Prevalence and factors associated with transfusion transmissible infections among blood donors at Regional blood transfusion center Nakuru and Tenwek Mission Hospital, Kenya

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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I dedicate this work to my dear husband James for his support, my Dad Hosea and my Mum Christine for their tireless inspiration and encouragement.

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ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
ELISA	Enzyme-linked immune-sorbent assay
FRD	Family replacement donors
HBV	Hepatitis B virus
HCV	Hepatitis C virus
HIV	Human Immune deficiency Virus
KAIS	Kenya AIDS Indicator Survey
KNBTS	Kenya National Blood Transfusion Services
NBTS	National Blood Transfusion Service
O.R	Odds Ratio
RBTC	Regional Blood Transfusion Center
SSA	Sub-Saharan Africa
STI	Sexually transmitted infection
TTIs	Transfusion transmissible infections
VNRBD	Voluntary non-remunerated blood donors
WHO	World Health Organization

ABSTRACT

Blood transfusion is an essential therapeutic procedure. Although timely transfusion saves millions of human lives worldwide each year, unsafe transfusion practices can put millions of people at risk of transfusion transmissible infections. In Kenya the blood transfusion policy requires screening of blood for HIV-1 and HIV-2, hepatitis B surface antigen (HBsAg), hepatitis C virus antibodies (ant-HCV) and syphilis. Malaria is also a blood-borne disease which is not currently screened for. Blood donor selection criteria in Kenya were reviewed in 2009. Since the epidemiology of Transfusion Transmissible Infections (TTIs) evolves with time, regular review of effectiveness of donor selection criteria can help reduce TTI's prevalence amongst donors and thus make blood supply safer. A cross sectional study was conducted among blood donors in Regional Blood Transfusion Center Nakuru and Tenwek Mission Hospital, Kenya. Donor samples were obtained through systematic sampling. Each donor sample was screened, for HIV-1 and HIV-2, hepatitis B surface antigen (HBsAg), hepatitis C virus antibodies (ant-HCV), syphilis and malaria parasites. Associated risk factors were determined using the standard donor questionnaire. A total of 594 participants were enrolled into the study. Males constituted 72% (n=429), 53% (n=315) of overall donors being between 16-20 years of age. Sixty two percent of donors (n=367) were students, 75% (n=446) were single and 67% (n=399) had attained secondary school education. The overall prevalence of TTI's was 14.1%; n=84 (11.9% in Nakuru and 25% in Tenwek). The prevalence of Transfusion Transmissible Infections among blood donors in

the two sites ranged from 0.7% for malaria to 5.6% for HBsAg. In multivariate analysis, blood donors who were married (OR=4.56; P-value=0.0057) with non-formal/primary education (OR=9.05; P-value=0.0262), informal occupation (OR=4.08; P-value=0.0176) and multiple sexual activity (OR=189.78; P-value=0.0144), were at higher risk of HIV infection. History of blood transfusion/blood products (OR=9727.90; P-value=0.0055) and being married (OR=12.27; P-value=0.0053) were high risk factors associated with positive syphilis. Male gender (OR=2.92; P-value=0.0479) was a high risk factor to HBV infection. This study identifies a low risk donor as unmarried, less than 30 years of age, and having education beyond primary level who donates voluntarily. Potential donors with history of previous transfusion and multiple sexual activity should be deferred from donation. Measures should be taken to prevent transfusion transmission of malaria. The donor selection questionnaire should be updated to screen persons exposed to malaria.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

A blood transfusion is the transfer of blood or blood products from one person (donor) into another person's bloodstream (recipient). This is usually done as a life saving maneuver to replace blood cells or blood products lost through severe bleeding, during surgery, when blood loss occurs or to increase the blood count in an anemic patient. Blood transfusion is an essential therapeutic procedure. Although timely transfusion saves millions of human lives worldwide each year, unsafe transfusion practices can put millions of people at risk of transfusion transmissible infections (TTI) (Diro *et al*., 2008). Evaluation of data on the prevalence of transfusion transmissible infections which include among others; HIV, HBV, HCV, syphilis and malaria, in blood and blood component donors, permits an assessment of the occurrence of infections in the blood donor population and consequently the safety of the donations (Bhawani *et al*., 2010). It also gives an idea of the epidemiology of these diseases in the community (Alli *et al*., 2010).

Transfusion associated infections continue to be a big threat globally (Bhawani *et al*., 2010). While the search for an effective therapy and vaccine continues, prevention and control of these infections such as HCV infection should be the goal of public health efforts. To increase the efficacy of these interventions, it is important to understand the

risk factors for these infections in different populations (Polizzotto *et al*., 2008; Colin *et al*., 2005). Stringent measures have been put in place worldwide to minimize the risk of TTIs. These include utilization of volunteer non-remunerated blood donors, donor selection, blood screening and appropriate blood use (Salawu *et al*., 2010). Donor selection involves deferral of persons based on a questionnaire that evaluates both health status and behavioural lifestyle of prospective donors. Donor selection questions are determined based on current epidemiological and scientific knowledge pertaining to specific TTIs. The donor selection criterion in Kenya was reviewed in 2009. Donor selection criteria should be reviewed periodically as disease epidemiology changes (Alli *et al*., 2010).

Kenya's need for blood is estimated at between 200,000 and 250,000 units per year. However, with the WHO guidelines estimate of 10-20 units per 1,000 people then the need in Kenya can be estimated at between 380,000–760,000 units annually. Currently, 125,000 units of blood are collected through the National Blood Transfusion Service (NBTS). The deficit is thought to be covered by family replacement donors (Bloodlink Foundation, 2008). Family replacement donors account for up to 35 percent of donors in Kenya, despite them being more risky (Bloodlink Foundation, 2008).

In this study blood donors were either non-remunerated volunteers or family replacement blood donors. Nakuru Regional blood transfusion center recruited volunteer non-remunerated blood donors from low-risk populations, while in Tenwek Mission

Hospital donors were relatives or friends of patients to replace blood used. A standard questionnaire was administered to all consenting donors from the two facilities. Regular review of effectiveness of donor selection criteria can help reduce TTIs prevalence amongst donors and thus make the blood supply safer. This study aimed to determine prevalence, socio-demographic profiles and examine associated risk factors of blood donors at RBTC Nakuru and Tenwek Mission Hospital. The findings will guide RBTCs in targeting low risk donors and improving donor selection.

1.2 Problem Statement

Transfusion transmissible infections can exist asymptomatically in donors, so donors must be screened for high-risk behavior related diseases. In Africa 5-10% of HIV transmission is as a result of contaminated blood transfusions (Fessehaye *et al.*, 2011). Infection by HBV and HCV causes serious mortality, morbidity and financial burden and thus is a major global health problem (Bhattacharya *et al*., 2007). In Sub-Saharan Africa, 12.5% of patients who receive blood transfusion are at risk of post-transfusion hepatitis (Tessema *et al*., 2010).

Syphilis is less readily transmitted by blood and the prevalence is low in most studies reported (Bhawani *et al*., 2010). In sub-Saharan Africa, syphilis remains a serious public health problem. Prevalence of active syphilis infection among African countries showed 12.8% in Tanzania and 3.8% in Kenya, in a study carried among donors for a period of five years from 2003 to 2007 in Northwest Ethiopia. A study carried out among

Ethiopian blood donors in 1995 to assess the prevalence of infection, showed that the sero-prevalence of HIV-1, syphilis and HBV was 16.7%, 12.8% and 14.4%, respectively (Tessema *et al*., 2010). Malaria causes about 350-500 million infections in humans and it is responsible for approximately 1.3-3.0 million deaths annually. In Africa a child dies every 45 seconds of malaria, the disease accounts for 20% of all childhood deaths (Alli *et al*., 2010). Studies conducted in Benin revealed the presence of *Plasmodium falciparum* in 30.2 and 33.5% of blood donors respectively (Tagny *et al*., 2010).

In Kenya there is highlighted abuse of drugs, and the link between drug abuse and HIV/AIDS. Seroprevalence study among IDUs in Mombasa indicates that 50% of those in the city are HIV positive and 70% are positive for hepatitis C. In Kenya, school students are the main donor group. A study indicates that the HIV prevalence rate in six Regional Blood Transfusion Centers, and the variation by months, is markedly elevated in April, August and December. These are periods when the schools are closed and transfusion centers rely on out-of-school donors. Infection rates are higher in this population group (NASCOP, 2005).

An unsafe blood transfusion is very costly from both human and economic points of view. Morbidity and mortality from transfusion of infected blood have far-reaching consequences, not only for the recipients themselves, but also for their families, communities and the wider society (WHO, 2002), since a person can transmit an infection during its asymptomatic phase. Transfusion can contribute to an ever widening

pool of infection in the population. The economic costs of the failure to control the transmission of infection include increased requirement for medical care, higher levels of dependency and the loss of productive labor force, placing heavy burdens on already overstretched health and social services and on the national economy (Buseri *et al*., 2009).

1.3 Study Justification

In Sub-Saharan Africa, blood transfusion safety is marred by the high prevalence of infectious agents (Jean-Pierre, 2011). Kenya is one of the countries with high prevalence of HIV, HBV, HCV and other bloodborne infections (Makokha *et al*., 2004). The population prevalence is HIV (7.0%), HBV (5-30%) & HCV (10%); therefore there is little published data on prevalence of TTIs, socio-demographic characteristics & associated risk factors among blood donors in Kenya. In Kenya, the current blood transfusion policy recommends screening of blood for HIV, Hepatitis B, Hepatitis C and syphilis. Malaria is also a blood-borne disease which is not screened for. This study included testing for malaria parasites which is not done routinely within NBTS.

Human immunodeficiency virus and malaria are among top ten diseases of public health importance. In Kenya, high numbers of road traffic accidents, malaria infections and anemia in children and women of child bearing age leads to a high requirement for blood transfusions to save lives. If the blood that will be transfused is carrying blood-borne pathogens, then the patient's situation becomes more complicated. It is necessary to

obtain screened blood from a reputable source, so that these populations are protected from blood-borne pathogens.

While the search for effective therapies and vaccines continues, prevention and control of these blood-borne infections should be the goals of sustained public health efforts. The first step in ensuring blood safety is the selection of low risk blood donors. National blood transfusion service questionnaire was introduced in 2009. The donor selection criterion has not been reviewed since then. Donor selection criteria should be reviewed periodically as disease epidemiology changes (Alli *et al*., 2010). Since introduction, the validity of the questionnaire has not yet been tested. This study will give NBTS very useful information on the strength of the questionnaire in eliminating high risk donors.

Many TTIs including HIV and hepatitis have an infectious latent phase when carriers are seemingly healthy. In malaria endemic regions healthy persons may have low grade parasitaemia that can cause death in non-immune persons. These latency stages pose major challenges to Blood Transfusion Services across the world as they seek to minimize collection of blood from infected persons through appropriate donor selection. To increase the efficacy of donor screening and selection, it is important to understand the risk factors for these infections in different populations (Polizzotto *et al*., 2008). Several studies within Africa, suggest that the African blood donor is mostly young (Tagny *et al*., 2010), with a mean age of 28·9 ± 8·5 years. This is also the population at highest risk of acquiring HIV and malaria infections.

There is need to ensure that the blood the recipients receive is safe from known infections. This study therefore seeks to determine prevalence, socio-demographic profiles and examine associated risk factors of blood donors at RBTC Nakuru and Tenwek Mission Hospital. The information obtained will guide donor selection practices within the Kenya National blood Transfusion Service with the aim of ensuring a safer blood supply in Kenya.

1.4 Research Questions

- What are the socio-demographic characteristics of blood donors at RBTC-Nakuru and Tenwek Mission Hospital?
- What is the prevalence of HIV, HBV, HCV, syphilis and malaria parasites among blood donors?
- What are the behavioral risk factors associated with TTIs among blood donors?

1.5 Study Objectives

1.5.1 General Objective

To determine prevalence and factors associated with transfusion transmissible infections among blood donors at Regional Blood Transfusion Centre-Nakuru and Tenwek Mission Hospital.

1.5.2 Specific Objectives

- To determine socio-demographic characteristics of blood donors at Regional Blood Transfusion Centre-Nakuru and Tenwek Mission Hospital.
- To determine the prevalence of transfusion transmissible infections among blood donors
- To determine behavioural risk factors associated with transfusion transmissible infections among blood donors

1.6 Limitations of the study

Responses from donors could not be verified and no effort was made to do so. None of the donors in Tenwek responded positively to any of the risk factors. It is likely that risky behaviours of these blood donors were purposely denied so as not to lose face amongst family and friends who had approached the donor on behalf of a sick relative requiring transfusion. Such pressure would not be there for volunteer non remunerated blood donors. It is important to point out that the results obtained in this study do not reflect the prevalence of markers of transfusion-transmissible infections in the unselected general population because blood donors are a pre-selected group and all of them are within the sexually active age group.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Occurrence and Distribution of Transfusion Transmissible Infections

Several studies have documented high prevalence of infection with hepatitis C and B viruses and HIV among injecting drug users, both in industrialized and developing countries. The average age of drug users was 32.61+/-4.2 years old, and the majority of them (58%) were in 20-34 age groups. Fifty percent of them were labor workers and 5% had no occupation. Among them, 55% were single and others were married (Mirahmadizadeh *et al*., 2004). An overall sero-prevalence of HBsAg, HIV, ant-HCV and syphilis among prospective blood donors in Osogbo, Nigeria was 18.6, 3.1, 6.0 and 1.1%, respectively. In their study in Nigeria the highest prevalence of HBsAg, HIV, ant-HCV and syphilis infections occurred among commercial blood donors and those aged 18-47 years, the most sexually active age group (Buseri *et al*., 2009).

2.1.1 Human Immunodeficiency Virus (HIV)

Sub-Saharan Africa has been severely hit by the HIV/AIDS pandemic. Human immunodeficiency virus is the leading cause of death in Africa, replacing malaria and other communicable diseases (Alli *et al*., 2010). Most cases of HIV around the world have been attributed to HIV-1. Nearly all cases of HIV in the United States are due to HIV-I. In Nigeria, the prevalence of HIV has increased steadily over the years, from 1.8% in 1991 to 3.8% in 1993, 4.5% in 1996, 5.4% in 1999, 5.8% in 2001 and 5.0% in

2003 (Awortu *et al* ., 2009). Sub-Saharan Africa has 10% of the world's population, yet it accounts for about 60% of the estimated 40 million HIV infections globally. The key risk factors for the dominant mode of acquiring HIV in Africa are transactional sex, multiple partners and several epidemiological studies, find that vulnerable groups like, female sex workers (FSW) and their clients, who have high rates of acquiring and transmitting HIV, play key roles in the spread of HIV and for maintaining HIV infection levels in the general population (Chen *et al*., 2007).

The prevalence of HIV infection in Africa varies from one region to another. In South Africa and central Africa Republic, it was, 0.1% and 15% respectively in new donors in 2004. The prevalence of blood transmissible viruses is dependent on the type of blood donor; voluntary donors have lower prevalence (Tagny *et al*., 2010). According to 2007 KNBTS statistics, 1.2% of all units donated to the KNTBS network tested positive for HIV. This comprised mostly volunteers and some family/replacement donors. Human immunodeficiency virus prevalence was similar among persons who had received a blood transfusion and those who did not (7.0% and 7.1%) respectively. More men compared to women donated blood from a blood transfusion service (69.2% compared to 30.8%) respectively, family/replacement donor (81.4% versus 18.6%) respectively (KAIS, 2007).

2.1.2 Hepatitis B Virus (HBV)

Hepatitis B infection is a health problem worldwide. Globally it is estimated that about 320-350 million individuals are chronic carriers, and about 1.5 million people die annually from HBV-related causes (Alao *et al*., 2009). This infection occurs frequently in Nigeria. In a study done from 2006-2008, it is estimated that about 12% of the total Nigerian population are chronic carriers. These blood donors were mostly males (98%) between the ages of 18 and 60 years and comprised mostly relatives and friends of hospital in-patients and some paid donors (Alao *et al*., 2009). Most people infected by these viruses are asymptomatic and are unaware of the infection, but can transmit the virus to others. In donors after testing positive to the viruses, counseling is withheld as it is thought that it may frustrate donors and lower the blood pool. The effect of this is that those uncounselled sero-positive donors are innocently infecting the society (Alli *et al*., 2010).

About 30% of the world's population or about 2 billion persons have serological evidence of either current or past infection with hepatitis B virus. The prevalence of chronic HBV infection in India ranges from 2% to 10% as shown by different studies (Karandeep *et al*., 2009). Hepatitis B virus is mainly transmitted, from mother to child and through blood transfusions in adults. The prevalence of HBs antigen ranges from 8% to 15% in African blood donors from Tanzania, Cameroon, Mozambique, South Africa

and Lesotho. This prevalence has been reported to be reduced in regular donors (WHO, 2002).

2.1.3 Hepatitis C Virus (HCV)

Worldwide hepatitis C virus (HCV) infection is a health problem: it is estimated that more than one hundred million people are infected (Emmanuele and Federica, 2008). Hepatitis C virus has been shown to have a worldwide distribution occurring among persons of all ages, genders, races and regions of the world. Various prevalence rates of anti-HCV antibodies have been documented in African countries. Prevalence rates reported from some African countries also differ from place to place (Udeze *et al.,* 2009) reported 4.4% in Kenya in 2004, 2.5% in Ghana and 3.3% in Burkina Faso. Nigeria, is one of the countries highly endemic for viral hepatitis, the prevalence rate varies between 5.8% and 12.3% (Alli *et al*., 2010). Hepatitis C virus infections are a major cause of liver disease and hepatocellular carcinoma in the United States, of the estimated 2.7-3.9 million persons with active HCV infection, there was continued increase in rates of newly reported HCV infection among persons aged 15-24 years, and infection rates were equally distributed among males and females: among cases with available risk data, IDU was the most common risk factor for transmission (Abur-Raihan, 2011).

World Health Organization estimated that 3% of the world's population (more than 170 million people) is infected with HCV (Theodore and Jamal, 2006). World Health Organization reports global prevalence of ant-HCV ranges from 10 % to 15 % to as low

as less than 0.04%. Hepatitis C infection in blood donor varies from 0.4 % to 19.2%. Among voluntary blood donors the prevalence of ant-HCV in India, Japan and Germany were (0.8%) 0.3-1, (78%) 13, (0.6%) 14 and (0.2-0.8%) 15 respectively (Habibullah *et al*., 2009).

2.1.4 Syphilis

In many developing countries, syphilis remains a major public health problem, with an estimated 12 million cases per year globally, of which 4 million occur in Africa (Todd *et al*., 2001). Syphilis is an important cause of morbidity and if untreated has many complications, particularly among women and their newborn infants. In addition, syphilis in particular those resulting in genital ulceration are associated with enhanced sexual transmission of HIV (Todd *et al*., 2001). Serological surveys in Tanzania have shown that the prevalence of active syphilis is high, with adult prevalence's ranging from 5.9% in Kagera to 12.8% in roadside settlements in Mwanza. A previous study in Mwanza region in 1990 showed that the prevalence of active syphilis was 8.1% in males and 9.4% in females. Risk factor analysis showed an association between syphilis and a higher number of sexual partners in both sexes. A higher prevalence of syphilis was also common among uncircumcised men, men who were widowed, divorced, or separated, and women with a lower level of education (Todd *et al*., 2001).

2.1.5 Malaria

Malaria is an important parasitic infectious disease. Approximately 300-500 million people are infected, and over 1 million people die from this disease each year. Malaria is endemic in sub-tropical and tropical areas such as Central and South America, Africa, and Southeast Asia. About 400 to 1,000 cases of malaria were reported in Canada each year between 1990 and 1997, and most of these cases were associated with international travel to malaria endemic areas (PHAC, 2008). Approximately half of the world's population is at risk of malaria. Most malaria cases and deaths occur in sub-Saharan Africa. Asia, Latin America and to a lesser extent the Middle East and parts of Europe are also affected (WHO, 2012). Malaria remains a major cause of mortality among children under the age of 5 years; it is endemic throughout Nigeria with seasonal variation in different geographic zones of the country. Malaria can decrease gross domestic product by as much as 1.3% in countries with high disease rates. Non-immune travelers from malaria-free areas are very vulnerable to the disease when they get infected (Alli *et al*., 2010).

Malaria is endemic in Sub-Saharan Africa. In a district hospital in Malawi where microscopy is used to screen donor blood, a deferral rate of 10% was reported for malaria. Malaria has been reported to be more prevalent in non-remunerated blood donors than in family replacement donors. Non-remunerated blood donors often come from the poorest sectors of society, are more likely to live in densely populated, malaria-

infested, poor-sanitary environments. The screening of malaria is rarely undertaken in African blood banks. Up to a third of blood donor supply might be lost if such strategies are introduced. In areas of low immunity to malaria, transfusion recipients may benefit from screening for malarial parasites (Tagny *et al*., 2010).

2.2 Causes and Mode of transmission of Transfusion Transmissible Infections

Transfusion-transmissible infectious agents such as HBV, HIV, HCV, syphilis and malaria are among the greatest threats to blood safety, for transfusion recipients and pose a serious public health problem (Buseri *et al*., 2009). The periodic evaluation of the common modes of transmission of a disease is important, not only helps public health officials in developing specific prevention and control strategies for a given transmissible infection, but also helps to evaluate the impact of control strategies (Younus *et al*., 2009).

2.2.1 Human Immunodeficiency Virus (HIV)

Acquired immune deficiency syndrome is a life threatening complication of HIV which is caused by a retrovirus having two strains namely HIV 1 and 2 (Chen *et al*., 2007). Human immunodeficiency virus is transmitted through sexual contact, sharing of HIV contaminated needles and syringes, transfusion of blood components, and nosocomial exposure to HIV contaminated blood or bodily fluids, and can be passed vertically from a mother to her infant, although the majority of HIV infections via blood occur through injecting drug use (PHAC, 2008).

2.2.2 Hepatitis B Virus (HBV)

Hepatitis B is a liver disease caused by infection with the hepatitis B virus (HBV). Hepatitis B virus is transmitted cutaneously through injection of drugs, exposure to contaminated blood or bodily fluids, sexually through heterosexual or male homosexual activities, vertically from mother to infant, and horizontally among household contacts. In Canada, injection of drugs and risky of heterosexual activities are the major risk factors associated with HBV transmission (PHAC, 2008).

2.2.3 Hepatitis C Virus (HCV)

Hepatitis C infection is caused by the hepatitis C virus (HCV), which is spread when one comes in contact with contaminated blood. About 200 million people are infected with hepatitis C virus (HCV) worldwide, which covers about 3.3% of the world's population. Hepatitis C infection leads to chronic hepatitis in 50% to 80% of individuals. World Health Organization in 2004 estimated annual deaths due to liver cancer caused by HCV and cirrhosis were 308 000 and 785 000 respectively (Waheed *et al*., 2009). Hepatitis C infection is transmitted through several routes, including intravenous drug injection, nosocomial exposure to contaminated blood or bodily fluids, blood transfusion, sexual activities, from mother to infant or it can be inherited. The sexual transmission rate is lower (Awortu *et al*., 2009; PHAC, 2008), substandard hospital hygiene and a number of traditional cultural practices that favour contact with blood. Greater spreads of HCV are through unsafe therapeutic injections performed by both professionals and non-professionals. It has been estimated that approximately 2 million

HCV infections are acquired annually from contaminated health care injections, and may account for up to 40% of all HCV infections worldwide. Lack of attention to appropriate cleaning and disinfection of equipment used in hospital and dental settings also may be a source for HCV transmission (Alter, 2007). Among African blood donors, 0.3%-5.0% donors carry anti-HCV antibodies, with prevalence varying from 2.2% in Burkina Faso to 4.3% in Uganda, to as high as 12% in new donors in Senegal (Waheed *et al*., 2009).

2.2.4 Syphilis

Syphilis is a systematic disease caused by *Treponema pallidum*. In sub-Saharan Africa, syphilis remains a serious public health problem. Prevalence of active syphilis infection among African countries showed 12.8% in Tanzania and 3.8% in Kenya (Tessema *et al*., 2010). Syphilis is transmitted primarily through sexual contact with an infected individual who is in the primary, secondary or early latent stage of the disease. *Treponema pallidum* can also be transmitted from mother to fetus and from an infected donor to a recipient through unscreened blood or direct blood transfusion.

2.2.5 Malaria

Malaria is a life-threatening disease caused by four species of Plasmodium, including *Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale* and *Plasmodium malariae*. Malaria caused by *P. falciparum* often results in severe complications and/or death. On the other hand, malaria caused by other *Plasmodium* species usually results in non-life-threatening symptoms (PHAC, 2008; WHO, 2010). Malaria is the most

important tropical parasitic disease affecting about 247 million people each year among the 3.3 billion people at risk, resulting in nearly a million deaths, mostly children under the age of 5 years. The transmission is through the bites of infected mosquitoes. Malaria still remains one of the unconquered diseases in the world today which is exclusively transmitted through the bites of Anopheles mosquitoes. Malaria parasites can also be transmitted by blood transfusions, although this is rare (Alli *et al*., 2010). Human malaria parasites are transmitted to humans by the bite of an infected female Anopheles mosquito. They can also be transmitted from an infected mother to her fetus and from an asymptomatic donor to a recipient. Transfusion Transmitted malaria (TTM) is rare, but it is a potential severe complication in blood recipients. Three cases of TTM have been reported in Canada (PHAC, 2008).

2.3 Consequences of Transfusion Transmissible Infections

Hepatitis B and Hepatitis C infections have been associated with long-term morbidity and mortality due to complications like cirrhosis, portal hypertension, chronic liver diseases, and hepatocellular carcinoma, but in HIV infection, it accelerates the progression of HBV- and HCV-related chronic liver disease (Emmanuel *et al*., 2012). Hepatitis B virus causes acute and chronic hepatitis which usually progresses to cirrhosis and hepatocellular carcinoma. A previous study, reported a prevalence rate of 14% among blood donors in Zimbabwe, Southern Africa (Awortu *et al*., 2009). Hepatitis C virus infection is a common co-morbidity in HIV infected (HIV+) persons, and substance use may be a common risk factor for both. Infection with hepatitis C virus is one of the most common causes of chronic liver disease (Khalsa and Vocci, 2008).

Hepatitis C virus-HIV co-infection remains a frequent cause of morbidity in developed countries (Adwan, 2004). Studies have suggested that HCV infection in patients with HIV can lead to poor immune response after initiation of antiretroviral therapy (ART). This is because of deterioration of liver function, since patients with liver cirrhosis without HIV disease are immunocompromiseed (Slim *et al*., 2004). Hepatitis C infection is endemic among injection drug users. Chronic hepatitis C infection is a significant source of morbidity and mortality among people with HIV, and increases the risk of hepatotoxicity of antiretroviral therapy (WHO, 2007).

Human immunodeficiency virus, HBV, and HCV infection share similar transmission routes and therefore co-infection is common. In patients co-infected with HIV plus HBV or HCV, fibrosis rates are accelerated compared with those infected with HBV or HCV alone, leading to faster progression to end-stage liver disease (Deepak *et al*., 2011). Human immunodeficiency virus and substance use each can produce neurocognitive impairment. Syria is a developing country with low prevalence of HIV infection (Syrian Arab Republic, 2012). Infection with syphilis during pregnancy may lead to miscarriage, stillbirth, prematurity, and congenital syphilis. In addition, syphilis increases the risk of acquiring HIV infection, and tertiary syphilis in HIV infected individuals is difficult to treat (PHAC, 2008).

Malaria causes significant economic losses, and can decrease gross domestic product (GDP) by 1.3% in countries with high levels of transmission. The health costs of malaria are personal and public expenditures on prevention and treatment. In some heavy-burden countries, the disease accounts for, up to 40% of public health expenditures, 30% to 50% of inpatient hospital admissions and up to 60% of outpatient health clinic visits. Malaria affects poor people who cannot afford treatment or have limited access to health care, trapping families and communities in a downward spiral of poverty (WHO, 2010).

2.4 Interventions for Transfusion Transmissible Infections

The World Health organization (WHO) outlines a number of recommendations which countries should follow to maintain a safe and constant blood supply. These steps prevent transfusion-transmissible infections (TTIs), which include HIV-1, HIV-2, hepatitis B, hepatitis C and syphilis. According to the recommendations countries need: A national coordinated blood transfusion service, voluntary unpaid donors, testing of all donated blood, efficient and appropriate use of blood, safe transfusion practices and quality systems check throughout the blo

od transfusion process. The roll-out of widespread safety measures such as donor selection and screening guidelines makes the risk of HIV transmission today non-existent in developed countries. However, where guidelines for blood safety have not been implemented or are not followed, HIV infection continues to be a risk associated with blood transfusion (Polizzotto *et al*., 2008).

The injection drug use represents a significant and increasingly important public health issue globally. It is a leading cause of HIV, HBV, HCV, and other blood-borne infections, and a health and social issue with dramatic costs and consequences for individuals, families and communities. In an effort to prevent transmission, harm reduction, including needle exchange programs, people who use injection drugs are encouraged to use bleach to clean needles and syringes, if new needles are not available. There is little direct evidence, of the effectiveness of bleach in preventing Hepatitis C virus transmission

(Dinner *et al*., 2004). Needle exchange programs are a vital venue for introducing and integrating hepatitis C education, prevention counseling, testing, medical care, and support services for injection drug users. Successful program implementation requires engagement in broader policy issues that restrict access to appropriate care and services for injection drug users (Raymond *et al*., 2004). Currently, no vaccine against HCV is available. Prevention of HCV infection relies on public health education and programs aimed at reducing high-risk behaviours, such as initiating injection drug use and sharing needles (PHAC, 2008). Public health intervention should be the most effective method for preventing HCV. Most modern and sensitive screening of blood/blood products, adequate sterilization of reusable syringes, destruction of disposable needles, proper management of blood banks, and health education by increasing community awareness would be the best options to prevent HCV infection for a developing country (Habibullah *et al*., 2009).

Hepatitis B virus infection can be effectively prevented through immunization programs, which are widely available for infants and preadolescents (PHAC, 2008). A combination of preventive strategies such as safe injection practices, proper sterilization of medical equipment, public education programs for barbers, and issuance of relevant guidelines for counseling and management of donors may reduce the incidence of these transfusion-transmissible infections in developing countries (Awortu *et al*., 2009).

Prevention of transfusion-transmitted malaria relies on interviewing donors, for risk factors related to residence in or travel to areas with endemic infection or previous

treatment for malaria. The transfusion risk related to malaria can be reduced by an overall approach, including destruction of parasitic blood units, chemoprophylaxis for blood recipients, education for blood donors to prevent new infections with the use of insecticides treated mosquito nets, and a community campaign against mosquitoes. These approaches should be systematically documented and included into local policies. Drugs can also be used to prevent malaria. For travelers, malaria can be prevented through chemoprophylaxis, which suppresses the blood stage of malaria infections, thereby preventing malaria disease (Tagny *et al*., 2010). The donor deferral policy remains the most efficient way to prevent and reduce the occurrence of transfusion transmissible malaria in Canada (PHAC, 2008).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study sites

The study was carried out at Regional Blood Transfusion Center Nakuru and Tenwek Mission Hospital. Rift Valley Province covers an area of 7190 km^2 and lies between longitudes 35^o, 28^o and latitude O^o 13 and 1^o 10 South. It lies in the Great Rift Valley basin. Administratively it is divided into South and North Rift as regards Blood Transfusion services. There are two Regional centers that offer the same services. The Regional Centre based in Nakuru town covers, Nakuru, Naivasha, Nyahururu, Narok, Koibatek, Baringo, Laikipia, Tenwek and Samburu counties. Tenwek is a Mission Hospital situated at Tenwek County (Figure 3.1).

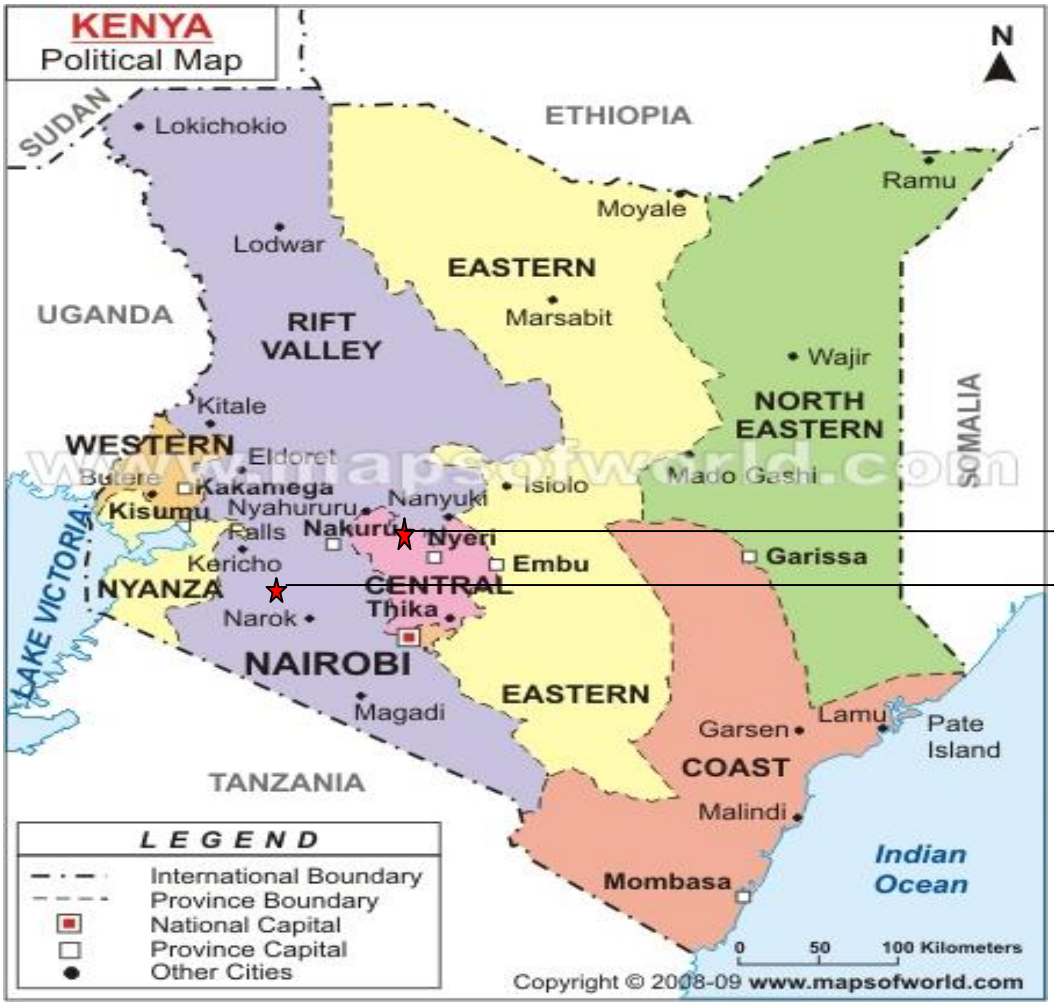

Figure 3.1 Map of Kenya showing Nakuru and Tenwek

Source: *www.mapsofworld.com*. *Last modified* on 20 October 2012.

3.2 Study design

This was a cross sectional study, whereby data on demographic characteristics and associated risk factors of TTIs was obtained from blood donors at two health facilities. Whereas RBTC Nakuru collects blood from volunteer-non numerated donors (VNRD), Tenwek uses family replacement donors (FRD) and does not subject them to the standard

questionnaire. All donated blood was screened for HBsAg, ant-HCV, HIV, syphilis and malaria parasites. The study was conducted between November 2011 and January 2012.

3.3 Study Population

The study population was blood donors in Nakuru Blood Transfusion Center and Tenwek Mission Hospital.

3.3.1 Inclusion Criteria

- Age 16 years and 65 years
- Body weight greater than 50 kg
- Haemoglobin level greater than 12.5 g/dl and informed consent to participate in the study.

3.3.2 Exclusion Criteria

- Age less than 16 years or more than 65 years
- Body weight less than 50 kg
- Haemoglobin values less than 12.5 g/dl
- History of jaundice, sickle cell disease, hypertension or current fever, recent illness or transfusion, high risk sexual behavior and lack of consent.

3.4 Sample Size Determination

Sample size calculation was carried using the Cochran formula (1977).

$$n = \frac{p(1-p)z^2}{d^2},$$

Where n is the sample size, z equals (1-α/2) percentile of a standard normal distribution, d is the absolute precision, p is the expected proportion.

In order to determine the sample size the following assumptions were made:

i. A 95% confidence level resulting into z =1.96

ii. Expected prevalence of HBV, HIV, HCV and Syphilis of 3.2%, 1.3%, 1% and 0.5%, respectively, among blood donors of transfusion-transmissible infections (NASCOP, 2005). Hence p=3.2% was adopted since it was giving the optimal sample size among the four diseases.

iii. A precision of 2% led to confidence interval of 1.2 % to 5.2%.

Therefore $n = \frac{0.032(0.968)1.96^2}{0.02^2} = 297$

For the two facilities a required minimum sample size equal to

$297 \times 2 = 594$

The number of blood donations at the two facilities was an average of 1,600 in Nakuru and 120 in Tenwek per month. Due to small workload in Tenwek a proportional allotment was not plausible. An intuitive assignment to Tenwek a sample size of **100** and to Nakuru

a sample size of 594-100= **494** was done. In Tenwek, 3-5 blood donors were sampled per day and 13-15 per day in Nakuru.

3.5 Sampling method

Systematic sampling method was used. Systematic sampling is a stastistical method involving the selection of participants from an ordered sampling frame. Sampling was estimated from the blood donor register. The sampling started by selecting a participant from the list at random and then every k^{th} participant in the frame was selected. A selection interval *(k)* was determined by dividing the total population listed by the sample size. A random starting point was selected after which every k^{th} person in the population list was selected. The sampling interval, also known as the skip, was calculated as follows:

$$k = \frac{N}{n},$$

Where N was the population size and n was the sample size.

k=3 in Nakuru and 1 in Tenwek.

Using this procedure each person in the population had a known and equal probability of selection.

3.6 Data collection tools

3.6.1 Questionnaire

The standard National Blood Transfusion Service questionnaire was administered in English, Kiswahili or Kalenjin depending on the language the donor could understand. An interview was conducted using the questionnaire with each study subject on socio-demographic characteristics such as age, sex, residence and various risk factor information which included; current and past history of STD, whether donor or partner have been tested for HIV, history of blood transfusion or blood products, live or had sex with someone with yellow eyes, tattooing or body piercing, accidental needle prick, received or given money in exchange of sex (Appendix 4).

3.6.2 Determination of Transfusion Transmissible Infections

3.6.2.1 Blood collection

Whole blood sample was collected from each donor at the time of donation, and dispensed into a red top vaccutainer tube, then allowed to clot naturally at room temperature. Separated testing sample was pipetted out of the vaccutainer tube which was used for the analysis. The following volumes of separated serum were used for screening various TTIs, 50ul, 75 ul, 25 ul and 50 ul for HIV, HBV, HCV and syphilis respectively. About 5ul whole blood was used to screen for malaria.

3.6.2.2 Serological Analysis

Hepatitis B surface antigen (HBsAg) was assayed using Hepanostika hepatitis B surface antigen (Murex Biotech S.A (pty) ltd, Abbott Murex, Biomerieux, Kyalami Business park, Kyalami boulevard-S.A), and Hepatitis C virus antibodies (ant-HCV) using Murex anti-HCV version 4.0 (Murex, Kyalami S.A, Marcy i'etoile, France). Manufacturer's negative and positive controls were included; known negative and positive samples were used for internal quality control.

Presence of antibodies to *Treponema pallidum* was screened using rapid plasma reagin test (RPR) (Omega diagnostics ltd. Omega, hill foots b/v.alva fk 125 dq, Scotland, U.K). Human Immunodeficiency Virus-1 and HIV-2 were screened using Vironostika HIV uni-form II Ag/Ab (Murex Biotech S.A (pty) ltd, Abbott Murex, Biomerieux, Kyalami business park, Kyalami boulevard-S.A). All the reactive samples were confirmed, using murex diagnostic enzyme-linked immunosorbent assay (ELISA) kits (Murex, Wiesbaden, Germany). A result was considered positive, if both the first and second tests were positive and negative if vice versa. Serum controls were included in the test run; these were negative and positive controls.

3.6.2.3 Malaria Parasites Screening

Plasmodium species was screened using SD Bio-line rapid diagnostic test kit (MT Promedt Consulting GmbH, Altenohofstrasse 80 D-66386 St. Ingbert Germany), and confirmed by microscopy using 10% giemsa stained blood films. Known positive and

negative slides were used for internal quality control.

3.7 Data Management and Analysis

The data generated was analyzed using Epi-info 3.5.1 statistical package (CDC, Atlanta, USA). Descriptive analysis was done where measure of central tendency, measure of dispersion and proportions were calculated. Chi square with Yates correction was used to determine any association between socio-demographic characteristic and exposure to risk factors. A $P<0.05$ was considered statistically significant. Prevalence odds ratio was used as the measure of association. All variables with a $P< 0.1$ were subjected to unconditional logistic regression where stepwise backward and forward elimination logistic regression was used to come up with the final "Best-fit" model.

3.8 Ethical Considerations

Study approval was granted by KEMRI Scientific Steering Committee (SSC), SSC No. 2113, the National Ethical Review Committee and Board of Postgraduates (BPS) of Jomo Kenyatta University of Agriculture and Technology. Prior to interview, each potential study participant was asked to provide written consent. Participant's confidentiality was ensured by coding and omitting information that identifies the participants. Privacy was maintained during interviews, questionnaires were kept in a lockable cabinet and data entered in the computer was password protected.

People who agreed to be in this study got their blood tested at Regional Blood Transfusion Center-Nakuru. Donors were given the chance to know their HIV, Hepatitis, syphilis, malaria status and haemoglobin level in accordance with NBTS norms. Human immunodeficiency virus positive donors were referred to nearby HIV care and treatment centers. Donors were able to use the results to seek further treatment where appropriate. No laboratory costs were paid by the donor. Apart from slight pain and discomfort during blood collection, no other distress was expected from this study. The procedure is routinely used and presents almost no risk.

CHAPTER FOUR

4.0 RESULTS

4.1 Socio-Demographic Characteristics of Blood donors

A total of 594 participants were enrolled into the study, 17% (n=100) were from Tenwek Mission Hospital (Family Replacement Donors) and 83% (n=494) were from Regional Blood Transfusion Centre Nakuru (Voluntary non remunerated Blood Donors). Of the 594 participants, males constituted 72% (n=429). Sixty two percent (n=367) of the study participants were students, overall 67% (n=399) had attained secondary school education. Regarding marital status, 75% of all donors (n=446) were single. In Tenwek Mission hospital, most donors were male 94% (n=100). In terms of occupation, 60% had informal occupation, 60% were married, with 60% having secondary education (Table 4.1).

Table 4.1: Socio-demographic characteristics of blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Variables	Nakuru + Tenwek Frequency N=594	RBTC Nakuru Frequency N=494	Tenwek Frequency N=100
Gender			
Male	429	335	94
Female	165	159	6
Marital status			
Married	140	80	60
Single	446	406	40
Divorced	7	7	0
Widowed	1	1	0
Level of education			
None	1	1	0
Primary	34	16	18
Secondary	399	339	60
Tertiary	160	138	22
Occupation			
Student	367	345	22
Unemployed	24	24	0
Formal	89	71	18
Informal	114	54	60

The overall ages of the donors ranged from 16-62 years, with 52% (n=308) being aged between 16-20 years (mean age 23.3±7.8 years, median 20.0 years). The socio-demographic characteristics of blood donors at RBTC Nakuru show that, the mean age of the blood donors was (22.4±7.3 years, median 19 years) and the age category was 16-20 years (59%), followed by 21-25 years of age (19%). In Tenwek Mission hospital the

biggest group of donors (31%) was in the age category of donors 21 to 25 years, (mean 27.9 ±8.7 years, median 25.5 years) as shown in figure 4.1.

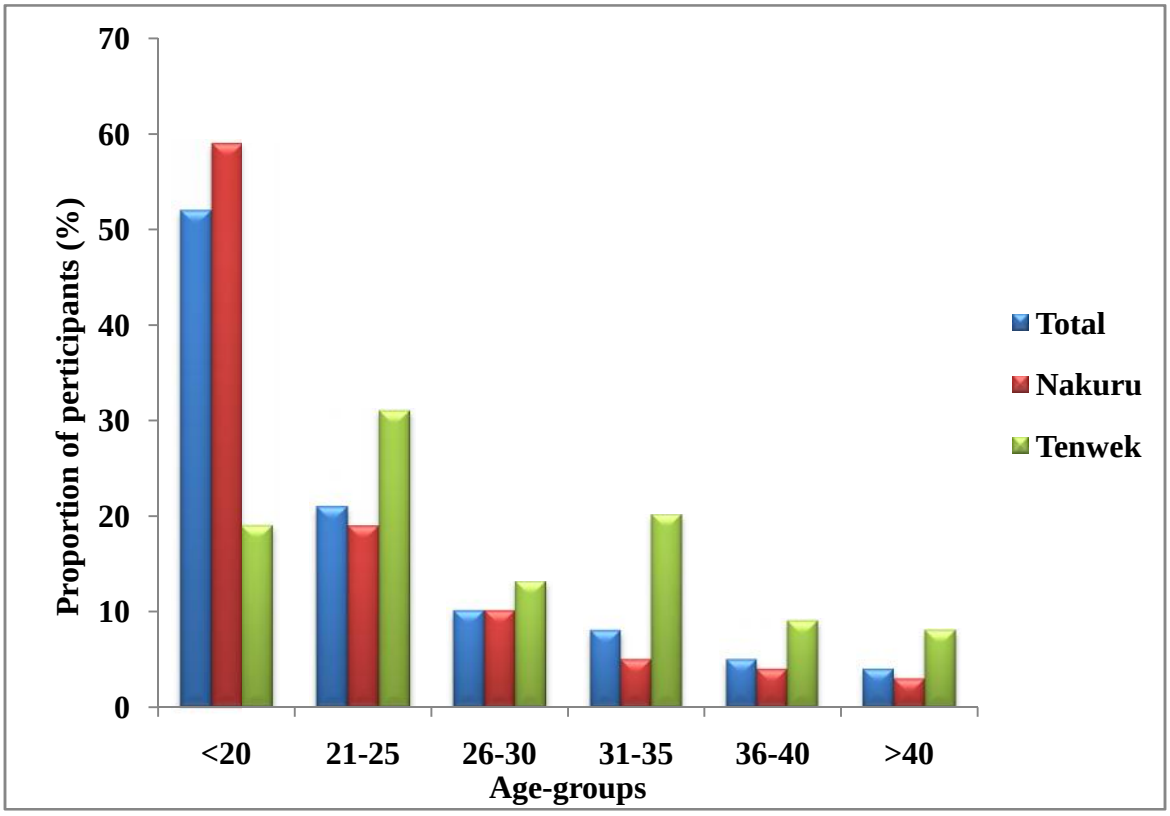

Figure 4.1: Proportion of donors per age-groups, in RBTC Nakuru and Tenwek Mission Hospital, 2011

4.2 Socio-demographic characteristics and prevalence of blood donors with Transfusion transmissible infections in RBTC Nakuru and Tenwek Mission Hospital

4.2.1 Socio-demographic characteristics and prevalence of blood donors with HIV

The overall prevalence of HIV among the blood donors was 3.5% (21/594) with a sero-prevalence of 3.7% among males, 14.3% among divorced and married 8.6%, donors with primary level of education were 14.7%. With reference to occupational status, those in informal occupation had the highest HIV prevalence (8.8%), followed by unemployed donors (8.3%). There was no significant difference of these aggregate results (RBTC Nakuru and Tenwek Mission Hospital) against those of RBTC Nakuru alone on prevalence of HIV. In Tenwek Mission Hospital, the married and males were the only groups positive for HIV with 15.0% and 9.6% respectively. Of these, 16.7% had primary education and 11.7% were in informal occupation (Table 4.2).

Table 4.2: Socio-demographic characteristics versus HIV prevalence among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

HIV	Nakuru/Tenwek		RBTC Nakuru		Tenwek	
Variable	**HIV Positive/ Total donors (%)**		**HIV Positive/ Total donors (%)**		**HIV Positive/ Total donors (%)**	
Gender						
Male	16/429	(3.7)	7/335	(2.1)	9/94	(9.6)
Female	5/165	(3.0)	5/159	(3.1)	0/6	(0.0)
Marital status						
Married	12/140	(8.6)	3/80	(3.8)	9/60	(15.0)
Single	8/446	(1.8)	8/406	(2.0)	0/40	(0.0)
Divorced	1/7	(14.3)	1/7	(14.3)	0/0	(0.0)
Widowed/widower	0/1	(0.0)	0/1	(0.0)	0/0	(0.0)
Level of Education						
None	0/1	(0.0)	0/1	(0.0)	0/0	(0.0)
Primary	5/34	(14.7)	2/16	(12.5)	3/18	(16.7)
Secondary	14/399	(3.5)	8/339	(2.4)	6/60	(10.0)
Tertiary	2/160	(1.3)	2/138	(1.4)	0/22	(0.0)
Occupation						
Student	6/367	(1.6)	6/345	(1.7)	0/22	(0.0)
Unemployed	2/24	(8.3)	2/24	(8.3)	0/0	(0.0)
Formal	8/89	(3.4)	1/71	(1.4)	2/18	(11.1)
Informal	10/114	(8.8)	3/54	(5.6)	7/60	(11.7)

In the two study sites, blood donors in age category 36-40 years accounted 10% prevalence of HIV infection; while in Tenwek 25% of donors were above 41 years of age (Figure 4.2).

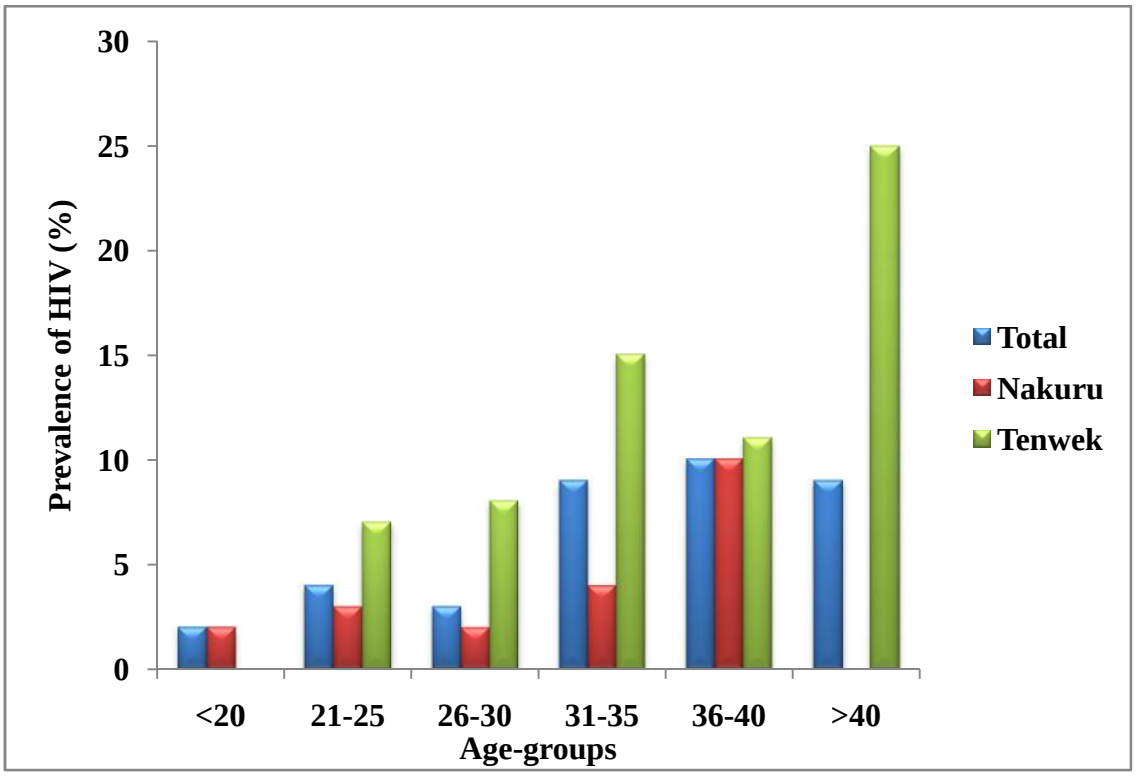

Figure 4.2: Age-groups versus HIV prevalence among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

4.2.2 Socio-demographic characteristics and prevalence of blood donors with HBV

Hepatitis B infection with a prevalence of 5.6% was the most prevalent of the TTIs among the blood donors at the two study sites. The prevalence of HBsAg was 6.8% among men, married 6.4%, those with tertiary education 8.1% and 8.3% in donors who were unemployed, while in Tenwek Mission Hospital, males were the only group positive for HBsAg with a prevalence of 8.5% and 11.1% having primary education (Table 4.3).

Table 4.3: Socio-demographic characteristics versus HBV prevalence among Blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

HBV	**Nakuru + Tenwek**		**RBTC Nakuru**		**Tenwek**	
Variable	**HBVPositive/ Total donors (%)**		**HBVPositive/ Total donors (%)**		**HBVPositive/ Total donors (%)**	
Gender						
Male	29/429	(6.8)	23/335	(6.9)	8/94	(8.5)
Female	4/165	(2.4)	4/159	(2.5)	0/6	(0.0)
Marital status						
Married	9/140	(6.4)	5/80	(6.3)	4/60	(6.7)
Single	24/446	(5.4)	22/406	(5.4)	2/40	(5.0)
Divorced	0/7	(0.0)	0/7	(0.0)	0/0	(0.0)
Widowed/widower	0/1	(0.0)	0/1	(0.0)	0/0	(0.0)
Level of Education						
None	0/1	(0.0)	0/1	(0.0)	0/0	(0.0)
Primary	2/34	(5.9)	0/16	(0.0)	2/18	(11.1)
Secondary	18/399	(4.5)	16/339	(4.7)	2/60	(3.3)
Tertiary	13/160	(8.1)	11/138	(8.0)	2/22	(9.1)
Occupation						
Student	20/367	(5.4)	19/345	(5.5)	1/22	(4.5)
Unemployed	2/24	(8.3)	2/24	(8.3)	0/0	(0.0)
Formal	5/89	(5.6)	4/71	(5.6)	1/18	(5.6)
Informal	6/116	(5.2)	2/54	(3.7)	4/60	(6.7)

Overall HBsAg was relatively higher in age group 36-40 years with 10% prevalence, in RBTC Nakuru; age categories 31-35 years had a high prevalence of 11.5% and in Tenwek 22.2% of donors with HBV infection were in age group 36-40 years (Figure 4.3).

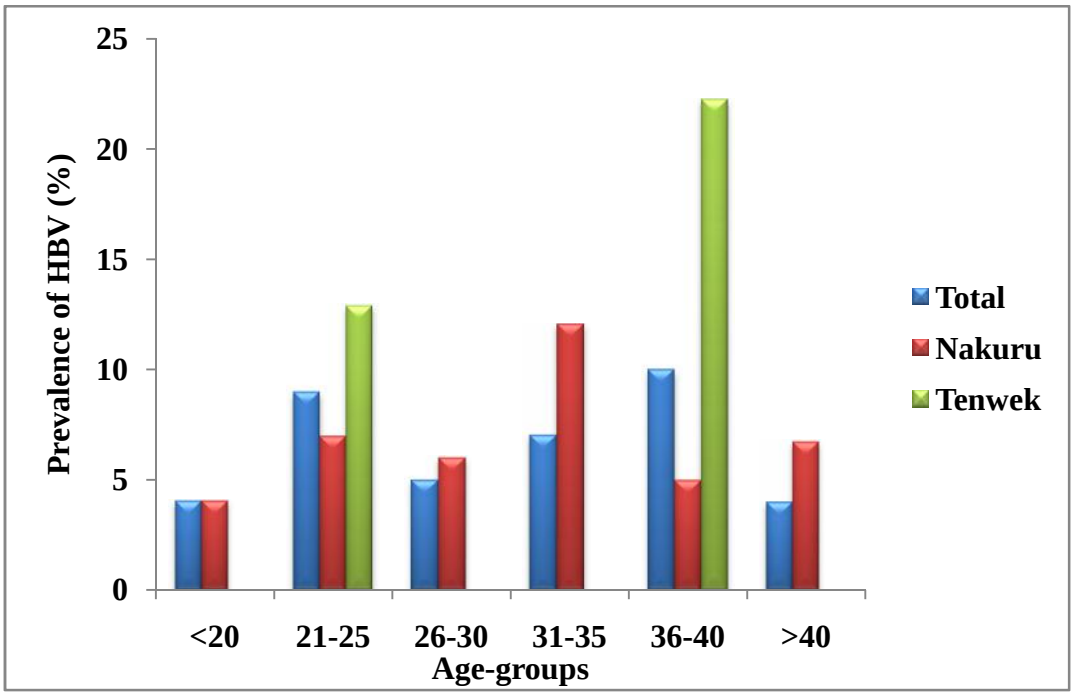

Figure 4.3: Age-groups versus HBV prevalence among Blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

4.2.3 Socio-demographic characteristics and prevalence of blood donors with HCV

In the two facilities hepatitis C infection was 4.0% in males, 3.6% in married and 0% in the divorced/widowed respectively. Among the HCV infected, informal occupation accounted for 6.1% and 3.3% with secondary as the highest level of education. In RBTC Nakuru 2.2% were detected to be having ant-HCV, of these; 2.7% were male, Students and those having tertiary education each yielded 2.9% and 2.7% were singles. Males were the only group with HCV infection in Tenwek Mission Hospital with a prevalence of 8.5%, married (8.3%). Informal occupation accounted for 10% and 10% having secondary education (Table 4.4).

Table 4.4: Socio-demographic characteristics versus HCV prevalence among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

HCV	Nakuru + Tenwek		RBTC Nakuru		Tenwek	
Variable	**HCVPositive/ Total donors (%)**		**HCVPositive/ Totaldonors (%)**		**HCVPositive/ Total donors (%)**	
Gender						
Male	17/429	(4.0)	9/335	(2.7)	8/94	(8.5)
Female	2/165	(1.2)	2/159	(1.3)	0/6	(0.0)
Marital status						
Married	5/140	(3.6)	0/80	(0.0)	5/60	(8.3)
Single	14/446	(3.1)	11/406	(2.7)	3/40	(7.5)
Divorced	0/7	(0.0)	0/7	(0.0)	0/0	(0.0)
Widowed/widower	0/1	(0.0)	0/1	(0.0)	0/0	(0.0)
Level of Education						
None	0/1	(0.0)	0/1	(0.0)	0/0	(0.0)
Primary	1/34	(2.9)	0/16	(0.0)	1/18	(5.6)
Secondary	13/399	(3.3)	7/339	(2.1)	6/60	(10.0)
Tertiary	5/160	(3.1)	4/138	(2.9)	1/22	(4.5)
Occupation						
Student	11/367	(3.0)	10/345	(2.9)	1/22	(4.5)
Unemployed	0/24	(0.0)	0/24	(0.0)	0/0	(0.0)
Formal	1/89	(1.1)	0/71	(0.0)	1/18	(5.6)
Informal	7/114	(6.1)	1/54	(1.9)	6/60	(10.0)

In the two facilities, HCV infection accounted for 4.8% in the age category 21-25 years old, In RBTC Nakuru 3.2% fall in the age category 21-25 years. In Tenwek Mission Hospital 12.5% prevalence was among those donors above 40 years (Figure 4.4).

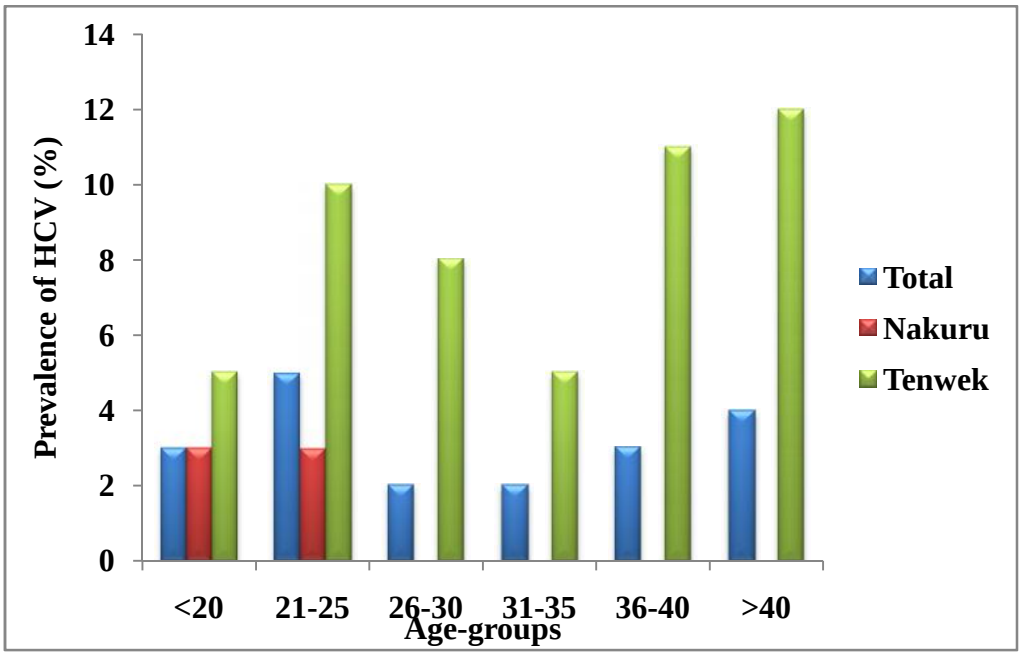

Figure 4.4: Age-groups versus HCV prevalence among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

4.2.4 Socio-demographic characteristics and prevalence of blood donors with syphilis

Overall, syphilis was commoner in males with 1.4%, 3.6% were married, 5.6% were in formal occupation and 2.5% had tertiary level of education. No syphilis was found in divorced/widowed donors in the two study sites. However in RBTC Nakuru, those with formal occupation accounted for 4.2%, while in Tenwek Mission Hospital, males with a prevalence of 2.1% were the only group positive for syphilis. In regard to occupational status, a prevalence of 11.1% for syphilis was found only in those with formal type of occupation. The other occupational groups were negative. As regards to education, 4.5% with syphilis had tertiary as the highest level of education (Table 4.5).

Table 4.5: Socio-demographic characteristics versus syphilis prevalence among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Syphilis	**Nakuru + Tenwek**		**RBTC Nakuru**		**Tenwek**	
Variable	**Syphilis Positive/ Total donors (%)**		**Syphilis Positive/ Total donors (%)**		**Syphilis Positive/ Total donors (%)**	
Gender						
Male	6/429	(1.4)	4/335	(1.2)	2/94	(2.1)
Female	1/165	(0.6)	1/159	(0.6)	0/6	(0.0)
Marital status						
Married	5/140	(3.6)	3/80	(3.8)	2/60	(3.3)
Single	2/446	(0.4)	2/406	(0.5)	0/40	(0.0)
Divorced	0/7	(0.0)	0/7	(0.0)	0/0	(0.0)
Widowed/widower	0/1	(0.0)	0/1	(0.0)	0/0	(0.0)
Level of Education						
None	0/1	(0.0)	0/1	(0.0)	0/0	(0.0)
Primary	0/34	(0.0)	0/16	(0.0)	0/18	(0.0)
Secondary	3/399	(0.8)	2/339	(0.6)	1/60	(1.7)
Tertiary	4/160	(2.5)	3/138	(2.2)	1/22	(4.5)
Occupation						
Student	2/367	(0.5)	2/345	(0.6)	0/22	(0.0)
Unemployed	0/24	(0.0)	0/24	(0.0)	0/0	(0.0)
Formal	5/89	(5.6)	3/71	(4.2)	2/18	(11)
Informal	0/114	(0.0)	0/54	(0.0)	0/60	(0.0)

In the two facilities, 4.3% of those positive for syphilis were above 40 years of age. In RBTC Nakuru, 6.7% of donors with syphilis were above 40 years. In Tenwek Mission Hospital syphilis was most frequent (11.1%) in age group 36-40 years, followed by 5.0% in age category 31-35 years. The other age groups were negative for syphilis (Figure 4.5).

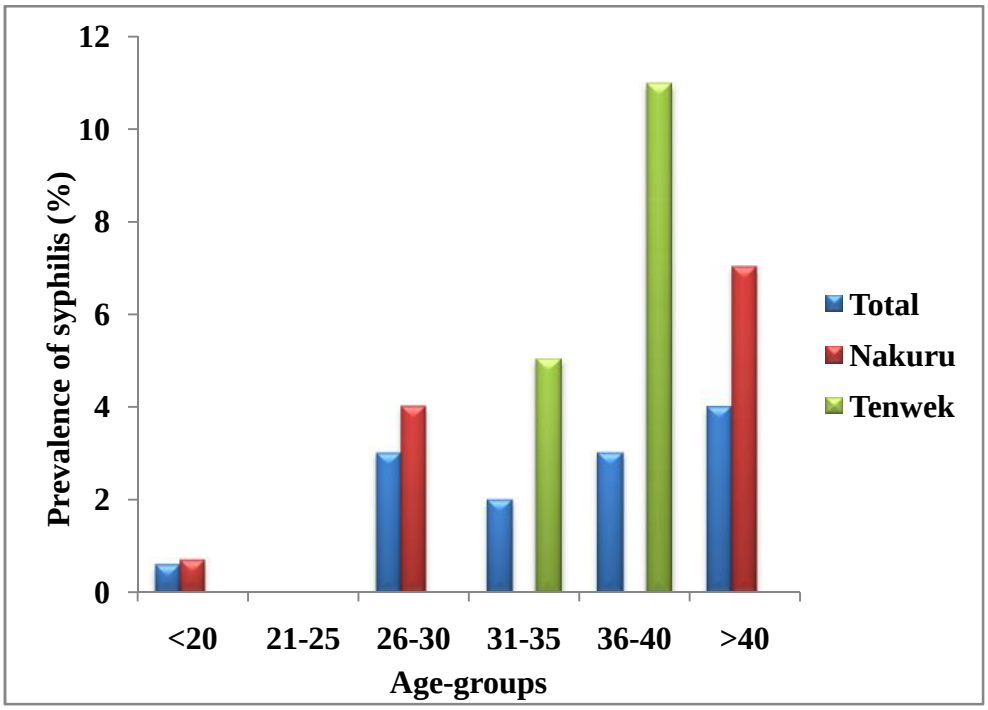

Figure 4.5: Age-groups versus prevalence of syphilis among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

4.2.5 Socio-demographic characteristics and prevalence of blood donors with malaria

From the two facilities, malaria with a prevalence of 0.7% among males was the TTI with the lowest prevalence. Students were the only occupational group with a prevalence of 1.1% for Malaria, 0.8% with secondary as the highest level of education, 0.9% among the singles and none in the other marital group. Out of 100 blood donors screened for malaria in Tenwek Mission Hospital, none of them tested positive (Table 4.6).

Table 4.6: Socio-demographic characteristics versus Malaria prevalence among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Malaria	**Nakuru + Tenwek**		**Nakuru**	
Variable	**Malaria Positive/ Total donors (%)**		**Malaria Positive/ Total donors (%)**	
Gender				
Male	3/429	(0.7)	3/335	(0.9)
Female	1/165	(0.6)	1/159	(0.6)
Marital status				
Married	0/140	(0.0)	0/80	(0.0)
Single	4/446	(0.9)	4/406	(1.0)
Divorced	0/7	(0.0)	0/7	(0.0)
Widowed/widower	0/1	(0.0)	0/1	(0.0)
Level of Education				
None	0/1	(0.0)	0/1	(0.0)
Primary	0/34	(0.0)	0/16	(0.0)
Secondary	3/399	(0.8)	3/339	(0.9)
Tertiary	1/160	(0.6)	1/138	(0.7)
Occupation				
Student	4/367	(1.1)	4/345	(1.2)
Unemployed	0/24	(0.0)	0/24	(0.0)
Formal	0/89	(0.0)	0/71	(0.0)
Informal	0/114	(0.0)	0/54	(0.0)

Overall syphilis was detected in 1.6% in the age category 21-25 years, 0.6% in donors $\leq$ 20 years and not detected in the rest of the age groups. In RBTC Nakuru, 2.1% of donors tested positive for malaria in the age group 21-25 years (Figure 4.6).

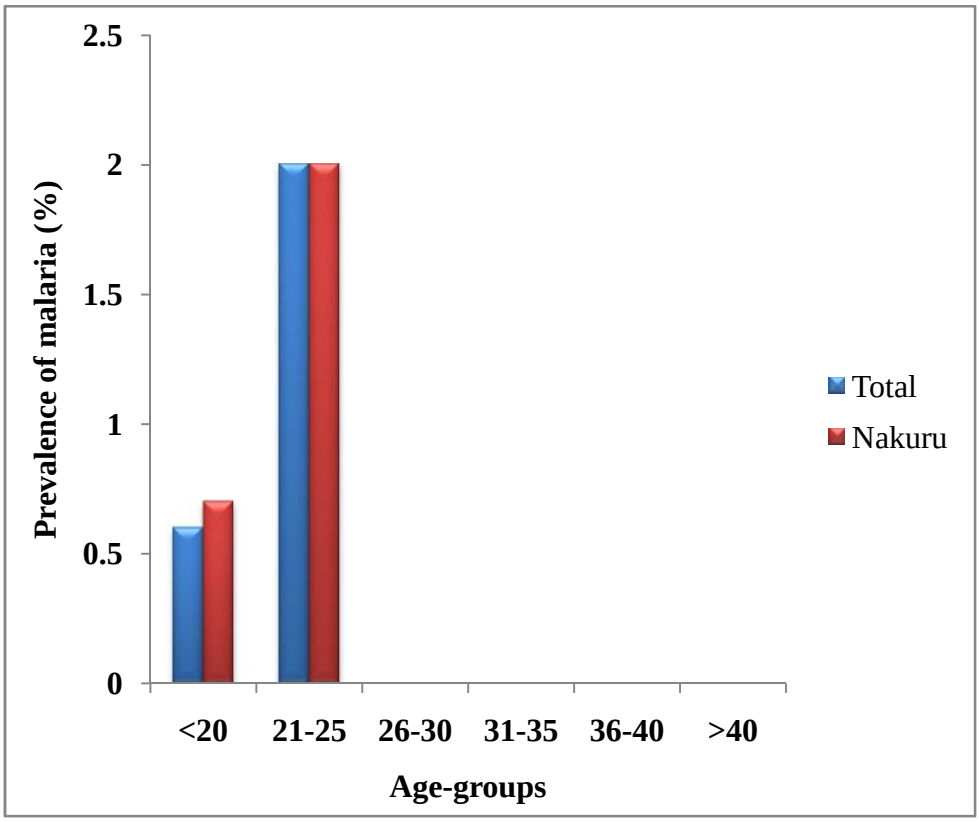

Figure 4.6: Age-groups versus prevalence of malaria among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

4.3 Prevalence of TTI's among blood donors in RBTC Nakuru and Tenwek Mission Hospital.

Of the 594 blood donors, the overall prevalence of TTI's was 14.1%; n=84 (11.9% in Nakuru and 25% in Tenwek). The prevalence of HBV, HIV, HCV, syphilis and malaria parasites among blood donors in the two sites were 5.6%, 3.5%, 3.2%, 1.2% and 0.7% respectively. The prevalence of TTI's was higher in Tenwek with an overall of 25% (n=25), while the individual prevalence of HBV, HIV, HCV, syphilis and malaria parasites was 6.0%, 9.0%, 8.0%, 2.0%, 0.0% respectively. At Tenwek, the commonest TTI was HIV, and there were no units positive for malaria parasites. In RBTC Nakuru TTIs markers were detected in 11.9% (n=59) of donors. The prevalence of HBV, HIV, HCV, syphilis and malaria parasites were 5.5%, 2.4%, 2.2%, 1.0% and 0.8% respectively and the most common TTI was HBV (Figure 4.7).

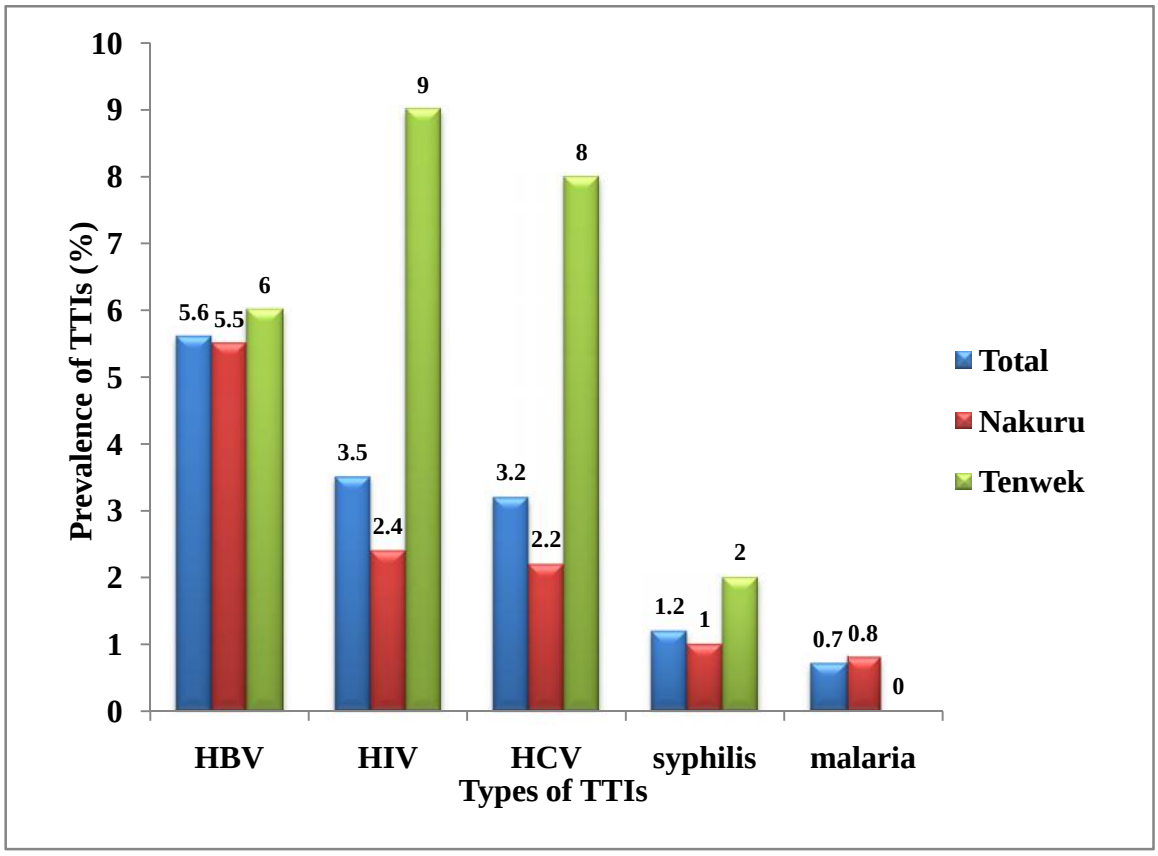

Figure 4.7: Proportion of TTIs among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

4.4 Bivariate and Multivariate analysis of factors associated with TTI's among blood donors in RBTC Nakuru and Tenwek Mission Hospital

Potential factors associated with various TTI statuses among blood donors in the two sites were analyzed. On bivariate analysis, three socio-demographic high risk factors were found to be significantly associated with positive HIV status. Age above 30 years (P-value=0.003), being married (P-value=0.0007), having informal occupation (P-value=0.05) and not educated beyond primary level (P-value=0.005). Low risk factors significantly associated with HIV positive status were: age below 20 years (P-value=0.02), being single (P-value=0.0001) and being a student (P-value=0.02). The following factors, although associated with positive HIV status did not have a significant association; gender, age 20-30 years, divorced/widowed and unemployed. (Table 4.7).

Table 4.7: Bivariateanalysis of socio-demographic factors associated with HIV status among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Exposure	HIV Positive No. (%)	HIVNegative No. (%)	OR (95% CI)	P-value
Gender				
Male	16(76.2)	413(72.1)	1.24(0.45-3.44)	0.87
Female	5(23.8)	160(27.9)		
Age in years				
<20	5(23.8)	303(52.9)	0.28(0.1-0.77)	**0.02**
	16(76.2)	270(47.1)		
20-30	7(33.3)	180(31.4)	1.09(0.43-2.75)	0.96
	14(66.7)	393(68.6)		
>30	9(42.9)	90(15.7)	4.02(1.65-9.83)	**0.003**
	12(57.1)	483(84.3)		
Marital status				
Married	12(57.1)	128(22.3)	4.64(1.91-11.25)	**0.0007**
	9(42.9)	445(77.7)		
Single	8(38.1)	438(76.4)	0.19(0.08-0.47)	**0.0001**
	13(61.9)	135(23.6)		
Divorced/widowed	1(4.8)	7(1.2)	4.04(0.47-34.44)	0.25
	20(95.2)	566(98.8)		
Level of Education				
None/ primary	5(23.8)	30(5.2)	5.66(1.94-16.48)	**0.005**
Secondary/tertiary	16(76.2)	543(94.8)		
Occupation				
Student	6(66.7)	361(93.8)	0.13(0.03-0.56)	**0.02**
	3(33.3)	24(6.2)		
Unemployed	2(22.2)	22(5.7)	4.71(0.92-24.05)	0.1
	7(77.8)	363(94.3)		
Informal	1(11.1)	1(0.3)	48(2.75-837.25)	**0.05**
	8(88.9)	384(99.7)		

On bivariate analysis, having multiple sexual activity (P-value=0.02) was a risk factor significantly associated with positive HIV status. The following factors, were associated with positive HIV status but did not have a significant association; received a blood transfusion or any blood products, having sexual activity with a person whose background one does not know, tested or partner been tested for HIV and donor blood is considered safe to transfuse to a patient (Table 4.8).

Table 4.8: Bivariate analysis of behavioural factors associated with HIV status among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Exposure	HIV Positive No. (%)	HIVNegative No. (%)	OR (95% CI)	P-value
Received a blood transfusion/products				
Yes	1 (4.8)	7 (1.2)	4.04(0.47-34.44)	0.25
No	20 (95.2)	566 (98.8)		
Bleeding condition/blood disease				
Yes	1(4.8)	4 (0.7)	7.11(0.76-66.56)	0.17
No	20(95.2)	569 (99.3)		
Had sexual activity with a person whose background do not know				
Yes	1(4.8)	17(3.0)	1.64(0.21-12.9)	0.48
No	20(95.2)	556(97.0)		
Had sexual activity with anyone besides regular sex partner				
Yes	2(9.5)	5(0.9)	11.96(2.18-65.6)	**0.02**
No	19(90.5)	568(99.1)		
Tested or partner been tested for HIV				
Yes	12(57.1)	343(59.9)	0.89(0.37-2.16)	0.98
No	9(42.9)	230(40.1)		
Donor blood safe to transfuse				
Yes	20(95.2)	528(92.1)	1.7(0.22-13)	0.5
No	1(4.8)	45(7.9)		

The socio-demographic factors significantly associated with HIV infection, identified in RBTC Nakuru, were informal occupation (P-value=0.047 and being student (P-value=0.02). None/primary education was only associated with HIV infection (Table 4.9).

Table 4.9: Bivariate analysis of socio-demographic factors associated with HIV status among blood donors in RBTC Nakuru, 2011

Variable	HIV Positive No. (%)	HIVNegative No. (%)	OR (95% CI)	P-value
Gender				
Male	7(58.3)	328(68)	0.66(0.21-2.1)	0.33
Female	5(41.7)	154(32)		
Age in years				
<20	5(41.7)	284(58.9)	0.5(0.16-1.59)	0.18
	7(58.3)	198(41.1)		
20-30	4(33.3)	139(28.8)	1.23(0.37-4.16)	0.48
	8(66.7)	343(71.2)		
>30	3(25.0)	59(12.2)	2.39(0.63-9.08)	0.18
	9(75.0)	423(87.8)		
Marital status				
Married	3(25.0)	77(16.0)	1.75(0.46-6.62)	0.31
	9(75.0)	405(84.0)		
Single	8(66.7)	398(82.6)	0.42(0.12-1.43)	0.15
	4(33.3)	84(17.4)		
Divorced/widowed	1(8.3)	7(1.5)	6.17(0.70-54.51)	0.18
	11(91.7)	475(98.5)		
Level of Education				
None/primary	2(16.7)	15(3.1)	6.23(1.25-30.93)	0.06
Secondary/tertiary	10(83.3)	467(96.9)		
Occupation				
Student	6(66.7)	339(93.4)	0.14(0.03-0.60)	**0.02**
	3(33.3)	24(6.6)		
Unemployed	2(22.2)	22(6.1)	4.43(0.87-22.59)	0.11
	7(77.8)	341(93.9)		
Informal	1(11.1)	1(0.3)	45.25(2.59-789)	**0.047**
	8(88.9)	362(99.7)		

In RBTC Nakuru, history of multiple sexual activity was the only bahavioural risk factor significantly associated with HIV positive (Table 4.10).

Table 4.10: Bivariate analysis of behavioural factors associated with HIV status among blood donors in RBTC Nakuru, 2011

Variable	HIV Positive No. (%)	HIVNegative No. (%)	OR (95% CI)	P-value
Received a blood transfusion/products				
Yes	1 (8.3)	4 (0.8)	10.86(1.12-105.3)	0.12
No	11 (91.7)	478 (99.2)		
Bleeding condition/blood disease				
Yes	1(8.3)	4 (0.8)	10.9(1.12-105.3)	0.12
No	11 (91.7)	478 (99.2)		
Had sexual activity with a person whose background one do not know				
Yes	1(8.3)	17(3.5)	2.49(0.30-20.4)	0.36
No	11(91.7)	465(96.5)		
Had sexual activity with anyone besides regular sex partner				
Yes	2(16.7)	5(1.0)	19(3.3-110.4)	**0.01**
No	10(83.3)	477(99.0)		
Tested or partner been tested for HIV				
Yes	5(41.7)	269(55.8)	0.57(0.18-1.81)	0.50
No	7(58.3)	213(44.2)		

In Tenwek Mission Hospital, none of the socio-demographic factors examined were found to be significantly associated with HIV positivity at a p-value of 5% (Table 4.11).

Table 4.11: Bivariate analysis of socio-demographic factors associated with HIV status among blood donors in Tenwek Mission Hospital.

Variable	HIV Positive No. (%)	HIVNegative No. (%)	OR (95% CI)	P-value
Age in years				
20-30	3(33.3)	41(45.1)	0.61(0.14-2.59)	0.38
	6(66.7)	50(54.9)		
>30	6(66.7)	31(34.1)	3.87(0.91-16.54)	0.06
	3(33.3)	60(65.9)		
Level of Education				
None/primary	3(33.3)	15(16.5)	2.53(0.57-11.27)	0.20
	6(66.7)	76(83.5)		
Secondary/tertiary	6(66.7)	76(83.5)	0.39(0.09-1.76)	0.20
	3(33.3)	16.5)		

In Tenwek Mission Hospital, there were no behavioural factors found to be significantly associated with HIV positivity at a p-value of 5% (Table 4.12).

Table 4.12: Bivariate analysis of behavioural factors associated with HIV status among blood donors in Tenwek Mission Hospital, 2011

Variable	HIV Positive No. (%)	HIVNegative No. (%)	OR (95% CI)	P-value
Tested or partner been tested for HIV				
Yes	7(77.8)	74(81.3)	0.8(0.15-4.22)	0.54
No	2(22.2)	17(18.7)		
Donor blood safe to transfuse				
Yes	8(88.9)	89(97.8)	0.18(0.015-2.21)	0.25
No	1(11.1)	2(2.2)		

All factors that were significant at p≤0.1 were subjected to the unconditional logistic regression model using backward stepwise elimination method. The final "best-fit" model contained four factors that were independently associated with positive HIV status; married (P-value=0.0057), none/primary education (P-value=0.0262), informal occupation (P-value=0.0176) and having multiple sexual activity (P-value=0.0144) (Table 4.13).

Table 4.13: Final model of factors associated with positive HIV status among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Term	Odds ratio	95%	C.I	P-Value
Married	4.56	1.55	13.40	0.0057
None/primary education	9.05	1.30	63.17	0.0262
Having multiple sexual activity	189.78	2.84	12700.67	0.0144
Informal occupation	4.08	1.28	13.04	0.0176

None of the socio-demographic factors analyzed during bivariate analysis were significantly associated with HBsAg positive among blood donors in RBTC Nakuru and Tenwek Mission Hospital at an alpha level of significance of 5% (Table 4.14).

Table 4.14: Bivariate analysis of socio-demograghic factors associated with HBV among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Exposure	HBV Positive No. (%)	HBVNegative No. (%)	OR (95% CI)	P-value
Gender				
Male	29(87.9)	400(71.3)	2.92(1.01-8.43)	0.06
Female	4(12.1)	161(28.7)		
Age in years				
<20	12(36.4)	296(52.8)	0.51(0.25-1.06)	0.1
	21(63.6)	265(47.2)		
20-30	14(42.4)	173(30.8)	1.65(0.81-3.37)	0.23
	19(57.6)	388(69.2)		
>30	7(21.2)	92(16.4)	1.37(0.58-3.26)	0.63
	26(78.8)	469(83.6)		
Marital status				
Married	9(27.3)	131(23.4)	1.23(0.56-2.71)	0.76
	24(72.7)	430(76.6)		
Single	24(72.7)	422(75.2)	0.88(0.4-1.93)	0.91
	9(27.3)	139(24.8)		
Level of Education				
None/primary	2(6.1)	33(5.9)	1.03(0.24-4.5)	0.59
Secondary/tertiary	31(93.9)	528(94.1)		
Occupation				
Student	20(90.9)	347(93.3)	0.72(016-3.26)	0.46
	2(9.1)	25(6.7)		
Unemployed	2(9.1)	22(5.9)	1.59(0.35-7.25)	0.39
	20(90.9)	350(94.1)		

There were no behaviural factors found to be significantly associated with HBsAg positive among blood donors in the two facilities at an alpha level of significance of 5% (Table 4.15).

Table 4.15: Bivariate analysis of behavioural factors associated with HBV among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Exposure	HBV Positive No. (%)	HBVNegative No. (%)	OR (95% CI)	P-value
Tested or partner been tested for HIV				
Yes	23(69.7)	332(59.2)	1.59(0.74-3.4)	0.31
No	10(30.3)	229(40.8)		
Donor blood safe to transfuse				
Yes	31(93.9)	517(92.2)	1.32(0.31-5.7)	0.52
No	2(6.1)	44(7.8)		

In RBTC Nakuru, none of the socio-demographic factors evaluated were significantly associated with positive HBsAg among blood donors (Table 4.16).

Table 4.16: Bivariate analysis of socio-demographic factors associated with HBV among blood donors in RBTC Nakuru, 2011

Variable	HBV Positive No. (%)	HBVNegative No. (%)	OR (95% CI)	P-value
Gender				
Male	23(85.2)	312(66.8)	0.35(0.2-1.0)	3.15
Female	4(14.8)	155(33.2)		
Age in years				
<20	12(44.4)	277(59.3)	0.55(0.25-1.2)	0.19
	15(55.6)	190(40.7)		
20-30	10(37.0)	133(28.5)	1.48(0.66-3.31)	0.46
	17(63.0)	334(71.5)		
>30	5(18.5)	57(12.2)	1.63(0.60-4.49)	0.24
	22(81.5)	410(87.8)		
Marital status				
Married	5(18.5)	75(16.1)	1.19(0.44-3.24)	0.45
	22(81.5)	392(83.9)		
Single	22(81.5)	384(82.2)	0.95(0.35-2.58)	0.54
	5(18.5)	83(17.8)		

In RBTC Nakuru, none of the behavioural factors analyzed were significantly associated with positive HBsAg among blood donors (Table 4.17).

Table 4.17: Bivariate analysis of behavioural factors associated with HBV among blood donors in RBTC Nakuru, 2011

Variable	HBV Positive No. (%)	HBVNegative No. (%)	OR (95% CI)	P-value
Tested or partner been tested for HIV				
Yes	19(70.4)	255(54.6)	1.97(0.85-4.6)	0.16
No	8(29.6)	212(45.4)		
Donor blood safe to transfuse				
Yes	26(96.3)	425(91.0)	2.57(0.34-19.41)	0.3
No	1(3.7)	42(9.0)		

In Tenwek Mission Hospital, all the socio-demographic factors evaluated were not significantly associated with positive HBsAg among blood donors (Table 4.18).

Table 4.18: Bivariate analysis of socio-demoraphic factors associated with HBV among blood donors in Tenwek Mission Hospital, 2011

Variable	HBV Positive No. (%)	HBV Negative No. (%)	OR (95% CI)	P-value
Age in years				
20-30	4(66.7)	40(42.6)	2.7(0.47-15.47)	0.23
	2(33.3)	54(57.4)		
>30	2(33.3)	35(37.2)	0.8(0.15-4.84)	0.61
	4(66.7)	59(62.8)		
Marital status				
Married	4(66.7)	56(59.6)	1.4(0.24-7.78)	0.54
	2(33.3)	38(40.4)		
Single	2(33.3)	38(40.4)	0.7(0.13-4.23)	0.54
	4(66.7)	56(59.6)		
Level of Education				
None/primary	2(33.3)	16(17.0)	2.4(0.41-14.46)	0.29
	4(66.7)	78(83.0)		
Secondary/tertiary	4(66.7)	78(83.0)	0.4(0.07-2.43)	0.29
	2(33.3)	16(17.0)		

In Tenwek Mission Hospital, no behavioural factors evaluated were significantly associated with positive HBsAg among blood donors (Table 4.19).

Table 4.19: Bivariate analysis of behavioural factors associated with HBV among blood donors in Tenwek Mission Hospital, 2011

Variable	HBV Positive No. (%)	HBV Negative No. (%)	OR (95% CI)	P-value
Tested or partner been tested for HIV				
Yes	4(66.7)	77(81.9)	0.4(0.075-2.61)	0.32
No	2(33.3)	17(18.1)		
Donor blood safe to transfuse				
Yes	5(83.3)	92(97.9)	0.1(0.01-1.41)	0.17
No	1(16.7)	2(2.1)		

Gender with (P<0.1) was not significant during bivariate analysis was entered into multivariate analysis. It was noted that being male was independently associated with positive HBsAg (OR, 2.92; 95% CI, 1.01–8.43, P=0.0479).

In RBTC Nakuru and Tenwek Hospital, bivariate analysis revealed, no significant association of all socio-demographic factors analyzed with ant-HCV positive as shown in Table 4.20.

Table 4.20: Bivariate analysis of socio-demographic factors associated with HCV among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Exposure	HCV Positive No. (%)	HCV Negative No. (%)	OR (95% CI)	P-value
Gender				
Male	17(89.5)	412(71.7)	3.36(0.77-14.72)	0.15
Female	2(10.5)	163(28.3)		
Age in years				
<20	9(47.4)	299(52)	0.83(0.33-2.07)	0.87
	10(52.6)	276(48)		
20-30	7(36.8)	180(31.3)	1.28(0.5-3.31)	0.79
	12(63.2)	395(68.7)		
>30	3(15.8)	96(16.7)	0.94(0.27-3.27)	0.61
	16(84.2)	479(83.3)		
Marital status				
Married	5(26.3)	135(23.5)	1.16(0.41-3.29)	0.48
	14(73.7)	440(76.5)		
Single	14(73.7)	432(75.1)	0.93(0.33-2.62)	0.53
	5(26.3)	143(24.9)		
Level of Education				
None/primary	1(5.3)	34(5.9)	0.88(0.11-6.82)	0.69
Secondary/tertiary	18(94.7)	541(94.1)		

In RBTC Nakuru and Tenwek, on bivariate analysis, there was no significant association of behavioural factors analyzed with ant-HCV positive (Table 4.21).

Table 4.21: Bivariate analysis of behavioural factors associated with HCV among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Exposure	HCV Positive No. (%)	HCV Negative No. (%)	OR (95% CI)	P-value
Bleeding condition/blood disease				
Yes	1(5.3)	4(0.7)	7.93(0.84-74.6)	0.15
No	18(94.7)	571(99.3)		
Tattooing/body piercing				
Yes	1(5.3)	8(1.4)	3.94(0.47-33.2)	0.26
No	18(94.7)	567(98.6)		
Tested or partner been tested for HIV				
Yes	13(68.4)	342(59.5)	1.48(0.55-3.94)	0.59
No	6(31.6)	233(40.5)		
Donor blood safe to transfuse				
Yes	18(94.7)	530(92.2)	1.53(0.2-11.71)	0.56
No	1(5.3)	45(7.8)		

In RBTC Nakuru, none of the socio-demographic factors analyzed were significantly associated with positive ant-HCV (Table 4.22).

Table 4.22: Bivariate analysis of socio-demographic factors associated with HCV among blood donors in RBTC Nakuru, 2011

Variable	HCV Positive No. (%)	HCV Negative No. (%)	OR (95% CI)	P-value
Gender				
Male	9(81.8)	326(67.5)	0.46(0.10-2.16)	0.26
Female	2(18.2)	157(32.5)		
Age in years				
<20	8(72.7)	281(58.2)	1.92(0.5-7.32)	0.26
	2(27.3)	202(41.8)		
20-30	3(27.3)	140(29.0)	0.92(0.24-3.51)	0.6
	8(72.7)	343(71.0)		

In RBTC Nakuru, history of having a bleeding condition or a blood disease was the only factor found to be associated but not significant (Table 4.23).

Table 4.23: Bivariate analysis of behavioural factors associated with HCV among blood donors in RBTC Nakuru, 2011

Variable	HCV Positive No. (%)	HCV Negative No. (%)	OR (95% CI)	P-value
Bleeding condition/blood disease				
Yes	1(9.1)	4(0.8)	11.98(1.23-116.97)	0.1
No	10(90.9)	479(99.2)		
Tattooing/body piercing				
Yes	1(9.1)	8(1.7)	5.94(0.68-52.06)	0.18
No	10(90.9)	475(98.3)		
Tested or partner been tested for HIV				
Yes	6(54.5)	268(55.5)	0.96(0.29-3.2)	0.59
No	5(45.5)	215(44.5)		
Donor blood safe to transfuse				
Yes	10(90.9)	441(91.3)	0.95(0.12-7.62)	0.64
No	1(9.1)	42(8.7)		

In Tenwek Mission Hospital, none of the socio-demographic and behavioural factors were significantly associated with ant-HCV positivity among the blood donors (Table 4.24).

Table 4.24: Bivariate analysis of factors associated with HCV among blood donors in Tenwek Mission Hospital, 2011

Variable	HCVPositive No. (%)	HCVNegative No. (%)	OR (95% CI)	P-value
Age in years				
Age <20	1(12.5)	18(19.6)	0.59(0.07-5.08)	0.53
	7(87.5)	74(80.4)		
20-30	4(50.0)	40(43.5)	1.3(0.31-5.52)	0.5
	4(50.0)	52(56.5)		
>30	3(37.5)	34(37.0)	1.02(0.23-4.55)	0.63
	5(62.5)	58(63.0)		
Marital status				
Married	5(62.5)	55(59.8)	1.12(0.25-4.98)	0.60
	3(37.5)	37(40.2)		
Single	3(37.5)	37(40.2)	0.89(0.20-3.96)	0.60
	5(62.5)	55(59.8)		
Level of Education				
None/primary	1(12.5)	17(18.5)	0.63(0.07-5.47)	0.56
Secondary/tertiary	7(87.5)	75(81.5)		
Tested or partner been tested for HIV				
Yes	7(87.5)	74(80.4)	1.7(0.2-14.73)	0.53
No	1(12.5)	18(19.6)		

Being married (P-value=0.009) was a high risk factor significantly associated with syphilis positive status, while being single (P-value=0.01) was a low risk factor among blood donors (Table 4.25).

Table 4.25: Bivariate analysis of socio-demographic factors associated with syphilis among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Exposure	SyphilisPositive No. (%)	SyphilisNegative No. (%)	OR (95% CI)	P-value
Gender				
Male	6(85.7)	423(72.1)	2.33(0.28-19.47)	0.38
Female	1(14.3)	164(27.9		
Age in years				
<20	2(28.6)	306(52.1)	0.37(0.07-1.91)	0.2
	5(71.4)	281(47.9)		
20-30	2(28.6)	185(31.5)	0.87(0.17-4.52)	0.61
	5(71.4)	402(68.5)		
>30	3(42.9)	96(16.4)	3.84(0.85-17.4)	0.09
	4(57.1)	491(83.6)		
Marital status				
Married	5(71.4)	135(23)	8.37(1.61-43.63)	**0.009**
	2(28.6)	452(77)		
Single	2(28.6)	444(75.6)	0.13(0.02-0.67)	**0.01**
	5(71.4)	143(24.4)		

Having received a blood transfusion or any blood products was associated with syphilis infection but this association was however not significant (Table 4.26).

Table 4.26: Bivariate analysis of behavioural factors associated with syphilis among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Exposure	SyphilisPositive No. (%)	SyphilisNegative No. (%)	OR (95% CI)	P-value
Received a blood transfusion/products				
Yes	1(14.3)	7(1.2)	0.07(0.01-0.68)	0.09
No	6(85.7)	580(98.8)		
Had sexual activity with a person whose background one do not know				
Yes	1(14.3)	17(2.9)	5.59(0.64-49.0)	0.19
No	6(85.7)	570(97.1)		
Tested or partner been tested for HIV				
Yes	5(71.4)	350(59.6)	1.69(0.33-8.8)	0.41
No	2(28.6)	237(40.4)		

In RBTC Nakuru, on bivariate analysis, being married (P-value=0.03) was identified to be significantly associated with positive syphilis, while being single (P-value=0.04) was a low risk factor (Table 4.27).

Table 4.27: Bivariate analysis of socio-demographic factors associated with syphilis among blood donors in RBTC Nakuru, 2011

Variable	SyphilisPositive No. (%)	SyphilisNegative No. (%)	OR (95% CI)	P-value
Gender				
Male	4(80.0)	331(67.7)	0.52(0.06-4.72)	0.48
Female	1(20.0)	158(32.3)		
Age in years				
<20	2(40.0)	287(58.7)	0.47(0.08-2.83)	0.34
	3(60.0)	202(41.3)		
20-30	2(40.0)	141(28.8)	1.65(0.27-9.95)	0.45
	3(60.0)	348(71.2)		
>30	1(20.0)	61(12.5)	1.75(0.19-15.95)	0.49
	4(80.0)	428(87.5)		
Marital status				
Married	3(60.0)	77(15.7)	8.03(1.32-48.83)	**0.03**
	2(40.0)	412(84.3)		
Single	2(40.0)	404(82.6)	0.14(0.02-0.85)	**0.04**
	3(60.0)	85(17.4)		

In RBTC Nakuru, having a history of blood transfusion or blood products (P-value=0.05) was found to be significantly associated with positive syphilis (Figure 4.28).

Table 4.28: Bivariate analysis of behavioural factors associated with syphilis among blood donors in RBTC Nakuru, 2011

Variable	SyphilisPositive No. (%)	SyphilisNegative No. (%)	OR (95% CI)	P-value
Received a blood transfusion/products				
Yes	1(20)	4(0.8)	30.31(2.74-334.86)	**0.05**
No	4(80.0)	485(99.2)		
Had sexual activity with a person whose background do not know				
Yes	1(20)	17(3.5)	6.94(0.74-65.47)	0.17
No	4(80.0)	472(96.5)		
Tested or partner been tested for HIV				
Yes	3(60.0)	271(55.4)	1.21(0.20-7.29)	0.60
No				

During bivariate analysis there was no factor significantly associated with positive syphilis among blood donors in Tenwek Mission Hospital.

In the multivariate analysis, independent predictors of positive syphilis were: being married (P-value=0.0053) and having a history of blood transfusion or blood products (P-value=0.0055) (Table 4.29).

Table 4.29: Unconditional logistic regression of factors associated with positive syphilis among blood donors in RBTC Nakuru and Tenwek Mission Hospital, 2011

Term	Odds Ratio	95%	C.I	P-Value
Married	12.27	2.11	71.34	0.0053
History of blood transfusion/products	9727.90	14.89	6355911.32	0.0055

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSIONS AND RECCOMENDATIONS

5.1 Socio-demographic characteristics of blood donors

This study revealed that, the majority of blood donors were young males 72%, with secondary education as their highest level of education. This may be attributed to deferral of potential female donors due to anaemia, pregnancy, breast feeding or childbirth which are all criteria for donor exclusion. A difference in occupation and marital status was noted between the two facilities, whereby in Tenwek Mission Hospital, most donors 60% had informal occupation and 60% were married, while in RBTC Nakuru 70% students and 82% singles were the predominant group. This group of students were mostly high school students who were perceived by the RBTC to be a low risk population.

In this study the ratio of male to female blood donors is similar to other studies. Alli *et al.* (2010) found male: female ratio was 5:1. According to (KAIS, 2007) more men compared to women donated to a blood transfusion service among voluntary and family replacement donors. The prevalence was male 69.2% compared to 30.8% female and 81.4% male versus 18.6% female respectively. A study of blood donors in Ethiopia reported that males were more than females with 87.9% and 12.1% respectively, but the infection rate of TTIs was higher among females (Tessema *et al*., 2010). Most studies in Africa report a male dominance in blood donation programmes. Tagny *et al*. (2010) in Togo reported 61% of their donor population to be males; 71·2% in blood donors in Burkina Faso, whereas 90% of 3801 Ghanaian donors were males. Olokoba *et al*. (2009b) in their study found 96.0%

blood donors in Yola, Nigeria were males. However, all the donors were males in the study of (Elfaki *et al*., 2008) among the Sudanese. In the African context, there is a general belief that men are healthier than women, which may explain the tendency for more men to donate blood.

Majority of the participants 52%, were aged between 16-20 years. Routinely, RBTC targets donors of a younger age, mostly high school and college students, as this group are perceived to be more willing to donate blood and also a low risk group. The findings of this current study partly agrees with a study done in Ethiopia (Tessema *et al.,* 2010), whereby 52.8% were in age group of 17-25 years. These findings are similar with a study in Kenya where 59% of voluntary donors were <25 years old (Kimani *et al.,* 2011). In a review of blood donors in Africa (Tagny *et al.*, 2010) it was observed that, African blood donor is mostly young. In Kenya, a mean age of 28·9 ± 8·5 years was reported among blood donors; in Burkina Faso, reported a mean age of 28 ± 7·9 years. In other countries of East/Southern Africa, the mean ages reported were less than 28 years in Mozambique and Uganda. In Rwanda (Tagny *et al.*, 2010) observed that more than 75% are less than 30 years. These mean ages are 10–15 years less than those observed in European countries. This difference may be explained by the fact that the voluntary donor programmes in Africa tend to be centered on secondary school and university students and (Donor ages tend to relate to the donor type), where the median ages for secondary school, public blood drive and family replacement donors were 18, 25 and 32 years, respectively.

In this study most of the donors 67%, had attained secondary school education, 62% were students, while 75% were single. This is biased by higher predominance of students especially among voluntary donors; most of the recruitments were from secondary school students. These results are in line with those reported by Cunha and his collaborators in Mozambique, who noted that the proportion of volunteer donors (69%) who completed secondary school education was higher than the familial ones. This contrasts with findings from Burkina Faso, which found that more than 31% of their donor population is illiterate or received only primary school education (Tagny *et al.,* 2010).

5.2 Socio-demographic characteristics of blood donors with TTIs in RBTC Nakuru and Tenwek Mission Hospital

The prevalence of TTI's was high among male donors. Apart from HBV there was no significant difference in the distribution of most infections by gender. Comparison of prevalence of TTI's among different sex blood donors in this study may not be valid due to high percentage of male blood donors. This is because most females are excluded for not meeting the inclusion criteria.

The sex-related analysis of the viral carriage of HBsAg showed that males were more infected than females with a prevalence of 8.5% (Tenwek Mission Hospital). Pennap *et al*. (2011) in their study found male to female prevalence of (14.7% vs. 6.4%) respectively. In the current study, it was also observed that only males were positive for HCV antibodies with a prevalence of 8.5% (Tenwek Mission Hospital). Sex-dependence prevalence

revealed that only male blood donors 2(1.1%) had HCV (Okonko *et al*., 2012). Egah *et al*. (2004) in their study reported that anti-HCV positive blood donors were male. Buseri *et al*. (2009) in which the anti-HCV positive blood donors were majorly male than females.

The overall prevalence of HIV was more in male than female, this is similar to what was reported in Osogbo, South-West Nigeria (Buseri *et al.*, 2009) in which more male (82%), were infected by HIV than females (18%). In Tenwek Mission Hospital, all males were infected with HIV with infection rate of 9.6%. The prevalence of HIV in RBTC Nakuru was higher in females 3.1% than in males 2.1%, though this difference was not statistically significant. This HIV seropositivity among female donors observed in voluntary donors in this study is possibly because, women of all ages are more likely than men to become infected with HIV during unprotected vaginal intercourse which may be attributed to socioeconomic, cultural and biological factors which have shown to contribute to the female gender's vulnerability to HIV (Tessema *et al*., 2010). A study of transfusion transmissible viral infection among university fresh students in Nigeria (Awortu *et al*., 2009) reported a prevalence of HIV of female to male to be 1.3% to 0.4% respectively. A study in sub-Saharan Africa shows that there were 12 to 13 HIV-infected women for every 10 infected men (Gupta, 2002). All of the blood donors with syphilis (2.1%) in this study were males and they were all from Tenwek Mission Hospital. Various studies have reported male dominance in syphilis positivity, 96% (Okoloba *et al*., 2009a), and 95% in the study of Egah *et al*. (2004). However all the donors were males in the study of (Elfaki *et al.*, 2008) among Sudanese blood donors. In this study three males and

one female tested positive for malaria with 0.7% prevalence.

Increased seroprevalence of HBsAg was not limited to any particular age group but was more common among blood donors of 36-40 year age group. The higher prevalence rate of HBV among relatively older people in this study indicates that most of these participants may have been infected at earlier stage of their life. Alternatively they may have acquired the infection through sex and possibility also exists of horizontal spread of the infection. The HBV infection usually occurs during infancy and childhood by horizontal transmission among children (Tagny *et al*., 2010). The sub-Saharan region is highly endemic with HBsAg carrier rates of 9-20%, whereas 56-98% of the adult population shows evidence of past exposure to HBV infection. Studies in Kenya showed an HBsAg carrier rate of 5 - 30% (Mutuma *et al*., 2011). The first peak of HBV infection in Kenya appears to be at early school age, whereas the second peak occurs at puberty and childbearing age. This finding is similar with a previous report (Tessema *et al.*, 2010) in which higher prevalence of HBsAg was observed among the youths in the age groups of 26-36 years and 36-45 years compared to age group of greater than 45 years. Pennap *et al*. (2011) reported the highest prevalence of infection was 25% found among those aged 31-35 years. The findings by (Buseri *et al.*, 2009) found, the highest rate of HBsAg positivity (29.8%) was in the 18–27 year-old age group. Analysis of the age-related prevalence of ant-HCV in this study showed that age above 40 years, (Tenwek Mission Hospital) had 12.5% prevalence to HCV antibodies. This could be due to high infectivity of the virus and the longetivity of the virus to die. In a study of blood donors (Okonko *et al*., 2012)

they reported 2.1% prevalence of ant-HCV in age group 40 years and above.

In HIV positive donors, the highest infection occurred in the age group 36-40 years and above 40 years of age. The possible reason could be these are age groups which are sexually active and married. It has been shown in this study that being married is significantly associated with positive HIV status (P-value=0.0057). These findings are partly in line with previous results (Buseri *et al.*, 2009; Alli *et al*., 2010) where the most affected were the youth of age group 18-47 years. The low risk group of below 20 years for HIV (RBTC Nakuru) supports the idea of NBTS in recruiting donors from high school and college students which falls under this age group. The age specific infection rate showed that blood donors in 21-25 years age category had the higher infection rate of 2(2.1%) for malaria. This could be possibly by targeting the young age in blood donation exercise. These findings contrasts with a study conducted in Nigeria which showed that blood donors in age group 45 years and above (3.5%) had the higher falciparum malaria parasitaemia load/density exceeding >250,000 parasites μL^{-1} of blood than those <45 years of age (20.9%) (Alli *et al*., (2010). In this study, students, singles and donors with secondary education were the majority. Most TTIs were common among donors with informal occupation (P-value=0.0176), married (P-value=0.0057) and none/primary education (P-value=0.0262). These factors were all identified to be significantly associated with HIV positive status. The risk of HCV infection was higher (10%, Tenwek Hospital) among donors with secondary school education than for other groups. This is different from results obtained in a study in southern Brazil (Brandao and Fuchs; 2002),

the risk was greater among illiterate donors or donors with little schooling. Higher prevalence of anti-HCV (9.8%) was also observed in Tenwek Mission Hospital among donors with informal occupation. This is probably because the prominent occupation in Tenwek is farming. Baye and Yohannes (2008) working in Northern Ethiopia found anti-HCV prevalence was higher 0.7% in farmer blood donors.

Donors with secondary education (0.7%) had the highest infection rate for malaria. The findings contrast to the results by (Alli *et al*., 2010) which showed that donors with non-formal education had the highest infection rate for malaria 83.3%. This was followed by those with primary education 50.0%; tertiary education 45.0% and those with secondary education had least infection rate of 44.1%. In the present study malaria was common among those with secondary education, because the highest number of blood donors happened to be students and being the only group positive for malaria infection. These findings contrasts with a study conducted in Nigeria in which malaria infection was higher among farmers 83.3%, followed by artisans 48.1%, donors with undisclosed occupation status 48.0% and traders 44.0%. Donors who belonged to the civil servant occupational group had the least infection rate for malaria 23.5% (Alli *et al*., (2010).

5.3 Prevalence of TTIs among the blood donors in RBTC Nakuru and Tenwek Mission Hospital

This study revealed that TTIs are common and a major concern among the blood donors with an overall prevalence of 14.1%. Tenwek Mission Hospital with mainly family

replacement donors (FRD) had the highest prevalence of TTIs (25%), in contrast to 11.9% in Nakuru with voluntary non-numerated blood donors (VNRD). The prevalence of 25% among family replacement donors and 11.9% in voluntary non-remunerated donors is comparable to other studies. In a study conducted in Kenya on comparison of voluntary and family replacement donors on a population based survey, found a prevalence of 7.4% and 2.6% respectively (Kimani *et al.,* 2011). In another study in Eritrea, the total blood donors positive for serological markers for TTI's was 3.8%, of these, voluntary blood donor positive for TTI markers was 3.5% and 5.1% for family replacement donors (Fessehaye *et al.*, 2011).

The high prevalence of TTIs in Tenwek Mission Hospital could be attributed to the fact that most of the times, relatives or friends of the family are brought in to cater for their relative's blood needs. As evidenced by the findings of this study, FRDs present a greater risk than voluntary, regular, non-remunerated blood donors. The low prevalence of TTI's in VNRD in this study could be attributed to the fact that voluntary donors are recruited from low-risk populations, coupled with well trained blood donor staffs at the RBTC who practice effective donor education, stringent donor selection, and no pressure associated with self-deferral as is likely to happen with FRDs. This blood donor recruitment strategy is advocated for by the World Health Organization to improve overall blood safety (WHO, 2011).

In this study the prevalence of all the individual TTI's markers, except malaria was higher

among the family replacement donors than voluntary non-remunerated donors. Family replacement donors accounted for 9.0%, 6.0%, 8.0%, 2.0% and 0% of the participant's positive for HBsAg, HIV, HCV syphilis and malaria respectively as compared to 2.4%, 5.5%, 2.2%, 1.0% and 0.7% for voluntary non-remunerated blood donors. This difference was statistically significant for HIV (P=0.0025) and HCV (P=0.0051). It is conceivable that a person in need of money is more likely to conceal his/her true state of health. Monetary motivation of donors might be highly appealing to people who live in desperate financial need. It has been observed that family replacement donors are more likely to transmit transfusion-transmissible infections than are voluntary donors (Buseri *et al*., 2009). These findings are similar to a study in India (Kaur *et al.*, 2010), the study has shown that replacement donors have higher sero-activity rates than voluntary donors due to a number of factors including high risk behaviour and paid donors posing as relatives.

The overall prevalence of TTI agents HBsAg 5.6%, HIV 3.5%, ant-HCV 3.2% and syphilis 1.2% respectively are higher than previously found in Kenya where they reported prevalence of HBV, HIV, ant-HCV and Syphilis of 3.2%, 1.3%, 1% and 0.5%, respectively, among blood donors of transfusion-transmissible infections (NASCOP, 2005) and in Kerala where the prevalence were HBsAg 1.3%, HIV 0.2%, ant-HCV 1.4%, and syphilis 0.2% (Mathai *et al.,* 2002). However these findings are lower than the prevalence of HBsAg 18.6, ant-HCV 6.0% but differ with regards to HIV (3.1%) for which higher prevalence was observed in the current study, but similar (1.1%) with syphilis in the study done in Osogbo, South-West Nigeria (Buseri *et al.*, 2009).

Overall, the commonest TTI was HBsAg with 5.6% positivity rate. The possible reason for the high rate of HBV is a high prevalence in the general population arising from high infectivity potential of the virus, low immunization status and bloodletting exercises to treat different diseases. This data is similar with earlier reports that Kenya is a high endemicity area for HBV. Studies in Kenya showed HBsAg carrier rates of 5-30% (Mutuma *et al*., 2011). Hepatitis B virus therefore is highly contagious and relatively easy to be transmitted from one infected individual to another. This is because HBV virus is present in all body fluids and secretions, including blood, saliva, semen, sweat, breast milk, tears and urine, and therefore, virus is transmitted through various routes, apparently depending on the incidence of the disease in the region (Mutuma *et al*., 2011). Previous study has reported that prevalence of an infection among the donors reflects the disease burden in the society (Sinha *et al*., 2012). This figure (5.6%) prevalence of HBsAg in the current study is higher than 2.58% reported by (Fessehaye *et al.*, 2011), 4% in Kenya donors (Abdalla *et al.*, 2005), 4.3% in Egyptian donors (Alavian and Fallahian, 2009), and 2.48% by (Gulia *et al*., 2011). It is lower than 14% among blood donors in Zimbabwe, Southern Africa (Awortu *et al*., 2009) and 11.5% by (Pennap *et al*., 2011.

In this study 19 (3.2%) of blood donors were seropositive for HCV antibodies. The low overall prevalence of ant-HCV (3.2%) when compared to HBsAg might be due to the fact that HCV is less infective when compared to HBV (Fessehaye *et al.*, 2011) and HCV is transmitted primarily through transfusion of blood or blood products and intravenous drug abuse. These modes of transmission were not common in this study during bivariate

analysis, the questionnaire could not pick for any of the factors. Possibly these blood donors don't have enough knowledge and awareness on hepatitis, especially family replacement donors, who lack pre-counseling and education before donation. The seroprevalence of ant-HCV found in the present study of 3.2% is similar to what was found in Port Harcourt Nigeria (Koate *et al.*, 2005), however higher than what has been found in other areas of Africa which ranges from 0.2% to 2.4% (Abdalla *et al*., 2005, Olokoba *et al*., 2009b), but lower than in other studies 5.0% to 6% (Jeremiah *et al.*, 2008, Buseri *et al.*, 2009).

The overall 3.5% sero-prevalence of HIV in this study is similar with 3.1% found in Nigeria (Buseri *et al.*, 2009), 3.8% in Northwest Ethiopia (Tessema *et al.*, 2010), however it is lower than 10.0% seroprevalence rate of HIV among blood donors in Benin city, Nigeria by (Umolu *et al*., 2005). The highest HIV prevalence was observed in family replacement blood donors in Tenwek (9.0%) which is comparable to the findings by (Buseri *et al.*, 2009) who reported higher prevalence of HIV (36.4%) among family replacement donors. The possible reason for high prevalence of HIV in the current study from family replacement donors could be due to high pressure of the blood donors having in mind that the recipient of their blood are relatives.

It was revealed in this study that 1.2% of study participants had *Treponema Pallidum*. The reasons for the relatively lower rate of seroprevalence, is conceivable that syphilis is less often transmitted by blood. The prevalence is low in most studies reported (Bhattacharya

et al., 2007), 1.2% seroprevalence of syphilis (Abdalla *et al.*, 2005) among Kenyan donors, 1.2% found in Northern-Eastern, Nigeria by (Olokoba *et al.*, 2009a). However it is lower than 3.96% reported in Burkina Faso (Marius *et al*., 2011), but is higher than 0.05% among donors in South India (Mythreyee *et al*., 2011) and 0.2% among blood donors in Niger delta of Nigeria (Erhabor *et al.*, 2007). The low prevalence of syphilis in this study might be through increased awareness of the disease and prompt treatment which is cheap and effective. Antenatal screening and treatment for syphilis might also have contributed to low prevalence of syphilis.

There is scant information on malaria among blood donors. Malaria screening test has not been incorporated as one of the routine tests in NBTS panel of testing. In this study a prevalence of malaria of 0.7% was found. All the four cases came from voluntary blood donors at Nakuru. This study was conducted in a low-malaria prevalence region which gets malaria only in the rainy seasons from April to October (non-endemic region). This can be anticipated that, during the high season the prevalence can be higher. This is almost in accordance with a study by (Baye and Yohannes, 2008) which explains the low prevalence of malaria parasites (1%) among blood donors was due to the sampling period (December to February) as explained by the seasonal changes in mosquito density. The prevalence of 0.7% of TTM in this study contrasts with 46.5% for *Plasmodium falciparum* parasites among voluntary blood donors in Nigeria (Alli *et al.*, 2010). In the Nigerian study donors with history of past infections had higher infection rate of 54.5% for malaria than those without past history of infection 46.0%. Donors with previous history of blood

transfusion had higher infection rate of 60.0% for malaria than those without such history 46.2%. Various histories of donors showed that donors with history of previous donation had higher infection rate 48.7% than those donating for the first time (fresh donors) 45.1% (Alli *et al*., 2010). Studies conducted in Benin revealed the presence of *Plasmodium falciparum* parasites in 30.2 and 33.5% of blood donors respectively (Tagny *et al.,* 2010).

5.4 Socio-behavioural risk factors associated with TTI's among blood donors

Being married (P-value=0.0057) was a high risk factor for HIV positive status. This is not surprising considering that HIV is a sexually transmitted infection. In many countries there is risk of HIV infection within marriage. In a study in India, 90% of women being treated for STI had only one lifetime partner, and 14% were HIV-positive. In Kisumu, Kenya and Ndola, Zambia, adolescent married girls' aged 15-19 years were found to have higher prevalence of HIV infection than non-married sexually active girls of the same age, demonstrating that marriage can increase risk of HIV infection (Glynn *et al*., 2001).

Non-formal or primary education status was a high risk factor to being positive HIV (P-value=0.0262). The sero-prevalence of HIV in this study was found to decrease with increasing level of education among VNRD. This might be attributed to the fact that as the level of education increases there is high probability of being aware of preventive measures against HIV infection. Additionally, it is likely that those with high education understand criteria for self-deferral better. Some studies suggest that better educational attainment may correlate with a lower risk of infection among blood donors (Tagny *et al*.,

2010).

Multiple sexual activity was statistically associated with positive HIV (P-value=0.0144). Being a sexually transmitted disease, it is not surprising that increased exposure to sexual activity is associated with increased HIV prevalence. The key mode of acquiring HIV in Africa is sexual activity, multiple partners being one of the main risk factor. (Chen *et al*., 2007).

Informal occupation (P-value=0.0176) was identified to be independently associated with positive HIV status. These informal workers constitute of business people and farmers which is a major portion of the general population in this region. Farming is predominant occupation in Tenwek while business is in Nakuru.

Low risk factors significantly associated with HIV positive status were; age below 20 years, being single, highest educational status of secondary or tertiary education and being a student, though these associations were not statistically significant during multivariate analysis. This might be attributed through the pre-donation counseling and education, also ongoing educational programmes targeting mostly the youth. Studies worldwide indicate that the volunteers, who are composed mostly of students, produce the safer blood supply. In Kenya, school students are the main donor group as they are perceived by NBTS to be the low risky group and more willing to donate blood (NASCOP, 2005). This study has shown that students are safer blood donors than the other groups.

History of blood transfusion/blood products (P-value=0.0055), were identified to be high

risk factors independently associated with positive syphilis. The possible reason for this association is not clear and further evaluation is needed. Being married (P-value=0.0053) was a high risk factor statistically associated with positive syphilis. The opinion may be, since syphilis is being primarily transmitted by sexual route, the transfusion risk of syphilis is closely related to the sexual behaviours. The presence of syphilis points towards donors' indulgence in high-risk behaviours (Buseri *et al*., 2009) and consequently higher risk of exposure to infections such as HIV (Elfaki *et al*., 2008).

Being male (P-value=0.0479), was identified to be independently associated with positive HBsAg. This association might be attributed by cultural practices which could expose to HBV infection like circumcision using non-sterile equipment. In a study conducted in Nigeria, a positive association was noted between sex and hepatitis B ($\chi 2 = 9.589$, $P < 0.002$) (Awortu *et al*., 2009).

None of the factors analyzed during bivariate analysis were significantly associated with positive HBsAg and ant-HCV at an alpha level of significance of 5%. The possible reason could be the questionnaire was not able to pick for the risk factors. This might be due to lack of knowledge and awareness of hepatitis by the blood donors. In a study by (Olokoba *et al*., 2009b), none of the risk factors examined were significantly associated with the carriage of HBV infection.

5.5 Conclusions

The conclusions of the study are:

- The results indicate that the profile of the low risk blood donor is a young single male aged between 16 to 20 years, student with secondary education.
- Transfusion transmissible infections are prevalent in Regional Blood Transfusion Center Nakuru and Tenwek Mission Hospital, with 14.1% overall prevalence. Malaria as a new test in this study had an overall prevalence of 0.7%.
- The following factors were identified to be (high risk) factors independently associated with positive HIV status; being married, non-formal or primary education, informal occupation and having multiple sexual activities. History of blood transfusion/blood products and being married were high risk factors significantly associated with positive syphilis.

5.6 Recommendations

- It will be important for the NBTS to continue focusing blood donation exercise on students, below 20 years, singles with secondary educations, who were identified as the low risk group.
- The prevalence of TTI's among apparently healthy blood donors in this study was significant and there is a need to have targeted intervention among this group of blood donors to enhance not only safety of the donated blood products but also of the donors themselves.

- The 0.7% prevalence of malaria parasites requires greater concern by NBTS, particularly in malaria endemic areas and it is also recommended that there may be need of including malaria in the TTI screening panel of NBTS and questionnaire to be reviewed to include malaria.
- There is need for NBTS to strengthen criteria for selection of blood donors; to defer of donors with high risk behavior.

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APPENDICES

Appendix 1: Consent Form (English Version)

Title: Prevalence and factors associated with transfusion transmissible infections among blood donors at Regional Blood Transfusion Center Nakuru and Tenwek Mission Hospital

Investigators and their affiliations:

Principal investigator: Grace Bartonjo Master of Science in Laboratory

Management and Epidemiology, Student Jomo Kenyatta University of Agriculture and Technology.

Supervisors: Dr. Joseph Oundo- Resident Laboratory Advisor, CDC Kenya

Dr. Jane Mwangi-Chief, Division of Global HIV/AIDS Program,

Laboratory Branch, CDC Kenya.

Prof. Zipporah Nganga-Director ITROMID, Jomo Kenyatta University

of Agriculture and Technology.

I'm a student at Jomo Kenyatta University of Agriculture and Technology; I want to do a research at Regional Blood Transfusion Center-Nakuru, and Tenwek Mission Hospital. I would like you to be part of this study by allowing me to interview you. You have a choice to be or not to be in the study. The purpose of the research is to assess the

prevalence of infections in donated blood before it is given to a patient for transfusion. I will also look at what are the main behavioural risk factors associated with these infections. The study duration will be two months. In case I need any clarification from you, it will happen within this period of time. If you decide to participate I will ask you questions and then collect a small blood sample from a finger prick to test for haemoglobin level, if haemoglobin will be above 12.5gm/dl then you will proceed to donate a maximum of 450 ml of blood. Donated blood will be screened or tested for HIV, HBV, HCV, Syphilis and malaria.You have an opportunity to ask questions, all of which will be answered to your satisfaction. People who agree to be in this study will get their blood tested at Nakuru Regional Blood Transfusion Center. Donors will be given the chance to know their HIV, Hepatitis, syphilis, malaria status and haemoglobin level in accordance with NBTS norms. HIV positive donors will be referred to nearby HIV care and treatment centers. Donors will be able to use the results to seek further treatment where appropriate. No laboratory costs will be paid by the donor.

The finger prick and venipunture when donating blood may cause some temporary pain in your finger and arm. On very rare occasions, blood donors have fainted. If this happens there is always a clinician to give a first aid. The procedure is routinely followed and presents almost no risk. Your answers will be treated in a confidential manner. Participant's confidentiality will be ensured by coding and omitting information that identifies the participants. Privacy will be maintained during interviews,

questionnaires will be kept in a lockable cabinet and data entered in the computer will be password protected.

In the event of any questions about the study please contact: Grace Bartonjo mobile number 0722497286 or address P.O. BOX 71, Nakuru or in case there are questions concerning your rights of participation, you are free to contact the Chairman KEMRI National Ethical Review Committee, P.O BOX. 54840 00200, Nairobi or telephone number 2722541, 2713349, 0722 205901 email info@kemri.org. Participating in this study will be voluntary; there will be no compensation or incentives given for participation.

After collection of blood from relatives for transfusion in Tenwek, the samples will be transported to Regional blood transfusion center-Nakuru on a daily basis. In Nakuru on return from blood campaigns, the samples will also be transported to Regional blood transfusion center-Nakuru. All the samples will be tested for HIV, HBV, HCV, Syphilis and malaria, and thereafter stored at -2˚C for retrieval for the duration of the study.

Consent signing

I declare that the information I will give is correct. I understand that my blood will be tested for HIV, Hepatitis B & C, syphilis and malaria, and the results of my tests may be obtained from the Regional Blood Transfusion Center - Nakuru.

By signing this form I indicate that the consent form has been explained to me by the investigator. I was given an opportunity to ask questions, all of which have been answered to my satisfaction and that I have chosen to participate.

Participant's name: _____

Signature or thumbprint: _____Date:_____

Witness: _____Date:_____Signature:_____

Name of person obtaining consent: _____

Signature _____Date: _____

Appendix 2: Consent Form (Kiswahili Version)

Fomu ya idhini

Mada: Maambukizi na mambo yanayohusiana na maambukizi kuongezewa damu Transmissibel kati ya wafadhili katika. Mkoa wa damu mishipani Nakuru na Misheni ya Tenwek.

Wachunguzi na ushirikiano wao:

Mkuu wa uchunguzi: Grace Bartonjo-mwanafunzi Chuo Kikuu cha Jomo Kenyatta cha Kilimo na Teknolojia.

Wasimamizi: Daktari. Joseph Oundo- Resident Laboratory Advisor, CDC Kenya.

Daktari. Jane Mwangi-Chief, Division of Global HIV/AIDS Program,

Laboratory Branch, CDC Kenya.

Prof. Zipporah Nganga Director ITROMID, Jomo Kenyatta University of Agriculture and Technology.

Mimi ni mwanafunzi katika Chuo Kikuu cha Jomo Kenyatta cha Kilimo na Teknolojia, Mimi nataka kufanya utafiti katika Mikoa kuongezewa damu wa Nakuru, na Tenwek Hospitali ya Misheni. Ningependa kuwa sehemu ya utafiti huu kwa kuniruhusu mahojiano na wewe. Una hiari ya kuwa au si kwa kuwa katika utafiti. Madhumuni ya utafiti ni kutathmini kiwango cha maambukizi katika damu kabla ya msaada kutolewa kwa mgonjwa kwa damu. Mimi pia kuangalia ni nini sababu kuu ya hatari ya kuhusishwa na maambukizi haya. kipindi cha utafiti itakuwa miezi miwili, katika muda

huu ukiwa na haja yoyote ya ufafanuzi kutoka kwa wewe, itakuwa kutokea ndani ya kipindi hiki cha wakati. Kama kuamua kushiriki nitakuuliza maswali na kisha kukutoa damu ndogo kutoka kidole kupima kiwango cha damu, kama damu watakuwa juu 12.5gm/dl basi utakuwa kuendelea kuchangia damu usiozidi kiwango 450ml kwa wenye wanahitajika. Watachangia damu itakuwa kupimwa au kupima VVU, HBV, HCV, Kaswende na malaria.Utakuwa na nafasi ya kuuliza maswali, ambayo yote yatajibiwa na kuridhika yako. Watu ambao wanakubaliana kuwa katika utafiti huu kupata damu yao majaribio katika maabara, na kupata kujua hali yao ya VVU, Hepatitis, kaswende, malaria na kiwango cha damu. Wanaweza pia kutumia matokeo kutafuta matibabu zaidi kama ni muhimu. Gharama hakuna kwa wafadhili, maabara watalipia. Washiriki kupata matokeo kutoka Kituo cha damu mishipani wa Mkoa. Kuchoma kidole na mshipa wakati wakitoa damu inaweza kusababisha baadhi ya maumivu ya muda mfupi katika kidole chako na mkono, unaweza pia kuwa na dalili za baadhi ya watazirai kidogo wakati wa kuchangia damu. Kama hali hii ikitokea kila mara kuna muuguzi kutoa huduma ya kwanza lakini kuzirai mara chache hutokea. utaratibu ni mara kwa mara hutumiwa na inatoa karibu hakuna hatari. Majibu yako itakuwa kutibiwa kwa njia ya siri. Siri ya mshiriki itakuwa ya kuhakikisha kwamba taarifa kubainisha na washiriki. Utasimamiwa faragha wakati wa mahojiano, hojaji yatawekwa katika baraza la mawaziri na matokeo ya kuiingia katika kompyuta itakuwa password ya hifadhi. Katika tukio la maswali yoyote kuhusu utafiti tafadhali wasiliana na: Grace Bartonjo simu namba 0722497286 au anwani PO BOX 71, Nakuru au katika kesi kuna maswali juu ya haki yako ya

ushiriki, wewe ni huru kuwasiliana KEMRI Mwenyekiti wa Kamati ya Taifa ya Maadili, PO BOX. 54840 00200, Nairobi au simu namba 2722541, 2713349, 0722205901 barua pepe info@kemri.org. Kushiriki katika utafiti huu utakuwa wa hiari, hakutakuwa na fidia au malipo ya aina yoyote. Baada ya ukusanyaji wa damu kutoka kwa ndugu kwa ajili ya damu katika Tenwek, sampuli kusafirishwa mpaka kwa Mkoa wa damu mishipani kituo cha-Nakuru kila siku. Katika Nakuru juu ya kurudi kutoka kampeni za damu, sampuli ya kusafirishwa kwenda katika kituo cha damu mishipani wa Mkoa-Nakuru. Sampuli yote itakuwa kupima VVU, HBV, HCV, Kaswende na malaria, na baada ya hapo kuhifadhiwa kwenye -2˚C kwa muda wa masomo.

Uamuzi wa mshiriki:

Mimi natangaza kwamba habari nimetoa ni sahihi. Ninaelewa kwamba damu yangu itakuwa kupima VVU, Hepatitis B & C, kaswende na malaria, na matokeo ya vipimo yangu zinaweza kupatikana kutoka Mkoa wa Kituo cha damu mishipani Nakuru. Kwa kutia saini fomu hii unaonyesha kwamba fomu ya idhini imeelezwa na wewe kwa uchunguzi.Wewe ulipewa nafasi ya kuuliza maswali, wote ambao wamekuwa wakajibiwa kwa kuridhikana na kwamba umeamua kushiriki.

Mshiriki:_____Sahihi au kutia kidole : _____ tarehe :_____

Msimamizi:_____tarehe:_____Sahihi:_____

Jina la mtu kupata idhini:_____Sahihi _____tarehe:_____

Appendix 3: Consent Form (Kalenjin Version)

Fomit ab ruse

Telelet: Oindo ak tuguk che rikyingei ak korotwek che inamtai kakaitaetab korotik eng bik chekoitoi korotik ak kegeberwekab kakaitaetab korotik eng ketesietab Nakuru ak Tenwek Mission Hospital.

Chigiliik ak olebunu:

Chikilinoed neo: Grace Bartonjo –Kipsomaniat eng Jomo Kenyatta University nebo Kabatisiet ak Musuoknatet.

Kayakinik: Daktari Joseph Oundo – Resident Laboratory Advisor, CDC Kenya

Daktari Jane Mwangi_Chief, Division of Global HIV/AIDS Program, Laboratory Branch, CDC Kenya.

Prof. Zipporah Nganga_Director ITROMID, Jomo Kenyatta University of Agriculture and Technology.

Anendet ko Kipsomaniat [kipsomanindet] eng sugulitab kabatisiet ak musuoknatet nebo Jomo Kenyatta; amache ayai chikilisiet eng kebeberta nebo kakaitaetab korotik eng ketesietab Nakuru ak sibitalitab Mission nebo Tenwek. Asome ale itoreto eng chikilisioni. Ye icham atebenen tebutik. Imuche icham anan imuche Kora komat icham ketebenen tebutik. Amune asi asir ak ayai chikilisioni, ko anai oindo nebo kanamtaetab

korotwek yekikoitoi korotik kotomo kikochi korotik chito ne miani. Awendi Kora asi anai kabarunoik chetinye bichiinwekik chenekite kanamtaetab korotwek. Somanani keibei orowek oeng. Ingot koit kasarta ne amache inaiseiwo komie ko nyolu konyaak eng kasari kityo. Ingot iyan ieku agenge nebo chikilisioni, atebenen tebutik ak amuchi aib korotik tut kin eng baragutap mornetap eut. Asi achigil oindab haemoglobin.

Ingot kosirei haemoglobin 12.5gm/dl, ko imuche i cheru korotikuk chenekite 450 ml. korotik che kakicher, kechigili kutikab HIV, HBV, HCV, Kisonono anan ko Malaria. Itinye kasarta iteb tebutik che kimuchi kewalun tugul agoi inyoru wolutiet ne nyolu. Bik chekeyan koek agenge eng Somanani kechigili korotikwai eng ketesietab ne kechigili korotik. Imuche inyoru anan inai akobo Ukimwi, Hepatitis, Syphilis, Malaria ak oindo haemoglobin. Imuche iboisie kabarunoik chekenyoru inyaenkei amami libanet age tugul ne kilibani. Imuche kobet ngwanindo ne matia eng mornetap ab eut ole kakicherune korotik. Eng betusiek chengering, ko ng`ab kotanui chito ye kakinem korotik. Ako kitinye bik chetaret chito neu noto. Wolutikab korotikuk komokiborchin chi age tugul. Kiyaei kit aketugul eng ungotet ye ketebenen tebutik ak kegonor wolutikuk tugul eng computer nemakimuchi kayat ingot ko momi ngolyot ne kikiuny.

Ingot komi tebutiet aketugul ko gaigai birchi simoit Grace Bartonjo eng simoit 0722497286 anan Box 71 Nakuru anan ingot komi tebutiet aketugul ne imuche inai imandangung nebo ieku agenge nebo Somanani imuche inyoru nebo ng`echeret Kemri National Ethical Review Committee , P.o Box 54840-00200 Nairobi anan ko simoit 2722541, 2713349, 0722205901, email info@kemri.org. Chi aketugul ne egu agenge

nebo Somanani koyaei eng toretet, momi libanet aketugul nekelibani chito age tugul yekake ib korotik eng Tenwek, kimuchi keib kegonor eng kebeberta nebo korotik eng ketesietab Nakuru. Kechigili HIV, HBV, HCV, Syphilis ak Malaria eng korotik tugul ak kende kaititiet nebo -2˚C.

Siknature nebo chomchinet:

Kamwa ale, kit aketugul ne am woe koboiman. Angen ale kechigili HIV, Hepatitis B & C, Syphilis ak Malaria eng korotikuk ako Wolutikab chikilisiet kimuchi kegonor eng ketesietab kebeberwek ab korotik eng Nakuru.

Yeisainani fomini, ko iboru kole kakonaiseun kit aketugul chigilnded. Kikonin boroindo iteb tebutik tugul chekakewol asi inyoru kaguyet ne nyolu.

Kainet ab chito ne katoretin: _____

Sahi anan ko mornetap eut: _____Betut_____

Baoriat: _____Sahi_____Betut_____

Kainetab chito ne tinyei chomchinet: _____Sahi_____

Betut: _____

Appendix 4: National Blood Transfusion Questionnaire (English Version)

NATIONAL BLOOD TRANSFUSION SERVICE

Clinic Venue ---------- Clinic Code: ----------Donor Number---------

DONOR REGISTRATION FORM (Donors please complete this section below)

Surname: _____ Other Names: _____ _____

Student Number/ National ID Number: _____ Date of Birth: --------- /--Sex: F/M

Marital Status:	Single	Married	Divorced/Separated	Widowed

Contact Details: Postal Address (where you would like to receive your correspondence)

Code

Home phone number: ---------- Cell phone number: ----------

Email: ----------

Level of education: None/ Primary/ Secondary/ Tertiary Occupation: ...……

When did you last donate Blood? …….. Blood Group: …….

HEALTH QUESTIONNAIRE Circle the appropriate answer

1. Are you feeling well and in good health today?	Yes/No
2. Have you eaten in the last 6 hours?	Yes/No
3. Have you ever fainted?	Yes/No
In the past 6 months have you:	
4. Been ill, received any treatment or any medication?	Yes/No
5. Had any injections or vaccinations (immunizations)?	Yes/No
6. Female Donors: Have you been pregnant or breast feeding?	Yes/No
In the past 12 months have you:	
7. Received a blood transfusion or any blood products?	Yes/No
Do you have or have you ever had:	
8. Any problems with your heart or lungs e.g. asthma?	Yes/No
9. A bleeding condition or a blood disease?	Yes/No
10. Any type of cancer?	Yes/No
11. Diabetes, epilepsy or TB?	Yes/No
12. Any other long term illness Yes/No Please Specify	

RISK ASSESSMENT QUESTIONNAIRE

Circle the appropriate answer

In the past 12 months have you:
1. Received or given money, goods or favours in exchange for sexual activities? Yes/No
2. Had sexual activity with a person whose background you do not know? Yes/No
3. Been raped or sodomized? Yes/No
4. Had a stab wound or had an accidental needle stick injury e.g. injection needle? Yes/No
5. Had any tattooing or body piercing e.g. ear piercing? Yes/No
6. Had a sexually transmitted disease (STD)? Yes/No
7. Live with or had sexual contact with someone with yellow eyes or yellow skin? Yes/No
8. Had sexual activity with anyone besides your regular sex partner? Yes/No
Have you ever:
9. Had yellow eyes or yellow skin? Yes/No
10. Injected your-self or been injected, besides in a health facility? Yes/No
11. Used non medical drugs such as Marijuana, Cocaine etc? Yes/No
12. Have you or your partner been tested for HIV? Yes/No
13. Do you consider your blood safe to transfuse to a patient? Yes/No

Appendix 5: National Blood Transfusion Questionnaire (Kiswahili Version)

Maswali

NATIONAL BLOOD TRANSFUSION SERVICES.

Mahali pa kliniki---------- Nambari ya mahali pa Kliniki: ----------

Nambari ya wafadhili----------

FOMU YA WAFADHILI (Wafadhili tafadhali jibu maswali yaliyofuata)

Jina---------- Majina nyingine: ---------- ----------

Nambari ya shule ya Mwanafunzi / Nambari ya kitambulisho: ----------

Tarehe ya kuzaliwa: ---------- Jinsia: Mwanamke/Mwanaume

Hali ya Ndoa: Hujaolewa/umeoa au olewa/umetengana au mjane/umetaliki au talikiwa.

Kuwasiliana maelezo: Anwani ya posta (ambapo ungependa kupokea mawasiliano yako-

----

Nambari ya simu ya nyumbani: ---------- Simu ya mkono: ----------

Barua pepe: ----------

Kiwango cha elimu: Hakuna Msingi/Eneo la Msingi----------

Kazi----------

Lini mara ya mwisho kuchangia damu.....Aina ya damu.....

Maswali ya afya	**Mduara jibu sahihi**
1. Je, wewe kujisikia vizuri na afya njema leo?	Ndiyo / La
2. Wewe umekula katika masaa 6 ya mwisho?	Ndiyo / La
3. Na wewe milele umepata kizuizi?	Ndiyo / La
Katika kipindi cha miezi 6 na wewe umekuwa;	
4. Mgonjwa, kupokea matibabu yoyote au dawa?	Ndiyo / La
5. Umekuwa na sindano yoyote au chanjo (kinga)?	Ndiyo / La
6. Wanawake Wafadhili: Je, umekuwa na mimba au kunyonyesha?	Ndiyo / La
Katika kipindi cha miezi 12 na wewe;	
7. Umepokea damu au bidhaa yoyote ya damu?	Ndiyo / La
Je, una au na wewe milele na:	
8. Matatizo ya moyo wako au mapafu mfano pumu?	Ndiyo / La
9. Hali ya kutokwa na damu au ugonjwa wa damu? Ndiyo/ La	
10. Aina yoyote ya Kansa?	Ndiyo / La
11. Kisukari, kifafa au kifua kikuu?	Ndiyo / La
12. Ugonjwa nyingine yoyote ya muda mrefu? Tafadhali taja	Ndiyo/ La

Tathmini maswali hatari	**Mduara jibu sahihi**
Katika kipindi cha miezi 12 na wewe;	
1.Umepokea au kupewa fedha, mali au neema badala ya shughuli za ngono?	Ndyio /La
2. Ulikuwa na shughuli za ngono na mtu ambaye historia hamjui?	Ndyio / La
3. Umebakwa ?	Ndyio / La
4. Ulikuwa na jeraha ya kuchomwa au ajali wa sindano, mfano kuumia sindano wenye ugonjwa?	Ndiyo/La
5. Umetoboa mwili kwa mfano kutoboa sikio?	Ndiyo / La
6. Ulikuwa na ugonjwa wa zinaa (STD)?	Ndiyo / La
7. Umeishi au ulikuwa na ngono na mtu wa macho wa njano au ngozi ya manjano? Ndiyo/La	
8. Ulikuwa na shughuli za ngono na mtu yeyote zaidi ya mpenzi wako mara kwa mara ?Ndiyo /La	
Na wewe milele;	
9. Ulikuwa na macho ya njano au ngozi ya manjano?	Ndiyo / La
10. Umejichanja mwenyewe au umechanjwa katika kituo cha afya?	Ndiyo / La
11. Umetumia madawa zisizo matibabu, madawa ya kulevya kama vile bangi, Cocaine nk? Ndiyo / La	
12. Je, wewe au mpenzi wako mumewahi kupima VVU?	Ndiyo / La
13. Je, unaona kama damu yako uko salama kumwongezea mgonjwa?	Ndiyo / La

Appendix 6: National Blood Transfusion Questionnaire (Kalenjin Version)

NATIONAL BLOOD TRANSFUSION SERVICES

Tebutik

Elekicherunen korotik----------Nambait neboyoton----------Nabaitab chito necheru korotik----------

Fomit Nekisirchinen Chito Ne Cheru Korotik (chito ne cheru korotik gaigai inyit kasarta ne isibu)

Kainet nebo gaa----------koinutik alak chekuket---------- ----------

Nambaitab lakwetab sukul anan nambaitab kipandet----------Betutab siket----------muren/tie----------

Eleu en keset Kip/chepsongoiyat Tunot/Kesot Kikebesye/Mokimenye kot tuwan Kikome chito/Kwondo

Eletoskinyorchinin: Nambarisiekab posta (Eletos imuche inyorunen baronok)

Nambarisiekab simoit ab gaa----------Nambarisiekab simoitab eut----------

Nambarisiekab baruet nebo koristo (E-mael) ----------
Elekiit en somanet: Masoman/kiait primary/kiait secondary/kiosir secondary kasit ne oyoe----------

Betut nebo let nekiicheru korotik kwou? ---------- Kurubit nebo korotikuk----------

Tebutik chenomekei ak tililitab bortangung Inte alamet wolutiet nebo iman

1.Ikose komie bortangung raini? Ee/achicha
2. En saisiek loo chekokosirto tos koriomisie? Ee/achicha
3. Tos miten Betut ne kiritonui besio? Ee/achicha
En orowek loo chekokosirto:
4. Tos kirimiani, anan kikinyain, anan kikekonin kerich? Ee/achicha
5. Tos kikerutin anan kikechachanin (chachanet)? Ee/achicha
Eng kwonyik che checheru korotik
6. Tos kiriiku solot anan kikochuchunin lakwet besio? Ee/achicha
Eng orowek taman ak oeng chekokosirto
7. Tos kikekonin korotik anan kikekonin tukun alak chebunu korotik? Ee/achicha
Itinye anan kirisich besio:
8. Koimutietab muguleldo anan kipsegeret kou asma? Ee/achicha
9. Koimutietab nemo nyweltos korotik anan miontab korotik aketugul? Ee/achicha
10. Miontab lubaniat aketugul? Ee/achicha
11. Miontab sukaruk, kipapa anan Tiibi? Ee/achicha
12. Tos itinye miodage tugul ne kikokayenen ge? Ee/achicha

Opoetab tebutik chemogororon en chi **Inte alamet wolutiet nebo iman**

En orowek taman ak oeng che kikosirto
1. Tos kirinam anan kirikoite rabinik anan ko kiy aketugul? Ee/Achicha
2. Tos kiroruye ak kwony anan muren ne meken atebtanyin ii? Ee/Achicha
3. Tos kikeborienen anan kobalinchibai? Ee/Achicha
4. Tos itinye moet nekitorin kiy anan kikotorin sindanut ni kigeboisien komenai? Ee/Achicha
5. Tos itinye ngotobosiek chekigichobun chebo lelesta chemiten bortangugung kou barbaretabitik? Ee/achicha
6. Tos miten Betut ne kigenamten miontab kesesnotet ii? Ee/achicha
7. Tos kiroruyei ak kwony anan muren ne kitinye konyek che kitolelyonen ii? Ee/achicha
8. Tos mi betut ne kiroruye ak kwony anan muren nemo chamanengung nebo kila? Ee/achicha
Tos miten kasarta:
9. En besio ne kiwalak konyek chekuget kotolelionitu? Ee/achicha
10. Tos miten kasarta ne kiririut gei en elemo sipitali? Ee/achicha
11. Tos miten betut ne kiriboisien kerichek alak chemokinyoen gei kou bangik? Ee/achicha
12. Tos kigepimanin akobo miondo nebo kasari (ukimwi)? Ee/achicha
13. Tos imongu ile miachen korotikuk ako imuche kikochi chito nemioni? Ee/achicha

Appendix 7: Unconditional Logistic Regression Model Building Process

Step 1: Unconditional Logistic Regression model building process

HIV

Term	Odds Ratio	95%	C.I.	P-Value
Age 20 (Yes/No)	1.0836	0.2963	3.9626	0.9034
Age 30 (Yes/No)	0.3200	0.0631	1.6227	0.1690
Diabetes/epilepsy/TB (Yes/No)	85077.7691	26.6119	271992050.5976	0.0058
Informal occupation (Yes/No)	3.6859	0.8811	15.4190	0.0740
Married (Yes/No)	5.3111	0.0901	313.0649	0.4221
Multiple sexual activity (Yes/No)	173.1704	2.3103	12980.2624	0.0193
None/primary education(Yes/No)	7.8950	1.0751	57.9792	0.0422
Single (Yes/No)	1.8666	0.0260	134.1203	0.7748
Student (Yes/No)	2.0457	0.3593	11.6460	0.4199
CONSTANT	*	*	*	0.1840

Step 1: Unconditional Logistic Regression

HBV

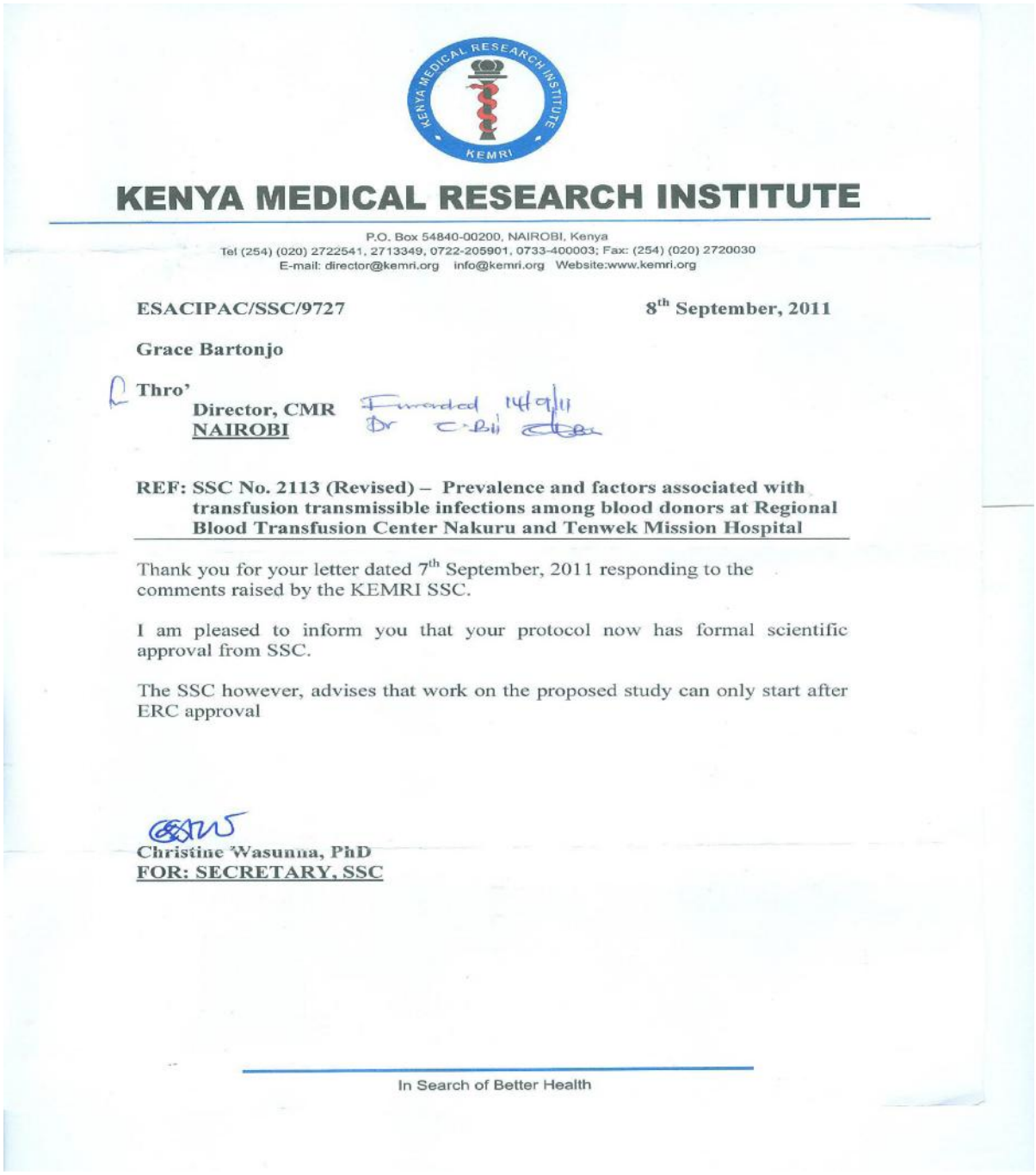
Term	Odds Ratio	95%	C.I.	P-Value
male (Yes/No)	2.9181	1.0099	8.4319	0.0479
CONSTANT	*	*	*	0.0000

Step 1: Unconditional Logistic Regression

Syphilis

Term	Odds Ratio	95%	C.I.	P-Value
Age 30 (Yes/No)	0.8805	0.0588	13.1870	0.9266
History of transfusion/products (Yes/No)	9786.6225	14.9350	6412998.2582	0.0055
Married (Yes/No)	16.1871	0.0216	12125.0894	0.4097
Single (Yes/No)	1.2338	0.0014	1077.1400	0.9515
CONSTANT	*	*	*	0.1198

Appendix 8: Approval Letter, Kemri Scientific Steering Committee



KENYA MEDICAL RESEARCH INSTITUTE

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E-mail: director@kemri.org info@kemri.org Website:www.kemri.org

ESACIPAC/SSC/9727 **8th September, 2011**

Grace Bartonjo

Thro'
Director, CMR
NAIROBI

Forwarded 14/9/11

REF: SSC No. 2113 (Revised) – Prevalence and factors associated with transfusion transmissible infections among blood donors at Regional Blood Transfusion Center Nakuru and Tenwek Mission Hospital

Thank you for your letter dated 7th September, 2011 responding to the comments raised by the KEMRI SSC.

I am pleased to inform you that your protocol now has formal scientific approval from SSC.

The SSC however, advises that work on the proposed study can only start after ERC approval

Christine Wasunna, PhD
FOR: SECRETARY, SSC

In Search of Better Health

Appendix 9: Approval Letter, Kemri Ethical Review Committee

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KEMRI/RES/7/3/1 **November 11, 2011**

TO: **GRACE BARTONJO,**
PRINCIPAL INVESTIGATOR

THRO': for **DR. SAMUEL KARIUKI,**
THE DIRECTOR, CMR,
NAIROBI

Forwarded
18/11/2011

RE: **SSC PROTOCOL NO. 2113 – Revised- (*RE-SUBMISSION*): PREVALENCE AND FACTORS ASSOCIATED WITH TRANSFUSION TRANSMISSIBLE INFECTIONS AMONG BLOOD DONORS AT REGIONAL BLOOD TRANSFUSION CENTRE NAKURU AND TENWEK HOSPITAL**

Make reference to your letter dated November 6, 2011 received on November 10, 2011. Thank you for your response to the issues raised by the Committee. This is to inform you that the issues raised during the 194th meeting of the KEMRI/ERC meeting held on October 11, 2011, have been adequately addressed.

Due consideration has been given to ethical issues and the study is hereby granted approval for implementation effective this **11th day of November 2011,** for a period of twelve (12) months.

Please note that authorization to conduct this study will automatically expire on **10th November 2012.** If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to the ERC Secretariat by **1st September 2012**.

You are required to submit any amendments to this protocol and other information pertinent to human participation in this study to the ERC prior to initiation. You may embark on the study.

Yours sincerely,

RCJKithinji

Caroline Kithinji,
FOR: SECRETARY,
KEMRI/ETHICS REVIEW COMMITTEE

In Search of Better Health