



**PREVALENCE OF HEPATITIS B AND C IN SICKLE-
CELL DISEASE PATIENTS AT UNIVERSITY
TEACHING HOSPITAL, LUSAKA, ZAMBIA.**

BY

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DECLARATION

I hereby declare that this dissertation represents my own work and has not been presented either wholly or in part for a degree at the University of Zambia or any other university.

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ABSTRACT

Background: Sickle Cell Disease (SCD) is highly prevalent in Africans. The SCD trait is 18% in the general population in Zambia and University Teaching Hospital in Lusaka has under its care over 1500 SCD patients. SCD causes high morbidity and mortality. Patients with SCD often have pathologies that require a blood transfusion. Specific indications for blood transfusion in SCD include acute splenic sequestration, aplastic crises, cardiopulmonary symptoms or signs (e.g. high-output heart failure or hypoxemia), preoperative use, priapism, and life-threatening events that would benefit from improved oxygen delivery such as sepsis, severe infection, acute chest syndrome, stroke, and acute organ ischemia. In addition, blood transfusion remains the first-line therapy for primary and secondary stroke prevention in children with SCD. Transfusion is usually performed when haemoglobin is less than five g/dL.

Both hepatitis B and C are blood-borne and therefore can be transmitted by blood transfusion. SCD patients are a special population that requires frequent blood transfusions. Thus, they are prone to acquiring hepatitis B and C. Screening services have greatly reduced the risk of infection via blood transfusion, but transmissions still occur.

Methods: A cross-sectional study was done to determine the prevalence of hepatitis B (HBV) and / or hepatitis C (HCV) infection in the SCD population at UTH in Lusaka. Basic demographic characteristics, medical information and laboratory data were collected and used to determine the predictors for hepatitis B and HCV infections in SCD children and adults.

A total of 138 patients were screened for Hepatitis B surface antigen, which is a marker for HBV infection, as well as for hepatitis C antibody, the surrogate marker for HCV infection. Human-immuno-deficiency virus or HIV testing was done on all the samples.

Findings: Fifty-nine percent of the participants enrolled were female. The mean age at diagnosis was 2years 9 months \pm 2.5. The mean haemoglobin level was 7.2g/dL. Only 37% had confirmation of SCD diagnosis on their medical record. HBV prevalence amongst the SCD is 2.2%. Its prevalence is not associated with blood transfusions, age, tattoos or

gender. It has a non-significant association with increasing age and sexual activity. HBV infection has been markedly reduced due to vaccination introduced in 2005 in Zambia. The prevalence of HCV is 0.7% and could not be subjected to much statistical manipulation.

Conclusion: HBV prevalence amongst the SCD is 2.2%. Its prevalence was not associated with increase in number of blood transfusions. There was a non-significant association between HBV prevalence and increase in age as well as sexual activity. The prevalence of HCV is 0.7%.

Key words: Sickle cell disease; hepatitis B; hepatitis C; University Teaching Hospital.

DEDICATION

I dedicate this work to my parents - Jameson and Gertrude Nchimba, the two people who have been such pillars of strength in my life; they have encouraged me and provided for me to excel academically even when it meant much sacrifice on their part. They have done it with such unconditional love.

I also dedicate this study to Japhet Hamuyuni, the love of my life and my closest friend. I deeply appreciate his presence, support and understanding throughout my busy years of study.

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ABBREVIATIONS AND ACRONYMS

ab	antibody
AIDS	Acquired immunodeficiency syndrome
CLD	chronic liver disease
CMIA	chemiluminescent microparticle immunoassay
CVA	cerebro-vascular accident
DPT-HepB-HiB	Diphtheria-Pertussis-tetanus toxoid-hepatitis B-Haemophilus influenza B pentavalent vaccine
EDTA	Ethylenediaminetetraacetic acid
ELISA	enzyme-linked immunosorbent assay
EPI	Expanded Programme for Immunisation
HBsAg	hepatitis B surface antigen
HbSS	homozygous haemoglobin S
HBV	hepatitis B virus
HCC	hepatocellular carcinoma
HCV	hepatitis C virus
HIV	human immunodeficiency virus
HPLC	High-performance liquid chromatography
PEPFAR	United States Presidents Emergency Plan for AIDS relief
RLU	relative light unit
SCA	sickle cell anaemia
SCD	sickle cell disease
TRALI	transfusion associated lung injury
UNZABREC	University of Zambia Biomedical Research Ethics Committee
UTH	University Teaching Hospital
WHO	World Health Organisation

CHAPTER ONE

1.1 INTRODUCTION

Sickle cell disease (SCD) is one of the most common inherited blood anaemias (Shiel 2011). The disease predominates in Africa, primarily affecting Africans and also African Americans in America (WHO 2012). It has a huge presence in Zambia, particularly in the Northern Province of Zambia. In Lusaka, the haematology unit in the Department of Paediatrics and Child Health at University Teaching Hospital (UTH) currently follows up over 1050 children with SCD.

SCD occurs when a person inherits two abnormal genes for haemoglobin β , one of which codes for haemoglobin S (HbS). Sickle cell anaemia (the homozygous form of SCD) occurs when two abnormal genes, both coding for HbS, are inherited. Under conditions such as physical stress, infection, dehydration, hypoxia, and exposure to cold, this mutation results in the formation of inflexible and abnormally shaped sickled red cells (Marouf 2011).

The most frequent clinical feature of patients with SCD is acute episodes of pain secondary to vaso-occlusive crises that generally require hydration and analgesia (Kliegmann 2007). However, patients with SCD often have other pathologies that require a blood transfusion. Specific indications for blood transfusion in SCD include acute splenic sequestration, aplastic crises (this exacerbates the chronic anaemia), cardiopulmonary symptoms or signs (e.g. high-output heart failure or hypoxemia), preoperative use, priapism, and life-threatening events that would benefit from improved oxygen delivery such as sepsis, severe infection, acute chest syndrome, stroke, and acute organ ischemia (Robert 2011). In addition, blood transfusion remains the first-line therapy for primary and secondary stroke prevention in children with SCD (Marouf 2011). Transfusion is usually performed when haemoglobin is less than five g/dL. Patients with SCD will have haemoglobin levels as low as six g/dL in their steady state.

While blood transfusion benefits patients who have the complications discussed above, the procedure is not without risks. Moreover, multiple blood transfusions compound the risks. Apart from the non-infectious dangers such as transfusion reactions, fluid overload, electrolyte imbalance, and transfusion-associated lung injury (TRALI), one may become infected with viral hepatitis B or C, human immunodeficiency virus (HIV), or other less common organisms (Goodnough 2003). Although the chance of infection is reduced by blood-screening procedures, the risk cannot be totally eliminated (Blood Bank Data 2011).

Hepatitis B virus (HBV) is one of the most common serious liver infections in the world. Worldwide, about 350 million people have chronic infection with HBV, 620,000 of whom die annually from liver-related disease (Abdel-Hady 2013). Hepatitis C, caused by the hepatitis C virus (HCV), is another infectious disease primarily affecting the liver. An estimated 150 million people worldwide are infected with hepatitis C and more than 350,000 people die every year from hepatitis C-related liver diseases (World Health Organization Factsheet 2012).

The disease process of both HBV and HCV affects liver function. The liver parenchyma progressively destructs and regenerates, which leads to fibrosis and cirrhosis. Liver disease may lead to life-threatening complications. These include portal hypertension (ascites, hypersplenism, and lower oesophageal and rectal varices), synthetic dysfunction (resulting in hypoalbuminemia and coagulation disorder), hepato-renal syndrome, hepatic encephalopathy, and hepatocellular carcinoma (HCC; also called hepatoma). In Zambia, once an individual is diagnosed with chronic liver disease, treatment entails only supportive management since liver transplant services are unavailable. For this reason, mortality rates remain very high.

Both viruses are blood-borne and the important modes of spread are sexual, by intravenous drug use by sharing of needles, exposure to body fluids particularly among health workers and also via blood or blood product transfusion.

Cultural practices such as visiting traditional healers that administer tattoos for any chronic illness is common in rural Africa. A study was done in Nigeria that sought to determine whether certain socio-demographic characteristics and cultural tendencies of SCD patients affected the rate of infection with hepatitis B virus infection. It concluded that demographic and sociocultural factors such as social class and cultural practices did not appear to influence the prevalence of HBsAg among children with SCD in Enugu, Nigeria. (Emechebe 2010).

Sickle cell disease patients receive multiple transfusions and so may be at an increased risk of infection of Hepatitis B and C. At UTH the number of children with SCD who may be infected with HBV or HCV is unknown.

1.2 LITERATURE REVIEW

1.2.1 Magnitude of the SCD problem

Sub-Saharan Africa carries the greatest burden of SCD. Seventy-five percent of the 300,000 global births of SCD-affected children live in that region, and estimates suggest that 50 to 80 percent of these patients will die before adulthood (Makani 2011; Weatherall 2006).

This disorder has profound manifestations. These include pain syndromes, anaemia and its sequelae, infection, organ failure, and co-morbid conditions. Pain, however, is the insignia of SCD and is the hallmark of patients' clinical presentations throughout their lives. Management of SCD can be very costly given its chronicity and association with recurrent hospitalizations, surgical and nonsurgical treatment, use of intensive care facilities, and multidisciplinary approach to management (Ballas 2009).

In Africa, many SCD patients die before their fifth birthday (Makani 2011), as compared to 42 and 46 years of age in Western countries (Ballas 2009). Approximately 50 to 90 percent of all deaths in the SCD population are associated with the homozygous variant (Grosse 2011). Experts agree that the majority of Africans born with SCD die during childhood (Christianson 2006; Ebrahim 2010; Grosse 2009; McAuley 2010). Research leading to improved treatments for SCD may reduce the myriad problems associated with it.

1.2.2 The role of blood transfusions in SCD management and the associated complications

Blood transfusion has an established role in the management of both acute and chronic SCD complications. Transfusion can correct anaemia, decrease the occurrence of HbS, suppress HbS synthesis, and reduce haemolysis (Rees 2010).

The prevalence of SCD in Zambia is not well established, but the carrier rate in the northern region is estimated to be between 14 and 18 percent (Barclay 1970; Piel 2010). The UTH alone is following 1,050 SCD patients, and at any one time approximately thirty

patients are admitted. Up to 25 percent of those admitted receive transfusions. The Zambian National Blood Transfusion Service (ZNBTS) has implemented regulations intended to mitigate the risk of transmitting infection via blood transfusions. The regulations are 100 percent dependent on voluntary, non-remunerated low-risk blood donors and require the screening of blood using national and World Health Organization (WHO) standards (Blood Bank Data 2013). Using ELISA technology, the blood to be transfused is screened for HIV, syphilis, and both hepatitis B and C, among others (Murex Diasorin, London 2012). Despite this screening, the possibility of infection still exists, and cases of transmitted hepatitis, HIV and other infections are still being reported (Gerard 2004; Marouf 2011).

Chronic blood transfusion is inevitably associated with iron overload, most of which occurs in the liver (Wood 2004). Autopsy series indicate a 16 to 29 percent prevalence of cirrhosis in sickle cell anaemia patients (Bauer 1980; Green 1953; Song 1957). Cirrhosis in SCD patients is usually secondary to chronic hepatitis B or C infection or because of iron overload (Banerjee 2011).

Regarding outcome of SCD, the literature is inconsistent. In a large study examining the deaths of 209 adults with SCD, hepatic dysfunction did not appear to be associated with an increased risk of death. By contrast, renal dysfunction, episodes of acute chest syndrome, neurologic manifestations, and degree of anaemia did seem linked to a higher risk of death (Platt 1994). A smaller multi-centre analysis of causes of death of 53 SCD patients implicated cirrhosis in nearly one-fifth of the cases (Perronne 2002). Similarly, a recent single-center analysis of 141 patients identified 11.3 percent as having died as a result of cirrhosis (Darbari 2006).

1.2.3 The burden of hepatitis B and C in patients with haemoglobinopathies

Globally the prevalence and number of people with anti-HCV is 2.8% (Hanafiah 2013) and that of HBV is between 2 and 8% (World Health Organisation 2012).

A 1996 study in the United States set out to determine the prevalence of HCV in SCD patients. The antibody to HCV was detected in ten percent of the patients. Twenty-three percent of patients who received more than ten units of packed red blood cells were

positive for HCV antibody. Only 7.9 percent of patients with fewer than ten units of packed red blood cells in the past were positive for HCV antibody. None of the patients who never received a blood transfusion were positive for HCV antibody. A total of seven liver biopsies were performed on patients positive for HCV antibody. Twenty-eight percent showed significant liver damage. One revealed cirrhosis, and another showed chronic active hepatitis (Hasan 1996).

Four studies performed in Nigeria demonstrate that HBV infection is highly endemic in that country, commonly occurring in early childhood. Three of the four studies show that HBV infection occurs at a rate between ten and 30 percent for both healthy children and children afflicted with SCD (Anoyo 1999; Kaine 1983; Lesi 1977). The other study, by contrast, reported a much higher prevalence of HBV infection among children with sickle cell anaemia when compared with controls (Abiodun 1989).

In Nigeria, the difference in the prevalence of HCV antibody between the transfused patients and the non-transfused patients was not statistically significant. However, there was a positive association between the number of transfusions and HCV seropositivity (Ejiofor 2009).

Below is a table that shows the various prevalence rates in some selected countries:

Table 1:

YEAR OF STUDY	COUNTRY	POPULATION	PREVALENECE	REFERENCE
2003	Brazil	SCD children and adults	HCV 14.1%	Torres 2003
2006	Turkey	SCD and Thalasia children and adults	HIV 0.00% HBV 0.75% HCV 4.50%	Sabahattin 2006
2006	Togo	SCD children and adults	HIV 5.04% HBV 20.20% HCV 6.50%	Segbena 2005
2007	Congo DR	SCD children	HIV 11.30% HBV 10.00%	Tshilolo 2007
2007	Uruguay	Multi-transfused patients	HBV 1.00% HCV 12.7%	Lopez 2007
2009	Tanzania	SCD children	HBV 0.60% HCV 0.9% HIV 4.4%	Kassim 2009

Generally, the prevalence of HCV is higher in American countries than in African ones. One possible reason for this could be that the recreational abuse of intravenous drugs that is more prevalent in these industrialized countries has resulted in high HCV levels in the general population (Garfein 1996; Conroy 1996). Screening of HCV in donor blood only started in the early 1990s in most industrialized countries and hence the increased spread to patients who frequently received blood (Schreiber 1996; Alter 1995). Conversely, the prevalence of HBV seems higher in the African setup than in Europe and Latin America where screening of donor blood against HBV was introduced much earlier

and the Hepatitis B vaccine has been part of the routine immunization programs for a long time now – since the early 1980s (WHO position paper on hepatitis B 2009).

In Zambia, one study showed that the prevalence of hepatitis C among Zambian adults at the country's largest health facility, UTH, was quite low. Of 735 adults from three different populations, only three samples (0.41 percent) were positive for HCV antibody. One of the populations screened was composed of regular blood donors and no one was hepatitis C positive from this group (Oshitani 1995). This finding was supported by a more recent study, which screened HIV-positive patients for both hepatitis B and C. Of 323 enrolled patients, 9.9 percent were HBsAg positive, while only 1.2 percent were HCV antibody positive (Kapembwa 2011). A study at UTH determined that the prevalence of HBV among the paediatric and adult SCD population - it showed that there was no difference between the transfused and the non-transfused groups (Mbewe 1992). It did note, however, that subjects who had received multiple transfusions had a higher prevalence of hepatitis B infection.

1.3 STATEMENT OF THE PROBLEM

SCD in Africa is highly prevalent. It causes high morbidity and mortality rates. The prevalence of hepatitis B and hepatitis C in the SCD population is unknown in Zambia. Sickle cell disease patients often receive repeated blood transfusions and are therefore at risk of hepatitis B and C infection. These infections can cause liver failure, cirrhosis, and hepatoma, yet no screening for these viral infections currently occurs. Knowledge of the prevalence of both types of hepatitis in the SCD population would improve care and reduce the morbidity and mortality rates. For example, patients with known positive statuses can be treated and sequelae such as CLD minimised or prevented altogether, thus improving on the quality of life and prolonging longevity.

1.4 STUDY JUSTIFICATION

This study aims to determine the prevalence of hepatitis B and C infections in the SCD population in Lusaka, Zambia. Viral hepatitis infections are often asymptomatic, but chronic infections can eventually lead to chronic liver disease (CLD).

Both hepatitis B and C are blood-borne and therefore can be transmitted by blood transfusion. SCD patients are a special population that requires frequent blood transfusions. Thus, they are prone to acquiring hepatitis B and C. Screening services have greatly reduced the risk of infection via blood transfusion, but transmissions still occur. Furthermore, a large proportion of SCD patients now under UTH's care received blood transfusions before 2005, when screening for hepatitis C began. This study would determine how the screening procedures have affected the prevalence of hepatitis C in the SCD population at UTH.

Increased knowledge about the effects of viral infections on SCD has the potential to help lengthen patients' lives and provide them a higher quality of care throughout their adolescent and adult years. Establishing the prevalence of the two viral hepatitides will not only add to the existing body of knowledge, but may also aid clinicians and policy-makers in serving the SCD patient population.

CHAPTER TWO

2.1 GENERAL OBJECTIVE

To determine the prevalence of hepatitis B and C infection in the SCD population at UTH in Lusaka.

2.2 SPECIFIC OBJECTIVES

1. To ascertain the number of SCD patients who have received at least one blood transfusion.
2. To compare the prevalence of hepatitis B and C between SCD patients who have received one or more blood transfusions and SCD patients who have not received any blood transfusions.
3. To determine the difference in hepatitis C prevalence between patients who received blood transfusions prior to the 2005 implementation of blood-screening procedures and patients who received transfusions after the implementation.

CHAPTER THREE

3.0 METHODOLOGY.

3.1 Study design

The study was a cross-sectional study.

3.2 Study site

The study was conducted in Clinic Four (haematology clinic) at University Teaching Hospital (UTH) in Lusaka. UTH is a third-level hospital. It is the largest hospital in Zambia – catering for the population in Lusaka and surrounding areas. It also receives referral cases requiring specialist attention from hospitals all over the country.

3.2.1 Haematology clinic at UTH

Established in 1973, the haematology clinic at UTH provides care for more than 1,000 outpatient SCD children and an increasing number of adults with the same condition. An average of four doctors attends to the patients each Friday morning. A medical staff weighs the patients and runs blood tests, the results of which are reviewed by the doctors. If the patient is unwell or the blood tests reveal an illness, the patient is admitted. Patients whom the doctors deem well are sent home on malaria chemoprophylaxis and folic acid.

3.3 Duration of the study

Participants were recruited for the study over a period of five months from November 2013 to March 2014.

3.4 Target population and Study population

The target population included all SCD patients that attended the clinic and met the eligibility criteria. The study population comprised SCD patients between the ages of two and 35 years who presented to the SCD clinic for their routine needs.

3.4 Eligibility

3.4.1 Inclusion criteria

- All SCD children and young adults presenting to Clinic 4 (haematology clinic) on Friday mornings for their routine visits.

3.4.2 Exclusion criteria

- SCD patients below the age of two years and above the age of 35 years.
- All patients (or parents/guardians of the patients) who decline to participate in the study

3.5 Definition of a sickle cell disease patient in this study

Any patient monitored in the haematology clinic who had a diagnosis of SCD was considered a SCD patient for purposes of the study. Note that some of the children did not have a diagnosis specifying the variant of SCD they have because that requires electrophoresis or high-performance liquid chromatography (HPLC) tests, which often are not readily available. Many of the patients may have only a screening test result in their file. Excluding such patients would have resulted in fewer individuals available for the study.

3.6 Description of variables

3.6.1 Dependent variables

3.6.1.1 Primary outcomes (1) Positive test results for hepatitis B and/or C.

3.6.1.2 Secondary outcomes (1) Number of SCD patients who have received one or more blood transfusions.

(2) Number of patients who are hepatitis C positive who received a blood transfusion prior to the 2005 implementation of blood screenings compared to the number of patients who are hepatitis C positive who received blood transfusions after 2005.

3.6.2 Independent variables

- (1) Residence
- (2) Religion
- (3) Age
- (4) Education
- (5) Economic status
- (6) HIV status
- (7) Vaccination against hepatitis B
- (8) Presence of tattoos on the body
- (9) Age when SCD was diagnosed
- (10) Sexual activity
- (11) Abuse of illicit intravenous drugs

3.7 Sampling method

The convenience sampling method was used. All patients who qualified were enrolled and included in the study until the sample size was met.

3.8 Sample size

The following prevalence formula was used to calculate sample size:

$$N = Z^2 [P (1-P)/(D^2)]$$

Where:

N = sample required

Z = Z statistic = 1.96 (95 percent C I)

P = expected prevalence of 0.1 (assuming 10 percent of the patients were hepatitis B or C positive. (9% HBsAg positive and 1% HCV ab positive).

D = acceptable accuracy range (precision) of 0.05

Therefore N = $\frac{(1.96)^2 \times 0.1(1-0.1)}{(0.05)^2}$

$$(0.05)^2$$

N = 139

Total number of patients enrolled was 158. Total number of patients with primary outcome (hepatitis B, hepatitis C results) was 138 and hence this was the total number of patients available for the analysis.

3.9 Study procedures

3.9.1 Patient screening, study enrolment, and collection of socio-demographic and medical file information

SCD patients and their caregivers attending the haematology clinic at the UTH were asked to participate in the study. The purpose of the study and the procedures involved were explained.

Participants who assented or consented and whose guardians gave consent for them to participate in the study were enrolled. Informed written assent and consent was obtained from the participants and guardians (Appendices 1, 2, and 3). Participants below the age of 12 years were included if they gave a verbal assent and their parents or guardians consented. Study participants were assured that the information they gave and their results would be confidential.

The patient's demographic and clinical information were obtained using a structured questionnaire (Appendix 4). Personal information that may identify the patient was not included on the Data Collection Tool. The only recorded identification for each patient was the study number.

Each participant's medical file was consulted for demographic data, the mode used to diagnose SCD and the number of blood transfusions received. This information was entered in the Data Collection Tool (Appendix 4).

3.9.2 Laboratory procedures and data collection

Four milliliters of blood was drawn from a vein on the dorsal aspect of a hand or cubital fossa using a sterile disposable needle and syringe. The blood was put into an EDTA bottle and transported to the blood bank, where the serum was analysed for HBsAg, HCV, and HIV. Pre-test counseling was performed on each patient tested for HIV.

A laboratory method called chemiluminescence was employed. Chemiluminescence is the emission of light as a result of a chemical reaction. Abbott Laboratories have developed a technology /equipment called Architect that were used in this study. A direct relationship exists between the amount of antigen or antibody present in the sample and the amount of light produced by the chemical reaction and is thus detected by the ARCHITECT / System optics.

The ARCHITECT HBsAg Qualitative assay is an immunoassay for the qualitative detection of HBsAg in human serum and plasma using chemiluminescent microparticle immunoassay (CMIA) technology with flexible assay protocols, referred to as Chemiflex. The serum sample, anti-HBs coated paramagnetic microparticles, and anti-HBs acridinium-labeled conjugate were combined to create a reaction mixture. HBsAg present in the sample bound to the anti-HBs coated microparticles and to the anti-HBs acridinium-labeled conjugate. After washing, ancillary wash buffer is added to the reaction mixture. Following another wash cycle, pre-trigger and trigger solutions are added to the reaction mixture. The resulting chemiluminescent reaction was measured as relative light units (RLUs). The presence or absence of HBsAg in the sample is determined by comparing the chemiluminescent signal in the reaction to the cutoff signal determined from an active calibration curve. If the chemiluminescent signal in the specimen was greater than or equal to the cutoff signal (in this case 1.00), the sample was considered reactive for HBsAg.

Architect Anti-HCV assay by Abbott, a two-step immunoassay for the qualitative detection of Hepatitis C Antibody (anti-HCV) in human serum and plasma was used in this study.

In the first step, sample, recombinant HCV antigen coated paramagnetic microparticles and assay diluent were combined. Anti HCV present in the sample bound to the HCV coated microparticles. After washing, anti-human IgG/IgM acridinium-labeled conjugate was added in the second step. Following another wash cycle, pre-trigger and trigger solutions are added to the reaction mixture. The resulting chemiluminescent reaction

was measured in RLUs. A relationship existed between the amount of anti-HCV in the sample and the RLUs detected by the Architect i optical system.

The presence or absence of anti-HCV in a sample was determined by comparing the chemiluminescent signal in the reaction to the cut-off signal determined from an active Architect anti-HCV calibration curve. If the chemiluminescent signal of the sample was greater than or equal to the cutoff signal (again 1.00), the sample was considered reactive for anti-HCV.

The ARCHITECT HIV Ag/Ab Combo assay (Abbott) was used to test for HIV infection. It is a CMIA for the simultaneous qualitative detection of human immunodeficiency virus (HIV) p24 antigen and antibodies to HIV type 1 (HIV-1 group M and group O) and/or type 2 (HIV-2) in human serum and plasma (EDTA).

The presence or absence of HIV in a sample was determined by comparing the chemiluminescent signal in the reaction to the cut-off signal determined from an active Architect HIV calibration curve. If the chemiluminescent signal of the sample was greater than or equal to the cutoff signal (again 1.00), the sample was considered reactive for HIV.

Participants who tested positive for either hepatitis B or C or HIV were referred for appropriate care and treatment. Appropriate treatment following detection may cure, reverse, or delay further liver damage (WHO 2012i; Hassan 1996).

3.10 DATA MANAGEMENT AND ANALYSIS

Data was collected using a structured data entry questionnaire for each study subject. Data was entered on an Epi-Data database. The data was analysed using Stata version 12.0 (Stata Corp, College Station, Texas). Frequency tables were used to describe the socio-demographic characteristics. Fischer's exact tests were used to make associations between categorical variables and primary outcomes – particularly to make associations between those who have received blood transfusions versus those with hepatitis B or C infection. Fischer's exact test was used because the number of the positive outcomes was very small. To compare the association between the number of transfusions and hepatitis prevalence, T-test was used. To model the effect of independent variables on SCD prevalence, logistic regression was used.

3.11 ETHICAL CONSIDERATIONS

The study endeavoured to adhere to the ethics standards of the University of Zambia Biomedical Research and Ethics Committee (UNZABREC) and the Helsinki Declaration. Ethical approval was sought from UNZABREC of the School of Medicine. Permission to perform the study was obtained from the UTH administration. Informed and written consent was sought from the guardians of the participants who were younger than 18 and from the participants who were older than 18. Assent was sought from participants below the age of 18 years.

3.11.1 Confidentiality

No names were recorded on the individual questionnaires; the information was instead coded. Study information was handled carefully and stored securely to maintain confidentiality. The information obtained from the participants and results of the tests were not shared with anyone outside the study team. However, shared confidentiality (with other health workers) was employed when a participant tested positive for an infection, as the need for referral and further treatment then arose. Patients who declined to participate in the study were offered the same standard of care as those who participated. All patients enrolled were tested for HIV infection. Pre-test counseling, disclosure and the post-test counseling counselling was done.

3.11.2 Advantages to the participants

Participants had the opportunity to be tested for hepatitis B and C infection. These tests are not usually part of routine care and most patients are not aware of their hepatitis status. Participants who tested positive for either hepatitis B or C were referred for appropriate treatment. Appropriate treatment following detection may cure, reverse, or delay further liver damage.

3.11.3 Disadvantages to the participants

The participants were exposed to risks similar to those present during their regular course of care. These included the discomfort of veni-puncture and possible

psychological trauma. Veni-puncture may be associated with the risk of bleeding, thrombo-embolism, and infection. Those risks were minimised by skillful aseptic blood collection techniques and haemostatic procedures after blood collection.

3.11.4 Benefit to the community

The study results aimed to show the extent of viral hepatitis infections in the SCD population, which are not currently monitored. Treatment of the infections will prevent or delay progression to liver failure, cirrhosis, and hepatoma. Additionally, treating hepatitis infections will free up financial resources, which will be diverted to the community's other medical need

CHAPTER FOUR

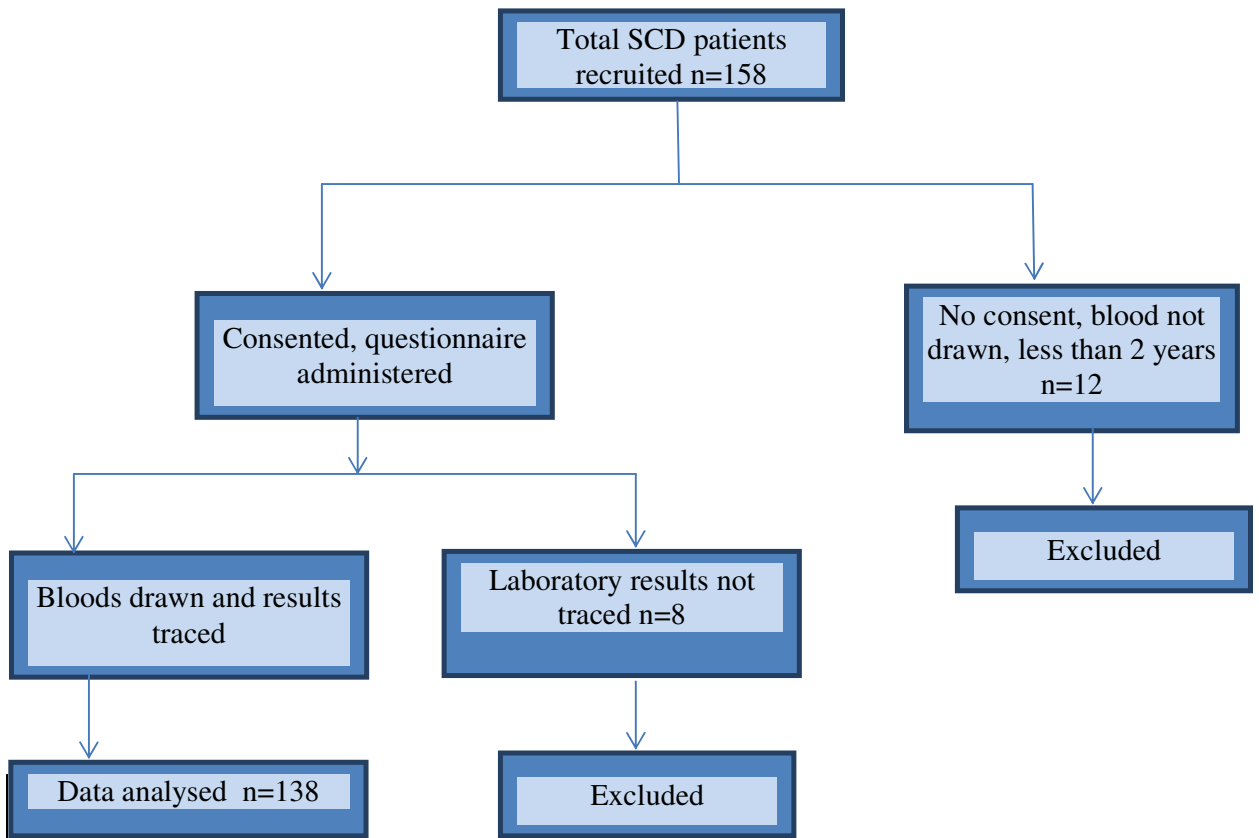
FINDINGS

1. GENERAL CHARACTERISTICS

Age and sex

A total of 138 patients were included in the final analysis; the youngest was two years and the oldest was 32 years old. The mean age was 9.4 years. Fifty-nine percent (n=82) were females.

FLOWCHART OF STUDY PROCEDURES



Ninety-three percent (n=128) of all the respondents came from Lusaka and the districts surrounding it. Most (59% or 81) of these were from Lusaka's low-cost residential areas.

Seventy-eight percent (n=108) of the respondents came from homes that earned less than K5000 (USD 750) per month. Thirty-five respondents had another family member or family members who were also affected by SCD.

Eight (5.8%) of the patients were Jehovah's Witnesses. Four had received blood transfusions before while the other four had never received blood because of their religious convictions. In fact, one patient had lost a sibling to severe anaemia for which the parents had declined blood transfusion and another child was frequently ill and looked frail but would not receive blood transfusion because of the parents' religious affiliation.

The mean age at diagnosis was 2 years 9 months \pm 2.5 while the youngest age was 6 months and the oldest 12 years at the time of diagnosis of SCD. The monthly income or the residential type – high cost versus medium cost versus low cost – did not affect age at diagnosis of SCD: (P value=0.317 for monthly income and p= 0.812 for residential area).

The mean haemoglobin recorded was 7.2g/dl. The least was 4.8g/dl and this patient was admitted for transfusion. There were three patients with haemoglobin levels at around 12g/dl, which are amounts usually seen more commonly amongst the normal population – this is a highly unlikely event amongst the SCD population. The most reasonable explanation for this would be that the participants might not be true SCD patients. This is in reference to the fact that definitive diagnosis of SCD may not always be available with most clinicians having to rely on the screening sickling test. Diagnostic challenges – only 37% of the respondents had a confirmatory diagnosis of SCD by either haemoglobin electrophoresis or high precision liquid chromatography (HPLC). All the patients who had a definitive diagnosis were HbSS – the homozygous sickle cell anaemia and the most severe form of SCD

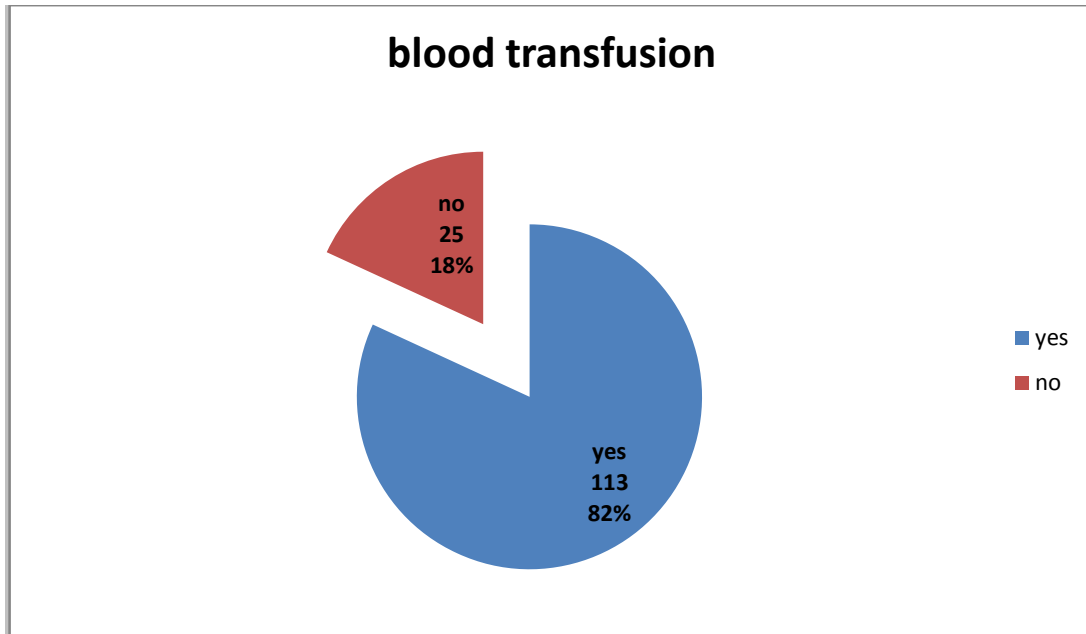
Table 2: Characteristics of participants enrolled in the study

Variable	Total number of participants	Value (\pm SD or %)
Age (years)	n=138	9.4 \pm 5.9
Sex (female) n(%)	n=138	82(59)
Age at diagnosis (years)	n=137	2.9 \pm 2.5
Definitive diagnosis of SCD n(%)		
Yes		38 (37)
No	n=106	59(56)
Unknown		9(8)
Haemoglobin (g/dl)	n=138	7.2 \pm 1.1
Ever received blood n (%)		
Yes	n=138	113 (82)
No		25 (18)
Mean no. of blood transfusions	n=138	2.9 \pm 2.7
Family history of SCD n (%)		
Yes	n=137	48 (35)
No		89 (65)
Monthly income (K) n(%)		
<1000		55 (41)
1000-5000	n=133	49 (37)
5000-10000		12(9)
>10000		17(12)
Radius Lusaka		
Within Lusaka	n=137	128 (93)
Outside of Lusaka		9(7)
Religion n (%)		
Christian		128 (93)
Islam		3 (2)
Jehovah's Witnesses	n=138	6 (4)
Atheist		1(1)
Others		0 (0)
Has tattoos n (%)		
Yes	n=138	18 (13)
No		120 (87)
IV drug abuse n (%)		
Yes	n=138	0 (0)
No		138 (100)
Sexually active n (%)		
Yes	n=138	6 (4)
No		132(94)

2. BLOOD TRANSFUSIONS

- A. One hundred and thirteen or 82% of the participants had received at least one blood transfusion.

Figure 1: Proportion of participants who had received at least one blood transfusion



- B. The mean number of blood transfusions per participant was 2.9 ± 2.7 . Eight percent or nine of those had received at least 9 blood transfusions, the highest being an 8 year old with repeated cerebro-vascular accidents (CVAs) who had received a total of 16 transfusions.

Increase in the number of blood transfusions was related to the indication being CVAs; and not to indications such as severe anaemia, hyperhaemolysis, renal complications, prolonged vaso-occlusive crises and peri-surgical needs, which are the other common indications for blood transfusions in the sickle cell disease population. Increase in age was not associated with increased number of blood transfusions received ($p = 0.7$). Blood transfusion was not associated with infection with hepatitis B ($p=0.2$) or HIV ($p=0.8$)

3.0 SEROPREVALENCES

1. Hepatitis B: three patients tested positive for Hepatitis by HBsAg (2.2%); two were adults above the age of 15 years while one was a male adolescent. The adolescent had never received blood transfusion before.

Table 3: characteristics of HBsAg positive participants

Age (years)	Sexual activity	HIV	Hep C ab	Blood transfusion	Tattoo	Iv drug abuse
11.8	No	Neg	Neg	No	No	No
28	Yes	Neg	Neg	Yes	No	No
32	Yes	Neg	Neg	Yes	Yes	No

The analysis of the variable 'Age' showed an association between increasing age and positivity for HBsAg by a factor of 1.26 ($p = 0.003$). Additionally, the odds for the sexually active respondents to have HBsAg was significantly increased by a factor of 52 ($p = 0.002$). However the 95% confidence interval was very wide (4.014 – 673.5) suggesting that this may have been a finding purely by chance. Blood transfusion was not associated with increased infectivity and neither was the increase in the number of blood transfusion. Other factors analysed such as gender, monthly income, use of tattoos or HIV positivity were not associated with increased hepatitis B positivity. Refer to *table 4* below.

Table 4: Risk factors for HBV infection

Variable	HBsAg pos n=3	HBsAg neg n=135	Unadjusted Odds ratio	95% Confidence interval	P value
Increasing Age	3	135	1.26	1.08 – 1.47	0.003
Age	3	135	20.5	1.73-242.9	0.017
>15 years	2	12			
≤ 15 years	1	123			
Sex (Male)			3	0.27 – 33.9	0.352
Female	1	81			
Male	2	54			
Monthly income			N/A	N/A	0.411
<K1000	2	53			
K1000 to K5000	1	49			
K5000 to K10 000	0	12			
>K10 000	0	17			
Tattoos			N/A	N/A	0.291
Yes	1	17			
No	2	118			
Sexual activity			52	4.014 – 673.5	0.002
Yes	2	4			
No	1	131			
Blood transfusion			0.36	0.060 – 2.154	0.265
Yes	2	111			
No	1	24			
Increase in number of blood transfusions	3	135	0.54	0.04-6.93	0.636
HIV status			N/A	N/A	0.832
Pos	0	2			
Neg	3	133			

Fischer’s exact test was used to make associations between categorical variables.

The above table suggests statistically significant values for HBsAg positivity when it was related to increasing age and sexual activity. However, the wide confidence intervals for both parameters noted suggest that these may be pure chance findings. This is because the number of positive outcomes was quite low to provide a conclusive result.

Furthermore, multivariate logistic regression applied for both age and sexual activity in relation to HBsAg positivity showed that they were not significantly associated: p value was 0.15 for increasing age and p value was 0.438 for sexual activity.

```
. logistic hbsag age sexactiv

Logistic regression               Number of obs   =       138
                                LR chi2(2)      =       11.39
                                Prob > chi2     =       0.0034
Log likelihood = -8.7567164       Pseudo R2      =       0.3941
```

hbsag	Odds Ratio	Std. Err.	z	P> z	[95% Conf. Interval]
age	1.17858	.1347738	1.44	0.151	.9419371 1.474675
sexactiv	4.991358	10.336	0.78	0.438	.0862121 288.9811
_cons	.0012268	.0023372	-3.52	0.000	.0000293 .0513383

2. **Hepatitis C infection:** one early adolescent had a positive hepatitis C antibody test. Because of the very low frequency in hepatitis C positivity, it was not possible to subject this to statistical analysis. The participant’s characteristics are summarized in the table below:

Table 5: Characteristics of the HCV positive participant

Age (years)	Sexual activity	HIV	HBsAg	Blood transfusion	Tattoo	Iv drug abuse
11.7	No	Neg	Neg	Yes	No	No

3. **HIV** – only two participants tested positive for HIV (1.4%); both were known HIV positive patients even before the results and both have been on anti-retroviral therapy (ART) for years now. The young woman who tested positive has had several sexual partners and the adolescent female received her HIV infection from her mother who had died from HIV-related illnesses.

CHAPTER FIVE

DISCUSSION

GENERAL CHARACTERISTICS

The mean age was 9.4 years and the age range was from 2 years to 32 years. The oldest patient in the clinic is a 53 year old woman who was not included in this study (Mantina 2014). The majority of the patients were under ten years of age. As recently as 1973, the average lifespan for people with sickle cell disease was only 14 years (Diggs 1973). New and aggressive treatments for sickle cell disease are prolonging life and improving its quality. Currently, fifty-percent of the SCD population in the developed world survives their fifth decade (Platt OS 1994). Women with sickle cell live longer than their male counterparts (Platt OS 1994).

Residence and Economic Status

The majority (57%) of patients were coming from low –cost residential areas of Lusaka and 41% were coming from homes that earned less than K1000 (USD 175) per month. This shows that the sample was a true reflection of Lusaka’s population that is mainly concentrated in the high-density areas and is unemployed, earning very little money from small-scale enterprises.

Clinical Characteristics

The mean age at diagnosis of SCD of 2 years 9 months is comparable to another African study done in Ibadan that had a mean age of two years (Brown 2010). This is highly unacceptable especially that neonatal screening of SCD has been known as an effective method of diagnosis since the 1980s (). Of note in this study is a family of three girls who had all suffered CVAs of varying severities without the parents or the primary healthcare providers knowing what was going on. The two younger siblings came in limping with hemi-paretic gaits but a more severe observation was noted in the older sibling. She was eleven years old and had experienced several CVAs. She was mentally retarded, was wheelchair-bound with spastic diplegia, and was dumb and depressed. All this morbidity

could have been prevented with timely diagnosis and appropriate treatment. Indeed the institution of neonatal screening for SCD is important to improve care.

Hepatitis B

Three patients (2.17%) tested positive for HBsAg; one female aged 32 years and two males. Two were above the age of 15 years and one was an 11-year-old child who had never received a blood transfusion. These results are quite different from what was expected. Zambia still is in the category of the countries that are endemic for HBV at above 8% of the general population. The results are also much lower than those found in previous studies done in this country. For example, a study done in 1996 by Oshitani showed HBsAg prevalence at 7.1% while another done recently in 2011 (Kapembwa 2011) amongst HIV positive adults showed the prevalence to be at 9.9% (and therefore falling into the high prevalence bracket). High risk sexual behavior is a recognised predisposing factor for HBV infection in both upper-income countries and developing ones.

The results of this study bring out an important aspect of the evolution of the blood transfusion service in this country. Nineteen years ago, a study showed that there was a significant increase in the prevalence of hepatitis infection in SCD patients who had received multiple blood transfusions compared to those who had received nothing or few; suggesting a cumulative risk associated with exposure to donated blood (Mbewe 1995).

The ZNBTS is a statutory board under the MOH and the only institution mandated to ensure efficient and effective implementation of the national blood safety in this country. In the year 2004, ZNBTS introduced the PEPFAR funded “Rapid Strengthening of Blood Transfusion Services Program.” This is a national program aimed at scaling-up safe blood transfusion services to ensure efficient, effective, equitable, and affordable access to safe blood and blood products throughout the country (Mulenga 2007)

Zambia identified the need and commenced the implementation of a comprehensive blood safety program, founded on the WHO guidelines for the establishment of national blood transfusion services. This program places an emphasis on the following:

- 1) Promotion of dependency on regular repeating VNRD (voluntary non-remunerated donors) from low-risk population groups, particularly regular repeating donors
- 2) Development and application of stricter criteria for selection of blood donors
- 3) Mandatory laboratory screening of blood for HIV, Hepatitis and Syphilis
- 4) Application of appropriate technologies, methods and standards for laboratory screening and processing of blood
- 5) Promotion of appropriate methods for clinical use of blood, so as to reduce blood transfusions to a bare minimum
- 6) Development of appropriate national policy and legal framework to guide blood transfusion practices; and
- 7) Establishment of appropriate nationally coordinated blood transfusion system, with strong government support. (Mulenga 2007)

This study is perfect testimony that indeed the blood bank service in this country has made great strides in its effort to provide blood in accordance to the above ideals.

The role of Hepatitis B Vaccine

The low prevalence of HBsAg in this study may be related to the fact that the majority of participants were children under the age of 10 years who were born in the era of vaccination against hepatitis B. It must also be remembered that the increase in age and with that, sexual activity, was associated with higher infection rates of HBV (even if the findings were not significant). HBV vaccine was introduced in the national Expanded Programme on Immunisation (EPI) in this country in 2005 as part of a pentavalent cocktail given in three doses beginning at age six weeks (WHO/Zambia Final Report on the Introduction evaluation of the Pentavalent vaccine in Zambia 2009). This cocktail also includes vaccines against diphtheria, tetanus, pertussis as well as haemophilus influenza – otherwise known as the DPT-HepB-HiB. In this study, many children came to the SCD clinic without their under-five cards to show proof that they had received the

vaccine even though 87% of the mothers asked said they had completed the three doses of vaccination. Consequentially, the information about vaccine coverage could not be extracted because very few brought under-five cards to the clinic. Nonetheless, studies in this country have showed that coverage levels for the penta valent vaccine are around 92.3% for the first dose of the DPT-HepB-HiB and 79.7% for the third dose of vaccine at 14 weeks of age (Kalesha 2007). Of course what would have been more helpful would be the inclusion of a serological test that confirmed vaccination and good response to it; the hepatitis B surface antibody test (HBsAb).

The results in is study are comparable to several other studies done elsewhere that have shown a reduction in the prevalence of hepatitis infection in the paediatric population after introduction of the vaccine. Neighbouring Tanzania introduced the vaccine much earlier than Zambia in 2002 (Metodi 2010). It's prevalence in the pre-vaccine era was 11.2% (Bart 1997) compared to that afterwards which reduced to 1.7% in the paediatric population (Metodi 2010). United States of America also shows a reduction among children after the vaccine was launched (Wasley 2010). Perhaps one of the most important improvements has been noted in Taiwan where cases and mortality rates from hepatocellular carcinoma have reduced significantly after the introduction of universal hepatitis B vaccine in 1984 (Chang 1997). It should be remembered that in this country, pregnant mothers are not routinely screened for hepatitis infection and babies only receive their first vaccine at six weeks of age; a time too late for the intra-partum vertical transmission of infection from positive mothers. Some countries found out over long periods of time that to reduce the rates to near zero, this population of the under-six week olds had to be given attention by beginning vaccination at birth (Wasley 2010).

Hepatitis C

Only one patient tested positive for Hepatitis C infection. Because of the very low prevalence, it was difficult to subject this to any statistical analysis. This is a low prevalence and seem to be in agreement with other previous studies done in this country on hepatitis C prevalence that have consistently shown low rates of infection in different subpopulations in this country (Oshitani 1995, Kapembwa 2011). The risk factors frequently cited as effective routes of transmission include the transfusion of blood from

unscreened donors, intravenous drug abuse and the use of unsafe therapeutic injections (Shepard 2005). A prospective study done in Italy followed up 895 monogamous partners of HCV positive people for 10 years and concluded that the risk of sexual transmission of HCV is extremely low (Vendalli 2004). Blood transfusion has become a less important route of transmission in many countries where measures such as adopting an all-volunteer donor system (as opposed to the use of paid ones) and screening of potential blood donors against HCV infection are taken. Egypt has the highest reported seroprevalence of hepatitis C infection world-wide because of the use of contaminated glass-syringes in a nationwide campaign against schistosomiasis infection carried out from 1960 to 1987 (Frank 2000). One veterans' hospital in the United States of America has experienced large reductions in the incidence of HCV infections after the proportion of paid-blood donor blood use was reduced from 91% to 4% (Seeff 1975). Zambia screens all donated blood for HCV and has adopted the WHO recommendation of using blood from unpaid volunteers only. Additionally, it is routine practice in this country to dispose needles and syringes only after single use.

Human Immuno-deficiency Virus

Two patients or 1.4% of the participants tested positive for HIV infection. There is not much information available regarding the impact of co-existence of HIV and SCD. In Zambia, HIV is quite common at 14.3% in the general population and it was somewhat surprising that it was this low in this study. Of course, one obvious reason is that this population was predominantly youthful with little sexual exposure (the main route of transmission). However studies done have actually showed that there is a lower risk of HIV co-morbidity with SCD. They have also showed that SCD HIV positive patients are likely to progress slower than normally. This suggests the possibility that SCD may have a unique effect in altering the risk of HIV infection or progression (Nouriae 2012; Bagasra1998). Investigation of how the haemolytic and immunological changes of SCD influence HIV might lead to new therapeutic or preventive approaches.

One retrospective study done in the USA showed that children with both HIV and SCD had an increased risk of bacterial infections (by encapsulated organisms) and

pneumonias and experienced longer hospital stay. However, as the studies cited above, it showed that the risk of vaso-occlusive crisis was reduced and case fatality rate was lower than with those with SCD alone (Kourtis 2007).

CHAPTER SIX

6.1 CONCLUSION

At the University Teaching Hospital in Lusaka, HBV prevalence amongst the SCD patients is 2.2%. Its prevalence is not associated with blood transfusions.

HBV prevalence in this study has a non-significant association with increasing age and sexual activity. HBV infection has been markedly reduced as this study of a mainly young population has showed and this is most likely due to vaccination introduced in 2005 in Zambia. The prevalence of HCV is 0.7% and could not be subjected to much statistical manipulation.

6.2 LIMITATIONS

1. Inability to classify HBV positivity as to whether the infection was acute or chronic as this would have required the application of other tests.
2. Due to the low numbers of positive outcomes, this study was under-powered to identify the risk factors for each infection.

6.3 RECOMMENDATIONS

1. To the adult Haematology clinic: It may be worthwhile to screen all SCD adults for HBV.
2. To the blood bank: it is important to continue the meticulous screening of all donated blood in accordance to the national guidelines.
3. Further strengthening of timely birth-dose vaccination will be important for reducing chronic HBV infection.
4. It is important to perform large longitudinal study that will better identify the risk factors for hepatitis infection in SCD patients.

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APPENDICES

1.0 INFORMATION SHEET.

My name is Dr .Lweendo Nchimba and I am a medical doctor training to be a paediatrician and Child Health Specialist. I am doing research on the prevalence of blood-borne hepatitis B and C in sickle cell disease (SCD) patients who present to University Teaching Hospital (UTH) in Lusaka.

Sickle cell disease is one of the most common inherited blood anaemias. The disease primarily affects people of African origin and is prevalent in Zambia. In Lusaka, the haematology unit in the Department of Paediatrics and Child Health at UTH is currently following more than 1,000 children with SCD.

Studies have shown that there is a high prevalence of hepatitis B and C among sickle cell disease patients who have received blood transfusions. Treatment for these hepatitides is not always initiated because some patients are asymptomatic. However, the lack of treatment may lead to chronic liver disease and even liver carcinoma. Early detection and treatment of hepatitis infections may reduce disease progression and may even cure the problem.

This study aims to determine the prevalence of hepatitis B, hepatitis C, and HIV among SCD patients at UTH. A questionnaire will be administered to you/your child and four milliliters of blood will be drawn from the cubital fossa of the child. This sample will be tested for hepatitis B, hepatitis C, and HIV. The results will be communicated to you at your next review and if any test result is positive, the researcher and her team will ensure that you are given the appropriate care.

If you have any questions, please feel free to contact me or the chair of the University of Zambia Biomedical Research Ethics Committee at the addresses or phone numbers below.

Thank you.

Dr. Lweendo Nchimba

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LUSAKA

2.0 CONSENT FORM.

I,.....,as a parent/guardian to the child named..... aged, agree to participate in a study on the prevalence of hepatitis B and C in sickle cell disease patients presenting to the University Teaching Hospital in Lusaka. I understand that the research will involve the drawing of four millilitres of blood for purposes of hepatitis B, hepatitis C, and HIV testing, as well as an interviewer-administered questionnaire. I also understand that the veni-puncture procedure, which is the drawing of blood from the above-named child, will be performed by adequately trained and experienced medical staff. Further, it has been explained to me that the above procedure presents minimal risk and minimal pain to the child. In the unlikely event that any adverse event arises from the procedure, I understand that all reasonable measures will be taken in accordance with the standard medical practice to mitigate adverse results.

PARENT/ GUARDIAN

WITNESS

..... Signature

..... Signature

..... Date

.....Date

..... (Relationship to Child)

..... (Name and Designation)

Thumb Print

3.0 ASSENT FORM (for participants below the age of 18 years).

I,....., being a female / male adolescent aged, agree to participate in a study on the prevalence of hepatitis B and C in sickle cell disease patients presenting to the University Teaching Hospital in Lusaka. I understand that the research will involve the drawing of four millilitres of blood for hepatitis B, hepatitis C, and HIV testing as well as an interviewer-administered questionnaire. I also understand that the veni-puncture procedure, which is the drawing of blood, will be performed by adequately trained and experienced medical staff. Further, I understand that the veni-puncture procedure presents minimal risk and pain. In the unlikely event that any adverse event arises from the procedure, I understand that all reasonable measures will be taken in accordance with the standard medical practice to mitigate adverse results.

ADOLESCENT

WITNESS

..... Signature

..... Signature

..... Date

.....Date

.....(Name and designation)

Thumb Print

4.0 Hepatitis B and C prevalence in SCD Data Collection Tool

Study ID

Date of interview

Interviewer _____

Patient's initials

Date of birth

Age

01. Gender (please tick)

F or M

02. Residence

• Tick one of the two:

Within Lusaka District

Outside Lusaka District

• Place of residence

03. Monthly income in the home is

<KR1000

KR1000 to KR5000

KR5000 to KR10,000

>KR10,000

04. Religion

Christian Islam Jehovah's witness Atheist Other (specify)

05. At what age was sickle cell disease diagnosed? _____

06. Was electrophoresis or high-performance liquid chromatography done? YES or NO

If YES, what was the result? _____

07. What was the main presenting complaint at first presentation? (tick)

Hand and foot syndrome

Painful crisis

Anaemia

Jaundice

Cerebro-vascular accident

Infection, e.g. pneumonia (specify) _____

Family member with sickle cell disease

Other (specify) _____

08. Are there other family members affected by sickle cell? YES or NO

If YES, specify relationship: _____

09. How many blood transfusions have you received?

10. In which year was the first blood transfusion? _____

11. What was/were the reason(s) for the transfusion(s)?

Anaemia

Stroke

Vaso-occlusive crisis (unresolving)

Hyperhaemolytic syndrome

Pre – operative

Renal problem

Other (specify) _____

12. Have you ever had a blood test for hepatitis B? YES or NO

If YES, what was the result? POSITIVE or NEGATIVE

13. Have you ever had a blood test for hepatitis C? YES or NO

If YES, what was the result? POSITIVE or NEGATIVE

14. Have you ever had a blood test for HIV? YES or NO

If YES, what was the result? POSITIVE or NEGATIVE

15. Have you ever had any of the following:

Tattoos

Intravenous drug abuse

Sexual activity

Initials of research assistant: _____

FOR LABORATORY USE ONLY

- Tick as appropriate

Test	Positive	Negative
Hepatitis B surface Ag test		
Hepatitis C antibody test		
HIV test		

Initials of Lab tech: _____