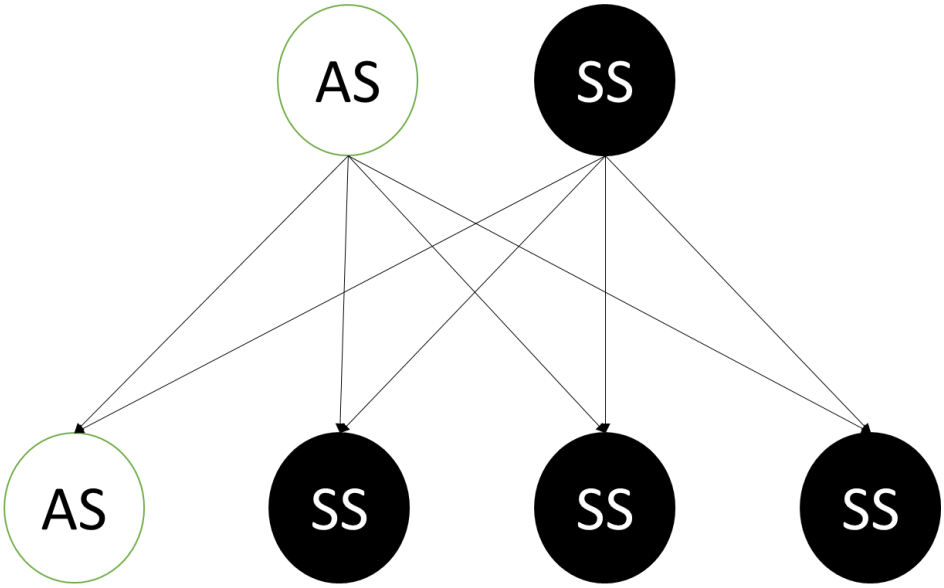
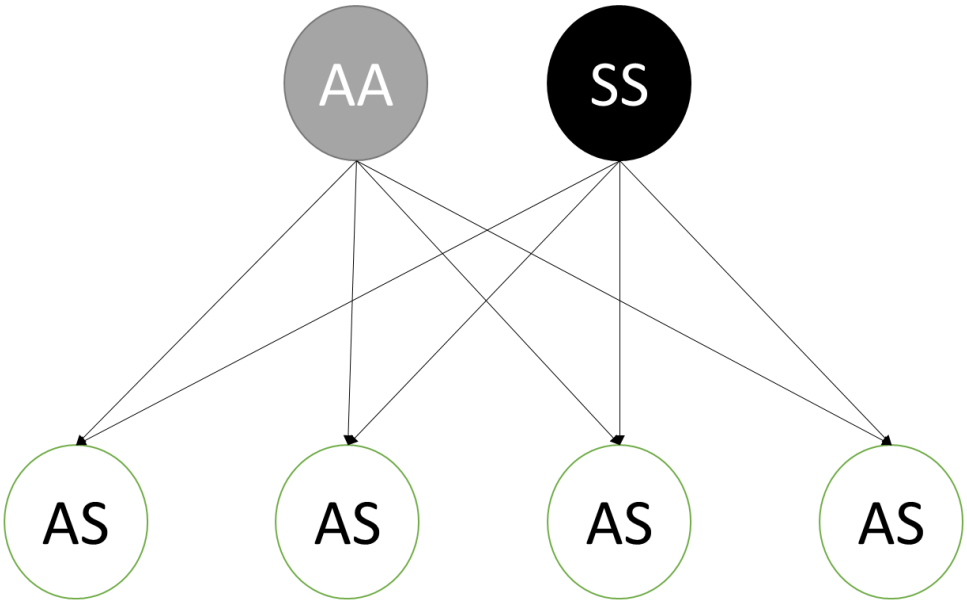


Fig 2.6 AS and SS (Self developed)

In relation to Fig 2.6, if one parent has sickle cell trait (HbAS) and the other has sickle cell anaemia (HbSS), there is a 1-in-4 chance (25%) that the baby will have haemoglobin (AS), a

75% chance that the baby will have sickle cell trait (AS), a 1-in-4 chance (25%) that the baby will have sickle cell anaemia (SS).



Self-developed

Fig 2.7 AA and SS

Illustration in Fig 2.7 showed that if one parent has sickle cell anaemia (HbSS) and the other is completely unaffected (HbAA) then all the children will have sickle cell trait. None will have sickle cell anaemia. The parent who has sickle cell anaemia (HbSS) can only pass the sickle haemoglobin gene to each of their children.

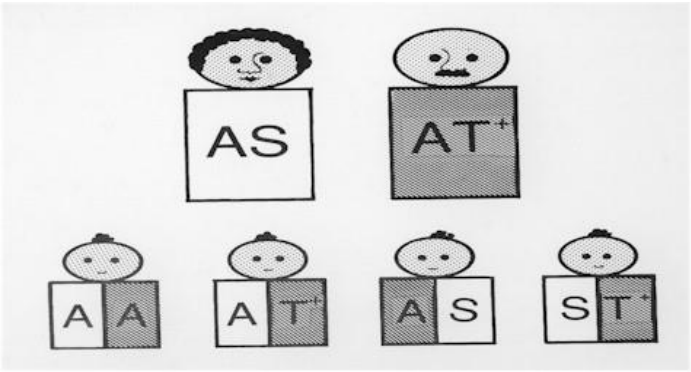


Fig 2.8 AS and AT+

Vedro and Morrison, 2002.

The above illustration in Fig 2.8 explains that when one parent has Sickle Trait (AS) and the other parent has Beta Thalassemia Zero Trait (AT) there is a l-in-4 chance the baby will have

normal hemoglobin (AA), Beta Thalassemia Zero Trait (AT, Sickle Beta Zero Thalassemia (STO), or Sickle Trait (AS). These chances remain the same for each pregnancy.

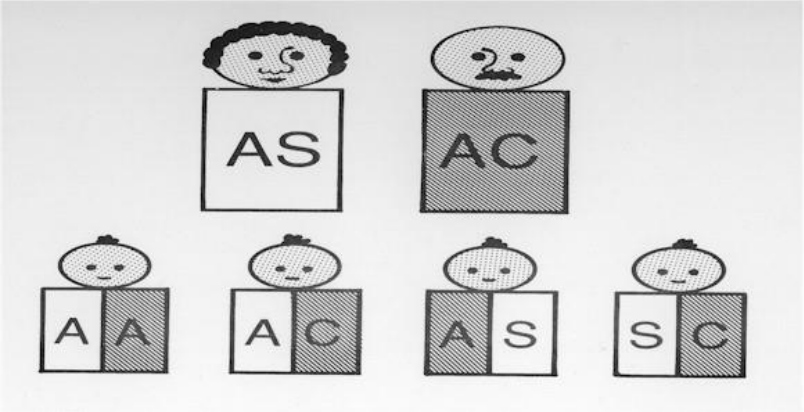


Fig 2.9 AS and AC

Vedro and Morrison, 2002.

Fig 2.9 shows that if one parent has AS and the other AC, there is a 1-in-4 chance (25 percent) the baby will inherit AA, AS, AC, or SC Disease. AS and AC are carrier states, not disease conditions.Sickle Heamoglobin C (SC Disease) is a milder form of Sickle Cell Disease. The baby has inherited two (2) abnormal haemoglobins, haemoglobin S and heamoglobin C. Approximately one in l,000 black babies are born with SC Disease. Haemoglobin C Trail (AC) occurs in about one in 40 black babies.

Classification of Sickle Cell Disease

There are different types of sickle cell disease. They are classified according to the haemoglobin abnormality.

Sickle Cell SS (HbSS)

This is also known as HbSS. Haemoglobin SS disease is the most common type of sickle cell disease. People who have this form of SCD inherit a sickle cell gene (S) from each parent. Haemoglobin is a protein that allows red blood cells to carry oxygen to all parts of the body. This is usually a milder form of SCD. Sickle cell anaemia refers to the form of the disease when there is homozygosity for the gene mutation that is responsible for causing the production of sickle haemoglobin. This occurs when a child inherits the sickle gene from both parents and is the most serious form of the disease with the potential for serious complications. There are various names that can be used to indicate sickle cell anaemia. These may include HBSS, SS disease or sickle cell disease-SS. People who have this form of SCD inherit two sickle cell genes (S), one from

each parent (Wilson, Forsyth and Whiteside, 2009). HbSS disease or sickle cell anaemia: homozygote for the beta S globin with usually a severe or moderately severe phenotype. In the United States, sickle cell anemia is the most common form of sickle cell disease and affects 65% of people living with SCD (Serjeant, 2010).

In Africa, there are 300,000 cases of people suffering from sickle cell disease (SCAF, 2015). 20 babies in 1000 births are HbSS with 90% in West Africa. In sub-Saharan Africa, 2% of all children born are having HbSS genotype. SCAF (2015) also stated that in North Africa, the carriers range between 1% and 2% while it is less than 1% in South Africa. The current estimates for Africa are probably much higher than stated in the literature because in Nigeria, like Ghana, 2% of the babies born have sickle cell disorder. West Africa with approximately 5 million births per year would have 200,000 babies with sickle cell disorder annually. United Nations Population.Nigeria, which is the most populous sub-Saharan African country, has 150,000 newborns with sickle cell disease annually (World Health Organization 2006). This accounts for almost half of the 444,000 babies born yearly with major haemoglobin disorders worldwide (World Health Organisation 2006). Nigeria has the largest population of people with sickle cell disorder with about 150,000 births annually. The incidence of sickle cell disorder in Nigeria is among the highest in the world with 150,000 being born each year with the disorder. This number far exceeds the total population of every other affected African country and several of them put together (SCAF 2015, Sheyin, 2012; Fields 2005; WHO, 2006). In Western Nigeria, the population of sickle disorder people is about 2.4% (Taiwo, Oloyede and Dosunmu, 2011). Ibadan has 5.5% of its population having HbSS genotype (Nabila, Ukaejiofor, Nubila and Azeez, 2013).

Sickle Cell Disease-SC (HbSC)

Haemoglobin SC disease is the second most common type of sickle cell disease. It occurs when the child inherits the Hb C gene from one parent and the Hb S gene from the other. Individuals with Hb SC have similar symptoms to individuals with HbSS, however, the anaemia is less severe. Sickle cell disease- with SC type affects people with the SC genotype (National Heart, Lung and Blood Institute (2009). (This is usually a milder form of SCD. It is present in 1 in 1100 African Americans. Red Blood Cells (RBC) contain 50% HbS and 50% HbC (Wilson, Forsyth and Whiteside, 2009).

Sickle Beta Thalassemia

Sickle Beta Thalassemia is another inherited health condition that affects the haemoglobin in the red blood cells. People who have this form of SCD inherit one sickle cell gene ("S") from one parent and one gene for beta thalassemia, another type of anaemia, from the other parent. There are two types of beta thalassemia: "0" and "+". Those with HbS beta 0-thalassemia usually have a severe form of SCD. People with HbS beta +thalassemia tend to have a milder form of SCD (UMMC, 2010). If a child inherits a sickle gene mutation from one parent and a thalassemia gene mutation from the other parent, sickle beta thalassemia can present with characteristics of both blood diseases (Sergeant, 2010). There are two kinds of sickle beta thalassaemia: sickle beta plus thalassaemia (HbS/β+) and sickle beta zero thalassaemia (HbS/β0). These are less common than the previous two types, accounting for 8% and 2% of patients with the disease in the United States respectively (SCDAA, 2012).

Sickle Cell Trait (HbAS)

Sickle cell trait refers to individuals that have inherited only one abnormal sickle gene and also possess one normal adult haemoglobin gene (UMMC, 2010). This is known as heterozygous, as there are different genes present and people with this type can sometimes be referred to as sickle cell disease carriers (Serjeant, 2010). It is unusual for people with the trait to experience symptoms. However, they have the potential to pass the gene on to their children who may suffer from sickle cell anaemia if the other parent is also a carrier of the gene mutation. The individual has 40% HbS and 60% HbA. (CDC, 2011).

There are also some rare types of sickle cell disease.

Haemoglobin SB+ (Beta) Thalassemia

Haemoglobin SB+ (Beta) thalassemia affects beta globin gene production (UMMC, 2010). The size of the red blood cell is reduced because less beta protein is made. If inherited with the Hb S gene, the individual will have Haemoglobin S Beta thalassemia (Sergeant, 2010). HbS/beta+ thalassemia can be mild or moderate in severity but vary in different ethnic groups (SCDAA), 2012; CDC, 2011).

Beta-Zero Thalassemia

Beta-Zero thalassemia is the second type of beta thalassemia. It has similar symptoms to Hb SS anemia. However, sometimes the symptoms of beta-zero thalassemia are more severe (Sergeant, 2010). It is associated with a poorer prognosis. HbS/betaZero thalassaemia has severe

double heterozygote for HbS and beta0 thalassemia, and almost clinically indistinguishable from sickle cell anemia (CDC, 2011; UMMC, 2010). These are also HbSD, HbSE, and HbSO. People who have these forms of SCD inherit one sickle cell gene S and one gene from an abnormal type of haemoglobin D, E, or O). The severity of these rare types of SCD varies. Other major sickle genotypes are HbS/hereditary persistence of fetal Hb (S/HPHP) which is symptom-free. HbS/HbE syndrome is very rare and generally very mild in clinical course (SCDAA, 2012).

Malaria and Sickle Cell Trait

The malaria parasite has a complex lifecycle and spends part of it in red blood cells. In a carrier, the presence of the malaria parasite causes the red blood cells with defective haemoglobin to rupture prematurely, making the plasmodium parasite unable to reproduce. Furthermore, the polymerization of Hb affects the ability of the parasite to digest Hb in the first place. Therefore, in areas where malaria is a problem, people's chances of survival actually increase if they carry sickle-cell trait. In the USA, with no endemic malaria, the prevalence of sickle-cell anaemia among blacks is lower with about 0.25% than in West Africa with about 4.0%. The widely accepted theory is that HbS offers selective protection against falciparum malaria by sequestration of parasitized red cells deep within reticulo-endothelial system where microenvironment is hostile for parasite growth. Thus people with sickle cell trait would have a better chance of surviving an outbreak of malaria and passing their genes (sickle and normal haemoglobin) to the next generation when they have children (Serjeant, 2010; Wellems, Hayton and Fairhust, 2009).

Signs, Symptoms and Complications of Sickle Cell Disease

The signs and symptoms of SCD will vary from person to person and can change over time. Most of the signs and symptoms of SCD are related to complications of the disease. Virtually all of the major symptoms of sickle cell anaemia are the direct result of the abnormally shaped, sickled red blood cells blocking the flow of blood that circulates through the tissues of the body. The tissues with impaired circulation suffer damage from lack of oxygen. Damage to tissues and organs of the body can cause severe disability in patients with sickle cell anaemia. The patients endure episodes of intermittent crises of variable frequency and severity, depending on the degree of organ involved. Inheritance of SCD starts with the baby at birth. Most infants do not have any problems from the disease until they are about 5 or 6 months of age. This is because baby or foetal haemoglobin protects the red blood cells from sickling before the age of four to

five months after which the foetal haemoglobin is replaced by sickle hemoglobin and the cells begin to sickle (Center for Disease Control and Prevention, 2015). Signs and symptoms of sickle cell disease usually begin in early childhood. Characteristic features of this disorder include a low number of red blood cells (aneamia), repeated infections, and periodic episodes of pain (Creary et al. 2007). The severity of symptoms varies from person to person. Some people have mild symptoms, while others are frequently hospitalised for more serious complications. Foetal haemoglobin is a special hemoglobin produced by babies before they are born. It protects against some of the effects of sickle cell disease. During the first four to six months of life, foetal haemoglobin decreases and sickle haemoglobin increases. This is why infants with sickle cell disease do not have painful crises during the first four to six months of life. Some children and adults maintain higher levels of foetal haemoglobin (CDC, 2015).

Dactylitis and Arthritis

Swelling and inflammation of the hands and/or feet is often an early sign of sickle cell anaemia in children. Swelling involves entire fingers and/or toes and is called dactylitis. Dactylitis is caused by injury to the bones of the affected digits by repeated episodes of inadequate blood circulation. Dactylitis generally occurs in children with sickle cell aneamia from age 6 months to 8 years (Dampier, 2008).During infancy, vaso-occlusive crises are generally manifested as dactylitis or hand-foot syndrome. This is characterised by soft tissue swelling, warmth and/or pain in the hands and/or feet due to decreased oxygen in these small bones (Gustafon, 2006). Dactylitis can be recurrent but not common after two or three years of age. The most common sites of pain in children over two years of age are the long bones, joints, back, and abdomen. Joint inflammation (arthritis) with pain, swelling, tenderness and limited range of motion can accompany dactylitis. Sometimes, not only the joints of the hands or feet are affected, but also a knee or an elbow (Gluckman, 2013).

Anaemia

The signs and symptoms of sickle cell disease are caused by the sickling of red blood cells. When red blood cells sickle, they break down prematurely, which can lead to anaemia. Anaemia can cause shortness of breath, fatigue, and delayed growth and development in children. The rapid breakdown of red blood cells may also cause yellowness of the eyes and skin which are signs of jaundice. Painful episodes can occur when sickled red blood cells, which are stiff and inflexible, get stuck in small blood vessels (Creary et al, 2007).These episodes deprive tissues

and organs of oxygen-rich blood and can lead to organ damage, especially in the lungs, kidneys, spleen, and brain. A particularly serious complication of sickle cell disease is high blood pressure in the blood vessels that supply the lungs (pulmonary hypertension). Pulmonary hypertension occurs in about one-third of adults with sickle cell disease and can lead to heart failure (Gladwin and Vichinsky, 2008).

Fatigue

Fatigue is a common symptom in persons with sickle cell aneaemia. Sickle cell anaemia causes a chronic form of anaemia which can lead to fatigue. The sickled red blood cells are prone to breakage (haemolysis) which causes reduced red blood cell life span that is between 15 and 20 days whereas, the normal life span of a red blood cell is 120 days (Adeyanju, 2010). These sickled red blood cells are easily detected with a microscope examination of a smear of blood on a glass slide. Typically, the site of red blood cell production (bone marrow) works overtime to produce these cells rapidly, attempting to compensate for their destruction in the circulation. Occasionally, the bone marrow suddenly stops producing the red blood cells which causes a very severe form of aneamia known as aplastic crises (Ameringer, Elswick and Smith, 2014).

Aplastic Anaemia

An aplastic crisis results from an infection caused by Parvovirus B19. It causes production of red blood cells (RBC) to be shut down for about 10 days. This means that RBC's are not being produced during this period. RBC's in children with sickle cell anaemia livefor 10 to 15 days compared to 120 days in children who do not have sickle cell anaemia. The blood count especially, haemoglobin drops very rapidly to a dangerously low level during the infection (Rees et al, 2010). Aplastic crisis usually occurs in children under the age of 16 years. It occurs in the general population but can only be noticed in those people with chronic haemolytic aneamia (e.g. sickle cell anaemia). Aplastic crises can be promoted by infections that otherwise would seem less significant, including viruses of the stomach, bowels and the flu (influenza). The anaemia in sickle cell anaemia tends to stabilize without specific treatments. The degree of aneamia is defined by measurement of the blood haemoglobin level. Blood haemoglobin levels in persons with sickle cell anaemia are generally between 6 to 8 gms/dl, the normal levels are above 11 gms/dl (Gold et al, 2011). Occasionally, there can be a severe drop in haemoglobin requiring a blood transfusion. Symptoms include paleness, lethargy, headache, fainting attacks, tiredness, a fast heart rate, irritability and difficulty in breathing (Creary et al, 2007).

Jaundice and Gallstones

Jaundice is yellowish discoloration of the white part of the eyes and skin. It is a common symptom of sickle cell anaemia. It occurs because the rapid breakdown of abnormal red blood cells leads to a build-up of a waste product in the body called bilirubin. Bilirubin is the yellow substance found inside red blood cells. When fragile sickled red blood cells break open, bilirubin leaks out into the blood stream, as it travels throughout the body, it causes the eyes and skin to turn yellow. The build-up of bilirubin often leads to the formation of small crystals called gallstones. Gallstones are small stones that form when bile hardens into a solid form. Bile is in liquid form and is used to help break down or digest fats. Bile is made by the liver and stored in the gall bladder. The gallbladder is a sack or pouch under the liver. It is in the right upper part of the belly. Children with sickle cell disease have more bile than the gallbladder can hold. The extra bile forms a thick sludge and causes stones to form gallstones.Gallstones are usually not harmful. If they get stuck in the tube that leaves the gallbladder, pain may occur. If the tube gets blocked by stones, infection can occur. This can affect other organs that are very close to the gallbladder, like the pancreas. About 1 in every 3 children with sickle cell disease can have gallstones. Symptoms include yellowish discoloration of the skin or eyes and sudden, sharp belly pain mostly on the upper right side. The pain may be worse after eating fatty foods, upset stomach or vomiting. Most gallstones don't cause symptoms but they can occasionally block the bile duct, which drains bile from the liver into the bowel. This can trigger jaundice. More commonly, a gallstone can get stucked in the gallbladder, causing it to become swollen and leading to abdominal pain and nausea (Meier and Miller, 2012).

Pain

As defined by the International Association for the Study of Pain, pain is an unpleasant sensory and emotional experience arising from actual or potential tissue damage or described in terms of such damage. Pain includes not only the perception of an uncomfortable stimulus but also the response to that perception. The acute sickle cell painful crisis is the hallmark of SCD and the number one cause of hospitalization (Creary et al, 2007; Erin, 2011; Gustafson et al, 2006). It is unpredictable and may be precipitated by known or unknown risk factors and triggers. Much of the devastation caused by the disease is the result of the recurrent acute painful crises (Gustafson, 2007). Clinical features of a typical painful crisis that people living with SCD experience is

sudden onset of pain in the low back or in one or more joints or one of the extremities (Ballas, Gupta and Adams – Graves, 2012). The pain may be localized or migratory and is continuous and throbbing. The severe pain causes patients to grunt, groan, cry, twist and turn to assume abnormal postures in the futile attempt to obtain relief. Descriptors of pain also include throbbing, sharp, pounding, dull, stabbing, cutting, and gnawing or like a generalized toothache (Dampier, 2008).

Pain crises in persons with sickle cell anaemia are intermittent painful episodes that are the result of inadequate blood supply to body tissues. The impaired circulation is caused by the blockage of various blood vessels from the sickling of red blood cells. The sickled red blood cells slow or completely impede the normal flow of blood through the tissues. This leads to excruciating pain, often requiring hospitalisation (Cleary et al., 2007; Gustafson et al, 2006). The pain typically is throbbing and can change its location from one body area to another. Bones are frequently affected. Pain in the abdomen with tenderness is common and can mimic appendicitis. Fever frequently is associated with the pain crises. A pain crisis can be promoted by preceding dehydration, infection, injury, cold exposure, emotional stress, or strenuous exercise (Meier and Miller, 2012; Aina and Onasoga, 2013). Studies indicate that acute pain is the main cause of hospitalization for people with sickle cell disease of all ages; however it occurs more often in teens and young adults (Elander, Marczewska, Amos, Thomas and Tangayi, 2006).

Splenic Sequestration

The spleen is normally a small organ located on the upper left side of the abdomen under the rib cage. When sickle cells are trapped in blood vessels of the spleen, the normal flow of the blood is blocked. Sudden pooling of blood in the spleen is referred to as splenic sequestration, as a result, the blood count falls and the spleen gels becomes large and easy to feel. If the spleen suddenly enlarges with a significant drop in the blood count, this is a serious and potentially life-threatening problem. When the spleen gradually gets larger over several weeks, the blood count does not change much, so it is not serious. Any enlargement of the spleen is of concern and must be watched. Babies and young children of six years of age with sickle cell anaemia are at the greatest risk of splenic sequestration. After age five years, the spleen becomes smaller and in most cases it cannot enlarge any more. Children with sickle cell disease usually experience this complication after the age of five years. Children with SC and ST+ are at risk of this

complication throughout their life. Untreated splenic sequestration can result in death (Khatib, Rabat and Sarnaik, 2009).

Acute Chest Syndrome

Acute chest syndrome (ACS) is the result of sickling in the lungs. It affects over 80% people suffering from SCD (Fawibe, 2008). Sickling in blood vessels of the lungs can deprive lung of oxygen and some areas of lung tissue are damaged and cannot exchange oxygen properly. This condition is known as acute chest syndrome. It often starts a few days after a painful crisis begins. A lung infection may accompany acute chest syndrome. Symptoms may include chest pain, fever, breathing difficulties, and cough (Burners, Antler, Williams and Cook, 2008). In acute chest syndrome, at least one segment of the lung is damaged. This may be triggered by a lung infection like pneumonia. Acute chest syndrome may develop right before, during, or after an episode of pain in the abdomen or bones. Signs and symptoms include chest pain, fast breathing and/or retractions, congested pneumonia-like cough, abdominal pain, fever and difficulty in breathing. ACS is the second most common reason for hospital admissions among people suffering from SCD. It results in about 25% of deaths (Rees et al, 2010; Paul, Castro, Aggarwal and Oneal, 2011; Knight-Madden, Forrester, Lewis and Greenbush, 2005; Gladwin and Vichinsky, 2008).

Lung and Heart Injury

Aside lung infection (pneumonia), the lungs of children with sickle cell anemia can also be injured by inadequate circulation of blood which causes areas of tissue death. This lung damage can be difficult to distinguish from pneumonia and is known as acute chest syndrome. These localized areas of lung tissue damage are referred to as pulmonary infarcts. Pulmonary infarcts often require a special x-ray test using a dye injected into the affected areas (angiogram) for diagnosis. Repeated pulmonary infarcts can lead to scarring of the lungs of children with sickle cell anaemia by the time they reach adolescence. The heart is frequently enlarged in children with sickle cell anaemia. Rapid heart rates and murmurs are common. The heart muscle can also be injured by infarcts and iron depositing in the muscle as it leaks from the ruptured red blood cells. Over time, the heart muscle weakens, the heart pumps more blood in order to compensate and this could be very dangerous (Rees et al, 2010).

Pulmonary hypertension (PH) results from the chronic haemolysis that occurs with SCD. This complication affects 30% of patients with SCD in the U.S. with a mortality rate of 40%

within 40 months of diagnosis (Aliyu et al, 2008). Although most information about PH in SCD patients is derived from studies on adults, new evidence suggests that PH is also a problem in the pediatric population. Although data about the incidence of PH among children in Africa is limited, the high incidence of known infectious risk factors for PH (HIV/AIDS, Hepatitis B and C, and malaria), may contribute to high rates of this complication in Africa (Battersby, Knox-Macaulay and Carrol, 2010; Serjeant, 2005). Injuries to the lungs or heart are treated according to the specific type of damage and the degree of impairment of organ function. Supplementary oxygen can be required. Infections of the lungs require aggressive antibiotics. Transfusions can sometimes help prevent further damage to the lung tissue. Heart failure can require medications to assist the heart in effectively pumping blood to the body (Rees et al, 2010). Fawibe, (2008) reported that 18.9% of people living with SCD in Nigeria have chronic lung complications.

Leg Ulcers

The legs of patients with sickle cell anaemia are susceptible to skin breakdown and ulceration. This may be as a result of the reduced blood flow caused by the sickled red blood cells. Injury to the skin of the legs or ankles can promote skin damage and ulceration. Sickle cell ulcers are sores that usually start small and then get larger and larger. Leg ulcers most commonly occur in adults and usually form over the ankles and sides of the lower legs. The ulcers can become severe, even encircling the leg and are prone to infection. Leg ulcers can become chronic and resistant to many treatments but topical creams are often used. Elevation of the leg, careful dressing changes, and other topical therapies can be helpful. Some ulcers can be so resistant that skin grafting is recommended, though this may be compromised by impaired healing (Minniti, Eckman, Sebastiani, Steinberg & Ballas, 2010).

Aseptic Necrosis and Bone Infarct

Inadequate circulation of the blood, which is a characteristic of sickle cell anaemia, also causes areas of death in bone tissue known as bone infaction. Aseptic necrosis or localized bone death is a result of inadequate oxygen supply to the bone. Aseptic necrosis is also referred to as osteonecrosis. While virtually any bone can be affected, the most common are the bones of the thighs, legs, and arms. The result can permanently damage or deform the hips, shoulders, or knees. Pain, tenderness, and disability frequently are signs of aseptic necrosis. Painful bone infarcts can be relieved by rest and pain medications. Aseptic necrosis can permanently damage

large joints (such as the hips or shoulders). Many children with SCD experience musculoskeletal complications due to avascular necrosis, osteomyelitis, and septic arthritis. Balogun, Obalum, Giwa, Adekoya-Cole, Ogo and Enweluzo, (2010) published findings in 2004 from a study of 318 SCD patients in Nigeria. Study participants ranged from 1 to 45 years of age, and 46% below age 10. These authors noted that children below age 10 years were more likely to have multiple musculoskeletal problems, and reported that among the children younger than 10 years in the study, 95% had septic arthritis 63.3% had osteomyelitis, and 7.2% had avascular necrosis of the femoral head. Among children between 11 and 20 years of age, 46.4% had avascular necrosis of the femoral head, 30.6% had osteomyelitis and 5% had septic arthritis.

Eye Damage

The critical area of the eye that normally senses light is called the retina. The retina is at the back of the eye and is nourished by many tiny blood vessels. The most common site of damage is the retina, where blood vessels can overgrow, get blocked or bleed. The retina is the light-sensitive layer of tissue that lines the inside of the eye and sends visual messages through the optic nerve to the brain. Impairment of the circulation from the sickling of red blood cells results in damage to the retina (retinopathy). The result can be partial or complete blindness. Bleeding can also occur within the eye (retinal hemorrhage) and retinal detachment can occur. When the retina detaches, it is lifted or pulled from its normal position. These problems can cause visual impairment or blindness (Elagouz, Jyothi, Gupta and Siraprased, 2010).

Stroke

A stroke is a sudden and severe complication of sickle cell anaemia. The most common cause of a stroke in children with sickle cell anemia is cerebral infarction (blockage of the oxygen supply to the brain by sickled cells). Strokes occur in six to 12 percent of individuals with sickle cell anaemia, more commonly between three and 10 years of age (Rees et al, 2010). Also, it occurs in 11% of sufferers of 20 years of age. A stroke may occur with a painful episode or an infection, but in most cases there are no related illnesses. Stroke due to vascular occlusion is one of the most serious complications of SCD (Kolapo & Vento, 2011). In high resource countries, it is estimated that the risk of developing a stroke among SCD patients is 250 times higher than for those without SCD (Makani, Williams, & Marsh, 2007). Verduzco & Nathan (2009) reported findings from a study in the U.S. indicating that 24% of patients with SCD suffer a stroke by the age of 45 years. Makani, Williams and Marsh (2007) estimated that the rate may

even be higher in Africa due to the high prevalence of several risk factors including low hemoglobin, and leukocytosis (Makani, Williams and Marsh, 2007).

Brain imaging and tests of thinking (cognitive studies) have shown that children and adults with haemoglobin SS often have signs of silent brain injury, also called silent stroke. Silent brain injury is damage to the brain without showing outward signs of stroke. This injury is common. Silent brain injury can lead to learning problems or trouble making decisions or holding down a job. Recovery from a stroke may be complete in some cases, frequent stroke attacks can cause brain damage, paralysis, convulsions, coma and even death with symptom of severe headache and fainting attacks. Repeat strokes occur in at least 60 percent of the children who have already suffered one stroke. A repeat stroke causes greater brain damage and increases the risk of death.

Heart

People with SCD can have problems with blood vessels in the heart and with heart function. The heart can become enlarged. People can also develop pulmonary hypertension. People with SCD who have received frequent blood transfusions may also have heart damage from iron overload (Coates and Wood, 2017).

Delayed Growth and Puberty

Children with SCD may grow and develop more slowly than their peers because of anaemia. They will reach full sexual maturity, but this may be delayed (Cleary et al. 2007). This may be due to bone marrow hyperplasia, which causes distortion and growth disturbance, particularly in the skull, vertebrae and long bones (Barakat, Schwartz, Simon and Radcliffe, 2008). Adolescents with sickle cell anaemia maintain a lower average height and weight than those with normal heamoglobin. Puberty is usually delayed by several years. Menarche (beginning of the menstrual period) is also delayed. It is important to reassure the adolescent that they will eventually catch up with their peers. This lower than average height and weight continues until late adolescence (Mitchell, Carpenter, Corby, Bishop, Hines and Noll, 2009; Melissa, Sylvie, Sadhna, Irma, Angel, Chung, Sari and Mache, 2009). Balogun et al, 2010 reported that musculoskeletal complications occurred in 31.4% of people living with SCD in Nigeria.

Priapism

Priapism is a persistent, unwanted erection of the penis in the absence of sexual activity or desire that is often extremely painful. Specific causes are unknown but it is common among young males suffering from SCD (Bennett and Mulhall, 2008). Acute episodes often begin during sleep or following sexual activity, but frequently, there is no identifiable event or cause. There is no current therapy to prevent episodes of priapism. There is no way to predict who will develop priapism and impotence. Those individuals experiencing repeated episodes are encouraged to avoid long periods of bladder distention, dehydration, and prolonged sexual activities. Priapism may present as stuttering which is repeated, reversible painful erections occurring over several hours. There are no problems with sexual functioning. There may be a prolonged, painful erection that does not go away for more than several hours. This type of priapism needs medical attention. The males should know that a full bladder can trigger priapism, and they therefore need to urinate regularly. They also should avoid prolonged sexual activity which can trigger an episode of crisis (Broderick, 2012).

Infection

Infection is the major cause of death in children with sickle cell anaemia under the age of five years. The spleen functions as part of the body's defense against infection by serving as a filter to remove bacteria from the blood stream. People living with SCD have a subnormal immunity which partly accounts for their increased susceptibility to infections. The spleen functions as part of the body's defense against infection by serving as a filter to remove bacteria from the blood stream. The sickle RBC's damage the spleen by about four months of age so that the spleen does not function normally. This can allow bacteria to grow in the blood stream and cause septicemia, which can be fatal. Children under the age of five years are at highest risk for septicemia (Ahmed, 2011). People with SCD who have damaged spleens are also at risk of other serious bacterial infections that are often life-threatening. Some of these bacteria include Pneumococcus, Hemophilus Influenza Type B, Meningococcus, Salmonella, Staphylococcus, Chlamydia and Mycoplasma Pneumonia and can cause a wide range of infections including lung infection (pneumonia), infection of the covering of the brain and spinal cord (meningitis) and bone infection (osteomyelitis).Pulmonary hypertension (PH) results from the chronic hemolysis that occurs with SCD. This complication affects 30% of patients with SCD in the U.S. with a mortality rate of 40% within 40 months of diagnosis. Although most information about PH in

SCD patients is derived from studies on adults, new evidence suggests that PH is also a problem in the pediatric population (Aliyu et al., 2008). Although data about the incidence of PH among children in Africa is limited, the high incidence of known infectious risk factors for PH (HIV/AIDS, Hepatitis B and C, and malaria), may contribute to high rates of this complication in Africa (Battersby et al., 2010, Williams et al., 2009).

This can allow bacteria to grow in the blood stream and cause septicemia, which can be fatal. Children under the age of five years are at highest risk for septiceamia. Streptococcus Pneumonia, (also called the pneumococcus) and Haemophilus influenza are the two bacteria most likely to cause septicemia in the child with Sickle Cell Anemia, ninety percent of the infections occur before the age of three years. Thirty-five percent (35 percent) of children with sickle cell anaemia who get pneumococcal sepsis die from the infection. (Meier and Miller, 2012).

Other signs and symptoms include fever, coughing, vomiting and or diarrhea, crankiness, rapid breathing, pale color, unusual sleepiness and breathlessness although fever may be the only initial sign of septicemia. Other potentially serious infections which are more likely to occur in the child with sickle cell anaemia are meningitis, pneumonia and osteomyelitis. Any infection in the child with sickle cell disease is an emergency. Infection is treatable and complete recovery is possible only if it is recognized and treated early enough. However, even with treatment, permanent disabilities and even death can result (Gustafson, 2006, Adebowale, 2014). Bacterial infections leading to septicemia are also major causes of morbidity and mortality for children with SCD in Africa, particularly those below age 2 years. Children with SCD are more likely to suffer from pneumococcal disease than those who do not have SCD (Battersby et al., 2010; Obaro, 2010). Even though Streptococcus pneumoniae is the widely causative agent of infections in SCD children, findings from studies published in 2005 and 2010 suggest that bacteremia in African children with SCD may be caused by other bacteria (Battersby et al., 2010; Obaro, 2010). Kizito, Mworozi, Ndugwa, and Serjeant (2007) reported findings from a study of 155 children with SCD in Uganda, indicating that Staphylococcus aureus accounted for 60% of the 47 positive blood cultures. Other organisms identified included Haemophilus influenza, Staphylococcus epidermis, S. pneumonia, Streptococcus viridans, and Escherichia coli. In 2010, Battersby et al. reported that septicemia due to non typhi Salmonella species and Klebsiella species were the most common cause of death in children below 5 years of age with SCD in

Nigeria (Battersby et al., 2010). Other causative organisms included Acinetobacter species (7%) and E. coli (7%). The findings from these studies suggest that the types of bacteria causing infections in children with SCD differ from country to country. In 2007, Kizito and colleagues emphasized the importance of identifying the organism causing bacterial infections in order to develop effective management strategies (Kizito et al., 2007). In 2005, Serjeant questioned the effectiveness of pneumococcal prophylaxis in SCD children in Africa where there is infrequent isolation of Salmonella pneumonia.

Diagnosis of Sickle Cell Disease

A blood test can check for haemoglobin S, the defective form of heamoglobin that underlies sickle cell disease so as to know whether an individual has a gene has that is suggestive of SCD. There are different times the blood test can be performed and at different times.

Prenatal screening called Chorionic villus sampling is done before the baby is born. It is carried out on pregnant mothers between the ages of 6 and 10 weeks of conception. This type of test was introduced to Nigeria in November, 1993 through an initiative of the Sickle Cell Club of Lagos and the collaboration of Obstetric and Gynaecology of Lagos State Teaching Hospital, Idi Araba and Nigerian Institute for Medical Research, Yaba. This is done by using a sample of amniotic fluid or tissue taken from the placenta which can be done as early as 8 – 10 weeks into the pregnancy. It is possible to detect HbA or HbS from the baby's developing placenta. There is risk of miscarriage because anything that interferes with pregnancy can cause a miscarriage (Singh, Shrivastava and Shrikhande, 2015; Sinou, 2015).

Newborn screening is done on newly born babies in order to have earlier knowledge and prevent complications. Accurate diagnosis is fairly simple using a variety of analytical techniques. Age for diagnosis is between the ages of two months. Although, sickle cell Hb is present at birth, most infants do not show the signs and symptomsof SCD until the affected baby reaches the age of six months to six months because of the predominant foetal Hb (Akodu, Akinkunmi and Fatunde, 2010). WHO recently issued directives to countries in Sub-Saharan Africa to develop newborn screening. In the study carried out by Ejiofor, Efobi, Emechebe, Ifezulike, Okeke, Mokebe, Obijiofor, Ideh and Onuh (2018) in Awka, South East, Nigeria showed poor awareness for newborn screening. Similarly, in another study by Akodu, Diaku-Akinwunmi and Njokanma, 2010 in Lagos State University Teaching Hospital, Ikeja, Nigeria

found out that that the mean age at comfirmation of Hb genotypewas between 27 and 33 months where one quarter of the population used for the study confirmed diagnosis before the age of one year and three quarter was confirmed at the age of three years.

Diagnosis can also be made through the manifestation of signs and symptoms of SCD. Unfortunately, in Africa, some babies are born outside the hospital or even die before diagnosis is made. Clinical manifestation can be grouped into four categories; anaemia, systemic manifestation which include impairmement of growth and development as well as susceptibility to infections. Others are vaso-occlusive and painful crises of varying severity and frequency affecting different parts of the body and organ damage which is the consequence of anaemia and vaso-occlusion.

Analytical techniques includeHaemoglobin electrophoresis which is the primary laboratory test used to detect abnormal forms of Hb and diagnose SCD definitively. To perform Hb electrophoresis, red blood cells (RBCs) are lysed to release Hb, which is then allowed to migrate through an electrophoresis substrate (gel) under an applied electric field. Different Hb forms migrate at different rates, creating easily recognizable patterns unique to known hemoglobinopathies. This assay is very accurate and can easily differentiate between the sickle cell trait (heterozygous HbA / HbS) and sickle cell disease (homozygous HbS / HbS), but it requires specialized equipment and reagents to produce, image the electrophoresis gels, and may take as long as 1 hour to complete. Abnormal forms of Hb can also be distinguished in the laboratory setting with the isoelectric focusing (IEF) technique, in which the conductive gel substrate is treated with an ampholyte solution to create a spatial gradient of pH on the substrate (Hager, Neila, Soundness, Fekria, Nabila, Mahbouba, FIFA, Amiga, Raja, Heidi, Sodom, Neiman, Slaheddine & Taieb, 2012). The advantage of the IEF technique is that it offers a clearer visual readout than Hb electrophoresis, but IEF uses even more specialized reagents and is a similarly lengthy procedure.

Cation-exchange high-performance liquid chromatography (HPLC) is another laboratory technique frequently used to distinguish between the different forms of Hb that may be present in a patient’s blood sample (Randolph and Wheelhouse, 2012). Cation-exchange is a very accurate laboratory technique that can easily differentiate between sickle trait and sickle cell disease for a definitive SCD diagnosis. The presence of HbS in the blood sample of the patient can be

detected at the point of care using the HbS solubility assay (e.g. Sickledex) which is commonly used by the blood centers for routine screening of donated blood for HbS. The HbS solubility assay is relatively fast (5-15 minutes), requires minimal reagents and can be easily performed at the point of care. This test has very limited use for definitive diagnosis of SCD, however, because it can only detect the presence of HbS, but can not differentiate between the sickle cell trait (HbA / HbS) and sickle cell disease (homozygous HbS / HbS). The relatively short shelf-life of the chemical solutions involved also makes this test a less viable option for low-resource healthcare systems who cannot afford regular restocking and chemical preparation.

SCD can also be diagnosed through direct microscopic observation of the morphology of the patient's RBCs in a peripheral blood smear preparation. In the absence of hypoxia, the routine peripheral blood smear for SCD patients does not contain sickled RBCs – to enable quantifiable RBC sickling, a deoxygenating agent (e.g. 2% sodium metabisulfite) is added to the preparation. Although trained staff, microscopes, and reagents are readily available in industrialized countries, this method may also be practically impossible in low-income areas of the world. In principle, the peripheral blood smear test can produce a definitive SCD diagnosis if performed perfectly. Performing the peripheral blood smear analysis relies entirely on human interpretation, however, the likelihood of testing inaccuracies through human error is very high. In regular practice, this test is used primarily for initial screening of blood samples and the definitive diagnosis of SCD or sickle trait is done with Hb electrophoresis. Neonatal screening is believed to be the most effective and efficient screening programs for the detection of SCD. A practical methodology currently used for SCD diagnosis in Africa is the isoelectric focusing (IEF) which is regarded as more convenient than other definitive tests such as the high performance liquid chromatography (HPLC).These are used to detect the presence of abnormal heamoglobin in whole blood. They are considered proven, reliable and accurate methods in defining SCD phenotype as they show foetal and sickle heamoglobin (Wang, Kennedy, Caggana, Zimmerman, Thomas, Berninger, Harris, Green, Oyeku, Hulihan, Grant, and Grosse, 2013). Other tests include the antibody-based HbS detection and Deoxyribonucleic acid based techniques.

Management of Sickle Cell Disease

Sickle cell disease is a life-long disease but can be managed. This can be supportive, symptomatic, abortive and preventive. The primary aim of management is to reduce the pain and

discomfort being experienced by adolescents living with the disease in order to carry on with normal living, improve the quality of life and reduce their burden of psychosocial and psychological trauma (Ballas, Kesen, Osunkwo, Goldberg, Lutty, Dampier and Malik, 2012). Supportive management is intended to maintain the essential requirements for good health, such as adequate diet, sleep, hydration and regular follow-up. Symptomatic management is targeted to alleviate the symptoms of the disease as they occur. Preventive management is to prevent the occurrence of complications of the disease. The possible triggers are infection, stress or fatigue, dehydration, exposure to very cold, very hot temperature and humidity. Abortive management is to abort painful crisis, thus preventing them from getting worse or precipitating other complications. Pain which is the trademark of SCD can be managed with plenty of fluid intake, massaging and application of heat to the affected area (Ballas, 2011). Preventive measures include increase in fluid intake of at least eight glass cups of water daily. This increases the blood volume and increases the blood vessel lumen thereby allowing free flow of blood through the blood vessels. Dressing in few layers of warm clothing during the cold season, avoiding getting wet, vigorous exercises that involve a lot of exertion and prompt recognition of serious and complicated symptoms are some preventive measures to prevent triggers (Adebowale, 2014). Prevention of infection includes proper and adequate personal hygiene such as washing of hands before eating, after attending toilets or touching dirty things and the practice of healthy eating habits with a lot of fruits and vegetables. Patients with SCD are at an increased risk for all types of blood sepsis. Standard childhood immunizations are recommended for all children, particularly children with SCD due to the high susceptibility to infection. Immunizations include the pneumococcal vaccines; yearly influenza vaccination; as well as meningococcal vaccination for children with SCD. Ice compression should be avoided as this constricts the blood vessels leading to reduced blood flow or vaso-occlusion. Alcohol, caffeine, caffeinated drinks and hard drug such as marijuana and cocaine use should be avoided as well as they may also contribute to vaso-occlusion (Brent Sickle Cell & Thalassemia Center, 2015; Solomon, 2008). The management could also be through blood transfusion, use of hydroxyurea drugs or bone marrow cell transplant.

Myths and Misconceptions about Sickle Cell Disease

There are myths and misconceptions about SCD which should be discouraged and clarified. Some people believe that the disease is caused by evil spirit or anger from God and this might be the reason why they call people living with SCD various names like 'Ogbanje' or a child that re-incarnates (Asakitipki, 2008). This may make very religious people to visit herbalist to seek assistance to appease gods or go to religious places for divine intervention. Other people feel the disease is contagious or communicable. The disease is so named because of the sickle shape of the red blood cells and it cuts across all races, it is not an African disease. It is widespread due migration and inter-racial marriages. A person cannot catch it as cold or flu but both parents must carry the sickle cell gene to have a child with the disease. Another notion about the disease is that a child with SCD may not live to adulthood. Today, people living with SCD can live into 50 years and even beyond because of adequate management. Modern medicine has proffered solution to the disease, it can be cured but the process is expensive and complicated unlike in the past when people believe there is no cure. SCD can be managed, it is not a terminal disease (Fowora, 2016).

People living with SCD can live a normal life with proper management and avoidance of triggers of crises characterized by the disease. The occasional yellowish of the eyes is due to increased breakdown of red blood cells and accumulation of bilirubin, a bye product that is yellow in colour which clears off as days go buy. Healthy peers should not be afraid of this development. Furthermore, the stunted growth may be present, some just get delayed, some may not experience this, but it does not mean they have low Intelligence Quotient compared to their healthy peers. People living with SCD may experience occasional crisis which when properly managed, will ease off (Nairaland Forum, 2016).

Prevalence of Sickle Cell Disease

SCD is the term used to refer to a group of complex genetic disorders characterized by aneamia, severe pain, potentially life threatening complications such as bacterial septicemia, splenic sequestration, acute chest syndrome and chronic organ dysfunction. A common misconception is that SCD affects only people from African ancestry. SCD can affect people of any race and ethnicity. Genes for SCD are common in persons from African, Mediterranean,

Indian ancestry, Carribean, parts of Central and South America. This is due to migration and slave trade.

SCD is the best known hereditary haematological disorder in human beings. Estimates suggest that between 20 to 25 million children are born annually with sickle cell anaemia worldwide and thus, it is among the most important genetic diseases in Brazil and the world (Aberdian, Howard, Rawle and Thomas, 2010; Rees, Williams and Gladwin, 2010). SCD affects millions of people throughout the world and is particularly common among those whose ancestors came from sub-Saharan Africa; Spanish-speaking regions in the Western Hemisphere (South America, the Caribbean, and Central America), Saudi Arabia, India and Mediterranean countries such as Turkey, Greece, and Italy (National Heart Lung and Blood Institute (NHLBI), 2012). Almost 312,000 children are born with a form of sickle-cell disease every year, mostly in sub-Saharan Africa, 200,000 in Africa but also in other parts of the world such as the West Indies and in people of African origin elsewhere in the world (W.H.O, 2011). In 2013 it resulted in 176,000 deaths up from 113,000 deaths in 1990. Sickle cell disease occurs more often among people from parts of the world where malaria is or was common. It is believed that people who carry the sickle cell trait are less likely to have severe forms of malaria (Wellems, Hatton and Faurhust, 2009). It is estimated that SCD affects 90,000 to 100,000 Americans, about 1 out of every 500 Black or African-American births, 1 out of every 36,000 Hispanic-American births (CDC, 2009; SCAF, 2014).

Sickle-cell disease is a common genetic condition due to a haemoglobin disorder, inheritance of mutant haemoglobin genes from both parents and is globally widespread (CDC, 2011). About 5% of the world's population carries genes responsible for 'S' haemoglobinopathies. Globally, there are more carriers in certain areas and this leads to a high rate of affected newborns.

Migration increased the frequency of the gene in the American continent (Sickle Cell Disease Association of America, 2012). In India, the population is about 1.2 million and it has about 50% of the world's SCD people with the highest prevalence in socio-economically disadvantaged communities (Balgir, 2007). In Italy, there is less than 1,500 cases of SCD and they are mainly of African origin. In some areas of sub-Saharan Africa, up to 2% of all children are born with the condition. The prevalence of the sickle-cell trait ranges between 10% and 40% across equatorial Africa and decreases to between 1% and 2% on the North African coast and

less than 1% in South Africa. This distribution reflects the fact that sickle-cell trait confers a survival advantage against malaria and that selection pressure due to malaria has resulted in high frequencies of the mutant gene especially in areas of high malarial transmission (Williams, 2010). In West African countries such as Ghana and Nigeria, the frequency of the trait is 15% to 30%.

Frequencies of the carrier state determine the prevalence of sickle-cell disease at birth. For example, in Nigeria, the most populous country in the sub region, 24% of the population arecarriers of the mutant gene and the prevalence of sickle-cell anaemia is about 20 per 1000 births. This means that in Nigeria, about 150 000 children are born annually with sickle-cell anemia (Falusi, 2013; Akinyanju, 2009). The sickle-cell gene has become common in Africa because the sickle cell trait confers some resistance to falciparum malaria during a critical period of early childhood, this development favours survival of the host and subsequent transmission of the abnormal haemoglobin gene. Although a single abnormal gene may protect against malaria, inheritance of two abnormal genes leads to sickle-cell anaemia, it offers no such protection and malaria is a major cause of ill-health and death in children with sickle cell anaemia. There is increasing evidence that malaria does not only influence outcome but also changes the manifestations of sickle cell disease in Africa. Enhanced phagocytosis occurs in carriers, destroying malaria infested blood cells than in individuals with normal HbAA. Most people with normal HbAA die prematurely due to severe illness caused by malaria. Infants and children are vulnerable because they would have had malaria infections and could not build immunity against the parasite (Rees et al, 2010; Welles, Hayton and Fairhust, 2009). Hence, the available people with genotype ‘AS’ live because they are not greatly affected by malaria, they intermarry which makes majority become carrier of sickle cell; the carriers would then increase, thus making the control of SCD more difficult (CDC), 2007).

In the United States, the prevalence of the disease in the United States is approximately 1 in 500 mostly affecting Americans of sub-Saharan African descent and one in every 36,000 Hispanic-American children have sickle-cell anaemia. It is estimated that sickle-cell disease affects 90,000 Americans. Most infants with SCD born in the United States are now identified by routine neonatal screening. Forty-four states along with the District of Columbia, Puerto Rico and the Virgin Islands currently provide universal neonatal screening for SCD. It is estimated that 2.5 million Americans are heterozygous carriers for the sickle-cell trait.

In Brazil, the disease is more frequent where the proportion of African descendants are greater (the North Eastern region and the States of São Paulo, Rio de Janeiro and Minas Gerais). In these regions, there are new cases of sickle cell disease in every 1000 births and sickle cell trait carriers in every 27 births. It is estimated that approximately 2500 children are born every year with sickle cell disease. As a result of population growth in African-Caribbean regions of overseas France and immigration from North and sub-Saharan Africa to mainland France, sickle cell disease has become a major health problem in France. In 2010, 31.5% of all newborns in mainland France, 253,466 out of 805,958 were screened for SCD, this percentage was 19% in 2000, 341 newborns with SCD and 8,744 heterozygous carriers were found representing 1.1% of all newborns in mainland France. The Paris metropolitan district (Île-de-France) is the region that accounts for the largest number of newborns screened for SCD, 60% in 2010. The second largest number of at-risk is in Provence-Alpes-Côte d'Azur at nearly 43.2% and the lowest number is in Brittany at 5.5% (Bardakdjan-Michau, Bahuau, Hurtrel, Godert, Riou, Mathis, Goossens, Badens, Ducrocq, Elton and Perini, 2009).

In the United Kingdom, it is believed that between 12,000 and 15,000 people have sickle cell disease with an estimate of 250,000 carriers of the condition in England. In Saudi Arabia, about 4.2% of the population has the sickle-cell trait while 0.26% have sickle-cell disease. The highest prevalence is in the Eastern province where approximately 17% of the population has the gene while 1.2% has sickle-cell disease (Jastaniah, 2011). In 2005, Saudi Arabia launched a mandatory pre-marital test including HB electrophoresis and this was aimed at decreasing the incidence of SCD and thalassemia (Memish and Saeedi, 2011). Sickle-cell disease is common in the tribal people of central India who share a genetic linkage with the African race, where the prevalence has ranged from 9.4% to 22.2% in endemic areas of Madhya Pradesh, Rajasthan and Chhattisgarh (Awasthy, Aggarwal, Goya, Prasad, Salujal and Sherman, 2008). It is also endemic among Tharu people of Nepal in India, however, they have a sevenfold lower incidence of malaria despite living in a malaria infested zone. In Jamaica, 10% of the population carries the sickle-cell gene, making it the most prevalent genetic disorder in the country. Asnani, McCaw-Bins and Reid (2011) reported that three quarters of sickle-cell cases occur in Africa. WHO (2006) report estimated that around 2% of newborns in Nigeria were affected by sickle cell anaemia with a total of 150,000 affected children born every year. The carrier frequency ranges between 10% and 40% across equatorial Africa, decreasing to 1–2% on the North African coast

and less than 1% in South Africa. This happened in predominant areas of malarial cases. The highest frequency of sickle cell disease is found in tropical regions, particularly sub-Saharan Africa, tribal regions of India and the Middle-East. Migration of substantial populations from these high prevalence areas to low prevalence countries in Europe has dramatically increased in recent decades and in some European countries. In 2013, it resulted in 176,000 deaths due to SCD from 113,000 deaths in 1990.

In Africa, there are 200,000 cases of people suffering from sickle cell disease (SCAF, 2015). 24% of the African population are carriers, 20 babies in 1000 births are HbSS with 90% in West Africa. In sub-Saharan Africa, 2% of all children born are having HbSS genotype while people with trait are between 10% and 40% across equatorial Africa. SCAF (2015) also stated that in North Africa, the carriers range between 1% and 2% while it is less than 1% in South Africa. The current estimates for Africa are probably much higher than stated in the literature because in Nigeria, like Ghana, 2% of the babies born have sickle cell disorder. West Africa with approximately 5 million births per year would have 200,000 babies with sickle cell disorder annually. United Nations Population Fund (UNFPA) (2008) estimated that in Africa, 444,000 babies have sickling disease.

Prevalence of Sickle Cell Disease in Nigeria

Nigeria which is the most populous sub-Saharan African country has 150,000 newborns with sickle cell disease annually. This accounts for half of the 300,000 babies born yearly with major haemoglobin disorders worldwide (W.H.O., 2006). Nigeria has the largest population of people with sickle cell disorder. The incidence of sickle cell disorder in Nigeria is among the highest in the world. It also stated that 40 million Nigerians are carriers of the 'S' gene. This number far exceeds the total population of every other affected African country and several of them put together (SCAF 2015, Sheyin, 2012; Fields 2005; WHO, 2006). In Western Nigeria, the population of sickle disorder people is about 2.4% (Taiwo, Oloyede and Dosunmu, 2011). Ibadan is a cosmopolitan town and it is one of the largest and most populous urban centers in Nigeria. Ibadan has 5.5% of its population having HbSS genotype and 25% as HbAS; that is, carriers of 'S' gene (Nabila, Ukaejiofor, Nubila and Azeez, 2013).

Adolescents and Sickle Cell Disease

Adolescence is the period between 10 and 19 years and is also regarded as a period of transition into adulthood. Complications of SCD become more challenging during adolescence. In a study conducted by Patel and Pathan (2005), adolescents with SCD were concerned about their illness and the perception that accompanies having a different physical appearance from their peers. Body image issues are delayed growth, late sexual maturation, bone age retardation, small body mass, delayed menache and delayed secondary sex characteristics (Sankar, Cho, Walpe and Shatner, 2006). Sickle cell disease is a major public health issue and second leading cause of mortality in children (W.H.O 2006). The disease is a genetic condition that is characterized by abnormal shaped red blood cells. It affects 1.2 billion adolescents worldwide (UNICEF, 2011).

The complications of the SCD are often life-threatening ranging from anaemia which can be either moderate or severe, damage to vital organs like the heart, kidney, liver and lung. Other complications that may arise include bone marrow failure, cognitive impairment and delay in physical and mental development (William-Smith, 2015; Erin, 2011; Jisieke, 2007; Nandanwar and Kamdi, 2013). These complications start to manifest in the early teenage years and exacerbate as the child living with SCD reaches adolescence accompanied by embarrassment, stigmatization and a feeling of low self-esteem. Examples of these complications are leg ulcers which may be a source of embarrassment to the adolescent and yellowish discoloration of the eyes as well. Priapism which can occur at any time of the day could also be embarrassing.

McPherson,Thaniel and Minniti (2009) found out that adolescents reported an inadequate level of preparation for transition to adult care. Attitude towards transition such as interest in learning about the process and anticipated difficulty improved with age but were negatively affected by disease severity. Most children and adolescents with SCD (94%) in western countries live to the age of 18. Adolescence is generally at the healthiest stage in a human life when peaks in strength, fitness and many cognitive abilities are reached. This is also a period when signs and symptoms of sickle cell disease become more debilitating and noticeable. It is also a period when major physiological changes occur and health risk with potentially life-threatening consequences become more prominent but they may live long and fulfilling lives like their healthy counterparts. The burdens of the disease can affect all aspects of the lives of the adolescent with the disease including physiological, psychological and social wellbeing (Jenerette and Brewer,

2010). About 50-80% of 400,000 infants with SCD die before the age of five (Weatherall et al 2006).

Prevention of infection and engaging in moderate physical exercise are also tips to avoid crisis and live independently in school. Decline in academic performance, inability to maintain attention, difficulty with organization might be due to the silent stroke in SCD and may not be due to poor attention and lack of motivation. Sufferers, due to their small stature, are more likely to be bullied and therefore avoid confrontations with their peers. The SCD is widespread in the Africa region, the B (betas) gene prevalence in at least 40 countries varies between 2% and 30% resulting in high SCD-related morbidity and mortality. Deaths from SCD complications occur mostly in children and adolescents (Weatheral et al, 2006).

Activities such as going to college and independent learning may be challenging. Good medical care and practice of good health habits, for example, drinking of 8-10 glasses of water daily for good hydration, avoidance of high or low temperature environment as well as stress reduction are imperative. Prevention of infection and engaging in moderate physical exercise are also tips to avoid crisis and live independently in school. As with other chronic illnesses, SCD can be associated with psychological difficulties in affected children particularly in developing countries. Bakare et al (2008), in his study showed significantly more psychological difficulties among children with SCD (38%) compared with controls with no chronic illness (11%). Disclosure to peers was perceived less favorable as the sufferers have experiences of victimization from peers on becoming aware of their SCD status and also reported that schooling experiences of young people with SCD in England are confronting dilemmas (Dyson, Atkins, Culley, Dyson & Evans, 2010).

Adolescents that are affected by delayed puberty with psychological and social effects, result in low self-esteem in boys and difficulty in separating from parents due to apparent immaturity. Girls are more likely to have more emotional problems than their healthy counterparts leading to depression and a low self-esteem. Furthermore, there is increase in dependency on parents in adolescence when usually the reverse should be the case (W H O, 2007; Michaud, Suris and Viner, 2007). Impairment of body image and long term neuropsychological effects can also occur in adolescents with SCD. Pain which is the hallmark of the disease is believed to make adolescents exhibit certain behaviour that are often perceived as withdrawal symptoms of hard drugs although addiction to pain medication in adolescents

suffering from SCD is very likely to occur (Jacob, Miaskowski, Savedra, Beyer, Treadwell and Styles, 2006, Jenrette and Brewer, 2010). Burners, Antler, Williams and Cook (2008) opined that emotional problems and less total competence may lead to heightened level of over protective behaviors in schools. The impact of pain episodes have shown to have adverse effects on adolescents' physical functioning, school attendance, academic performance and social roles.

The management could also be through blood transfusion, use of hydroxyurea drugs or bone marrow cell transplant (Locatelli and Pagliara, 2012). The bone marrow must be rich in stem cells. Stem cells are a type of unspecialized cell that can change into a more specialised cells such as healthy red blood cells under certain conditions. Scientists are working on a new procedure such as gene therapy which may offer lasting treatment without the need of finding compatible bone marrow donors (NHLBI, 2012). Prevention of SCD is when parent with sickle cell trait and SCD do not marry each other and this can happen when each person knows his or her genotype.

Attitude is a psychological construct which expresses one's disposition towards an issue. In a study conducted by Bakare et al (2008), in his study showed significantly more psychological difficulties among children with SCD (38%) compared with controls with no chronic illness (11%). Disclosure to peers was perceived less favorable as the sufferers have experiences of victimization from peers on becoming aware of their SCD status and also reported that schooling experiences of young people with SCD in England are confronting dilemmas (Dyson, Atkins, Culley, Dyson & Evans, 2010). A study conducted with trainee teachers who were university students in Southern Nigeria, showed that participants had negative attitudes towards their classmates with SCD. For instance only 24% of the students believed their peers would invite fellow classmates with SCD to their birthday party and 31.9% uncovered that most of their peers would engage in study sessions with a fellow classmate with SCD. 15 – 53% of the students believed that other students would not associate with their peers with SCD. The study found that gender and perceived negative family attitudes significantly influenced unkind attitudes towards SCD. Males had more negative attitudes towards their peers living with with SCD compared to females and untoward attitude increased with the person's perceived family negative attitude. A significant proportion of participants believed that their family members perceived SCD as something to be ashamed of.. 43.6% kept it secret while 32% would oppose friendships with anyone with SCD (Ani, Amanda, Kinance, Olay & Kramer, 2012).

Bazuaye and Olayemi (2009) in their study on the attitude of senior secondary schools students in Benin City, Edo State, Nigeria towards SCD found that 66% had a good attitude and 18% had a negative attitude towards other students with SCD. Olarewaju, Enwerem, Adebimpe and Olugbemga – Bello (2013) discovered in their study that 76% showed negative attitude towards individuals with SCD among the secondary school students in Jos, Nigeria. Likewise, more than half of the respondents, 51% responded showing negative attitude in the study by Durotoye, Salaudeen, Babatunde, Bosch and Ajayi (2013) in Ilorin Metropolis, Kwara State, Nigeria. A study among the Trainee teachers who were University students in Southern Nigeria revealed that the participants had negative attitude towards their classmates living with SCD. 24% would associate with their mates living with SCD (Ani, Amanda, Kinance, Olay and Kramer 2012). Dyson, Atkins, Culley, Dyson and Evans (2010) confirmed that schooling experiences of young people living with SCD are confronting dillemmas.

Ani, Aranda, Kinanee, Olay and Kramer (2012) in Port Harcourt, Nigeria showed negative attitude towards people living with SCD as 24% only will invite them to their birthday parties while 68% will not like to study with them. Oludare and Ogili (2013) also found that 13.4% of the study population among the unmarried youths in Yaba, Lagos State, Nigeria showed negative attitude to people suffering from sickle cell disease. The result of the study emphasized that 50% of the adolescents in the study group showed negative attitude. Olatona, Odeyemi, Onajole and Asuzu (2012) found out in their study that the attitude of Youth Corps members in Lagos State, Nigeria towards SCD was positive.

Attitude towards Sickle Cell Diseases

As with other chronic illnesses, SCD can be associated with psychological difficulties in affected children, particularly in developing countries. Studies from Nigeria consistently show increased rates of emotional difficulties among children with SCD. For example, an earlier study found parent-rated psychiatric morbidity in 26.6% of children with SCD compared with 4.8% of healthy matched controls in Eastern Nigeria. It also showed significantly more psychological difficulties among children with SCD (38%) compared with controls with no chronic illness (11%) (Bakare, Omigbodun, Kuteyi, Meremikwu & Agomoh, 2008).

An important aspect of the social environment is the attitude and perception of non-sufferers towards persons living with sickle cell disease. The relevance of negative attitude to the lives of children living with SCD is increasingly being recognised (Dyson, Atkins, Curley,

Dyson, Evans & Rowley, 2010; Jenerette & Brewer, 2010; Dyson, Atkins, Curley, Dyson & Evans, 2011). School is an important aspect of every child's social experience, not least because children spend a significant proportion of their lives in this setting. Thus understanding the schooling experiences of affected children and the attitudes of their healthy mates is important (Knight-Madden et al, 2011). In their study of the schooling experience of young people with SCD in England, Dyson (2010) and Dyson (2011) found that young people with SCD were confronting dilemmas in school.

Some of the dilemmas include the children's attempt to adhere to medical advice which conflicts with their effort to abide by school rules and another dilemma relates to whether or not to disclose their SCD to teachers and peers (Dyson et al 2010). Disclosure of their genotype to peers was perceived less favourable and brings judgment in whatever they do. Indeed, some of the young people described experiences of bullying and teasing from peers on becoming aware of their SCD status (Dyson et al 2010). The studies by Dyson and colleagues focused on the experiences of the young people with SCD in school which is important. Affected children may need additional support from their mates to achieve their full educational potential. In fact, Dyson and colleagues identified a few examples of good practice, where SCD-friendly school policies made a positive difference to the experience of affected children. The current study focused on trainee teachers. This could help them to improve the experience of children with SCD in school (Adewuya and Makanjuola, 2008).

A study conducted with trainee teachers who were university students in Southern Nigeria, showed that participants had negative attitudes towards their classmates with SCD. For instance only 24% of the students believed their peers would invite fellow classmates with SCD to their birthday party and 31.9% uncovered that most of their peers would engage in study sessions with a fellow classmate with SCD. 15 – 53% of the students believed that other students would not associate with their peers with SCD. The study found that gender and perceived negative family attitudes significantly influenced unkind attitudes towards SCD. Males had more negative attitudes towards their peers living with with SCD compared to females and untoward attitude increased with the person's perceived family negative attitude. A significant proportion of participants believed that their family members perceived SCD as something to be ashamed of.. 43.6% kept it secret while 32% would oppose friendships with anyone with SCD (Ani, Amanda, Kinance, Olay & Kramer, 2012).

Multiple factors related to the disease as well as social and environmental factors are likely to be contributing to the psychopathology in SCD. An important aspect of the social environment is the attitude and perception of non-suffers towards affected persons. The relevance of negative attitude to the lives of children living with SCD is increasingly being recognised (Dyson et al 2010, Jenerette & Brewer, 2010; Dyson et al, 2011). Increased unkind attitude would be associated with limited knowledge of SCD. School is an important aspect of every child's social experience because children spend a significant proportion of their lives in this setting. Thus understanding the schooling experiences of affected children and the attitudes of their mates and other people who work in schools is important (Knight-Madden, Tyson, Reid and Moosang, 2011).

Management of sickle cell disease

The management of SCD is very important as the knowledge of the management will reduce the frequency of crisis, morbidity and associated psychosocial and psychological effects. SCD is a life-long disease, however it can be managed. This can be supportive, symptomatic, abortive and preventive (Ballas, Kesen, Goldberg, Lusty, Dampier, Osunkwo & Malik, 2012). The primary aim of the management is to reduce the pain and discomfort being experienced by adolescents suffering from the disease in order to carry on with normal living, improve the quality of life and reduction the psychosocial condition of people living with SCD (Ballas, 2010; Jenrette & Murdaugh, 2008). This can be done by avoiding the triggers of crises such as infections, especially malaria, over exposure to extreme humidity of coldness, hot weather and rigorous exercise (Adewoyin, 2014; Brent Sickle Cell & Thalassemia Center, 2015). Fowora (2016) and Adewoyin (2014) found out in their study that adequate management can help minimize the complications of SCD, thereby increasing the quality of life and reduction in psychosocial and psychological problems. Prompt attention is also needed in case of crises.

Durotoye, Salaudeen, Babatunde, Bosah and Ajayi (2013) in their research work on awareness on SCD in Higher Secondary School Students reported that this disease can be efficiently reduced through a strategic balance of disease management and prevention programmes. It was found out that only 4% of the students were aware of the management. Good medical care, prevention, good hydration and other tips to avoid trigger of crises can also go a

long way in the management of SCD (Dyso, Atkins, Culley, Dyson and Evans, 2010). Prevention of SCD is when parents with SCD and traits do not marry each other.

Empirical Studies

Knowledge of Sickle Cell Disease

There are various studies on knowledge of SCD and some of them are discussed. Sickle cell disease knowledge among local government workers in Ile Ife, Osun State, Nigeria revealed that 69% of the study subjects had poor knowledge of SCD. Despite the abundance of information, the knowledge and attitude of Nigerians in general to sickle cell disease is worrisome. In the study research carried out by Bazuaye and Olayemi (2009) among students in Benin City, Nigeria, among the Senior Secondary students, it was found that out of eight hundred and fifty students who were interviewed, only 18% had correct idea about SCD, 48% had wrong idea while 34% had no idea at all. It was concluded that there is poor knowledge about SCD amongst senior secondary school students in Benin City, Nigeria. The general public should be aware that these population are the future generation that should have the knowledge of SCD. There is also some level of stigmatization. There is also postulation that SCD education should start as early as at the level of secondary school. This is in support of what the researcher sets about doing. The awareness which when starts early in life may inform adolescents to help have an informed choice of future partners in order to avoid having children with SCD.

Durotoye, Salaudeen, Babatunde, Bosah and Ajayi (2013), in their study, came out with the report that 26% had good knowledge, 31.7% had fair knowledge and 63.3% had poor knowledge of SCD and Bazuaye and Olayemi (2009) reported that 38% knew about the causes of SCD among the senior secondary schools students in Benin City, Edo State, Ilorin Metropolis, Kwara State and Abuja respectively. Adewuyi (2000) in his study among fresh graduates in Ilorin, Kwara State revealed 43% showing little understanding of the disease. Research study by Oludare and Ogili (2013) among the unmarried youths in Yaba, Lagos State showed that 80% of the study population had knowledge of SCD while Olarewaju, Enwerem, Adebimpe and Olugbenga- Bello (2013) in Jos, Nigeria came out with the result that 83.2% of the study population were aware of SCD. It also stated that comprehensive knowledge about SCD was low among the respondents and therefore recommended a need to raise awareness about SCD especially among students in secondary schools in Nigeria.Studies in United States of America revealed 27.0% of Dominicans identified with SCD as an inherited blood disorder compared to

46.0% of Afro–American. Olatona, Odeyemi, Onajole and Asuzu (2013), in their study found out that the proportion of the respondents who had the knowledge of SCD was low (25%) among the Youth Corps members in Lagos State, Nigeria.

Another study carried in India by Desai, Bhandari, Desai and Shah (2014), on awareness on SCD among Higher School students, it was found out that 40% were aware of the disease and 100% were interested to know about the disease and even, ready to spread the knowledge to others. The researcher opioned that information and awareness-related activities should be an important component of effective public health strategies at reducing the morbidity and mortality among people living with SCD.

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Effects of Heamatologic Education

Olatona, Odeyemi, Onajole and Asuzu (2013) reported increase in the knowledge of SCD post intervention by 64.1% from25% and attitude increased in most aspects of the disease considered among the Youth Corps members in Lagos State, Nigeria. Adewoyin, Alagbe, Adedokun and Idubor (2015) in their study among Youth Corps members in Benin City, Edo State revealed moderate level of knowledge of SCD after intervention. Similar study by Guobadia (2015) also recorded that hematologic education increased the knowledge and improved the attitude of the North Texas college students. Abioye- Kuteyis, Oyegbade, Bello and Osakwe (2009) revealed that in Cyprus, the incidence of b-thalassaemia, a type of SCD reduced after health intervention. Chen, Lu, Wang, Ma, Zhao, Geo, Hu, Wang, Huang & Chen (2008) also reported increase in knowledge of SCD after implementation of teaching unit.

In their research work among senior secondary school students, revealed that only 4% of the students were aware of the management of sickle cell disease but the knowledge on the management improved in the experimental group. Fowora (2016) and Adewoyin (2014) also reported adequate knowledge in the management of sickle cell disease can increase the quality of life and reduce psychosocial and psychological effects. Furthermore, Olatona et al (2013), Goubadia (2015) and Idubor (2015) recorded improved attitude after the heamatologic education. Conversely, a satisfactory report on attitude towards sickle cell disease in a study in Western Sudan was made by Daak, Elsamani, Ali, Mohamed, Abdel Rahman, Elderdery, Talbot, Kraft,

Ghebremeskel, Elbashir and Fawzi (2016). Desai, Ghandari, Desai and Shah (2014), in their research work among senior secondary school students revealed that only 4% of the students were aware of the management of sickle cell disease but the knowledge on the management improved in the experimental group as Fowora (2016) and Adewoyin (2014) also revealed that adequate knowledge in the management of sickle cell disease can increase the quality of life and reduce psychosocial and psychological effects.

Adewoyin, Alagbe, Adedokun and Idubor (2015), in their study among youth corps members in Benin, Edo State, Nigeria reported that 63.5% of the respondents had good knowledge of sickle cell disease. The increased knowledge post-intervention in the research work of Adewoyin, Alagbe, Adedokun and Idubor (2015) revealed increased level in the knowledge after intervention programme. Olatona, Odeyemi, Onajole and Asuzu (2013) who reported an increase in the knowledge of sickle cell disease post intervention by 64% from 25%. Similarly, Guobadia (2015), Abioye-Kuteyi, Oyegbade, Bello and Osakwe (2009) and Chen, Lu, Wang, Huang and Chen (2008) also revealed increase in knowledge of sickle cell disease after intervention. The finding of a study carried out in Pittsburgh by Gustafon (2006) showed that there was a significant overall knowledge gain after intervention; average score was 92% after education compared with 62% before education. Conversely, a satisfactory report on attitude towards sickle cell disease in a study in Western Sudan was made by Daak, Elsamani, Ali, Mohamed, Abdel Rahman, Elderdery, Talbot, Kraft, Ghebremeskel, Elbashir and Fawzi (2016). Durotoye, Salaudeen, Babatunde, Bosah and Ajayi (2013) in their research work among senior secondary school students, when they revealed that only 4% of the students were aware of the management of sickle cell disease but the knowledge on the management improved in the experimental group. Fowora (2016) and Adewoyin (2014) that adequate knowledge in the management of sickle cell disease increased the quality of life and reduce psychosocial and psychological effects.

Adewoyin, Alagbe, Adedokun and Idubor (2015), in their study among youth corps members in Benin, Edo State, Nigeria reported that 63.5% of the respondents had good knowledge of sickle cell disease post-intervention. The study also revealed increased level in the knowledge after intervention progrogram. Olatona, Odeyemi, Onajole and Asuzu (2013) reported an increase in the knowledge of sickle cell disease post intervention by 64% from 25%.

Similarly, Guobadia (2015), Abioye-Kuteyi, Oyegbade, Bello and Osakwe (2009) and Chen, Lu, Wang, Huang and Chen (2008) also revealed increase in knowledge of sickle cell disease after intervention. In Pittsburgh by Gustafon (2006) which showed that there was a significant overall knowledge gain after intervention; average score was 92% after education compared with 62% before education.

Appraisal of Literature Reviewed

Heamatologic diseases are diseases that affect the production of blood and its components such as blood cells, blood proteins, bone marrow, heamoglobin and blood vessels which can either be inherited, due to side effects of drugs or lack of certain nutrients in the body (ASH, 2018).Sickle cell disease (SCD) is a chronic hereditary disorder which affects the red blood cells and it is a major public health problem(Macon, Solan and Lamoreux, 2017). It is one of the most common hereditary diseases occurring world-wide with serious complications that may affect any organ or system of the human body. The disease also has major social, psychological and economic implication on the affected child and the family (Olubiyi, Umar, Ajiboye, Olubiyi and Abioye, 2013). Thus, heamatologic education on knowledge, attitude and management of sickle cell disease was chosen as a useful situational focus. Inadequate knowledge can be attributed to the prevalence and multiplication of sickle cell diseases.

This chapter extensively reviewed related literatures that were of great importance and relevance to the study. The reviewed literature discussed the overview of sickle cell diseases world-wide, in Nigeria and among secondary school adolescents, concept of haematologic diseases as well as concept of sickle cell disease. Nigeria is the most populous sub-Saharan African country and ranked first as the sickle cell endemic country in the world with 2 – 3% of the population living with SCD. W.H.O, (2006) confirmed that Nigeria has the largest population of people with SCD as 20 out of 1000 births or 1 in 50 babies are affected which is about 150,000 births annually and this accounts for almost one-third of the 444,000 babies born yearly with major haemoglobin disease worldwide. In the report by Falusi (2015), it was documented that 23%, that is 40 million Nigerians or 1 in 4 people are carriers of the ‘S’ gene and this number exceeds the total population of every other affected African country. In Western Nigeria, the population of people living with SCD is about 2.4% (Taiwo, Oloyede and Dosunmu, 2011; Anie, Egunjobi and Akinyanju, 2010).The literature reviewed also covered myths and misconceptions about sickle cell disease, pattern of inheritance and classification of sickle cell

disease (WHO, 2010; UNFPA, 2008; Afolayan and Jolayemi, 2011). The effects and complications of sickle cell disease are social, psychological, economic and physical were discussed also.

Gender and religion which are the moderating variables for the study were also reviewed. The literature reviewed revealed that males are likely to experience crises more than females. Highly religious people may have positive attitude towards people living with sickle cell diseaseand are likely to show more love and care as they may perceive the disease as an act of God or destiny while low religious people may not (Afolayan and Jolayemi, 2011). Effects of heamatologic education on behaviour modification were discussed. It further discussed the various ways of prevention of sickle cell disease which emphasized that carriers should avoid intermarriage, public attitude towards people living with SCD, both positive and negative and management of sickle cell disease especially, in relation to prevention of triggers of SCD that can aggravate the health status of the individual living with sickle cell disease (Solomon, 2015).

It was discovered that attitude plays a significant role in management of people with SCD and that one of the major advances in understanding and changing behaviour is intention and that knowledge is necessary, even if people are well informed, they still need to be committed to perform a behaviour and then implement these intentions, as the model of health behaviour used in the study stated. People's intentions to protect themselves from harm are enhanced by four critical beliefs or perceptions, regarding severity of risks, vulnerability to the risks, perceived efficacy of a protective response, and self-efficacy at performing advocated behaviour and that people's intentions to protect them are weakened by the perceived costs of the advocated risk-reduction behaviour and the perceived benefits of the opposing risk-enhancing behaviour.

The summary of literature reviewed is that knowledge of sickle cell disease is low among in-school adolescents despite the large number of carriers and even, people living with sickle cell disease. Lack of education may support the likelihood that multiplication of SCD will continue to be on the increase (WHO, 2010; Anie, Egunjobi and Akinyanju, 2013). Furthermore, most of the healthy adolescents displayed negative attitude towards their mates living with the disease thereby adding to the social and psychosocial problems of those living with the disease. The knowledge of the management in relation to prevention of triggers of sickle cell crises may reduce the regular crisis and encourage rendering assistance in case of crisis. In the literature reviewed, it was discovered that males may experience crises more than females and highly

religious people may have positive attitude towards people living with sickle cell disease as they are likely to show more love and care as they may perceive the disease as an act of God or destiny while low religious people may not (Afolayan and Jolayemi, 2005).

Increase in the knowledge, attitude and management of sickle cell disease in most of the literature reviewed was reported after the intervention (Adewoyin, Alagbe, Adedokun and Idubor, 2015; Guobadia, 2015; Olatona, Odeyemi, Onajole and Asuzu 2013.

CHAPTER THREE
METHODOLOGY

This chapter presents the methodology that was adopted for this study. The chapter discussed the following sub-headings:

1. Research design
2. Population of the study
3. Sample and sampling technique
4. Research instrument
5. Validity of the instrument
6. Reliability of the instrument
7. Field-testing of the instrument
8. Ethical consideration
9. Procedure for data Collection
10. Procedure for data Analysis

Research Design

The study adopted the randomised pretest-posttest control group quasi-experimental research design using 2x2x3 factorial matrix. This design was adopted because the participants in experimental and control group were equal in number and were randomly assigned to treatment and control groups. Also, observed changes in the post-test could be extensively attributed to the effects of intervention given (Kerlinger and Lee, 2000). The design also allowed comparism between the experimental and control groups and determined the impact the intervention had on the performance of the experimental group.

The research design is illustrated as follows:

T_1 and T_2 represent pre-test for the experimental group and control group

T_3 and T_4 represent post-test for the experimental group and control group

X_1 represents Heamatologic Education (experimental group)

X_2 represents Environmental Hygiene Education (Control group)

The research design is illustrated as follows:

T_1 X_1 T_3----------Experimental group

T_2 X_2 T_4---------- Control group

T_1 and T_2 represents pretest observation for the experimental and control groups respectively while T_3 and T_4 represents posttest observation for the experimental and control groups respectively, X_1 represents heamatologic education intervention on knowledge, attitude and management of sickle cell disease while X_2 represents the control group that were exposed to teaching on environmental hygiene education. The design employed the use of a 2x2x3 factorial matrix. The treatment was at two levels; experimental and control groups. Gender was at two levels; male and female while religion was at three levels; Christianity, Islam and Traditional.

Table 3.1:Diagramatic represention of the factorial matrix used

Treatment	Gender	Religion
Heamatologic education (experimental group)	Male	Christianity Islam Traditional
	Female	Christianity Islam Traditional
Environmental health education (control group)	Male	Christianity Islam Traditional
	Female	Christianity Islam Traditional

Population of the study

The population for this study consisted of all public junior secondary school students in Ibadan Metropolis, Oyo State.

Sample and Sampling Technique

The sample size for the study was two hundred and twenty in-school adolescents in Ibadan Metropolis. Multistage sampling procedure was used for the study. This included simple random sampling technique, purposive sampling technique and total enumeration. These were explained as follows;

Stage One:

Simple random sampling technique of fish bowl without replacement was used to select two (2) Local Government Areas (LGAs) out of the existing five (5) LGAs in Ibadan Metropolis.

Stage Two:

Random sampling technique was used to assign the two selected Local Government into experimental and control groups.

Stage Three:

Simple random sampling technique of fish bowl without replacement was used to select two (2) schools from the selected Local Government for experimental and two (2) schools from the selected Local Government for control group.

Stage Four:

Purposive sampling technique was used to select JS2 students as JS1 students were new and not yet settled in school while JS3 were preparing to write their final examination.

Stage Five:

Total enumeration of two hundred and twenty volunteers whose parents filled the informed consen forms were the participants. This was made up of fifty five adolescents from each of the selected schools.

Table 3:1: Tabular presentation of selected schools and participants

Serial no	Local Government Area	Name of School	Total no of students
1	Ibadan North East	Olubadan High School, Aperin	55
2	Ibadan North East	United High School, Agugu	55
3	Ibadan North	Immanuel College High School, University of Ibadan	55
4	Ibadan North	IMG GrammarSchool, Yemetu Alaadorin	55
	TOTAL		220

Inclusion and Exclusion Criteria

The study accomodated public junior secondary students whose parents voluntarily signed the consent forms in the selected schools while students from private secondary schools were excluded from the study.

Research Instruments

Two research instruments were used for the study:

1. **Training manual guide on Heamatological Disease**

The manual was used as a training guide for the experimental group which outlined step by step procedure. The manual guide was validated by experts in line with the variables under the study. The training manual guide provided outlines and instructions for eight weeks with the duration of one hour and ten minutes each week, content, audience, teaching methods, instructional materials and evaluation.

2. **Self-developed Questionnaire:**

In order to examine the effect of haematologic education on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State, a self-developed questionnaire was designed to test the hypotheses for this study. The questionnaire which was self-developed and validated by the researher's Supervisor, other lecturers from in and outside the Department of Human Kinetics and Health Education and Sickle Cell Hope Alive Foundation, University College Hospital, Ibadan.

The questionaire has four sections. Section A covers the socio-demographic characteristics of the respondents, section B consists of information on Knowledge of Sickle Cell Disease Scale (KSCDS), Section C is on Attitude Towards Sickle Cell Disease Scale (ATSCDS) and Section D consists of Management of Sickle Cell Disease (MSCDS). These were used to elicit responses in line with the stated variables in the hypotheses and research questions.

The sections of the questionnaire were explained as follows:

Section A: This was used to obtain information on socio-demographic characteristics of the respondents. Five items were generated and responded to by the respondents. The items included gender, age, class, religion and tribe.

Section B: Knowledge of Sickle Cell Disease Scale (KSCDS)

Knowledge of Sickle Cell Disease Scale (KSCDS) was used to elicit responses from respondents on knowledge of sickle cell disease. It has three options of Yes, No and I Don't Know. Initially, fifty two (52) items were generated and administered during the field-testing of the instrument. The result of the analysis showed that twenty eight (28) items met 0.60 criterion, hence were retained; the eight (8) that had 0.5 and 0.59 were restructured while the ten (10) that were too low with the values of less than 0.5 were expunged. This made the number of the items to be (thirty six) 36. Each response was scored on a 'Yes', 'No' and 'I Don't know' format. A cronbach alpha was used to determine the internal consistency of KSCDS and it yielded a reliability of 0.81.

Attitude towards Sickle Cell Disease Scale (ATSCDS) was used to elicit responses from respondents on attitude towards sickle cell disease. Sixteen items (16) items were generated and administered during the field-testing of the instrument. The result of the analysis showed that all the items met with the 0.60 criterion, thus the items were retained. The responses were scored on a 4-point modified Likert format of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with the allotment of points in the following order; SA = 4, A = 3, D = 2 and SD = 1. Cronbach alpha was used to test the internal consistency of ATSCDS and it yielded a reliability of 0.83.

Management of Sickle Cell Disease Scale (MSCDS) was used to elicit responses from respondents on knowledge of management of sickle cell disease. Eighteen (18) items were generated and answered during the pre-testing of the instrument. The result of the analysis showed that sixteen (16) of the items met up with the 0.60 criterion, hence the items were retained. Other items that did not meet up with the retention criterion were deleted. The response were scored on a 4-point modified Likert format of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with the allotment of points in the following order; SA = 4, A = 3, D = 2 and SD = 1. Cronbach alpha was used to test the internal consistency of ATSCDS and it yielded a reliability of 0.80.

Validity of the Instrument

Validity is one of the most important characteristics of a good measuring instrument. It is the ability to measure what it is designed to measure (Thomas, Nelson and Silverman, 2015). To ensure this, a draft of the questionnaire was presented to the researcher's supervisor as well as

experts in the Department of Health Kinetics and Health Education and other experts from other related fields within the University of Ibadan and Sickle Cell Hope Alive Foundation, Univresity College Hospital, Ibadan, Nigeria for content and construct validity of the instruments. Their comments, criticism, suggestions and modifications of the instrument were adhered to in order to improve the quality of the instrument.

The items of the questionnaire were developed based on initial exploratory discussion with people that share similar characteristics with the actual study population. In the first stage, 106 items were generated based on the exploratory survey discussion after which the questionnaire was presented to a professional health educator and experts in psychometrics. This led to subtraction, addition and modification of the items. The items were later reduced to 84 items. This in turn helped to remove ambiguities and item construction problems. This instrument was then subjected to exploratory factor analysis. A Kaiser-Meyer-Olin (KMO) of 0.71 was obtained which is above the bench mark of 0.60. This indicates that the sample size was adequate for the conduct of factor analysis. The test of sphericity of each of the scales was statistically significant which support the factorability of the correlation matrix as the p-value stands at 0.000. All the items that did not meet up with the retention criteria of 0.5 were removed leaving the number of items with 68.

Reliability of the instrument

Reliability is the accuracy of an instrument in relation to stability and precision over repeated use. To ascertain the reliability of the instrument, validated version of the questionnaire was administered to thirty public secondary school students at I. M. G. Grammar School, Sharp Corner, Oke Ado in Ibadan South West Local Government who were not part of the study group but possess the same characteristics with the study population. The result was subjected to Cronbach Alpha to determine the reliability co-efficient. Knowledge (KSCDS) yielded a reliability of 0.80, Attitude (ATSCDS) yielded 0.83 while Management (MSCDS) yielded 0.80.

Field Testing of the Instrument

The field testing of the instrument was carried out on thirty secondary school students from Ibadan Municipal Grammar School, Sharp Corner, Oke Ado in Ibadan South West LGA who were not be part of the sample for the study but possess the same characteristics with the study population. This helped in determining the reliability of the instrument and helped to assess the feasibility of the study.

Procedure for Data Collection

A letter of introduction was collected from the Head of Department of Human Kinetics and Health Education, University of Ibadan. This was taken to the Head of Service, Governor's Office, Secretariat, OyoState. Letter of approval to carry out the study programme was obtained from the Ministry of Education and given to the Zonal Local Inspector Officer and later presented to Local Inspection Officer before it was presented to the Principals of selected schools in Ibadan in order to have access to the schools and the respondents. Prior to the commencement of the study, ten research assistants to be engaged with the students' training were trained so as to get them acquainted with the intervention programme in line with what the researcher has set out to achieve. The date and time as well as each research assistants' responsibility were defined. The training of both the experimental and control groups were done at different locations. The experimental group consisted of one hundred and ten participants from Ibadan North East Local Government while the control group consisted of one hundred and ten participants from Ibadan North Local Government. The purpose of the study was explained to the participants in the experimental and control groups.

Pre-test was administered to the participants in both the experimental and control groups at different locations before the commencement of the intervention training and these were collected on the spot. The experimental group was exposed to eight weeks heamatologic education intervention while the control group was given a placebo on environmental hygiene education. The experimental training took place at the same time but different days of the week. Post-test was administered at the end of the training to the participants in both the experimental and control groups and the copies were collected on the spot.

Training Programme for Experimental Group

A	**B**	**C**	**D**	**E**	**F**	**G**
Week / Time	Training Objectives	Content	Audience	Method of delivery	Materials	Evaluation
Week 1 1hr 20mins	Attheendofthesession, Participants will understand the purpose, objectives and benefits of the training.	Introduction to familiarization with the participants of pre-test.	Participants for the study.	DirectInstruction	Biro, pen and questionnaire.	Questions as written in the instrument.

Week 2 1hr 20 mins	At the end of this session, participants will be able to state 1.The meaning of heamatological Disease. 2.The meaning of sickle cell Disease. 3. Explain normal haemoglobin. 4. Explain abnormal haemoglobin.	Meaning of haematologic al diseases Concept of sickle cell disease. Normal haemoglobin. Abnormal haemoglobin.	Participant s	Direct Instructi on and discussio n.	Charts and diagrams showing normal and abnormal haemoglo bin.	What are is heamatologic diseases? What is sickle cell disease? What do you understand by normal haemoglobin? What is abnormal haemoglobin?
Week 3 1hr 20 mins	At the end of this session, participants will be able to 1. List the causes of sickle cell disease, 2. Explain the term 'genotype'. 3. List common types of genotype.	Causes of sickle cell disease. Meaning of genotype. Common types of genotype.	Participant s	Direct Instructi on and discussio n.	Charts, Diagrams and posters.	What causes sickle cell disease? Explain the term'genotype'. List the common types of genotype.
Week 4 1hr 20 mins	At the end of this session, participants will be able to 1. Explain some signs and symptoms of sickle cell disease. 2. State some of the complications.	Three major signs of sickle cell disease. Some other symptoms of sickle cell disease. Some of the complication s of sickle cell disease.	Participant s	Direct Instructi on and discussio n.	Charts, Diagrams and posters.	What are the three major signs of sickle cell disease? Mention some of the symptoms of sickle cell disease. List some of the complications of sickle cell disease.
Week 5	At the end of the session,	Facts about sickle cell	Participant s	Brainsto rming,	Charts, Diagrams	What are the facts about

1hr 20 mins	participants will be able to 1. List some of the facts of sickle cell disease. 2. Understand myths and concepti ons. 2. Mention someofthe Myths and misconceptions of sickle cell disease.	disease. Myths and Misconceptio n about sickle cell disease.		Direct Instructi on and discussio n.	and posters.	sickle cell disease? What do you understand by the word 'myths and misconception s'? Can you list some of the myths and misconception s of sickle cell disease?
Week 6 1hr 20mi ns	At the end of this session, 1.Participants will understand the word 'attitude'. 3. Explain some of the attitude towards their peers suffering from sickle cell disease. 3. Identify negative attitude. 4. Identify positive attitude.	Definition of attitude. Identify negative attitude. Identify positive attitude.	Participant s	Brainsto rming, Direct Instructi on and discussio n.	Charts, Diagrams and posters.	What is attitude? List some of the negative attitude towards peers suffering from sickle cell disease. Listsomeofthe positiveattitud etowardspeers sufferingfroms icklecelldiseas e.
Week 7 1hr 20 mins	At the end of this session, participants will be able to 1. Enumerate the steps to take in the management of	Management of sickle cell disease. Prevention of sickle cell disease.	Participant s	Direct Instructi on and discussio n.	Charts, Diagrams and posters.	Enumerate the steps to be taken in the management of sickle cell disease. How can sickle cell

	sickle cell disease. 2. Mention the best way to prevent sickle cell disease.					disease be prevented?
Week 8 1 hr. 20 mins	At the end of this session, 1. Both the participants and the trainer will know the outcome of the training programme. 2. Summary of the whole training will be made by the participants and the trainer. 3. Clarification will be made on areas that the participants do not understand well.	Appraisal of the training: summary Questions and answers on the subject matter.	Participants and the trainers.	Discussion	Diagrams and Charts.	Questions and feedback between the participants and trainers. Administration of Post-test instrument.

Informed Consent Form

Each participant took an informed consent form home for the parent or guardian to fill and all the forms were returned to the researcher duly signed.This confirmed their agreement that their wards can go ahead with the study programme.

Ethical Consideration

Approval to carry out the reseach was granted bythe Chairman, Ethical Review Committee of University of Ibadan in conjunction with Collaborative Institutional Training Initiative (CITI).

Procedure for Data Analysis

Completed copies of the research instrument were collected, coded and analysed using descriptive statistics of frequency counts and percentages to discuss participants' demographic attributes while inferential statistics of Multiple Analysis of Covariance (MANCOVA) was used to test all the hypotheses at 0.05 alpha level.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND DISCUSSION OF FINDINGS

This chapter focuses on the analysis of data with respect to research questions and hypotheses earlier stated. The chapter is divided into three (3) sections. Section A presents the demographic information of the respondents; section B provided answers to the research questions while section C provided the result of the tested hypotheses. The total number of participants was 220 but there was a subject mortality of eight participants who did not complete the intervention training.

Section A: Demographic Information of the Respondents

TABLE 4.1: Distribution of respondents according to selected demographic characteristics

Gender	**Frequency**	**Percentage**
Male	92	43.4
Female	120	56.6
Total	**212**	**100.0**
Age		
9-11years	149	70.3
12-14years	63	29.7
Total	**212**	**100.0**
Religion		
Christianity	83	39.2
Islam	129	60.8
Traditional	–	–
Total	**212**	**100.0**
Tribe		
Yoruba	192	90.6
Igbo	20	9.4
Hausa	-	-
Total	**212**	**100.0**

Table 4.1 above shows that 92 (43.4%) of the respondents were male while 120 (56.6%) were female, showing that majority of the respondents were female, 149(70.3%) were between the ages 9 and 11 years, 63(29.7%) were between the ages of 12 and 14 years showing that majority of the respondents were between the ages of 9 and 11 years. Concerning religion, 83 (39.2%) were Christian while 129(60.8%) were Muslim, showing that majority of the respondents were Muslim. Concerning the tribe, 192(90.6%) were Yoruba while 20(9.4%) were Igbo showing that the majority of the respondents were Yoruba.

Section B

This section provided answers to the stated research question

Research question 1: Do in-school adolescents in Ibadan Metropolis have knowledge about sickle cell disease.

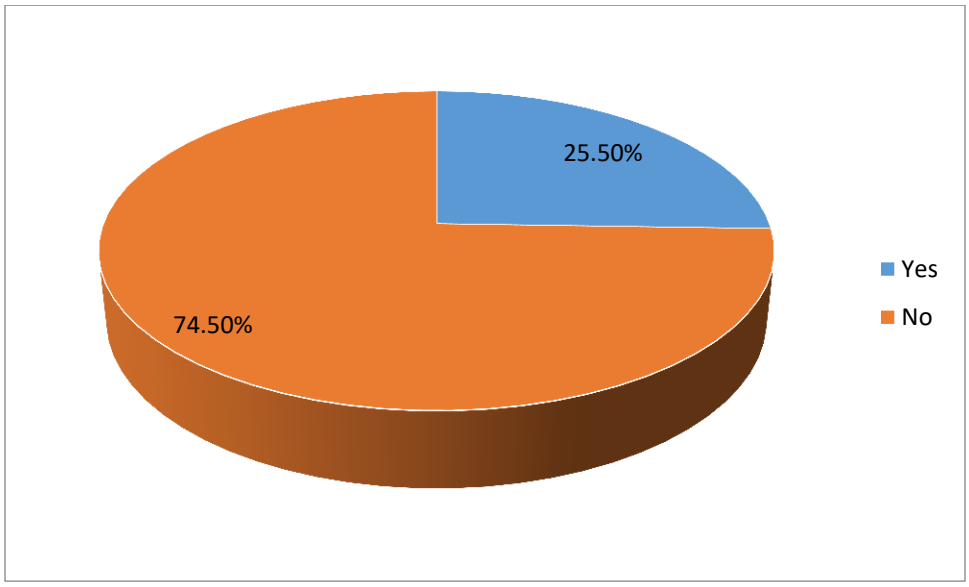

Fig.1.0: Pie chart showing the prevalence of knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis

The chart above revealed the prevalence of knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis. The chart shows that 54 (25.5%) have knowledge of sickle cell disease while 158 (74.5%) did not have. This shows that majority of the participants have no knowledge of sickle cell disease.

Research question 2: What are the common myths/misconceptions about the cause of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State?

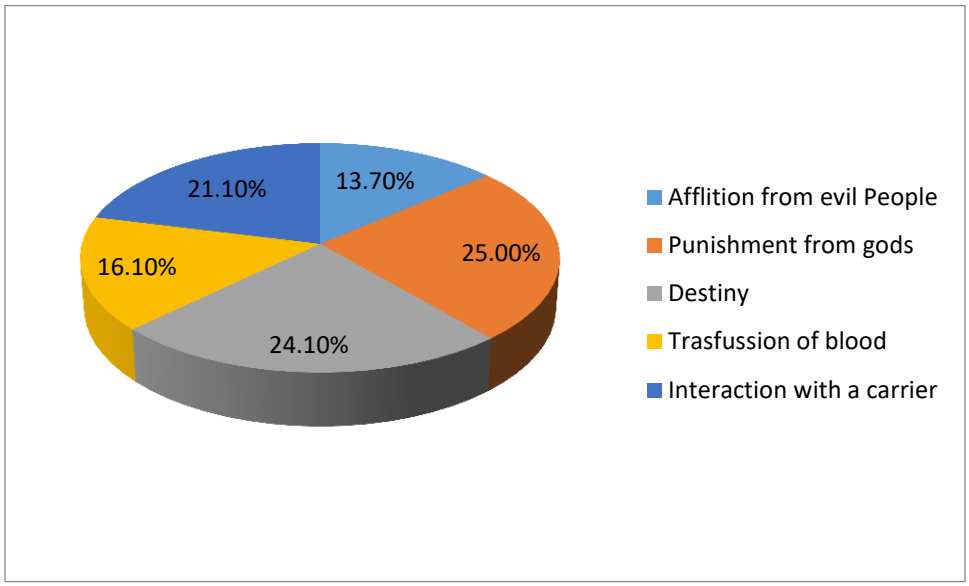

Fig. 2.0: Pie chart showing some myths/misconceptions about the cause of sickle cell disease among in-school adolescents in Ibadan Metropolis

The chart above revealed that 29 (13.7%) of the participants sees SCD as an affliction from evil people, 53 (25.0%) sees it as punishment from the gods, 51 (24.1%) sees it as destiny from God, 34 (16.1%) attributed it to blood transfusion while 45 (21.1%) believed it can be gotten by interacting with carriers. This shows that the most common myth about the cause of SCD is that it is a punishment from the gods.

Section C

Hypotheses testing

This section presents the result of the tested hypotheses

Ho 1a: There will be no significant main effect of treatment on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

Table 4.2: Summary of MANCOVA showing the pre-post test effects of treatment, gender and religion on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Knowledge	13153.150[a]	7	1879.021	14.368	.000	.330
	Attitude	66049.852[b]	7	9435.693	172.667	.000	.856
	Management	9345.676[c]	7	1335.097	22.246	.000	.433
Intercept	Knowledge	462973.918	1	462973.918	3540.076	.000	.946
	Attitude	218974.631	1	218974.631	407.092	.000	.952
	Management	128208.337	1	128208.337	136.239	.000	.913
Treatment	Knowledge	12461.766	1	12461.766	95.287	.000	.318
	Attitude	61537.082	1	61537.082	126.088	.000	.847
	Management	8368.943	1	8368.943	139.445	.000	.406
Religion	Knowledge	1095.681	1	1095.681	8.378	.004	.039
	Attitude	19.870	1	19.870	.364	.547	.002
	Management	154.249	1	154.249	2.570	.110	.012
Gender	Knowledge	482.994	1	482.994	3.693	.056	.018
	Attitude	110.197	1	110.197	2.017	.157	.010
	Management	630.171	1	630.171	10.500	.001	.049
Treatment *gender	Knowledge	70.436	1	70.436	.539	.464	.003
	Attitude	4.455	1	4.455	.082	.776	.001
	Management	325.154	1	325.154	5.418	.019	.026
Treatment * religion	Knowledge	222.744	1	222.744	1.703	.193	.008
	Attitude	95.184	1	95.184	1.742	.188	.008
	Management	338.038	1	338.038	5.632	.021	.027
Religion * gender	Knowledge	29.393	1	29.393	.225	.636	.001
	Attitude	2.971	1	2.971	.054	.816	.001
	Management	2.145	1	2.145	.036	.850	.001
Treatment *religion * gender	Knowledge	277.192	1	277.192	2.120	.147	.010
	Attitude	4.776	1	4.776	.087	.768	.001
	Management	99.891	1	99.891	1.664	.198	.008
Error	Knowledge	26679.279	204	130.781			
	Attitude	11147.940	204	54.647			
	Management	12243.249	204	60.016			
Total	Knowledge	537443.000	212				
	Attitude	314044.000	212				
	Management	159646.000	212				
Corrected Total	Knowledge	39832.429	211				
	Attitude	77197.792	211				
	Management	21588.925	211				

a. R Squared = .330 (Adjusted R Squared = .307)

b. R Squared = .856 (Adjusted R Squared = .851)

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Knowledge	13153.150[a]	7	1879.021	14.368	.000	.330
	Attitude	66049.852[b]	7	9435.693	172.667	.000	.856
	Management	9345.676[c]	7	1335.097	22.246	.000	.433
Intercept	Knowledge	462973.918	1	462973.918	3540.076	.000	.946
	Attitude	218974.631	1	218974.631	407.092	.000	.952
	Management	128208.337	1	128208.337	136.239	.000	.913
Treatment	Knowledge	12461.766	1	12461.766	95.287	.000	.318
	Attitude	61537.082	1	61537.082	126.088	.000	.847
	Management	8368.943	1	8368.943	139.445	.000	.406
Religion	Knowledge	1095.681	1	1095.681	8.378	.004	.039
	Attitude	19.870	1	19.870	.364	.547	.002
	Management	154.249	1	154.249	2.570	.110	.012
Gender	Knowledge	482.994	1	482.994	3.693	.056	.018
	Attitude	110.197	1	110.197	2.017	.157	.010
	Management	630.171	1	630.171	10.500	.001	.049
Treatment *gender	Knowledge	70.436	1	70.436	.539	.464	.003
	Attitude	4.455	1	4.455	.082	.776	.001
	Management	325.154	1	325.154	5.418	.019	.026
Treatment * religion	Knowledge	222.744	1	222.744	1.703	.193	.008
	Attitude	95.184	1	95.184	1.742	.188	.008
	Management	338.038	1	338.038	5.632	.021	.027
Religion * gender	Knowledge	29.393	1	29.393	.225	.636	.001
	Attitude	2.971	1	2.971	.054	.816	.001
	Management	2.145	1	2.145	.036	.850	.001
Treatment *religion * gender	Knowledge	277.192	1	277.192	2.120	.147	.010
	Attitude	4.776	1	4.776	.087	.768	.001
	Management	99.891	1	99.891	1.664	.198	.008
Error	Knowledge	26679.279	204	130.781			
	Attitude	11147.940	204	54.647			
	Management	12243.249	204	60.016			
Total	Knowledge	537443.000	212				
	Attitude	314044.000	212				
	Management	159646.000	212				
Corrected Total	Knowledge	39832.429	211				
	Attitude	77197.792	211				
	Management	21588.925	211				

a. R Squared = .330 (Adjusted R Squared = .307)

b. R Squared = .856 (Adjusted R Squared = .851)

c. R Squared = .433 (Adjusted R Squared = .413)

The results presented in Table 4.2 shows that there was a significant main effect of treatment on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 95.287, $p<.05$, $\eta^2=.318$). This implies that the treatments contributed significantly to the variation in participants' scores on knowledge of sickle cell diseases. The eta value of .318 shows that the treatments had a contribution of about 4% to knowledge of sickle cell disease of the participants. Therefore, the null hypothesis is rejected.

Table 4.3a: Adjusted Marginal Mean showing the direction of difference in knowledge of sickle cell disease between the treatment groups

Dependent Variable	Treatment Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Knowledge	Experimental	56.874	1.169	54.568	59.179
	Control	40.842	1.153	38.568	43.116

Table 4.3a showed that participants in experimental group obtained a higher mean score ($\bar{x}$ =56.874) while control had a mean score of ($\bar{x}$ =40.842). This shows that participants in experimental group had better knowledge of sickle cell disease than the control group. It then means that the treatment had better effect on knowledge of sickle cell disease of the participants in experimental group than the participants in the control group.

Ho 1b: There will be no significant main effect of treatment on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was a significant main effect of treatment on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis($F_{(1,204);}$ = 126.088, $p<.05$, $\eta^2=.847$). This implies that the treatments contributed significantly to the variation in participants' scores on attitude towards sickle cell diseases. The eta value of .847 shows that the treatments had a contribution of about 85% to attitude towards sickle cell disease among the participants. Therefore, the null hypothesis is rejected.

Table 4.3b: Adjusted Marginal Mean showing the direction of difference in attitude towards sickle cell disease between the treatment groups

Dependent Variable	Treatment Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Attitude	Experimental	51.414	.756	49.923	52.904
	Control	15.789	.746	14.319	17.259

Table 4.3b shows that participants in experimental group obtained a higher mean score ($\bar{x}$ =51.414) while control had a mean score of ($\bar{x}$ =15.789). This shows that participants in experimental group had better attitude towards sickle cell disease than the participants in the control group. It then means that the treatment had better effect on attitude towards sickle cell disease of the participant in experimental group than the participants in the control group.

Ho 1c: There will be no significant main effect of treatment on management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was a significant main effect of treatment on management of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 139.445, p<.00, η^2=.406). This implies that the treatments contributed significantly to the variation in participants' scores on management of sickle cell diseases. The eta value of .406 shows that the treatments had a contribution of about 41% to management of sickle cell disease of the participants. Therefore, the null hypothesis is rejected.

Table 4.3c: Adjusted Marginal Mean showing the direction of difference in management of sickle cell disease between the treatment groups

Dependent Variable	Treatment Groups	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Management	Experimental	32.280	.792	30.718	33.841
	Control	19.142	.781	17.601	20.682

Table 4.3c shows that participants in experimental group obtained a higher mean score

($\bar{x}$ =32.280) while control had a mean score of ($\bar{x}$ =19.142). This shows that participants in experimental group had better management of sickle cell disease than the control group. It then means that the treatment had better effect on management of sickle cell disease of the participants in experimental group than the participants in the control group.

H0 2a: There will be no significant main effect of religion on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was a significant main effect of religion on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 8.378, $p<.05$, $\eta^2=.039$). This implies that religion contributed significantly to the variation in participants' scores on knowledge of sickle cell diseases. The eta value of .039 shows that religions had a contribution of about 4% to knowledge sickle cell disease of the participants. Therefore, the null hypothesis is rejected.

Table 4.4a: Adjusted Marginal Mean showing the direction of difference in knowledge of sickle cell by religion between the treatment groups

Dependent Variable	Religion	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Knowledge	Christianity	51.235	1.264	48.743	53.726
	Islam	46.481	1.049	44.413	48.549

Table 4.4a shows that participants who are Christians obtained a higher mean score ($\bar{x}$ =51.235) while participants who are Muslim had a mean score of ($\bar{x}$ =46.481). This shows that participants who are Christians performed better than the participants who are Muslim. It then means that participants who are Christians had better understanding of sickle cell disease than participants who are Muslim.

H0 2b: There will be no significant main effect of religion on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 show that there was no significant main effect of religion on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = .364, p>.05, η^2=.002). This implies that religion did not contribute significantly to the variation in participants' scores on attitude towards sickle cell diseases. The eta value of .002 shows that religion had a contribution of about 0.2% to attitude towards sickle cell among the participants. Therefore, the null hypothesis is accepted.

Table 4.4b: Adjusted Marginal Mean showing the direction of difference in attitude towards sickle cell by religion between the treatment groups

Dependent Variable	Religion	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Attitude	Christianity	33.921	.817	32.311	35.532
	Islam	33.281	.678	31.944	34.618

Table 4.4b shows that participants who practices Christian religion obtained a higher mean score ($\bar{x}$ =33.921) while those who practices Islam had a mean score of ($\bar{x}$ =33.281). This shows that participants who are Christian had better attitude towards sickle cell disease than the participants who are Muslim. It then means that participants whose religion is Christianity had better attitude towards sickle cell disease than participants whose religion is Islam.

Ho 2c: There will be no significant main effect of religion on management sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant main effect of religion on management of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 2.570, p>.05, η^2=.012). This implies that religion did not contribute significantly to the variation in participants' scores on management of sickle cell diseases. The eta value of .012 shows that religion had a contribution of about 1.2% to management of sickle cell disease among the participants. Therefore, the null hypothesis is accepted.

Table 4.4c: Adjusted Marginal Mean showing the direction of difference in attitude of sickle cell by religion between the treatment groups

Dependent Variable	Religion	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Management	Christianity	26.603	.856	24.915	28.290
	Islam	24.819	.711	23.418	26.220

Table 4.4c shows that participants who are Christian obtained a higher mean score ($\bar{x}$ =26.603) while participants who are Muslim had a mean score of ($\bar{x}$ =24.819). This shows that participants who are Christian had better management of sickle cell disease than the participants with Islam religion. It then means that participants whose religion is Christianity had better management of sickle cell disease than participants with Islam religion.

Ho 3a: There will be no significant main effect of gender on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant main effect of gender on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 3.693, p>.05, η^2=.018). This implies that gender did not contribute significantly to the variation in participants' scores on knowledge of sickle cell diseases. The eta value of .018 shows that gender had a contribution of about 2% to knowledge of sickle cell disease among the participants. Therefore, the null hypothesis is accepted.

Table 4.5a: Adjusted Marginal Mean showing the direction of difference in knowledge of sickle cell disease by gender between the treatment groups

Dependent Variable	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Knowledge	Male	47.280	1.205	44.905	49.655
	Female	50.436	1.116	48.235	52.637

Table 4.5a shows that female participants obtained a higher mean score ($\bar{x}$ =50.436) while male had a mean score of ($\bar{x}$ =47.280). This shows that female participants had better knowledge of sickle cell disease than the male participants.

Ho 3b: There will be no significant main effect of gender on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant main effect of gender on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 2.017, p>.05, η^2=.010). This implies that gender did not contribute significantly to the variation in participants' scores on attitude towards sickle cell diseases. The eta value of .010 shows that gender had a contribution of 1.0% to attitude towards sickle cell disease among the participants. Therefore, the null hypothesis is accepted.

Table 4.5b: Adjusted Marginal Mean showing the direction of difference in attitude towards sickle cell disease by gender between the treatment groups

Dependent Variable	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Attitude	Male	32.847	.779	31.312	34.383
	Female	34.355	.722	32.932	35.777

Table 4.5b shows that female participants obtained a higher mean score ($\bar{x}$ =34.355) while male had a mean score of ($\bar{x}$ =32.847). This shows that female participants had better attitude towards sickle cell disease than the male participants.

Ho 3c: There will be no significant main effect of gender on management towards sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was a significant main effect of gender on management of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 10.500, p<.05, η^2=.049). This implies that gender contributed significantly to the variation in participants' scores on management of sickle cell diseases. The eta value of .049 shows that

gender had a contribution of about 5% to management of sickle cell disease among the participants. Therefore, the null hypothesis is rejected.

Table 4.5c: Adjusted Marginal Mean showing the direction of difference in management of sickle cell disease by gender between the treatment groups

Dependent Variable	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Management	Male	23.908	.816	22.299	25.517
	Female	27.513	.756	26.022	29.004

Table 4.5c shows that female participants obtained a higher mean score ($\bar{x}$ =27.513) while male had a mean score of ($\bar{x}$ =23.908). This shows that female participants had better management of sickle cell disease than the male participants.

Ho 4a: There will be no significant interaction effect of treatment and gender on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of treatment and gender on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = .539, p>.05, η^2=.003). This implies that the interaction effect of treatment and gender did not contribute significantly to the variation in participants' scores on knowledge of sickle cell diseases. The eta value of .003 shows that the interaction effect of treatment and gender had a contribution of less than 1% to management of sickle cell disease of the participants. Therefore, the null hypothesis is accepted

Table 4.6a: Adjusted Marginal Mean showing the direction of difference in knowledge of sickle cell disease by interaction of treatment and gender between the treatment groups

Dependent Variable	Treatment	Gender	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Knowledge	Experimental	Male	55.898	1.638	52.668	59.129
		Female	57.849	1.668	54.560	61.139
	Control	Male	38.661	1.767	35.178	42.145
		Female	43.023	1.483	40.098	45.947

Table 4.6a shows that female participants in control group obtained a higher mean score ($\bar{x}$ =43.023) than the male participants in the control group with a mean score of ($\bar{x}$ =38.661). This shows that female participants in control group performed better than the male participant in control group. Also from the table, female participants in experimental group obtained a higher mean score ($\bar{x}$ =57.849) than the male participants in experimental group with a mean score of ($\bar{x}$ =55.898). This shows that female participant in experimental group performed better than the male participants in the experimental group.

Ho 4b: There will be no significant interaction effect of treatment and gender on attitude of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of treatment and gender on attitude towards sickle cell diseaseamong in-school adolescents in Ibadan Metropolis, Oyo State ($F_{(1,204);}$ = .082, p>.05, η^2=.001). This implies that the interaction effect of treatment and gender did not contribute significantly to the variation in participants' scores on attitude towards sickle cell diseases. The eta value of .001 shows that the interaction effect of treatment and gender had a contribution of less than 1% to attitude towards sickle cell disease among the participants. Therefore, the null hypothesis is accepted.

Table 4.6b: Adjusted Marginal Mean showing the direction of difference in attitude toward sickle cell disease by interaction of treatment and gender between the treatment groups

Dependent Variable	Treatment	Gender	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Attitude	Experimental	Male	50.508	1.059	48.420	52.596
		Female	52.319	1.078	50.192	54.445
	Control	Male	15.186	1.142	12.935	17.438
		Female	16.391	.959	14.500	18.281

Table 4.6b shows that female participants in control group obtained a higher mean score ($\bar{x}$ =16.391) than the male participants in the control group with a mean score of ($\bar{x}$ =15.186). This shows that female participants in control group performed better than the male participant in control group. Also from the table female participants in experimental group obtained a higher mean score ($\bar{x}$ =52.319) than the male participants in experimental group with a mean score of (

$\bar{x}$ =50.508). This shows that female participant in experimental group performed better than the male participants in the experimental group.

Ho 4c: There will be no significant interaction effect of treatment and gender on management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 showed that there was a significant interaction effect of treatment and gender on management of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = .5418, p<.05, η^2=.026). This implies that the interaction effect of treatment and gender contributed significantly to the variation in participants' scores on management of sickle cell diseases. The eta value of .026 shows that the interaction effect of treatment and gender had a contribution of about 3% to management of sickle cell disease of the participants. Therefore, the null hypothesis is rejected

Table 4.6c: Adjusted Marginal Mean showing the direction of difference in management of sickle cell by interaction of treatment and gender between the treatment groups

Dependent Variable	Treatment	Gender	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Management	Experimental	Male	29.182	1.110	26.994	31.371
		Female	35.377	1.130	33.148	37.605
	Control	Male	18.634	1.197	16.275	20.994
		Female	19.650	1.005	17.668	21.631

Table 4.6c shows that female participants in control group obtained a higher mean score ($\bar{x}$ =19.650) than the male participants in the control group with a mean score of ($\bar{x}$ =18.634). This shows that female participants in control group performed better than the male participant in control group. Also from the table female participants in experimental group obtained a higher mean score ($\bar{x}$ =35.377) than the male participants in experimental group with a mean score of ($\bar{x}$ =29.182). This shows that female participant in experimental group performed better than the male participants in the experimental group.

Ho 5a: There will be no significant interaction effect of treatment and religion on knowledge of sickle cell disease among in-school adolescents in Ibadan metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of treatment and religion on knowledge of sickle cell disease among in-school adolescent in Ibadan Metropolis ($F_{(1,204);}$ = .1.703, p>.05, η^2=.008). This implies that the interaction effect of treatment and religion did not contribute significantly to the variation in participants' scores on knowledge of sickle cell diseases. The eta value of .008 shows that the interaction effect of treatment and religion had a contribution of less than 1% to knowledge of sickle cell disease of the participants. Therefore, the null hypothesis is accepted

Table 4.7a: Adjusted Marginal Mean showing the direction of difference in knowledge of sickle cell by interaction of treatment and religion between the treatment groups

Dependent Variable	Treatment	Religion	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Knowledge	Experimental	Christianity	60.322	1.866	56.644	64.000
		Islam	53.425	1.410	50.645	56.205
	Control	Christianity	42.147	1.705	38.785	45.509
		Islam	39.537	1.553	36.474	42.600

Table 4.7a shows that participants who are Christians in control group obtained a higher mean score ($\bar{x}$ =42.147) than the participants who are Muslim in the control group with a mean score of ($\bar{x}$ =39.537). This shows that participants who are Christians in the control group performed better than the participants who are Muslim in the control group. Also from the table participants who are Christians in experimental group obtained a higher mean score ($\bar{x}$ =60.322) than the Muslim participants in experimental group with a mean score of ($\bar{x}$ =53.425). This shows that participants who are Christians in experimental group performed better than the participants who are Muslim in the experimental group.

Ho 5b: There will be no significant interaction effect of treatment and religion on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of treatment and religion on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 1.742, p>.05, η^2=.008). This implies that the interaction effect of treatment and religion did not contribute significantly to the variation in participants' scores on attitude towards sickle cell diseases. The eta value of .008 shows that the interaction effect of treatment and religion had a contribution of less than 1% to attitude towards sickle cell disease of the participants. Therefore, the null hypothesis is accepted

Table 4.7b: Adjusted Marginal Mean showing the direction of difference in attitude of sickle cell by interaction of treatment and religion between the treatment groups

Dependent Variable	Treatment	Religion	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Attitude	Experimental	Christianity	52.434	1.206	50.057	54.812
		Islam	50.393	.911	48.596	52.190
	Control	Christianity	15.408	1.102	13.235	17.581
		Islam	16.169	1.004	14.189	18.149

Table 4.7b shows that participants who are Muslim in control group obtained a higher mean score ($\bar{x}$ =16.169) than the participants who are Christians in the control group with a mean score of ($\bar{x}$ =15.408). This shows that participants who are Muslim in the control group performed better than the participants who are Christians in the control group. Also from the table, participants who are Christians in the experimental group obtained a higher mean score ($\bar{x}$ =52.434) than the Muslim participants in the experimental group with a mean score of ($\bar{x}$ =50.393). This shows that participants who are Christians in experimental group performed better than the participants who are Muslim in the experimental group.

Ho 5c: There will be no significant interaction effect of treatment and religion on management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was a significant interaction effect of treatment and religion on management of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 5.632, p<.05, η^2=.027). This implies that the interaction effect of treatment and religion contributed significantly to the variation in participants' scores on management of sickle cell diseases. The eta value of .027 shows that the interaction effect of treatment and religion had a contribution of about 3% to management of sickle cell disease of the participants. Therefore, the null hypothesis is rejected.

Table 4.7c: Adjusted Marginal Mean showing the direction of difference in management of sickle cell by interaction of treatment and religion between the treatment groups

Dependent Variable	Treatment	Religion	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Management	Experimental	Christianity	34.492	1.264	32.000	36.983
		Islam	30.068	.955	28.184	31.951
	Control	Christianity	18.713	1.155	16.436	20.991
		Islam	19.570	1.052	17.495	21.645

Table 4.7c shows that participants who are Muslim in the control group obtained a higher mean score ($\bar{x}$ =19.570) than the participants who are Christian in the control group with a mean score of ($\bar{x}$ =18.713). This shows that participants who are Muslim in the control group performed better than the participants who are Christians in the control group. Also from the table participants who are Christians in the experimental group obtained a higher mean score ($\bar{x}$ =34.492) than the Muslim participants in the experimental group with a mean score of ($\bar{x}$ =30.068). This shows that participants who are Christians in the experimental group performed better than the participants who are Muslim in the experimental group.

Ho 6a: There will be no significant interaction effect of treatment on gender and religion on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of gender and religion on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 2.120, p>.05, η^2=.001). This implies that the interaction effect of gender and religion did not contribute significantly to the variation in participants' scores on knowledge of sickle cell diseases. The eta value of .010 shows that the interaction effect of gender and religion had a contribution of less than 1% to knowledge of sickle cell disease of the participants. Therefore, the null hypothesis is accepted.

Table 4.8a: Adjusted Marginal Mean showing the direction of difference in knowledge of sickle cell disease by interaction of gender and religion between the treatment groups

Dependent Variable	Gender	Religion	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
knowledge	Male	Christianity	49.267	1.744	45.828	52.707
		Islam	45.292	1.662	42.015	48.569
	Female	Christianity	53.202	1.829	49.596	56.808
		Islam	47.670	1.280	45.146	50.194

Table 4.8a shows that male participants who are Christians obtained a higher mean score ($\bar{x}$ =49.267) than the male participants who are Muslim in with a mean score of ($\bar{x}$ =45.292). This shows that male participants who are Christians performed better than the male participants who are Muslims in the group. Also from the table female participants who are Christians obtained a higher mean score ($\bar{x}$ =53.202) than the female participants who are Muslims with a mean score of ($\bar{x}$ =47.670). This shows that female participants who are Christians performed better than the female participants who are Muslim.

Ho 6b: There will be no significant interaction effect of gender and religion on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of gender and religion on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 054, p>.05, η^2=.001). This implies that the effect of gender and religion did not contribute significantly to the variation in participants' scores on attitude towards sickle cell diseases. The eta value of .001 shows that the interaction effect of gender and religion had a contribution of less than 1% to attitude towards sickle cell disease of the participants. Therefore, the null hypothesis is accepted

Table 4.9b: Adjusted Marginal Mean showing the direction of difference in attitude towards sickle cell disease by interaction of gender and religion between the treatment groups

Dependent Variable	Gender	Religion	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Attitude	Male	Christianity	33.291	1.128	31.068	35.514
		Islam	32.403	1.074	30.285	34.522
	Female	Christianity	34.551	1.182	32.220	36.882
		Islam	34.159	.828	32.527	35.790

Table 4.9b shows that male participants who are Christians obtained a higher mean score ($\bar{x}$ =33.291) than the male participants who are Muslim in with a mean score of ($\bar{x}$ =32.403). This shows that male participants who are Christians performed better than the male participants who are Muslims. Also from the table female participants who are Christians obtained a higher mean score ($\bar{x}$ =34.551) than the female participants who are Muslims with a mean score of ($\bar{x}$ =34.159). This shows that female participants who are Christians performed better than the female participants who are Muslim

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Ho 6c: There will be no significant interaction effect of gender and religion on management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of gender and religion on management of sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = 036, p>.05, η^2=.001). This implies that the interaction effect of gender and religion did not contribute significantly to the variation in participants' scores on management of sickle cell diseases. The eta value of .001 shows that the interaction effect of gender and religion had a contribution of less than 1% to the management of sickle cell disease among the participants. Therefore, the null hypothesis is accepted

Table 4.9c: Adjusted Marginal Mean showing the direction of difference in management of sickle cell disease by interaction of gender and religion between the treatment groups

Dependent Variable	Gender	Religion	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Management	Male	Christianity	24.695	1.182	22.365	27.025
		Islam	23.122	1.126	20.902	25.341
	Female	Christianity	28.510	1.239	26.067	30.953
		Islam	26.516	.867	24.806	28.226

Table 4.9c shows that male participants who are Christians obtained a higher mean score ($\bar{x}$ =24.695) than the male participants who are Muslim with a mean score of ($\bar{x}$ =23.122). This shows that male participants who are Christians performed better than the male participants who are Muslims. Also from the table female participants who are Christians obtained a higher mean score ($\bar{x}$ =28.510) than the female participants who are Muslims with a mean score of ($\bar{x}$ =26.516). This shows that female participants who are Christians performed better than the female participants who are Muslim.

Ho 7a: There will be no significant interaction effect of treatment, gender and religion on knowledge of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of treatment, gender and religion on knowledge of sickle cell disease among in-school adolescents

in Ibadan Metropolis ($F_{(1,204);}$ = 2.120, p>.005, η^2=.010). This implies that 3 ways interaction effect of treatment, gender and religion did not contribute significantly to the variation in participants' scores on knowledge of sickle cell diseases. The eta value of .010 shows that the interaction effect of treatment, gender and religion had a contribution of 1% to knowledge of sickle cell disease of the participants. Therefore, the null hypothesis is accepted.

Table 4.10a: Adjusted Marginal Mean showing the direction of difference in knowledge of sickle cell disease by interaction of treatment, gender and religion between the treatment groups

Dependent Variable	Treatment	Gender	Religion	Mean	Std. Error	95% Confidence Interval	
						Lower Bound	Upper Bound
Knowledge	Experimental	Male	Christianity	57.762	2.496	52.842	62.682
			Islam	54.034	2.124	49.847	58.222
		Female	Christianity	62.882	2.774	57.414	68.351
			Islam	52.816	1.855	49.158	56.474
	Control	Male	Christianity	40.773	2.438	35.966	45.580
			Islam	36.550	2.557	31.508	41.592
		Female	Christianity	43.522	2.385	38.820	48.223
			Islam	42.524	1.765	39.045	46.003

Table 4.10a shows that male participants who are Christians in control group obtained a higher mean score of ($\bar{x}$ =40.773) than the male participants who are Muslim in the control group with a mean score of ($\bar{x}$ =36.550). This shows that male participants who are Christians in the control group performed better than the male participants who are Muslims in the control group. Also from the table female participants who are Christians in the control group obtained a higher mean score ($\bar{x}$ =43.522) than the female participants who are Muslims in the control group with a mean score of ($\bar{x}$ =42.524). This shows that female participants who are Christians in the control group performed better than the female participants who are Muslim in the control group. Also from the table male participants who are Christians in experimental group obtained a higher mean score ($\bar{x}$ =57.762) than the male participants who are Muslims in the group. This shows

that male participants who are Christians in the experimental group performed better than the male participants who are Muslims. Also from the table female participants who are Christians in experimental group obtained a higher mean score ($\bar{x}$ =62.882) than the female participants who are Muslim with a mean score ($\bar{x}$ =52.816). This shows that female participants who are Christians in the experimental group performed better than the female participants who are Muslims in the experimental group.

Ho 7b: There will be no significant interaction effect of treatment, gender and religion on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of treatment, gender and religion on attitude towards sickle cell disease among in-school adolescents in Ibadan Metropolis ($F_{(1,204);}$ = .087, p>.05, η^2=.001). This implies that 3 ways interaction effect of treatment, gender and religion did not contribute significantly to the variation in participants' scores on attitude towards sickle cell diseases. The eta value of .001 shows that the interaction effect of treatment, gender and religion had a contribution of less than 1% to attitude towards sickle cell disease of the participants. Therefore, the null hypothesis is accepted.

Table 4.10b: Adjusted Marginal Mean showing the direction of difference in attitude towards sickle cell disease by interaction of treatment, gender and religion between the treatment groups

Dependent Variable	Treatment	Gender	Religion	Mean	Std. Error	95% Confidence Interval	
						Lower Bound	Upper Bound
Attitude	Experimental	Male	Christianity	51.820	1.613	48.629	54.990
			Islam	51.810	1.613	48.629	54.990
		Female	Christianity	53.059	1.793	49.524	56.594
			Islam	51.579	1.199	49.215	53.943
	Control	Male	Christianity	14.773	1.576	11.665	17.880
			Islam	15.600	1.653	12.341	18.859
		Female	Christianity	16.043	1.541	13.004	19.083
			Islam	16.738	1.141	14.489	18.987

Table 4.10b shows that male participants who are Muslims in the control group obtained a higher mean score ($\bar{x}$ =15.600) than the male participants who are Christians in the control group with a mean score of ($\bar{x}$ =14.773). This shows that male participants who are Muslims in the control group performed better than the male participants who are Christians in the control group. Also from the table female participants who are Muslims in the control group obtained a higher mean score ($\bar{x}$ =16.738) than the female participants who are Christians in the control group with a mean score of ($\bar{x}$ =16.043). This shows that female participants who are Muslim in the control group performed better than the female participants who are Christians in the group. Also from the table male participants who are Christians in the experimental group obtained a higher mean score ($\bar{x}$ =51.820) than the male participants who are Muslims in the group with the mean score ($\bar{x}$ =51.810). This shows that male participants who are Christians in the experimental group performed better than the male participants who are Muslims. Also from the table, female participants who are Christians in the experimental group obtained a higher mean score ($\bar{x}$ =53.059) than the female participants who are Muslim with a mean score ($\bar{x}$ =51.579). This shows that female participants who are Christians in the experimental group performed better than the female participants who are Muslims in the experimental group.

Ho 7c: There will be no significant interaction effect of treatment, gender and religion on management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State

The results presented in Table 4.2 shows that there was no significant interaction effect of treatment, gender and religion on management of sickle cell disease among in-school adolescent in Ibadan Metropolis ($F_{(1,204);}$ = 1.664, p>.05, η^2=.008). This implies that 3 ways interaction effect of treatment, gender and religion did not contribute significantly to the variation in participants' scores on management of sickle cell diseases. The eta value of .008 shows that the interaction effect of treatment, gender and religion had a contribution of about 0.8% to management of sickle cell disease of the participants. Therefore, the null hypothesis is accepted.

Table 4.10c: Adjusted Marginal Mean showing the direction of difference in management of sickle cell disease by interaction of treatment, gender and religion between the treatment groups

Dependent Variable	Treatment	Gender	Religion	Mean	Std. Error	95% Confidence Interval	
						Lower Bound	Upper Bound
Management	Experimental	Male	Christianity	30.571	1.691	27.238	33.905
			Islam	27.793	1.439	24.957	30.629
		Female	Christianity	38.412	1.879	34.707	42.116
			Islam	32.342	1.257	29.864	34.820
	Control	Male	Christianity	18.818	1.652	15.562	22.075
			Islam	18.450	1.732	15.035	21.865
		Female	Christianity	18.609	1.615	15.424	21.794
			Islam	20.690	1.195	18.334	23.047

Table 4.10b shows that male participants who are Christians in the control group obtained a higher mean score ($\bar{x}$ =18.818) than the male participants who are Muslims in the same group with a mean score of ($\bar{x}$ =18.450). This shows that male participants who are Christians in the control group performed better than the male participants who are Muslims in the control group. Also from the table female participants who are Muslims in the control group obtained a higher mean score ($\bar{x}$ =20.690) than the female participants who are Christians in the control group with a mean score of ($\bar{x}$ =18.609). This shows that female participants who are Muslim in the control group performed better than the female participants who are Christians in the control group. Also from the table male participants who are Christians in experimental group obtained a higher mean score ($\bar{x}$ =30.571) than the male participants who are Muslims in the group with the mean score ($\bar{x}$ =27.793). This shows that male participants who are Christians in the experimental group performed better than the male participants who are Muslims. Also from the table, female participants who are Christians in the experimental group obtained a higher mean score ($\bar{x}$ =38.412) than the female participants who are Muslim with a mean score ($\bar{x}$ =32.342). This shows that female participants who are Christians in the experimental group performed better than the female participants who are Muslims in the experimental group.

Discussion of findings

The result of hypothesis one showed that the in-school adolescents had poor knowledge of sickle cell disease before the haematologic education programme but there is significant main effect of treatment on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis. This is in line with the submission of Durotoye, Salaudeen, Babatunde, Bosah and Ajayi (2013) who came up with the report on the study among secondary school students in Jos that 63.3% of the participants had poor knowledge of sickle cell disease. Bazuaye and Olayemi (2009) concluded that secondary school students in Oyo state have poor knowledge of sickle cell diseaseas only 18% had correct idea about SCD, 48% had wrong idea while 34% had no idea at all. This result is also in line with Moronkola and Fadairo (2006) who also reported poor knowledge of sickle cell disease. Olarewaju, Enwerem, Adebimpe and Olugbenga-Bello (2013) also in support of this finding, confirmed that 83% of their study population were not aware of sickle cell disease. This is also supported by Olubiyi, Umar, Ajiboye, Olubiyi and Abioye (2013), with the result of the study that 30.3% of the respondents had the knowledge of sickle cell disease. The findings might be connected to poor knowledge of sickle cell disease among the population of the study.

The finding of hypothesis one which showed that the in-school adolescents in this study had negative attitude towards sickle cell disease before the haematologic education programme is at variance with Olarewaju et al (2013) who reported in the research carried out among Secondary School students in Jos, Nigeria that 76% showed negative attitude towards other students living with sickle cell disease. This is corroborated by Durotoye et al (2010) in the study among Senior Secondary school students in Ilorin Metropolis who recorded that more than half of the respondents displayed negative attitude. The result also tallied with Ani, Aranda, Kinance, Olay and Kramer (2012) in the study among Trainee-Teachers on stigmatizing attitude towards sickle cell disorders in Nigeria with the report that only 24% will invite mates living with SCD to their birthday party while 68% will not study with them. The researcher believed that lack of scientific knowledge of sickle cell disease might be a contributory factor to the display of negative attitude. Dyson, Atkins, Culley, Dyson and Evans (2010) also reported negative attitude among trainee-teachers in Southern Nigeria. The attitude of the in-school adolescents improved after the heamatologic intervention programme in this study. This finding supported the assertion of Olatona et al (2013) and Goubadia (2015) who carried out the study among among College

studentswho carried uot the study among who recorded improved attitude after the education. Conversely, a satisfactory report on attitude towards sickle cell disease in a study in Western Sudan was made by Daak, Elsamani, Ali, Mohamed, Abdel Rahman, Elderdery, Talbot, Kraft, Ghebremeskel, Elbashir and Fawzi (2016). Durotoye, Salaudeen, Babatunde, Bosah and Ajayi (2013) in their research work among senior secondary school students, who reported that only 4% of the students were aware of the management of sickle cell disease but the knowledge on the management improved in the experimental group. This agreed with Fowora (2016) and Adewoyin (2014) that adequate knowledge in the management of sickle cell disease can increase the quality of life and reduce psychosocial and psychological effects of those living with the disease.

Furthermore, Adewoyin, Alagbe, Adedokun and Idubor (2015), in their study among youth corps members in Benin, Edo State, Nigeria reported that 63.5% of the respondents had good knowledge of sickle cell disease in contrast to the findings in this study.The increased knowledge post-intervention in this study tallied with the findings of Adewoyin, Alagbe, Adedokun and Idubor (2015) that revealed increased level in the knowledge of sickle cell disease after intervention programme. This result is also in agreement with Olatona, Odeyemi, Onajole and Asuzu (2013) who reported an increase in the knowledge of sickle cell disease post intervention by 64% from 25%. Similarly, Guobadia (2015), Abioye-Kuteyi, Oyegbade, Bello and Osakwe (2009) and Chen, Lu, Wang, Huang and Chen (2008) also revealed increase in knowledge of sickle cell disease after intervention. This is further corroborated by the finding of a study carried out in Pittsburgh by Gustafon (2006) which showed that there was a significant overall knowledge gain after intervention; average score was 92% after education compared with 62% before education.

The result of hypothesis two revealed that there is no significant main effect of gender on knowledge andattitude towards sickle cell disease but was significant on management of sickle cell disease. This finding is in line with the finding of Liu (2006), who examined the condition of premarital screening and found that gender is not significantly associated with participation in genetic screening. Also in support of this finding, Wang, Wang, Fang and Weele (2013), in their study on factors influencing the decision to participate in medical examination in Hubei province, Mid-China found that gender had no significant effect on uptake of genetic screening.

Similarly, Roszanadia and Norazmir (2011) reported that gender did not have significant effect on healthy eating knowledge of adolescents. The reason why this is so in this study may be due to the fact that sickle cell disease affects male and female generally. This finding negate that of Al-Arrayed and Al-Hajeri (2010) in a study carried out in Bahrain, Saudi Arabia that sought to measure awareness about sickle cell disease in Bahrain and found that though there was no significant knowledge of sickle cell, women were found to be more knowledgeable than male. Arologun and Adefioye (2010) found out that women tend to have more knowledge (61.3%) about issues relating to reproductive health than males. This is supported by Farsi, Farsi, Gupta, Ouhtit, Farsi and Adawi (2014) with the result that females had increased awareness about G6PD than males in South Batinah Govenorate, Omar. Similarly, Amr, Amin and Omar (2013) revealed that more females in Jamaica scored higher than male with emphasis on adolescent females with sickle cell disease. The result is also in contrast to the finding of Adegoke, Fife and Corneille and Maya (2011) who found that there was a significant gender difference on knowledge, attitude and beliefs about contracting HIV/AIDs the first time an individual engages in sexual intercourse among adolescents in Ibadan Metropolis.

The study by Al-Aama (2010) on attitude towards mandatory national screening for hereditary hemolytic disorders showed that women had better knowledge (56.7%) and stronger attitude towards the implementation of screening (73.6%). Studies such as that of Khater and El-Ghazaly (2003); Abd Al-Azeem, Elsayed, El-sherbiny and Ahmed (2011) demonstrated that women were more oriented and more knowledgeable with important health issues related to genetics than men, which reflected on their attitude.Hejri, Mousa, Bushran, Al-Mutairi and Al-Harbi (2015) in a study evaluating genetic screening knowledge in Saudi students, the result showed that overall, unwillingness to perform pre-marital testing tended to be associated with female gender and some other factors. In contrast, their study further revealed that University students generally had moderate knowledge of genetic screening but males had more knowledge than their female counterparts, men had statistically significant increased awareness of sickle cell disease than women. Treadwell et al (2006) also supported that women exercise more influence more than men over decisions about reproduction.

Hypothesis three reported that there was no significant main effect of religion on knowledge and attitude towards sickle cell disease but had significant main effect on management. This result is supported by Omuemu, Obarisiagbon and Ogboghodo (2013) who in

their study on awareness and acceptability of screening for sickle cell disease among undergraduate students of the University of Benin found that respondents' cultural and religious beliefs did not influence their decision to accept screening for sickle cell. This finding is in line with the findings of Gullatte, Brawley, Kinney and Mooney (2010) that sought if an individual religion influences their attitude towards the treatment of a cancer diagnosis, it was reported that the participants who were more likely to delay seeking medical attention were those who were highly religious as they prefer to talk to God first. The findings of this study revealed that Christians performed better than the Muslim faithfuls. Furthermore, Nnaji, Ezeagwuna, Nnaji, Osakwe, Nwigwe and Onwurah (2013) established that the issue of Christians with increased knowledge may be due to the fact that church has become involved in creating awareness and encouraging their faithful on control of sickle cell disease by demanding for genotype result before consumating marriage in some churches. Zimmerman, Tabbaarah, Norwalk Raymund, Jewell and Wilson (2006) revealed that 83% of African Americans stated that religion influences their life quite a lot. This is supported by Anie, Egunjobi and Akinyanju (2010) and Afolayan and Jolayemi (2011) who confirmed that Nigerians engaged in more religious activities more than the Carribeans and people from United Kingdom when it comes to the issue of sickle cell disease. This finding is in contrast to the finding of Akintaro (2017), in his study on pre-marital genetic screening among Polytechnic students in Osun State when he found that religion has significant main effect on knowledge, attitude and uptake of pre-marital genetic screening among the participants.

Hypothesis four showed that the interaction effect of treatment and gender on knowledge, attitude and management of sickle cell disease is significant. The females had a higher mean score than males, this implied that male and female differ in their knowledge, attitude and management of sickle cell disease, both in control and experimental groups. This is in line with the findings of Kwan, Tam, Lee, Chan and Ngan (2011) in their school based educational study on adolescent girls found that there was greater knowledge and a more positive attitude with girls. This finding may be due to the fact that females care more when it comes to reproductive aspect of living.

The result of hypothesis five showed that there was no significant interaction effect of treatment and religion on knowledge and attitude towards sickle cell disease. The result revealed that Christians performed better in both the control and experimental groups in relation to

knowledge and attitude towards sickle cell disease. This might be due to the same reason that churches have become involved in creating awareness about sickle cell disease. This in line with Toni-Uebari and Inusa (2009) who revealed that church leaders as faith organisation have potential to influence health education with positive health outcomes and that, churches put in a lot of effort in creating awareness about transmission of sickle cell disease and its control. They also provide knowledge to at-risk population for increasing awareness about sickle cell disease. Nnaji et al 2013 corroborated this assertion. In relation to the management of sickle cell disease, the muslim faithfuls however performed better in control group while Christians performed better in the experimental group. This may be connected with the fact that muslim religious leader is also identifying with the control of sickle cell disease as Chiroma, Bukar and Abbo-Jimeta (2014) reported that Islam also encourages control of sickle cell disease as Kuwait have issued a mandatory rule that all intending couples should undergo genetic screening before marriage.

The result of hypothesis six reported that there was no significant interaction effect of gender and religion on knowledge, attitude and management of sickle cell disease. The result revealed that males and females who are Christians performed better in the control group, males and females who are muslim performed better in the experimental group in relation to knowledge of sickle cell disease while males that are Christians performed better than females who are Christians in both groups in relation to attitude and management of sickle cell disease. Onyeonoro, Chuckwu, Oshin, Nwanfor and Meka (2015) reported that being a Christian was associated with better knowledge of Tuberculosis and that people with low knowledge of Tuberculosiswere more likely to visit traditional healers. Pew Research Center (2016) revealed that women are generally more religious than men, particularly among Christians. Ugwu and Bregje (2014)concluded that females had a great reason for living, viewed their life as productive, meaningful and purposeful than males. They therefore regarded religion as a basis for life and may contribute to healing. Ugwu and Bregje (2015), in their study among pregnant mothers attending the antenatal clinicin a Missioary Hospital, Ijebu Ode, Ogun State agreed that religion and gender influences may lead to delays in emergency operations as engagement alternative providers (traditional birth attendants and faith healers) weilds much power in their communities and will be important to minimize delays and improve cultural acceptability of ceasarian section.

Hypothesis seven showed that there was no significant interaction effect of treatment, gender and religion on knowledge, attitude and management of sickle cell disease. Vieira, Gleici, Ana, Manoel, Daniella and Fernanda (2009) revealed in the study on the prevalence of violence among women by intimate partners among nurses and physicians in Internal Medicine and Gynaecology in Brazil that knowledge about epidermiology of violence was not found to be associated with sex or religion but in association with profession. Gender may have an impact on emotionally health and general health, the study observed that physical function, role of limitations due to emotional problems and general health were lower in males living with sickle cell disease but statistically significant. Energy, fatigue, emotional well-being, social function and pain scores were higher in males. The report concluded that routine medication did not have significant impact on their quality of life. This report is similar to the submission of Amir, Amin and Omar, (2013).This is contrary to Al Jaouni, Mahayawi, Halawi, Halawa and Mehayawi (2015) with the submission that adherence and early intervention improves their health related quality of life.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presentedthe summary, conclusion and recommendations which were drawn based on the result of the findings. Also the contributions of this thesis to knowledge as well as suggestions for further studies were documented.

Summary

The study revealed the effects of haematologic education on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State, Nigeria. The study was carried out using quasi-experimental research design of pretest-posttest control group type using 2x2x3 factorial matrix. Two hundred and twenty participants were selected as sample for the study using multi-stage sampling procedures that involved purposive, simple random sampling techniques and total enumeration but two hundred and twelve completed the intervention programme. The participants were placed in two groups; experimental and control group. Participants in experimental group were exposed to eight weeks training using the training manual developed by the researcher while the participants in the control group were given placebo (environmental health education). Data were collected before and after the intervention programme using self-developed questionnaire as instrument for data collection. Data were analysed using both descriptive and inferential statistics. The descriptive statistics used were frequency count, simple percentage and pie chart while Multivariate Analysis of Covariance was the inferential statistics used to determine the main as well as the interaction effects of the independent, dependent and moderating variables

The study provided answers to two research questions and tested seven hypotheses each with three sub variables, making it twenty one sub variables. Seven of the sub variables were rejected while the remaining fourteen were accepted. The result of the study shows that heamatologic education was effective on knowledge, attitude and management of sickle cell disease among in-school adolescents in Ibadan Metropolis, Oyo State, Nigeria. There was no significant main effect of gender and religion on knowledge and attitude towards SCD. The result also showed that the interaction effects of treatment and gender as well as the interaction

effect of treatment and religion were significant on management of sickle cell disease among the participants.

Conclusion

Based on the findings of this study, it was concluded that haematologic education was effective on knowledge, attitude and management of sickle cell disease. Gender has no significant effect on knowledge and attitude towards sickle cell disease. The study also concluded that the interaction effects of treatment and gender, treatment and religion as well as that of gender and religion were not significant on knowledge and attitude towards sickle cell disease. Both gender and religion have significant main effect on management of sickle cell disease. The 3-way interaction effect of treatment, gender and religion were not also significant on knowledge, attitude and management of sickle cell disease. The outcome of the study also led the researcher to conclude that very few in-school adolescents have knowledge about sickle cell disease while majority of them attributed the cause of sickle cell disease to punishment from the gods.

Recommendations

Based on the findings of this study and the conclusion, the following recommendations were made;

1. The findings of this study revealed the need for teachers in Ibadan, Nigeria to be trained on haematologic education, most especially, sickle cell disease which may lead to reduction in prevalence, mortality and morbidity associated with inadequate knowledge of sickle cell disease. Hence, the need for heamatologic education with emphasis on sickle cell, as part of basic science in Junior secondary school curriculum.
2. Since, the adverse health effects of lack or inadequate knowledge of sickle cell disease and its management are preventable, efforts to address this through practice and policy will contribute to the health of students and reduce stigmatization which will not only lead to enhanced health conditions but will also contribute to building healthier families and community.
3. Basic science teachers should be equipped with the knowledge of haematologic education so as to be able to teach the students.

4. Students at secondary school level should be encouraged to go for genetic screening so as to know their genotype and the implication of any decision they make, especially on the choice of their future partners, based on their gynotype.

Contributions to knowledge

This study established the following contribution to knowledge;

1. Haematologic education was effective in facilitating knowledge, attitude and management of sickle cell disease among in-school adolescents.
2. The majority of in-school adolescents believed that SCD is punishment from the gods.
3. The majority of in-school adolescents believed in scientific inheritance of SCD instead of erroneous believe that SCD is caused by gods.
4. Though gender did not have much effect on knowledge of SCD, however femalein-school adolescents were better in the knowledge of sickle cell disease when compared with their male counterparts.
5. Though gender did not have much effect on attitude towards sickle cell disease however, female in-school adolescents were better in attitude towards sickle cell disease.
6. Haematologic education when combined with gender and religion has no effect on knowledge, attitude and management of sickle cell disease.
7. Female in-school adolescents were better in the knowledge of management of sickle cell disease than male.
8. The in-school adolescents in the experimental group may serve as peer educators about the scientific knowledge of SCD.

Suggestions for further studies

Based on the findings and limitations of the study, the following studies are suggested to be considered worth investigating by researchers;

1. The study should be carried out on students in the rural local government areas as well by other interested researchers.
2. The study should be replicated on primary school pupils as well.
3. Study should be carried out on myths and misconceptions about sickle cell disease by Other researchers.

Training Programme for Control Group

A	B	C	D	E	F	G
Week/ Time	Training objectives	Topics/ Content	Audience	Methods	Materials	Evaluation
Week 1 1hour 20mins	At the end of this session, participants will understand the purpose, objectives and benefits of the training.	Introduction familiarization with the participants. Administration of pre-test.	Participants	Direct Instruction.	Biro and questionnaire.	Questions as written in the instrument.
Week 2 1hour 20mins	At the end of this session, participants will be able to define hygiene and explain the concept of environmental hygiene.	Concept of environmental hygiene, hygiene, environment.	Participants	Direct instruction andDiscussion.	Diagram	What is hygiene? What do you understand by environment? Define environmental hygiene.
Week 3 1hour 20mins	At the end of this session, participants will be able to list the importance of environmental hygiene.	Importance of environmental hygiene.	Participants	Direct instruction andDiscussion.	Diagram.	List the importance of environmental hygiene.
Week 4 1hour 20mins	At the end of the session, participants will be able to Understand good environmental hygiene and various ways of keeping to good environmental hygiene.	Good environmental hygiene. Various ways to good environmental hygiene.	Participants	Direct Instruction andDiscussion.	Diagram	What do you understand by good environmental hygiene? Mention some of the ways of keeping to good. environmental hygiene
Week 5 1hr 20 mins	At the end of the session, participants will be able tounderstand	Poorenvironmentalhygiene. Mention some activities that	Participants	DirectInstructionand Discussion.	Diagram, Posters.	What do you understand by poor

	poor environmental hygiene.	constitute poor environmental hygiene.				environmental hygiene? Mention some of the activities that constitute poor environmental hygiene.
Week 6 1hour 20mins	At the end of this session, participants should be able to Mention some diseases associated with poor environmental hygiene.	Diseases associated with poor environmental hygiene.	Participants	Direct instruction anddiscussion.	Charts, diagrams, posters.	List some of the diseases associated with poor environmental hygiene.
Week 7 1hour 20mins	At the end of the session, participants will be able to statetheir roles in the maintainance of good environmental hygiene.	Individual roles in maintaining good environmental hygiene.	Participants	Direct Instruction andDiscussion.	Posters.	Mention some of your roles in the maintenance of variousway sofgood environmental hygiene.
Week 8 1hour 20mins	At the end of this session, both participants and the facilitators will know the outcome of the programme summary of the whole training will be made by the participants and the facilitators. Clarification will be made on areas that participants do not understand well.	Appraisal of the training. Summary, questions and answers on the subject matter. Administration of posttest.	Participants	Discussion.	Posters	Questions and feedback between the participants and the facilitators.

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APPENDIX I

QUESTIONNAIRE

DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION

UNIVERSITY OF IBADAN, IBADAN, NIGERIA

QUESTIONAIRE ON KNOWLEDGE, ATTITUDE AND MANAGEMENT OF SICKLE CELL DISEASE AMONG ADOLESCENTS IN IBADAN METROPOLIS, OYO STATE.

Dear Participant,

I am a postgraduate student of the Department of Human Kinetics and Health Education, University of Ibadan, Ibadan. I am carrying out a research on the effect of heamatologic education intervention on knowledge and attitude towards sickle cell disease among adolescents in Ibadan. I am soliciting your cooperation in responding to the items in this questionnaire and in giving the correct response to the best of your knowledge. Your confidentiality is highly assured.

Thank you for your anticipated cooperation.

Yours faithfully,

Bhadmus-Ladi Yemisi C.

(The Researcher)

SECTION A

Demographic Data

INSTRUCTION: Please, tick (✓) the correct option as it applies to you.

Gender: Male ( )Female ( )

Age (years)_____

Class _____

Religion: Christianity ( ) (b) Islam ( ) (c) Traditional ( )

Tribe: Yoruba. ( ) (b) Igbo ( ) (c) Hausa ( )

Do you have knowledge about sickle cell (a) Yes (b) No

Which of the following do you believe to be a cause of sickle cell disease (a) Blood transfusion (b) Destiny (c) Punishment from the gods (d) Affliction by evil people (e) Interaction with carrier (f) Noneof the above

SECTION B

Knowledge of Sickle Cell Disease Scale (KSCDS)

INSTRUCTION: Please, tick (√) the answer that best represents your response.

S/N	Question items	Yes	No	I Don't Know
1.	Sickle cell disease is a heamatological or blood disease.			
2.	Sickle cell disease is an hereditary disease.			
3.	Sickle cell disease is caused by abnormal form of haemoglobin.			
4.	Individuals with sickle cell disease are born with it.			
5.	Someone who is living with SCD is often referred to as a 'sickler'.			
6.	A sickler lives with sickle cell disease throughout his or her lifetime.			
7.	Normal hemoglobin are round in shape and flexible.			
8.	Normal hemoglobin are commonly called hemoglobin A.			
9.	Abnormal haemoglobin are in sickle cell shape.			
10.	Abnormal hemoglobin are commonly called hemoglobin S.			
11.	Abnormal sickle shaped red blood cells easily clog together and may block the blood vessel of the body or reduce the blood flow.			
12.	Reduction or prevention of red blood cells from the affected part may cause full or partial damage to the body.			
13.	Someone with sickle cell disease has two abnormal haemoglobin 'S' commonly referred to as 'SS'.			
14.	People with only one of haemoglobin 'S' are commonly called carriers.			
15.	Inheritance of haemoglobin 'S' from both parents results in SCD.			
16.	Common types of genotype include 'AS' and 'SS'.			
17.	Sickle cell disease is not associated with supernatural forces or evil spirit.			
18.	Someone cannot get sickle cell disease from eating contaminated			

	food.			
19.	Touching an individual who is suffering from sickle cell disease cannot make the person have or catch the disease.			
20.	Touching an individual who is suffering from sickle cell disease cannot be a source of transfer of the disease.			
21.	Infection from organism is not a cause of sickle cell disease.			
22.	Infection from organism cannot be a cause of sickle cell disease.			
23.	Blood transfusion is not a cause of sickle cell disease.			
24.	Yellowish discolouration of the eyes can be a symptom of sickle cell disease.			
25.	Shortage of blood supply to any part of the body leads to pain experienced by the people living with SCD.			
26.	Someone with sickle cell disease may suffer from chronic pain in one or more parts of the body.			
27.	Long standing anaemia can be a symptom of sickle cell disease.			
28.	Sometimes, people with sickle cell disease may have a smaller stature than their healthy peers.			
29.	Someone with sickle cell disease may get tired easily.			
30.	Sometimes individual with sickle cell disease may fall sick often.			
31.	Pain experienced by someone living with SCD is often referred to as ‘crisis’.			
32.	There is no immunization or vaccine for the prevention of sickle cell disease.			
33.	Someone with haemoglobin ‘S’ (carrier) are advised not to marry a partner with haemoglobin ‘S’ to avoid sickle cell disease.			
35.	Marriage between carriers will lead to having children with sickle cell disease.			
36.	Sickle cell disease is a serious condition.			

SECTION C

Attitude Towards Sickle Cell Disease Scale (ATSCDS)

INSTRUCTION: Please, tick (√) the column that best represents your level of agreement or disagreement.

Keys: SA – Strongly Agree; A – Agree; D – Disagree; SD - Strongly Disagree

S/N	Question Items	SA	A	D	SD
1.	I cannot relate with someone suffering from sickle cell disease.				
2.	I cannot assist an individual in sickle cell disease crisis.				
3.	I avoid playing with a school mate suffering from sickle cell disease because they are fragile.				
4.	The yellowish discolouration of the eyes of someone living with sickle cell disease scares me, so I avoid them.				
5.	Sickle cell disease is shameful, so I cannot have a mate living with sickle cell disease as a friend.				
6.	It is a waste of time checking one's genotype.				
7.	I cannot invite someone suffering from sickle cell disease to my party.				
8.	I cannot share food and drink with a mate suffering from sickle cell disease.				
9.	I cannot engage in study sessions with a fellow classmate suffering from sickle cell disease.				
10.	Having sickle cell disease is by individual's destiny.				
11.	I consider people suffering from sickle cell disease as useless.				
12.	I regard sickle cell disease as deadly because it is not curable.				
13.	Individuals suffering from sickle cell disease can never live a normal life.				
14.	I detest people living with sickle cell disease.				
15.	I can never have anything to do with someone suffering from sickle cell disease.				
16.	I consider sufferers of sickle cell disease as people that are liable to die at any time.				

SECTION D

Management of Sickle Cell Disease Scale (MSCDS)

INSTRUCTION: Please, tick ( ) the column that best represents your level of agreement or disagreement as it relates to Management of sickle cell disease

Keys: SA – Strongly Agree; A – Agree; D – Disagree; SD - Strongly Disagree

S/N	Question Items	SA	A	D	SD
1.	People with sickle cell disease should report early the onset of fever or pain in any part of their body				
2.	People living with sickle cell disease are advised to take their recommended drugs regularly.				
3.	Someone living with sickle cell disease should avoid engaging in strenuous exercise.				
4.	People with sickle cell disease should always go for regular medical check-up.				
5.	Avoidance of very hot or cold weather is necessary in order to avoid crisis.				
6.	I motivate friends with sickle cell disease to eat adequate diet.				
7.	People with sickle cell disease should consume more of fruits and vegetables.				
8.	People with sickle cell disease need to cultivate the habit of good personal hygiene.				
9.	Regular washing of hands with soap and clean water many times a day is one of the ways to prevent getting an infection.				
10.	Alcoholic consumption, smoking and use of hard drugs should be avoided.				
11.	Moderate exercise is good for people suffering from sickle cell disease.				
12.	It is not advisable for someone living with sickle cell to be in a highly crowded place always.				
13.	Stings and bites must be avoided as much as possible.				
14.	Avoidance of self-medication is important.				
15.	Prevention of malaria fever is very important.				
16	Drinking of at least eight to ten cups of water daily is very important.				

APPENDIX II

TRAINING PROGRAMME FOR THE EXPERIMENTAL GROUP

The group will be taken through sickle cell education. The intervention is expected to last for eight weeks with a duration of 1 hour and 20 minutes per session. Summary is as follows:

SESSION ONE

Objectives of the session:

1. To state the purpose of the class sessions.
2. To explain the procedure to be followed by the trainers and the participants.
3. To administer the pre-test instrument on the participants.

Step 1:

The researcher will welcome the participants. The participants will be allowed to take turns to introduce themselves at the beginning of the session. This is to ensure familiarization between the participant and the trainers.

Step 2:

The trainer/research assistant will explain in clear terms the purpose, objectives and benefits of the training day and duration time for each teaching. .

Step 3*:*

The participants will be told what is expected of them in the course of the training session, the importance of punctuality, regular attendance, cooperation and participation during discussion.

Step 4:

The researcher thereafter will administer the pre-test on the participants with the help of the trained research assistants. Same will be collected on the spot.

Closing:

1. The participants will be commended.
2. The participants will be reminded of the time and venue for the next session.
3. The researcher will appreciate the participants and serve some snacks to close the session.

SESSION TWO

Topic: The Concept of sickle cell disease, Normal and Abnormal Heamoglobin

Objectives: At the end of the session, the participants should be able to:

1. Define heamatological disease.

1. State the concept of sickle cell disease.
2. State the meaning of SCD.
3. Explain the normal and abnormal hemoglobin.

Activity

Step 1: The trainer greets and welcomes the participants.

Step 2***:*** The topic for the week will be introduced and explained.

Step 3***:*** The trainer will ask questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks:

1. The trainer will commend the participants for their cooperation.
2. The participants are also reminded of the next class session and time.
3. The trainer closes the session.

SESSION THREE

Topic. : Causes of sickle cell disease and common types of genotype

Objectives: At the end of the session, the participants should be able to:

1. List the causes of SCD

2. Mention some common types of SCD and genotype.

Activity

Step 1: The session will commence with an overview of the previous session.

Step 2: The trainer introduces and explain the topic for the week.

Step 3***:*** The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.
2. The participants are also reminded of the next class and the tome.
3. The trainer closes the session.

SESSION FOUR

Topic:- Signs and symptoms of sickle cell disease.

Objective : At the end of the lesson, the participants should be able to:

1. List three major signs of sickle cell disease.

2. Mention some symptoms of sickle cell disease.
3. Mention some complications of sickle cell disease.

Activity

Step 1: The trainer welcomes the participants.

Step 2:The topic for the day will be introduced and explained.

Step 3:The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.

2. The participants are also reminded of the next class and time.

3. The trainer closes the session.

SESSION FIVE

Topic: Facts and Misconception about sickle cell disease

Objective: At the end of the lesson, the participants should be able to:

1. List facts about sickle cell disease.
2. Mention some misconceptions about sickle cell disease.

Activity:

Step 1:The trainer welcomes the participants

Step 2: The topic for the day will be introduced and explained.

Step 3: The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.

2. The participants are also reminded of the next class and the time.

3. The trainer closes the session.

SESSION SIX

Topic: Attitude towards mates/peers suffering from SCD.

Objectives: At the end of the class session, participant should be able to:

1. Explain the context attitude.

2. Mention some of the negative attitude.
3. Mention some of the positive attitude

Activity:

Step 1: The trainer welcomes the participants

Step 2: The topic for the day will be introduced and explained.

Step 3: The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.
2. The participants are also reminded of the next class and the time.
3. The trainer closes the session.

Closing:

1. The trainer commends the participants for their cooperation.
2. The participants are also reminded of the next class and the time.
3. The trainer closes the session.

SESSION SEVEN

Topic: Management and prevention of SCD

Objectives: At the end of the class session, participant should be able to:

1. Mention the best way in the prevention of SCD

Activity:

Step 1: The trainer welcomes the participants

Step 2: The topic for the day will be introduced and explained.

Step 3: The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.
2. The participants are also reminded of the next class and the time.
3. The trainer closes the session.

SESSION EIGHT

Topic: Review of the Previous Topics and Administration of Post-Test Instrument

Objectives: At the end of the session, the participants will be able to:

1. Summarize what they had learnt from the training programme.

2. Express their willingness and readiness to develop positive attitude towards their mates living with from sickle cell disease.

Activity:

Step 1: The trainer welcomes the participants.

Step 2: The trainer verifies the progress made by the participants.

Step 3: Questions will be asked bothering on knowledge and attitude towards people suffering from sickle cell disease and questions from the participants will be answered and clarified.

Step 5: The overall review of the training will done.

Step 6: Post-test instrument will be administered on the participants. Same will be collected on the spot with the help of the research assistants.

Closing remark:

1. The trainer will commend the participants.
2. The trainer will appreciate all the participant and serve some snacks to end the programme.
3. The participants are dismissed.

APPENDIX III

TRAINING PROGRAM FOR THE CONTROL GROUP ON ENVIRONMENTAL HYGIENE

SESSION ONE

Topic: Definition of hygiene and Concept of Environmental Hygiene

Objectives: At the end of the session, the participants should be able to:

1. Define hygiene.
2. State the concept of environmental hygiene.

Activity

Step 1: The trainer greets and welcomes the participants.

Step 2***:*** The topic for the week will be introduced and explained.

Step 3***:*** The trainer will ask questions to evaluate the topic taught and make corrections where necessary.

Closing Remarks:

4. The trainer will commends the participants for their cooperation.
5. The participants are also reminded of the next class session and time.
6. The trainer closes the session.

SESSION TWO

Topic. : Importance of Environmental Hygiene.

Objectives: At the end of the session, the participants should be able to:

2. List the importance of environmental hygiene.

Activity

Step 1: The session will commence with an overview of the previous session.

Step 2: The trainer introduces and explain the topic for the week.

Step 3***:*** The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

4. The trainer commends the participants for their cooperation.
5. The participants are also reminded of the next class and the tome.
6. The trainer closes the session.

SESSION THREE

Topic: Good Environmental Hygiene

Objectives: At the end of the class session, participant should be able to:

1. Understand the good environmental hygiene.

Activity:

Step 1: The trainer welcomes the participants

Step 2: The topic for the day will be introduced and explained.

Step 3: The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.
2. The participants are also reminded of the next class and the time.
3. The trainer closes the session.

SESSION FOUR

Topic: Poor Environmental Hygiene

Objective : At the end of the lesson, the participants should be able to:

Explain poor environmental hygiene.

Activity

Step 1:The trainer welcomes the participants.

Step 2: The topic for the day will be introduced and explained.

Step 3:The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.
2. The participants are also reminded of the next class and time.
3. The trainer closes the session.

SESSION FIVE

Topic: Diseases Associated with Poor Environmental Hygiene

Objective: At the end of the lesson, the participants should be able to:

Activity:

Step 1:The trainer welcomes the participants

Step 2: The topic for the day will be introduced and explained.

Step 3: The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.

2. The participants are also reminded of the next class and the time.

3. The trainer closes the session.

SESSION SIX

Topic: Diseases associated with poor environmental hygiene

Objective: At the end of the lesson, the participants should be able to:

Activity:

Step 1:The trainer welcomes the participants

Step 2: The topic for the day will be introduced and explained.

Step 3: The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.

2. The participants are also reminded of the next class and the time.

3. The trainer closes the session.

SESSION SEVEN

Topic: Individual roles in the maintenance of good environmental hygiene

Objectives: At the end of the class session, participant should be able to:

Mention various ways of maintaining good environmental hygiene.

Activity:

Step 1: The trainer welcomes the participants

Step 2: The topic for the day will be introduced and explained.

Step 3: The trainer asks questions to evaluate the topic taught and make corrections where necessary.

Closing:

1. The trainer commends the participants for their cooperation.

2. The participants are also reminded of the next class and the time.

3. The trainer closes the session.

SESSION EIGHT

Topic: Review of the Previous Topics and Administration of Post-Test Instrument

Objectives: At the end of the session, the participants will be able to:

1. Summarize what they had learnt from the training programme.
2. Express their willingness to practice good environmental hygiene.

Activity:

Step 1: The trainer welcomes the participants.

Step 2: The trainer reviews all the sessions done by asking questions and allowing contributions

from the participants.

Step 3: The trainer encourages the participants to set goals in achieving healthy attitudinal Behaviors.

Step 4: The overall review of the training will done.

Step 5: Post-test instrument will be administered on the participants. Same will be collected on the spot with the help of the research assistants.

Closing remark:

1 The trainer will commend the participants.

4. The trainer will appreciate all the participant and serve some snacks to end the programme.
2. The participants are dismissed.

Closing:

1. The participants will be commended.
2. The participants will be reminded of the time and venue for the next session.
3. The researcher will appreciate the participants and serve some snacks to close the session.

APPENDIX IV

HEAMATOLOGIC EDUCATION MANUAL

Purpose of the Intervention

The purpose of this education program is to see if there will be improved knowledge and positive attitude towards sickle cell disease among adolescents in Ibadan Metropolis, Oyo State, Nigeria.

Objectives of the intervention

By the end of the eight weeks heamatologic education, it is expected that adolescents programme, it is expected that adolescents in Ibadan metropolis will be able to:

1. Have better knowledge of sickle cell diseases.
2. Have better and positive attitude towards people suffering from sickle cell disease.

Modality of the intervention

The intervention programme shall be for:

1. A period of eight weeks
2. Adolescents in Ibadan Metropolis, Oyo State
3. One hour and twenty minutes once a week

Outline of the Programme

1. Pretest of participants' knowledge and attitude towards sickle cell disease.
2. Heamatologic education sessions for a period of eight weeks for the treatment group.
3. Environmental health education for a period of eight weeks for the control group.
4. Posttest of participants' knowledge and attitude.

Topics to be considered for the hematologic education

1. Meaning of hematologic diseases.
2. Concept of sickle cell disease.
3. Normal and abnormal hemoglobin
4. Inheritance of sickle cell disease
5. Signs and symptoms of sickle cell disease
6. Complications of sickle cell disease
7. Attitude towards people living with sickle cell disease
8. Management of sickle cell disease
9. Prevention of sickle cell disease.
10.

APPENDIX V

HEAMATOLOGIC EDUCATION TRAINING PACKAGE

Week One: Topic: General Orientation and Administration of Pretest Instrument

Objectives of the sessions are the following:

1. To state the purpose of the programme.
2. To explain the steps to follow by the trainers and the participants.
3. To administer the Pretest Instrument on the participants.

Step 1

The researcher will welcome the participants, solicit for their co-operation, punctuality and regular attendance.

Step 2

The researcher will state and explain in clear terms the purpose, objectives and benefits of the training day, duration (no of contacts), time and number of hours for each contact.

Step 3

Administration of a pretest. Participants will be encouraged to fill the questionnaire with all sincerity. Same will be collected on the spot.

Closing Remark

1. The participants will be commended for giving their time.
2. They will be reminded of the time and venue for the next session.
3. The researcher appreciates the participants and serve some snacks to end the session.

Week Two Topic: Meaning of heamatologic diseases,Concept of sickle cell disease, normal and abnormal hemoglobin.

Objectives: At the end of the lesson, participants should be able to:

1.State heamatologic diseases de

2. Define sickle cell disease.
3. Identify the role of haemoglobin
4. Identify normal and abnormal heamoglobin

Welcome of the participants

Step 2

The teacher introduces the topics for the day

Meaning of heamatologic diseases

Heamatologic diseases are blood diseases. Blood is composed of red blood cells which carry oxygen to the tissues of the body, white blood cells which help the body to fight infections and platelets which controls bleeding and clotting of blood.

Concept of sickle cell disease

Sickle cell disease is an inherited blood disorder that affects red blood cells (RBC).

Step 3: Normal and Abnormal heamoglobin

The part of the blood that carries oxygen is called heamoglobin. The role of heamoglobin is the deliver oxygen to the tissues and cells of the body. Normal red blood cells are round in shape, flexible and move easily through the blood vessels of the body. They are called Heamoglobin A. Abnormal red blood cells are sickle in shape, sticky, stiff and rigid. They are called heamoglobin S. People with sickle cell disease have the red blood cells that contain mostly heamoglobin S which is an abnormal type of hemoglobin. Normal red blood cells contain heamoglobin A. The disease affects about 25 million people in the world out of which about 15 million live in Africa. Nigeria has the highest number of sufferers.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.
4. The researcher appreciates the participants and serve some snacks to end the session.

Week Three Topic: Inheritance of sickle cell disease

Objectives: At the end of the session, the participants will be able to:

1. Explain the inheritance of sickle cell disease.

Step 1

The researcher welcomes the participants. They will be allowed to ask questions from the previous topics. The new topic will be introduced.

Step 2: Inheritance of sickle cell disease

Everybody has two genes in every cell in their body Every baby has two copies of heamoglobin in every cell in their body; one each from the father and the mother. The gene the baby gets therefore depend on the genes their parents have. The usual genes are normal gene of heamoglobin A and abnormal gene of heamoglobin S. In sickle cell disease, the individual inherits one heamoglobin S from the father and the other heamoglobin S from the mother, that is SS. Inheritance of one gene of heamoglobin A from one parent and another gene of heamoglobin S from another parent result is AS. Individual with heamoglobin AS is called a carrier. A carrier has sickle cell trait. A carrier may not get sick at all times, but is capable of passing the heamoglobin S to his or her children. Intermarriage between carriers

lead to individuals with heamoglobin SS, sickle cell disease. The most common types of sickle cell disease are heamoglobin SS and heamoglobin AS. Individuals with heamoglobin SS fall sick often with symptoms of sickle cell disease.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.
4. The researcher appreciates the participants and serve some snacks to end the session.

Week Four Topic: Signs, symptoms and complication of sickle cell disease

Objectives: At the end of the session, participants will be able to:

1. State reasons for encountering the signs and symptoms.
2. List some common signs and symptoms of sickle cell disease.
3. Mention some of the complications of sickle cell disease.

Step 1

Abnormal sickle shaped red blood cells easily clog together and may block the blood vessel of the body or reduce the blood flow. Blocking of the blood vessels reduces or prevents the blood supply to the affected part of the body. Reduction or prevention of red blood cells from the affected part of the body may cause full damage or partial damage. The partial damage or total damage leads to the symptoms of sickle cell disease.

Step 2

Some signs and symptoms of sickle cell disease

The signs and symptoms are due to the fact that sickled red blood cells clog together and causes either a partial or total blockage of blood vessels supply to some parts of the body. Partial blockage causes reduced blood flow to any part of the body affected. Total blockage causes stoppage of blood to any part of the body affected. Shortage of blood supply to any part of the body leads to pain. Crisis is episodes of severe pain experienced by people suffering from sickle cell disease. Pain is most felt in the bones of the body joints of the body and abdomen. Anaemia is severe drop in heamoglobin which gives blood the red colour. Anaemia occurs due to rapid breakdown of sickled red blood cells as they clog together. Anaemia also causes yellowish discolouration of the white part of the eyes due to accumulation of bilirubin. Bilirubin is the bye product of rapid breakdown of abnormal red blood cells that is yellow in color.

Step 3: Some of the complications of sickle cell disease

Chest pain, high temperature, inability to breathe properly and cough may present due to reduced blood supply to the lungs. Abdominal pains result from reduced or blockage of blood supply to the abdomen. Leg ulcers, especially over the ankles and sides of the lower legs due to reduced blood flow to the legs. Delayed growth or small stature occurs due to anaemia.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.
4. The researcher appreciates the participants and serve some snacks to end the session.

Week Five: Topic: Facts and misconceptions about sickle cell disease

Objectives: At the end of the session. Participants will be able to:

1. List facts about sickle cell disease.
2. Mention some of the misconceptions about sickle cell disease.

Step 1: Facts about sickle cell disease

Sickle cell disease is a genetic disease blood disorder caused by the presence of an abnormal form of heamoglobin. Yellowish colouration of the white part of the eyes are some of the signs of sickle cell disease Sickle cell disease is a hereditary disease. Sickle cell disease is a life-long disease. A male with sickle cell disease may have a smaller stature than males without the disease. Individual with sickle cell disease gets fired easily. Sickle cell disease makes victims fall sick often. Someone with sickle cell disease may be absent from school most of the times. Both parent contribute in passing the disease to their children. Pain in bones, pains in the chest, leg ulcer, abdominal pains and small stature are some of the signs and symptoms of sickle cell disease.

Step 2: Misconceptions about sickle cell disease

Sickle cell disease is an hereditary disease caused when the parents have hemoglobin S in the red blood cells. It is not contagious and not caused by supernatural forces or devil. Sickle cell disease cannot be acquired through touching, eating or playing with an individual with sickle cell disease. Sickle cell disease is not caused by a sin against God or as a result of punishment from God. The yellowish discoloration of the eyes and intermittent pains experienced by the sufferers are some of the symptoms of the disease. Sometimes, the symptoms can be severe to keep the sufferer away from school for a while.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.

2. The participants will be commended for giving their time.

3. They will be reminded of the time and venue for the next session.

4. The researcher appreciates the participants and serve some snacks to end the session.

Week Six Topic: Definition of Attitude, Positive and negative attitude towards people living with sickle cell disease.

Objectives: At the end of the session. Participants will be able to:

1. Define attitude.
2. List positive attitude towards people living with sickle cell disease.
3. Mention negative attitude towards people living with sickle cell disease.

Step 1: Definition of attitude

Attitude is the feeling or disposition of someone towards an issue.

Step 2: Positive attitude towards people living with sickle cell disease.

An individualcan assist people living with sickle cell disease when in crisis. They should be treated as every other normal person. One can engage in study session, play and relate with them. They can be invited to social gathering, for example, parties and share food and drinks with them. An individual can have them as a friend. People suffering from sickle cell disease can live a normal life like a non- sufferer andis not something to be ashamed of.

Step 3: Negative attitude towards people living with sickle cell disease

Individual living with sickle cell disease are not outcasts. They are also normal human being to be assisted during crisis. They are not to be bullied or made jest of. They can participate in all activities except very strenuous exercises.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.

2. The participants will be commended for giving their time.

3. They will be reminded of the time and venue for the next session.

4. The researcher appreciates the participants and serve some snacks to end the session.

Week Seven Topic: Management and prevention of sickle cell disease

Objectives: At the end of the session. Participants will be able to:

1. Explain the management of sickle cell disease.
2. Mention the prevention of sickle cell disease.

Step 1

The only known cause of sickle cell disease is bone transplant which is very expensive.

Sickle cell disease can be managed when efforts are made to lessen the signs and symptoms or complications of sickle cell disease. People with sickle cell disease should avoid stress,

fatigue, dehydration, exposure to very cold or hot weather eat should eat balanced diet with lots of fruits and vegetables, adequate rest and enough water. They should avoid infection by maintaining personal hygiene, also take childhood immunization and report at hospitals early for treatment. Alcohol and excessive caffeine consumption and use of hard drugs must be avoided. Regular attendance for hospital follow-up and prompt report for medical attention in case of crises is very important.

Step 2: Prevention of sickle cell disease

The best prevention of sickle cell disease is when partners with S gene do not intermarry.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.
4. The researcher appreciates the participants and serve some snacks to end the session.

Week Eight

Review of Previous Sessions and Administration of Post-test Instrument

Objectives: At the end of the session, participants should be able to:

1. Summarize what they have learnt from the training programme

Step 1: The participants will be welcomed warmly and commence the session with verification of progress made by individual during the past six weeks. The various assignments given to the participants in the course of the training will be reviewed.

Step 2: Questions will be asked on knowledge of SCD and attitudes towards the people living with SCD to know how the participants have internalized the training .

Step 3: The training programme will be brought to an end with encouragement to utilize what they have learnt during the training programme.

Step 4: Overall review of the programme will be done. Post-test instrument will be administered on the participants.

Closing remarks:

4. The trainer will commend the participants for their cooperation.
5. The participants will be encouraged to utilize what they have learnt during the course of the intervention programme.

Participants will be asked to make their comments and the trainer appreciates their consistency and patience in participating in the programme.:

Step 3 : Post-test instrument will be administered on the participants.

Closing remark: The researcher and trainer will commend the participants for their cooperation while the participants also make their final comments.

APPENDIX VI

ENVIRONMENTAL HYGIENE EDUCATION PACKAGE

Week One: General Orientation and Administration of Pre-test Instrument

Objectives: At the end of the session, the participants will be able to:

- State the purpose of the training programme
-Explain the procedure to follow by the trainers and the participants
-Administer the pre-test instrument on the participants

Activity :

Step 1:

The researcher welcomes the participants. Allows few minutes for interaction and solicit for their co- operation throughout the programme.

Step 2:

The researcher will explain in clear terms the purpose, objectives and benefits of the training day and duration time for each teaching. .

Step 3:

The researcher thereafter will administer the pre-test on the participants with the help of the trained research assistants. Same will be collected on the spot.

Week Two: **Topic: Hygiene and Environmental Hygiene**

Objectives: At the end of the session, participants will be able to:

1. Define hygiene.
2. Define environmental hygiene.

Step 1

Hygiene is a set of practices associated with the preservation of health and healthy living. Hygiene refers to the practices by which people maintain or promote good health. It is also conditions and practices that help to maintain health and prevent diseases.

Step 2

Environmental health is a group of activities that aim to protect people from dangerous conditions arising from unsanitary shelters and air supplies. These conditions include unsanitary water supplies, waste disposal systems, food sources and temporary or permanent housing structures.

Closing Remark

1. The teacher summarizes the lesson and entertained questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.

4. The researcher appreciates the participants and serve some snacks to end the session.

Week Three :**Topic:Importance of Environmental Hygiene**

Objective: At the end of the session, participants will be able to:

List the importance of environmental hygiene.

Environmental hygiene is geared towards improving the quality of the environment and reducing diseases. The living conditions will improve healthy living and health problems will decrease. The management of water, solid waste and industrial waste is highly essential to human existence.All these, if properly executed will amount to good and proper environmental hygiene and this will lead to healthy living and prevention of diseases.Good environmental hygiene prevents diseases. It improves quality of life, reduces exposure to diseases and ensures a sustainable environment.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.
4. The researcher appreciates the participants and serve some snacks to end the session.

Week Four: Topic: Good Environmental Hygiene

Objective: At the end of the session, participants will be able to:

1. Explain good environmental hygiene.
2. Mention various ways of good environmental hygiene.

Step1

Good environmental hygiene involves to the he living conditions that improve healthy living and reduce health problems.

Step 2

Various ways to good environmental hygiene include water and its storage. Sources of water include groundwater and surface water which may require treatment before being consumed because various chemicals, particles, and biological contaminants, like bacteria, can make the water undrinkable. The water is then stored properly. Many developed countries have water treatment plants where drinking water is cleaned of dirt and particles, disinfected, and stored until needed. This water may be run through pipes directly to homes and business. Other methods of treating water include boiling it or treating it with chemicals to kill harmful bacteria. In addition to other sources, water can become contaminated from household trash and human waste. If waste is not disposed of properly, it can mix with water in the ground or

with surface water that might be collected for drinking and cooking. When people drink tainted water, it can spread disease or even cause new outbreaks.

Step 3

Sweeping of the house and the surrounding to keep it clean.Proper disposal of dirts in designated bin for onward evacuation to dumping site for incineration.Provision of proper toilets and avoidance of indiscriminate dumping of human faces around the houses or inside rivers.Cutting of bushes that are very close to houses to make the area neat and free of dangerous reptiles.

Step 4

Good housing condition devoid of overcrowding with good living conditions and less air pollution such as indiscriminate burning of thrash like tyres and unnecessary bush burning.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.
4. The researcher appreciates the participants and serve some snacks to end the session.

Week Five: Topic:Poor Environmental Hygiene.

Objectives: At the end of the session, participants will be able to:

Mention various activities that constitute poor environmental hygiene.

Poor environmental hygiene constitute a menace and nuisance. It makes infection to be easily transmitted or spread. Some examples of poor environmental hygiene is lack of adequate hygiene in the environment which is a major threat to the environment. The threat include human diseases and poor overall human health degradation. Lack of clean water causes diseases. Also, indiscriminate disposal of solid and liquid wastes and pollution of fresh water by untreated human waste. Many of men's ill health can be traced to adverse environmental factors such as water, soil, air pollution, poor housing conditions, and presence of animal reservoir among or within human habitation, air pollution and poor housing conditions.

Week Six: Topic: Diseases associated with poor environmental hygiene

Objective: At the end of the session, participants will be able to:

List some of the diseases associated with poor environmental hygiene.

There are several diseases that can be contracted due to poor environmental hygiene. The most common comes through poor undrinkable water. The commonest of the diseases is diarrhoea which accounts for most of the infants' death followed by all forms of fever. The commonest of the fever is malaria and typhoid fever which can also kill very fast. Unkempt environment leads to a lot of all forms of dangerous flies and other vectors that transport and transmit diseases. Overcrowding can cause fast spread of diseases leading to epidemic. Air pollution caused by indiscriminate burning can cause diseases such as cough and serious allergy.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.
4. The researcher appreciates the participants and serve some snacks to end the session.

WEEK SEVEN: Topic: Individual roles in the maintenance of good environmental hygiene

Activity:

Every individual must task his or her self in a more collaborative and sustained ways to frequently embark on general cleaning exercise in our various houses, homes and communities. Our role include the promotion of health through the prevention of human contact with wastes as well as the treatment and proper disposal of sewage. Good hygiene and safe water are also essential. Garbage must be deposited at designated site for collection. Indiscriminate burning should be discouraged. Houses should be in clean and safe surrounding.

Closing Remark

1. The teacher summarizes the lesson and entertain questions from the participants.
2. The participants will be commended for giving their time.
3. They will be reminded of the time and venue for the next session.
4. The researcher appreciates the participants and serve some snacks to end the session

WEEK EIGHT: Review of the Previous Topics and Administration of Post-Test Instrument

Objectives: At the end of the session, the participants will be able to:

1. Summarize what they had learnt from the training programme.
2. Express their willingness to practice good environmental hygiene.

Activity:

Step 1: The trainer welcomes the participants.

Step 2: The trainer reviews all the sessions done by asking questions and allowing contributions

from the participants.

Step 3: The trainer encourages the participants to set goals in achieving healthy attitudinal behaviours.

Step 4: The overall review of the training will done.

Step 5: Post-test instrument will be administered on the participants. Same will be collected on the spot with the help of the research assistants.

Closing remark:

2 The trainer will commend the participants.

2. The trainer will appreciate all the participant and serve some snacks to end the Programme.

APPENDIX VII

LIST OF PUBLIC JUNIOR SECONDARY SCHOOLS IN IBABAN METROPOLIS IBADAN NORTH EAST LOCAL GOVERNMENT

S/N	SCHOOL
1.	I.M.S. Grammar School Gbelekale
2.	Ayekale Commercial Grammar School, Agugu
3.	Army Barracks Grammar School, Iwo Road
4.	Community Grammar School, Iwo Road
5.	Christ The King Senior Secondary School , Oluyoro
6.	Fazil-Omar-Ahmadiyya (F.O.A) Grammar School, Ajibola Aremo
7.	Holy Trinity Grammar School, Off Old Ife Road
8.	Islamic Mission Grammar School, Agugu
9.	Basorun High School, Basorun
10.	Lagelu Grammar School, Agugu
11.	Agugu High School, Agugu
12.	Hizibu Lahi-Algalib (HLA) Sec. School, Agodi, Gate
13.	I.M.G. High School (Along Renascent High School Road), Aremo
14.	Loyola College, Old Ife Road
15.	I.M.G. Gram. School, Agodi Gate
16.	Mufu Lanihun Comprehensive High School, Iwo-Road Express Road
17.	Okebadan High School, Oluyoro
18.	Olubadan High School, Aperin
19.	Community Grammar School, Orita Aperin
20.	Ode Aje/Ajibola High School,Ode Aje
21.	Queens of Apostles Sec. CommercialGrammarSchool, Oluyoro
22.	St. Claires Girls High School,
23.	Oluyoro Girls High School, Oluyoro Oke-Offa
24.	Ratibi College, Oluyoro Oke-Offa
25.	Renascent High School, Agugu
26.	St. John’s Senior Secondary, Ode-Aje
27.	United High School, Agugu
28.	Community Sec. School, Agugu

IBADAN NORTH LOCAL GOVERNMENT

S/N	SCHOOL
1.	Abadina College U.I. Ibadan
2.	Abadina Grammar School, U.I,Ibadan
3.	Anglican Commercial Grammar School, Total Garden
4.	I.M.G. Grammar School, Yemetu, Aladorin, Ibadan
5.	Basorun/Ojoo HighSchool,Ojoo
6.	Chesire HighSchool,Oke Ado
7.	CommunityHighSchool,Agbowo/Bodija
8.	CommunityGrammar School, Mokola
9.	Humani Alaga HighSchool, Sango
10.	Community Secondary School, Sango
11.	Ijokodo HighSchool, Ijokodo
12.	Ikolaba GrammarSchool, Ikolaba
13.	Community Secondary School, Ikolaba
14.	I.M.G. Grammar School, Yemetu Igosun
15.	Ikolaba High School, Ikolaba
16.	Immanuel College High School, Orita U.I
17.	Immanuel Grammar School, Orita U.I
18.	Comm. High School, Samonda
19.	Islamic High School, Basorun
20.	Methodist Grammar School, Bodija
21.	Methodist Secondary School, New Bodija
22.	Mount Olivet Grammar School, Bodija
23.	Nawar-Ul-Deen High School, Nalende
24.	Oba Akinbiyi High SchooI, Mokola Cultural Centrex, Mokola
25.	Oba Akinbiyi High School II, Mokola-Oremeji
26.	Oba Akinyele MemorialHigh School, Eleyele
27.	Polytechnic High School, Polytechnic Campus
28.	St. Gabriel Secondary Commercial, Sabo
29.	St. Brigids Secondary School, Mokola
30.	St. Louis Grammar School, Mokola
31.	St. Patrick Grammar School,Orita Basorun
32.	United Secondary School, Ijokodo
33.	Community Grammar School, Ijokodo
34.	Bishop Onabanjo High School, Bodija
35.	Ebenezer Grammar, School, Nalende
36.	Islamic Day Secondary School, Basorun

IBADAN SOUTH EAST

S/N	SCHOOL
1.	Adekile Goodwill Grammar School, Aperin
2.	Adelagun MemorialGrammarSchool, Odinjo
3.	Christ Church High School Orita-Aperin
4.	Anglican Grammar School, Molete
5.	Aperin Boys HighSchool, Orita- Aperin
6.	Aperin Oniyere CGS, Aperin
7.	IMG Grammar. School (Mixed), Aperin
8.	Eleta High School, Eleta
9.	Eyinni High School, Challenge
10.	Commercial Grammar School, Eyinni Area, Challenge
11.	Ibadan CAC GrammarSchool , Orita Aperin
12.	Ibadan CAC HighSchool,Orita Aperin
13.	Ibadan City Academy, Eleta
14.	Ibadan GrammarSchool, Kudeti
15.	Community Gramm. School, Kudeti
16.	Nuru Islamiyya Grammar, School, Osungbade, Molete
17.	Methodist Grammar School, Elekuro
18.	Olubi Memorial Grammar School, Molete
19.	St. Anne's School, Molete
20.	St. Anne's Girls High School, Molete
21.	St. David, Grammar School, Kudeti
22.	Ori-Aje CommercialSecondary, School, Kudeti
23.	St. Luke's College, Molete
24.	St. Luke's GrammarSchool, Molete
25.	Wesley College of Science, Elekuro
26.	Yejide Girls GrammarSchool, Kudeti
27.	Govt. Sec. School, Orita Aperin

IBADAN SOUTH WEST

S/N	SCHOOL
1.	Adifase HighSchool, Oojo
2.	IMG High School, Apata
3.	African ChurchGrammar School, Apata
4.	Apata CommercialGrammar School, Apata
5.	Apata Grammar School , Logudu, Apata
6.	Ansar-U-Deen (ADS) Grammar, School, Oke Ado
7.	Ansar-Deen SecondarySchool, Oke Ado
8.	Baptist Grammar School, Idi-Isin
9.	BaptistSecondaryGrammar School, Oke-Ado

10.	Basorun Ogunmola HighSchool, Basorun
11.	Celestial Church HighSchool, Oke Ado
12.	Community Gram. Schooling, Elewura
13.	Govt. CollegeIbadan (Apata)
14.	I.M.G. GrammarSchool, Sharp Corner,Oke Ado
15.	Odo Ona Girls Grammar School, Apata
16.	Oke-Ado HighSchool,Oke Ado
17.	Oke Bola ComprehensiveHigh School, Oke Bola
18.	Oluyole Estate Grammar School,StateHospitalRoad, Ring Road
19.	Oluyole Extension HighSchool, Oluyole
20.	Oluyole HighSchool, Oluyole, Ring Road
21.	Our Lady of Apostles, Odo-Ona
22.	Ibadan Boys HighSchool,Oke Bola
23.	People Girls GrammarSchool, Molete
24.	Queen's School, Ibadan (Apata)
25.	St. Teresa's College, Oke-Ado
26.	Urban Day GrammarSchool, Ring Road
27.	Oladipo Alayande S.O.S, Oke Bola
28.	CommercialGrammar School, Gbekuba
29.	CommercialGrammarSchool, Ring Road

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IBADAN NORTH WEST

S/N	SCHOOL
1.	Anwar-Ul-Islam GrammarSchool, Eleyele
2.	Eleyele High School, Polo Ground, Eleyele
3.	Army Day Grammar School,Letmuck barrack, Eleyele,
4.	Urban Day High School, Jericho
5.	Oba Abass Aleshinloye Grammer School, Eleyele
6.	Eleyele Secondary School Along School of Nursing Road, Eleyele
7.	Community High School, Adamasingba
8.	Sacred Heart Secondary School, Ode Olo
9.	Onireke Girls HighSchool, Onireke
10.	Jericho High School, Jericho
11.	Ansar-Ud-deen HighSchool, Sango-Eleyele Road
12.	Army Barracks Grammar School Letmuck Barracks, Eleyele
13.	Community Secondary School, Olopomewa

Source: Ministry of Education, Oyo State, 2015

APPENDIX VIII

INFORMED CONSENT FORM FOR THE PARTICIPANTS' PARENTS/ GUARDIAN

Dear sir/ma,

Your ward has volunteered to participate in a research programme on education on sickle cell disease. This is to improve their knowledge on sickle cell disease, improve their attitude and know some hints on the management of the disease. The programme has no financial implication on you. Participation in the study will be as normal class session with the duration of one hour and ten minutes once in a week for eight weeks. The research has been fully explained to your ward. Participation is voluntary and your ward is free to withdraw from the programme at any time without any implication. If you agree that your ward should be a part of the study, kindly fill the space provided below.

NAME OF THE PARTICIPANT…….

NAME OF THE WARD……

DATE……SIGNATURE……

INFORMED CONSENT FORM FOR THE PARTICIPANTS

CONFIDENTIALITY

All information obtained from the participants will be treated with utmost confidentiality.

VOLUNTARINESS

Only those who indicate genuine interest will be allowed to take part in the study. Also, any participant is free to withdraw from participating at any point. However, the researcher will make every effort to ensure participants' wishes are complied with as much as practicable.

STATEMENT OF PERSON OBTAINING INFORMED CONSENT

and given sufficient information about the study process to make informed consent.

DATE……. SIGNATURE……..

I have fully explained this research to……..

NAME……

STATEMENT OF THE PERSON GIVING CONSENT

The research study has been well explained to me and I fully understand the study process. I understand that my participation is voluntary. I understand that I may freely stop being part of the study at any time. I am willing to take part in the progrramme.

DATE……SIGNATURE…….

NAME……

OYO STATE APPROVAL

OYO STATE OF NIGERIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
OFFICE OF THE HONOURABLE COMMISSIONER

Your Ref: No.....
All correspondence should be addressed to the Honourable Commissioner quoting

*Our Ref:No.....*EDU215/T6/233 .....9th August, 17.....

Yemisi Bhadmus Ladi,

Department of Human Kinetics and Health Education,

University of Ibadan,

Ibadan

RE: PERMISSION TO COLLECT DATA

I am directed to refer to the above subject and inform you that the Honourable Commissioner for Education has graciously approved your request to conduct an academic research entitled **"Effects of Health Education (heamatologic) on Knowledge, Attitude, and Management of Sickle Cell Disease among In-School Adolescents in Ibadan Metropolis"**.

2. Please note that you are not to take physical samples from the students during the research. Also note that all data collected from sample schools should be used strictly for the research work.

3. In line with this, you are to liaise with the Zonal Inspectors of Education, Ibadan City and Ibadan Less City for necessary assistance.

4. I thank you.

Prof. J. A. Olowofela
Hon. Commissioner

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY, SECRETARIAT, IBADAN, OYO STATE.
E-mail: adeniyi.olowofela@oyostate.gov.org Tel.: 08033232226

ETHICAL APPROVAL

SOCIAL SCIENCES AND HUMANITIES RESEARCH ETHICS COMMITTEE (SSHREC)
UNIVERSITY OF IBADAN
Chairman: Prof. A. S. Jegede, B.Sc, M.Sc (Ife), MHSc (Toronto), Ph.d (Ibadan)
Tel: +234-8055282418
E-mail: sayjegede@yahoo.com
sayjegede@gmail.com
as.jegede@mail.ui.edu.ng

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

RE: HEAMATOLOGIC EDUCATION ON KNOWLEDGE, ATTITUDE AND MANAGEMENT OF SICKLE CELL DISEASE AMONG IN-SCHOOL ADOLESCENTS IN IBADAN METROPOLIS, OYO STATE.

UI/Social Sciences Ethics Committee assigned number: **UI/SSRHEC/2017/0013**

Name of Principal Investigator: **Yemisi Christianah BHADMUS-LADI**
Address of Principal Investigator: Human Kinetics & Health Education,
Faculty of Education,
University of Ibadan.

Date of receipt of valid application: **26/05/2017**
Date of meeting when final determination on ethical approval was made: **28th March, 2018.**
This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and given full approval by the SSHE Committee.

This approval dates from **28/03/2018 to 27/03/2019**. If there is delay in starting the research, please inform the SSHE Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. All informed consent forms used in this study must carry the SSHE Committee assigned number and duration of SSHE Committee approval of the study. It is expected that you submit your annual report as well as an annual request for the project renewal to the SSHE Committee early in order to obtain renewal of your approval to avoid disruption of your research.

Note: the National code for health research ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the SSHEC. No changes are permitted in the research without prior approval by the SSHEC except in circumstances outlined in the Code. The SSHE reserves the right to conduct compliance visit to your research site without previous notification.

Prof. A.S. Jegede

Researcher with cross-section of the participants in control group during administration of instrument

Researcher, one of the research assistant and a cross-section of the participants in experimental group during one of the sessions

Researcher, one of the research assistant and a cross-section of the participants in experimental group during one of the sessions

Researcher and a cross-section of the participants in experimental group during one of the sessions

Researcher and a cross-section of the participants in experimental group during one of the sessions

Researcher and a cross-section of the participants in experimental group during one of the sessions

Researcher and a cross-section of the participants in experimental group during one of the sessions

Researcher and a cross-section of the participants in experimental group during one of the sessions

One of the research assistant and a cross-section of the participants in experimental group during administration of instrument