A STATISTICAL ANALYSIS OF VOLUNTARY COUNSELING AND TESTING (VCT) DATA TO DETERMINE THE RISK FACTORS FOR HIV INFECTION IN NAMIBIA

A THESIS SUBMITTED IN FULFILMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

OF

THE UNIVERSITY OF NAMIBIA

BY

RICHARD CHAMBOKO

201127466

MARCH 2014

Supervisor: Dr. I. Neema

ABSTRACT

In an effort to provide information that can guide prevention strategies, this study determined the risk factors for HIV infection in Namibia and estimated the potential for HIV prevention. The study adopted a cross sectional research design with a sample of 14296 VCT clients from Oshana, Khomas and Kavango regions of Namibia for the period of 2009 to 2012. A multivariate logistic regression analysis was used to identify risk factors for HIV infection among VCT clients. For risk factors which are amenable to intervention, the Population Attributable Risk Percent (PAR %) was computed. The magnitudes of PAR% were then used as the basis for selecting risk factors that pose the greatest health threat to the population for prioritisation in HIV programming. From a targeting perspective, sex, condom use, marital status, region of residence, male circumcision status, age and level of education were found to be significant predictors of HIV infection. Alcohol use was not associated with HIV infection in these regions. Among these risk factors, not using condoms and not being circumcised are amenable to intervention and interventions that eliminate exposure to these risk factors can avert up to 22% and 18% of the disease burden respectively assuming all other conditions remain the same.

Keywords: HIV infection, VCT data, logistic regression, risk factors, attributable risk, HIV prevention.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

NOTES

This study was presented at two national conferences as well as one international conference. The list of the conferences is as follows:

1. The Colloquim on the Role of Statistics for Development, Safari Hotel**,** Windhoek, Namibia. 5th September 2013

2. Faculty of Science Annual Conference. University of Namibia, Windhoek, Namibia. 25-26 October 2013

3. 32nd Conference of the Southern Africa Mathematical Sciences Association (SAMSA), Stellenbosch, South Africa. 24-29 November 2013.

ACKNOWLEDGEMENTS

With all sincerity, I thank Dr Isak Neema who tirelessly and unwaveringly supported me to make this research a success story. I can say, I was fortunate to have you as my supervisor, taking time to graciously and generously review my work. Thank you!

Special thanks to my precious and only wife who served me delicious dishes when I was working on this research. You are a true friend, you are a darling!

To God, be the glory. Amen.

DEDICATION

To my mother Sabina and my wife Tabitha.

DECLARATION

I Richard Chamboko, declare hereby that this study is a true reflection of my own research and that this work, or part thereof has not been submitted for a degree in any other institution of higher education.

No part of this thesis may be reproduced, stored in any retrieval system, or transmitted in any form, or by means eg electronic, mechanical, photocopying, recording or otherwise) without the prior permission of the author or The University of Namibia in that behalf.

I Richard Chamboko, grant The University of Namibia the right to reproduce this thesis in whole or in part, in any manner or format, which The University of Namibia may deem fit, for any person or institution requiring it for study and research; proving that The University of Namibia shall waive this right if the whole thesis has been published in a manner satisfactory to the university.

12 November 2013

[Signature] Date

ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
AR	Attributable Risk
AR%	Attributable Risk Percent
CDC	Centre for Disease Control
CI	Confidence Interval
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
MC	Male Circumcision
MoHSS	Ministry of Health and Social Services
NDHS	Namibia Demographic Health Survey
NSF	National Strategic Framework
OR	Odds Ratio
PAR%	Population Attributable Risk Percent
PMTCT	Prevention of Mother to Child Transmission (of HIV)
RR	Relative Risk
SMA	Social marketing Association
SSA	Sub Saharan Africa
STI	Sexually Transmitted Infection
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
VCT	Voluntary Counselling and Testing
WHO	World Health Organisation.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The Joint United Nations Programme on Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome (UNAIDS) global report of 2012 reported that there were about 34.2 million people living with Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) in the world. The same report also stated that in the year 2011 alone, about 1.7 million people died from AIDS-related causes. A 2011 UNAIDS AIDS epidemic update report, further shows that the greatest burden of the epidemic (68%) is in sub-Saharan Africa with an estimated 22.5 million adults and 1.8 million children living with HIV. It was further stated in the UNAIDS global report of 2012 that about 34 percent of all people living with HIV in 2009 resided in the 10 countries of southern Africa (namely, Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe).With an estimated 5.6 million HIV positive people, South Africa continues to have the world's largest HIV epidemic. Swaziland has the highest adult HIV prevalence in the world, with an estimated 25.9 percent of adults in that country living with HIV in 2009 (UNAIDS, 2012).

Namibia's first case of HIV infection was reported in 1986, and today the country has a generalised, mature epidemic throughout society, with HIV primarily transmitted heterosexually (Ministry of Health and Social Services [MoHSS], 2011).

Importantly, the MoHSS and UNAIDS (2010) reported that 178 000 adults and children in Namibia were living with HIV and AIDS in 2009. The Namibia Demographic Health Survey (NDHS) report of 2006/7 recorded that life expectancy in Namibia has drastically dwindled from 61 years in 1991 to 49 years in 2001. It was also stated in the same NDHS that about 17 percent of children under the age of 18 in Namibia were orphaned by at least one parent.

Based on the 2009 estimates, the HIV prevalence rate for Namibia among adults was at 13.1 percent (MoHSS and UNAIDS, 2010). More recently, the report on the 2012 national HIV Sentinel Survey recorded 18.2 percent HIV prevalence rate amongst pregnant women. As shown in Figure 1.1, prevalence steadily increased from 4.2 percent in 1992 and peaked at 22 percent in 2002. Thereafter, Namibia started to register a slight decrease between 2004 and 2012, which generally has translated into an apparent stabilization of HIV prevalence rates.

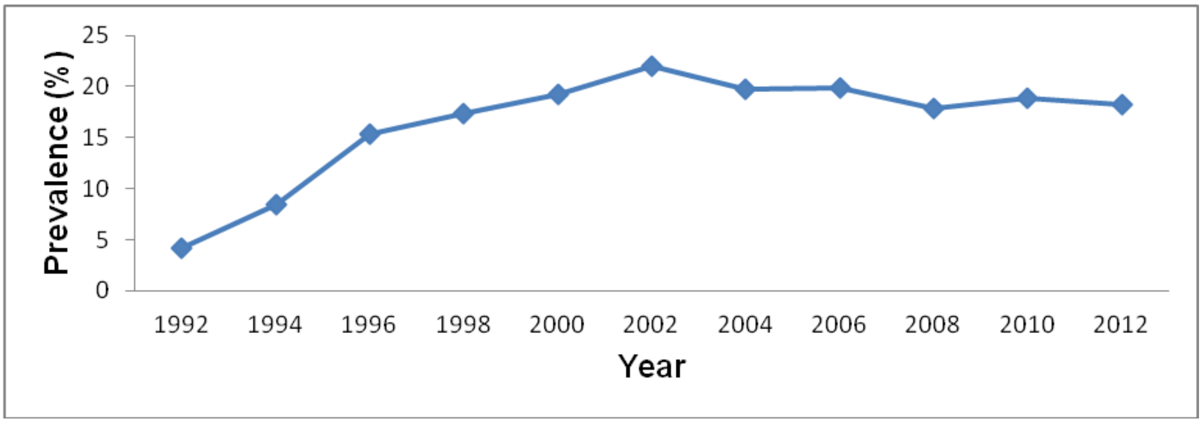

Figure 1.1: HIV Prevalence rate of pregnant women, bi annual surveys, 1992-2012

In addition, the national HIV Sentinel Survey (2012) also documented that HIV prevalence peaks in the age group of 35-39 years, with about 33.9 percent whilst the lowest rate (5.4%) was amongst women between 15-19 years (Figure 1.2).

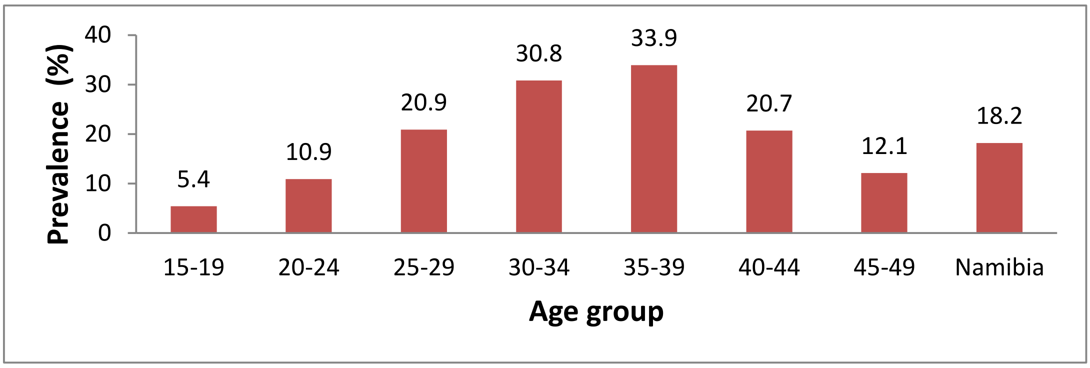

Figure 1.2: HIV Prevalence rate by age group, 2012 HIV Sentinel Survey, Namibia

Under the premise that pre and post-test counselling in a supportive environment can motivate a person undergoing voluntary HIV testing to change unsafe sexual behaviour and be referred to available treatment, care and support services, the Government of Namibia started Volunteering Counselling and Testing (VCT) initiatives in 2002 with the provision of Prevention of Mother To Child Transmission (PMTCT) in two pilot hospitals. At the same time the Social Marketing Association (SMA) also started three New Start Centres under an agreement with MoHSS. Concurrently Intra-Health started providing unlinked anonymous testing in seventeen centres. VCT uptake increased with the introduction of Highly Active Antiretroviral Therapy (HAART) in six pilot hospitals in 2003, and rolled out rapidly to thirty four public hospitals (MoHSS, 2007a).

MoHSS thus deemed VCT as an essential component in the continuum of prevention, treatment, care and support for persons living with or affected by HIV/AIDS. However, some VCT centres especially in urban areas were closed since 2010 as funds were being redirected to remote areas arguing that people could now access VCT services at public hospital and clinics.

Despite improved uptake of VCT services and significant coverage of HAART, the Government of the Republic of Namibia through line ministries and other stakeholders continue to be faced with the challenge of designing appropriate measures that can adequately respond to the need to care for the infected and prevent further infections. Vigorous studies within the care and prevention spheres can help to adequately inform decision-makers on the specific areas to target and programme implementers on areas to address with specific programmes and activities. In the past few years several HIV and AIDS related researches have been conducted throughout the country; each bringing segmented results to support government and civil society efforts in mitigating the current and possible future impact of HIV and AIDS in Namibia.

In particular, studies such as “Estimates and Projections of the Impact of HIV/AIDS in Namibia” (MoHSS, 2009a), “HIV/AIDs in Namibia: Behavioural and Contextual Factors Driving the Epidemic” (MoHSS, 2009b) focused on HIV impact and risk behaviours to gain an insight into which factors increase vulnerability and susceptibility to infection. Similarly, studies such as “Factors Influencing the Uptake of HIV VCT in Namibia" (Dzinotyiwei, 2009), and "Contraceptive Use Amongst Young Women in Namibia: Determinants and Policy Implications" (Indongo, 2007) targeted VCT uptake and condom use. However, there is lack of particular evidence that comprehensive studies to estimate HIV risk determinants and estimate the potential for prevention were ever undertaken in Namibia.

1.2 Statement of the problem

There is evidence that the government of Namibia, civil society and international development partners have committed significant resources in an effort to deter the further spread of HIV, provide care and treatment to the infected, and generally reconstruct societal fibre through programmes and activities targeted at lessening the impact of HIV and AIDS on communities. A 2006 MoHSS report on guidelines for voluntary counselling and testing clearly shows that the above efforts were evidenced by the following: strengthening of the capacity of those promoting behaviour changes, targeting vulnerable populations, prevention of transmission in health care settings, interventions in schools, programmes for youth, social mobilization and awareness activities, workplace programs, expanded condom promotion, strengthening sexually transmitted infections (STI) management, voluntary counselling and testing, safety of blood transfusion products, and addressing vulnerability based on gender inequalities, violence and alcohol abuse.

Furthermore, evidence from MoHSS and UNAIDS (2010) shows that during 2006/07, the total spending on HIV and AIDS was US$ 130.5 million, increasing to

US$ 212 million in 2007/08, while in 2008/09 this figure stood at US$ 194 million for Namibia alone. However, all the concerted efforts mentioned above are yet to halt further infections in an effort to achieve the desired zero infection rate. The fact that infections continue to occur is of on-going concern and requires continuous assessment to help in designing or redesigning interventions. Despite this, emphasis was put on studies investigating HIV awareness, treatment, response to antiretroviral therapy, mother-to-child transmission and condom use.

There is insufficient evidence to indicate that equal efforts have been exerted towards estimating risk determinants. Such estimations could be helpful in avoiding wrong targeting and the one size fits all approach to prevention. Furthermore, there is also lack of evidence to show that the potential for HIV prevention which is measured by attributable risk measures was ever studied in Namibia. According to Hagan (2003), the potential contribution of attributable risk measures to prevention planning and to our understanding of the underlying dynamics of occurrence of HIV in a community may be more relevant now than ever before. Hence, this study focused on the estimation of HIV risk determinants in Namibia in order to fill this void and also estimate the attributable risk measures to provide useful information on the potential for prevention. Hagan (3003) has demonstrated how attributable risk measures can be used in HIV prevention planning with data from Baltimore and Vancouver. Similary, Guy et al. (2011) also emphasised the use of population attributable risk to choose HIV prevention strategies in men who have sex with men.

1.3 Objectives of the study

The main objective of the study was to determine the risk factors for HIV infection and estimate the potential for prevention in Namibia in an effort to provide useful information that can be used to inform national prevention strategies and interventions. In the conduct of this study, the following secondary objectives were addressed:

(i) To estimate the prevalence of HIV and exposure among people who go through HIV VCT in Namibia.

(ii) To ascertain the significant risk determinants of HIV infection in Namibia;

(iii) To estimate the attributable risk of HIV infection due to exposure in the Namibian exposed population;

(iv) To estimate the potential for HIV prevention in the population studied; and

(v) To identify the most important risk factors that can be targeted by mass interventions.

1.4 Research Hypotheses

The specific research hypotheses tested in this study are as follows:

(i) Women in Namibia are at a higher risk of HIV infection compared to their male counterparts.

(ii) Male circumcision is an important factor in reducing the risk of HIV infection.

(iii) The use of alcohol increases the risk of HIV infection in Namibia.

(iv) Increased education reduces the risk of HIV infection among Namibians and

(v) Being married is protection against HIV infection for Namibians.

1.5 Significance of the study

The findings of the study will be useful to programme designers and activity implementers in developing targeted intervention strategies and activities for the prevention of further HIV infections. This is in line with recommendation 8.3 of the 2010 National HIV sentinel survey which recommended implementers to strategically address the drivers of the epidemic through intensified campaigns. A successful estimation of the risk determinants will therefore allow the desired strategic targeting of the drivers.

The insights of this scientific study are essential for policy makers to draw guiding principles from scientific research-based evidence in policy development and implementation as is the case with the Republic of Namibia National Policy on HIV/AIDS through which the guiding principle 1.5.9 states, "*it is essential that the national response to HIV/AIDS should be based on sound, current and evidence-based research. As aspects of the epidemic change from time to time and scientific, medical and programmatic knowledge of the epidemic progresses, our understanding of the HIV/AIDS epidemic and how best to respond to it continually evolves. This may necessitate changes in Namibia's response to the epidemic from time to time"* (MoHSS, 2007c).

Both applied and academic researchers may find this study useful when compiling literature for other related studies. The findings of the study can also be used to identify grey areas where further basic or applied research can be conducted in order to fully understand the factors driving the epidemic in the Namibian context.

CHAPTER 2

LITERATURE REVIEW

2.1 Related studies

The rationale of HIV infection growing faster is shaped by structural, socio-economic, sexual behavioural, individual contextual factors and biological vulnerability, which create inequalities in relations between groups of human beings (Barnett and Whiteside, 2002). The World Health Organisation (WHO) and UNAIDS (2007) reiterated that the existence of these factors create imbalances and unequal exposure to HIV infection among various populations. For the purpose of this study, the researcher divided the factors driving the spread of HIV into four categories namely: structural determinants, social-economic determinants, sexual behavioural determinants, and biological vulnerability and these are summarised in Table 2.1 and are further discussed in the chapter.

Table 2.1: Determinants of the Sexual Transmission of HIV/AIDS

Structural Determinants:	**Social and Economic Determinants**	**Sexual Behavioral Determinants**	**Biological Vulnerability:**
Poverty and Income inequality Gender Inequality Geography Discrimination based on race/ ethnicity Culture Religion Structure of the economy Policy environment War or civil unrest in the region	**Social determinants** Norms regarding sexual behaviors Women's status Marital status Migration pattern Community effects (geography) • Local prevalence • Distribution of services (health/education/employment) **Social-economic position** Education Poverty Mobility/migration Access to health services	**Sexual behavioral determinants** Multiple and concurrent Partnerships Partnership dynamics • Intergenerational sex • Transactional sex Condom use Coital frequency/abstinence **Individual Contextual Factors:** Age Gender • Decision -making ability over sex • Exposure to violence Ethnicity Alcohol use HIV testing Knowledge of HIV/AIDS Perceptions of risk	Sex Age (especially for women) Presence of other STIs Male circumcision Viral load Characteristics of sexual intercourse: • Oral/vaginal/anal sex • Forced sex • Dry sex Malnutrition and ill health

Source: MoHSS(2009b), HIV/AIDs in Namibia: Behavioral and Contextual Factors Driving the Epidemic.

A World Health Organisation (WHO) discussion paper for the Commission on Social Determinants of Health of 2007 defined structural determinants as factors that points to marked socio-economic differences in access to material resources, health-promoting resources, and in exposure to risk factors. They specifically refer to the components of people's socio-economic position. These factors, in turn, affect HIV transmission dynamics and the differential distribution of HIV/AIDS. Such factors include gender inequality, place of residence, culture, structure of the economy, policy environment just to mention a few. As a cultural component, Van Niekerk and Kopelman (2005) stated that it is a taboo to discuss sex in public, with children or with your partner in some parts of Namibia. Such a scenario impedes the discussion of sexual issues even in marriage and cohabiting relationships.

Even worst, parents also find it difficult to teach their children about HIV thus hampering the transfer of sexual education to children. Similarly, Pettifor et al. (2005) stated that where culture expects women to be passive and subservient to men, women and young people have little or no control over decision-making relating to neither sexuality, nor the sexual behaviour of their partners and thus putting them at risk of contracting HIV. A study conducted by Iipinge, Hone, and Friedman (2004) extended this notion by indicating that cultural norms that define men as superior to women make it difficult for women to protect themselves from HIV infection. They found that men in Namibia tend to advocate for multiple sexual partners, which is regarded as a symbol of status. Furthermore, it was noted that the disappearance of traditional values such as fidelity and abstinence are also contributing to the spread of HIV epidemic (Oguntibeju, Van Chalky, and Van Den Heaver, 2003).

Poverty, income inequality and employment status can be regarded as cross cutting between structural and socio economic factors driving the epidemic. Ackermann and de Klerk (2002) found poverty as a threat to the wellbeing of young people and women as it encourages behaviour that increases the risk of HIV infection. In line with that, Jackson (2002) regards poverty as the major cause of HIV infection. Similarly, Msiska (2003) also pointed out that external environmental factors such as poverty and inequality are two significant factors in enhancing vulnerability to HIV infection. In their studies Van Niekerk and Kopelman (2005) found that poverty and income inequality have accompanying side-effects that are major contributing factors to the current spread of HIV to the extent of some poor families in Namibia selling young females for survival.

MacLean (2006) seconded the notion stating that women and young people often do not have their own resources and being dependents, they lack economic empowerment thus increasing their vulnerability to HIV infection. In agreement, Campbell, Foulis, Maimane, and Sibiya (2005) stated that women are therefore forced to use various economic coping mechanisms which most of the time involve the option for economic dependency on older men to support them. In addition, the desire for cash, cars, cell phones and clothes is a major contributing factor to the spread of HIV that motivates risky sexual practices. Besides that females opt for multiple partners to ensure economic stability considering that many women are at the lower end of the socio-economic spectrum, and more women are living in poverty than men.

Fox (2010) added that economic inequality is significantly positively correlated with a number of adverse health outcomes and health-related behaviours, including HIV in the developed world context. He argues that it is not poverty driving the epidemic, instead, income inequality since within Sub Saharan Africa (SSA) at national level, the countries that have been most adversely affected by HIV/AIDS are not necessarily the poorest countries. In fact, countries such as South Africa and Botswana with some of the highest HIV prevalence rates in the world are considered to be middle-income countries by global standards and are the richest countries in Africa. Furthermore, evidence has shown that HIV tends to be concentrated in richer regions within countries and in urban areas, which tend to be richer than rural areas.

As a structural determinant of health status, the MoHSS find the policies in place playing a role on health outcomes (NDHS, 2006/7). The ministry argues that young people have limited capacity to influence policies and resource priorities. As such, it impairs their capacity to develop a feeling of ownership of HIV programs to enhance the sustainability of these programs. In support to that, Henwood (2005) indicated that the key to achieving efficient HIV prevention is to improve on the involvement of youth in policy design and formulation.

According to Graham (2004), social determinants of health has acquired a dual meaning, referring both to the social factors promoting and undermining the health of individuals and populations and to the social processes underlying the unequal distribution of these factors between groups occupying unequal positions in society. These include women's status, community effects, local prevalence of HIV, distribution of services and opportunities (health/education, access to HIV prevention and treatment services), education and poverty. Ackermann and de Klerk (2002) found that a change in social environment may result in a sense of anonymity, which may lead to risky behaviour. They cited urbanization and modernization to have changed the organization of sexual partnerships, and what has emerged is a sexual structure allowing men and mistresses to have love affairs. This configuration of the relationships has led to the rampant spread of HIV.

A study by Iipinge et al. (2004), points to issues such as lack of respect and low status of women as preventing women from negotiating safer sexual practices. Mba (2003) stated that there are cases were HIV infected men bribe young girls for sex or rape them and in many cases young women are not in position to negotiate sex or to ask their partners to use condoms. In addition, Otaala (2000) pointed out that the majority of Namibian young girls have sex only to get accepted, a tendency which puts them at risk of getting sexually transmitted infections including HIV. According to the NDHS of 2006/7, education attainment and school enrolment status may serve as proxies for socio-economic status. It states that educational background increases knowledge on HIV and AIDS and promotes more access to HIV and AIDS information through the internet, pamphlets, journals, books, newspapers and the general media. This was supported by Anderson and Beutel (2007) who stated that people who have completed more grades in school may have received more information about HIV and AIDS and that people who are in school may have more current exposure to HIV education and prevention methods than those who are not.

On the other hand, some studies have indicated that school environments are not conducive for female students, because they contribute to the increasing susceptibility of women to HIV and AIDS (Shapumba, Apollus, Wilkinson, & Shifiona, 2004 and Sabone et al. 2007). A Study by Iipinge et al. (2004) has shown that several African university situations make students vulnerable to HIV due to the presence of sugar daddies at campus, sexual experimentation, and prostitution on campuses, unprotected casual sex, gender violence and many more high risk activities. In agreement, Fox (2010) has shown that a positive gradient in HIV infection holds even more strongly for education, with adults with six years of schooling being as much as three percentage points more likely to be infected with HIV than adults with no schooling.

The World Health Organisation in 2007 identified personal behavioural and sexual networking factors as differences in lifestyle that could partially explain social inequalities in health. These include alcohol consumption, and lack of physical exercise, multiple and concurrent partnerships, condom use, gender and many others which again can be either health protecting or enhancing or health damaging. A study on the behavioural and contextual factors driving the epidemic in Namibia conducted by MoHSS in 2008 shows that Namibia has a high level of concurrent relationships and a rapid turnover of partners and this is documented as a significant contributor of the spread of HIV.

The NDHS (2006/7) documented that 16 percent of sexually active men and 3 percent of sexually active women reported having more than one partner in the previous 12 months. This was found to be even worse among young adults (15-29 years) with 20 percent of men and 4 percent of women reporting multiple partnerships in the previous 12 months. The report on the behavioural and contextual factors driving the epidemic of 2008 also reported that the prevalence of HIV generally rise with age due to increased exposure to different partners. Specifically, in Namibia prevalence is highest in the age range 30 to 44 years. Under such circumstances having sex with an older partner rather than a peer poses increased risk of infection for younger women.

In support of that, Weissman, Cocker, Sherburne, Powers, Lovich, and Mukaka (2006) stated that cross-generational relationships increase the spread of HIV and due to limited condom use; people get exposed to HIV through such relationships. Van Niekerk and Kopelman (2005) indicated that there is a rapid increase in ‘sugar daddy’ relationships in which older men/women seek out younger sexual partners because of their perception that young people might not be infected with HIV. As a result older partners tend to place young patners at greater risk of HIV infection.

A study by Varga (2000) pointed to the failure to use condoms as one of the drivers of the epidemic indicating that the use of condoms is complex. As such, even if an individual decides to use a condom as a protective measure, a number of barriers may stand in the way. Young people have been identified as having superficial knowledge on condom related issues which impairs their ability to consistently use condoms. Furthermore, the decision to use condoms is also determined by the individual's past experience, risk perception and type of partner as well as personal concerns and motivation (Brown, Franklin, Macnell, and Mills, 2001).

There are also barriers on skills to condom use such as education, training and religious prohibitions. Other barriers like gender roles, social pressure, norms and level of education are also connected to partner willingness to use condoms (Brown et al. 2001). Furthermore, condom use consistency remains low especially among regular steady relationships (Pettifor et al. 2005). In support of the forth going discussion, Visser (2005) concluded that HIV and AIDS awareness programs that focus on condom use and behavioural change towards safer sexual practices are priorities and remain the only means of primary prevention.

A study conducted by Simbayi et al. (2004) and Talavera (2002) indicated that the spread of HIV is also aggravated by wrong beliefs among men who believe that HIV can be cured by having sexual intercourse with a virgin. These beliefs make young people vulnerable and create a barrier to behavioural change among young people despite effective training and interventions for youth.

According to Salazar et al. (2005), there is evidence which suggests that forced sex, including rape, is a common occurrence for women. In line with that, WHO (2005) stated that women can be infected with the HIV virus through forced sex stating that the chances of a woman contracting HIV via a forced sexual encounter are probably increased since forced sex often involves trauma and tissue tearing which can provide an open door to the virus. Following that, Iipinge et al. (2004) indicated that violence affects all aspects of a woman's life: health, productivity and ability for selfcare adding that it undermines women's sense of self-worth, their sense of autonomy and ability to feel and act responsibly and it increases their risk to sexually transmitted infections including HIV.

A postal survey conducted on students in North East England and a quota survey of university students by McEwan, McCallum, Bhopal, and Madhok (1992) indicated that drinking was associated with failure to use contraceptives, having sex with a person who would not usually be chosen, and contact with more than one sexual partners. Overall, it was concluded that alcohol and other drugs may be associated with risky sex. In addition, it was stated that "from the beginning of civilisation there has been a connection between drinking and involvement with sex. Wine drinking by women was punishable by death in early Rome because it was linked directly to adultery" (Mbamalu, 2004). According to Leigh (1993), alcohol may be a symbolic instrument of courtship or an agent of physical incapacitation that enables men to take sexual advantage of women. The government of Namibia and the United Nations International Children's Emergency Fund [UNICEF] (2004) also noted that alcohol increases risk and makes people not to control their risky behaviour.

It was added that the influence of alcohol impairs the ability to remember that condoms can save lives arguing that excessive use of alcohol suppresses the function of the superego which is responsible for conscience. A study conducted by Parker and Connolly (2008) in Namibia showed an association between alcohol use and multiple or concurrent partnerships. Furthermore, Talavera (2002) stated that drunken men act irresponsibly and may force young girls to have sex with them. Chwee, Eke-Huber, Eaddy, and Collins (2005), also found that alcohol and drug use increases unsafe sexual behaviours and potential HIV risk among youth. In agreement to that Huba et al. (2003), indicated that high alcohol consumption and frequent use of drug substances impedes women’s ability to make correct decisions and enforce condom use with their partners.

Voluntary counselling and testing has been adopted in Namibia as an important prevention and control strategy. Unfortunately, access to such services remains limited due to various barriers. The barrier to access and take up voluntary counselling and testing services include negative attitude of health providers toward youth, lack of affordability of services and equity as well as stigma among others. According to MoHSS (2006), knowing one’s HIV status empowers individuals to make informed decisions about sexual lifestyles that would otherwise predispose them to HIV infection.

Biological factors driving the epidemic include genetic factors such as age, sex distribution, screening of STI and male circumcision, (WHO, 2007). According to Iipinge et al. (2004) and Oguntibeju et al. (2003), women are biologically more vulnerable to HIV infection. Physiologically, women appear to be at great risk of contracting HIV than men. It was added that women are more susceptible to most sexually transmitted infections' including HIV infection because of the greater mucoscal surface exposed to pathogens during sexual intercourse. Furthermore, young girls whose genital tracts are not fully mature are in particular more prone to contracting HIV. MacPhail, Williams and Campbell (2002) added that men pass on HIV more efficiently than women making a woman twice as likely to be infected by an HIV positive man as a man is to be infected by an HIV positive woman.

Epidemiologic data from randomized controlled trials (Auvert et al. 2005, Gray et al. 2007 and Bailey et al. 2007) conducted in South Africa, Kenya and Uganda has shown that male circumcision is a major protective factor against male heterosexual HIV transmission. This is a plausible explanation of the significant geographic differences in the prevalence of HIV observed within sub-Saharan Africa. These studies documented that men who had been circumcised by trained medical professionals and with appropriate surgical follow-up had 60 percent reduced risk of acquiring HIV.

In addition, an analysis of several HIV transmission studies by Mackesy-Amiti, McKirnan, and Ouellet (2010) found that the risk of contracting HIV through unprotected anal intercourse is eighteen times greater than for penile-vaginal intercourse. On the other hand, the Centre for Disease Control (CDC) (2013) indicated that oral sex like all sexual activity carries some risk of HIV transmission when one partner is known to be infected with HIV, when either partner's HIV status is not known, and/or when one partner is not monogamous or injects drugs. Even though the risk of transmitting HIV through oral sex is much lower than that of anal or vaginal sex, it was demonstrated that oral sex can result in the transmission of HIV and other sexually transmitted diseases (STDs). The presence of sexually transmitted infections and chronic sexually transmitted diseases complicated with genital ulcers increase the likelihood to HIV infection (Simbayi et al. 2005). In agreement, Wasserheit (1992) stated that ulcerative genital lesions might be thought to be particularly potent facilitators of HIV transmission expediting direct access to the mucosal tissues, lymphatic drainage and systemic leukocytes.

2.2 Theoretical Review

2.2.1 Risk

Risk can be defined as the probability of an event (such as the occurrence of a disease) occurring (Gordis, 2009). In studies of causation, the principal aim is to determine whether there is an association between exposure to a factor and development of a disease. If such an association exist, the next question will be how strong.

a) Risk Factor

Jeckel, Elmore and Katz (1996) defines a risk factor as a characteristic which, if present and active, clearly increases the probability of a particular disease in a population which is exposed to a factor compared to an otherwise similar population without it.

b) Absolute and relative risk

In order to ascertain if there is an association between exposure to a factor and development of a disease, we have to determine using data whether there is excess risk of the disease in population which has been exposed. Such an excess risk is calculated in two ways; either in relative terms (Relative Risk) or in absolute terms (Risk difference). Absolute risk is defined as the incidence of a disease in a population (Gordis, 2009). It indicates the magnitude of risk in a population with a certain exposure. On the other hand relative risk is the probability of an event (developing a disease) occurring in an exposed population compared to the probability in the nonexposed population or as the ratio of the two probabilities. Relative risk is calculated as follows: relative risk, $RR = \frac{I_e}{I_o}$, where I_e is the incidence in exposed population and I_o is the incidence in non exposed population. If the relative risk is equal to 1, it is an indication that there is no significant difference in disease risk between the two populations. If it is more than 1 or less than 1, then there is a significant difference in disease risk between the two populations.

On the other hand, risk difference (RD) = $I_e - I_o$. When the level of risk in the exposed group is the same as the level of risk in the unexposed group, the risk difference is 0. If the exposure is harmful, the risk difference is expected to be greater than 0. If an exposure is protective, the risk difference will be less than 0

c) Attributable risk measures

There are three commonly computed and used measures of excess risk namely attributable risk, attributable risk percent and population attributable risk percent and these are described below.

(i) Attributable Risk

If the association between exposure and disease is known or suspected to be a causal one, then the term attributable risk can be used to describe the difference in risk. It shows the added risk of the disease due to the exposure (Koepsell and Weiss, 2003).

(ii) Attributable Risk Percent (AR%)

After identifying the significant risk determinants and measuring the strength of the association between a risk factor and the presence of the virus, it is essential to ascertain how much of the infection that occurs can be attributed to the exposure.

According to Koepsell and Weiss (2003), if the results suggest a causal relationship, the percentage of exposed persons with the disease who developed it because of the exposure can be calculated. This measure, attributable risk percent (AR%) is defined as follows:

$$AR\% = \frac{I_e - I_o}{I_e} x100\% \qquad \textbf{(2.1)}$$

Rearranging equation **2.1** leads to the following:

$$\frac{I_e - I_o}{I_e} = \frac{I_e}{I_e} - \frac{I_o}{I_e}$$

$$= 1 - \frac{1}{RR}$$

$$= \frac{RR}{RR} - \frac{1}{RR}$$

$$= \frac{RR - 1}{RR} x100\% \qquad \textbf{(2.2)}$$

Using the odds ratio as estimate of the relative risk (RR), estimates of the AR% can be obtained using equation **2.2**. According to Collet (1994), odds ratios can be used to approximate the relative risk if the disease prevalence is low.

(iii) Population Attributable Risk Percent (PAR%)

In order to estimate the percentage of the disease's occurrence in the population studied (exposed and non-exposed), another measure of risk called population attributable risk percent (PAR%) is used, and is calculated as follows:

$$PAR\%) = AR\%(p_c)$$

$$= \frac{RR-1}{RR} \times p_c \times 100\% . \qquad \textbf{(2.3)}$$

Where p_c is the proportion of cases in the population exposed to the risk factor and RR is the relative risk. As shown in equation 2.3, this measure is obtained by multiplying the AR% by the proportion of cases in that population who were exposed. The PAR% quantifies the contribution of the risk factor to the outcome (HIV infection) and can thus help direct interventions. The higher the PAR%, the greater the proportion of the outcome that is attributable to the risk factor.

However, to use this measure, the following assumptions need to be met.

1. A causal relationship between risk factors and disease
2. The immediate attainment, among those formerly exposed of the unexposed disease risk following elimination of the exposures, and
3. Independence of the risk factors from other factors that influence disease risk.

Rockhill, Newman and Weiberg (1998) stressed that the PAR% is a useful tool in program planning which can be used to predict the impact of public health interventions on adverse outcomes, since it considers both the excess risk associated with the exposure and the proportion of the population that is exposed. However, it is underutilised. A risk factor with a large excess risk and widespread exposure poses the most severe public health risk. One with a relatively small excess risk and relatively rare exposure poses the lowest public health risk. Factors with small excess risk and wide exposure, or large excess risk and relatively rare exposure form an intermediate group of public health risks. A comparison of the values of population attributable risk percent for selected risk factors is usually done to identify risk factors that are most important for planning interventions.

2.2.2 Logistic Regression

Logistic regression is used to model the relationship between a categorical response variable and one or more explanatory variables that may be continuous or categorical. It is useful for situations where one wants to predict the presence (Y =1) or absence (Y= 0) of a characteristic or outcome based on values of a set of predictor variables. This situation differs from normal regression in that the response variable is not continuous, instead, it is dichotomous and therefore taking values 0 and 1, thus violating the normality assumption needed in the standard linear regression model.

Secondly, if the standard linear regression model $Y = \beta_0 + \beta_1 x$ is fitted with a dichotomous outcome, taking the mean of Y produces a model of the probability of a success outcome; $p = \beta_0 + \beta_1 x$, which is a linear probability model. In the equation, p is the probability that a success outcome will occur in the population. Applying the ordinary least squares on this model becomes problematic in that the predicted values of p may be outside the range [0,1] which does not make sense. To overcome this problem, the transformation of p is used instead of fitting the model for p. The commonly used transformation is the logistic transformation.

The logistic transformation of a success probability p is $log\ \frac{p}{1-p}$, written *as* *logit(p)*.The quantity $\frac{p}{1-p}$ is the odds of success and so the logistic transformation of p is the log-odds of a success, with this transformation any value of p in the range (0, 1) corresponds to a value of logit(p) in $(-\infty,\infty)$. As $p \to 0$, logit(p) $\to -\infty$, $p \to 1$, logit(p) $\to \infty$ and for p = 0.5, logit(p) = 0. Logit(p) = $log\ \frac{p}{1-p}$, is the link function that relates p to the linear component of the logistic model. It is the canonical link for binary data and therefore sufficient statistics can be found and conditional likelihoods constructed to analyze the data.

Now suppose that we have *m* binomial or binary (i.e in the outcome there are two possibilities), observations of form $\frac{y_i}{n_i}$ i = 1, 2, ..., n where $E(y_i) = n_i\, p_i$ and p_i is the success probability corresponding to the i^{th} observation. The linear logistic model for the dependence of p_i on the values of the *k* regressor variables $x_{1i}, x_{2i}, \ldots, x_{ki}$ associated with that observation, is

$$\log it(p_i) = log\ \frac{p_i}{1-p_i} = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki}$$

On re-arrangement ,

$$p_i = \frac{\exp(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki})}{1 + \exp(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki})} \qquad \textbf{(2.4)}$$

$$= \frac{e^{\eta_i}}{1+e^{\eta_i}} \quad \text{, where } \eta_i = \sum_j \beta_j X_{ji}$$

(i) Fitting the model

Suppose that binomial data of the form y_i successes out of n_i trials, i = 1, 2, ... n are available, where the logistic transform of the corresponding success probability, p_i is to be modelled as a linear combination of k explanatory variables, $x_{1i}, x_{21},..., x_{ki}$ as equation **2.4.** To be able to fit a linear logistic model, the k + 1 unknown parameter, $\beta_0, \beta_1, ..., \beta_k$ have to be estimated first. These are estimated using the method of maximum likelihood, where the likelihood function is given by;

$$L(\beta) = \prod_{i=1}^{n} \binom{n_i}{y_i} p_i^{y_i} (1-p)^{n_i - y_i}$$

This likehood depends on the unknown success probabilities p_i which in turn depends on the βs , thus the likelihood function can be regarded as a function of β. What is required now is to obtain the unkown values of $\beta_0, \beta_1, ..., \beta_k$ which maximises $L(\beta)$ by taking the log of $L(\beta)$ as follows;

$$\log L(\beta) = \sum_i \left\{ \log\binom{n_i}{y_i} + y_i \log p_i + (n_i - y_i)\log(1-p_i) \right\}$$

$$= \sum_i \left\{ \log\binom{n_i}{y_i} + y_i \log\left(\frac{p_i}{1-p_i}\right) + n_i \log(1-p_i) \right\}$$

$$= \sum_i \left\{ \log\binom{n_i}{y_i} + y_i \eta_i - n_i \log(1+e^{\eta_i}) \right\} \qquad \textbf{(2.5)}$$

where $\eta_i = \sum_{j=0}^{k} \beta_j x_{ji}$ and $x_{0i} = 1 \forall i$.

The derivatives of this log-likelihood function with respect to k+1 unknown parameters are :

$$\frac{\partial \log L(\beta)}{\partial \beta_j} = \sum y_i x_{ji} - \sum n_i x_{ji} e^{\eta_i} (1 + e\mu^{\eta_i})^{-1}, \, j = 0,1,\ldots,k$$

Evaluating these derivatives at $\hat{\beta}$ and equating them to zero gives a set of k + 1 non-linear equations in the unknown parameters $\hat{\beta} j$ that can only be solved numerically. To obtain the maximum likelihoods estimates of $\hat{\beta}$, the Fisher's method of scoring can then be used. Unlike in linear regression where we use the least squares techniques to estimate the regression coefficients, in logistic regression, the widely used general method of estimation is the method of maximum likelihood. The key feature of maximum likelihood estimation is that it estimates values for parameters which are most likely to have produced the data that have been observed. Rather than starting with the observed data and computing parameter estimates (as is done with least squares estimates) we determine the likelihood (probability) of the observed data for various combinations of parameter values. The set of parameter values that was most likely to have produced the observed data are called the Maximum Likelihood (ML) estimates.

(ii) Assessing model fit

After fitting the logistic model, the extent to which the fitted values of the response variable compare with the observed values has to be examined. If the agreement between the the observations and the corresponding fitted values is good, the model may be acceptable. If not, then the model will need to be revised and this aspect of model adequecy is known as goodness of fit. There are a number of summary statistics that measure the discrepancy between observed binomial proportions, $\frac{y_i}{n_i}$, and fitted proportions $\hat{p}_i$ under a model for the true success probability p_i.

Among them, the commonly used is the deviance statistic (D) which is based on the likelihood function for the model (equation 2.5). The value of the likelihood, when the unknown parameters are set equal to their maximum likelihood estimates, can therefore be used to summarise the extent to which the sample data are fitted by the current model. This is the maximum likelihood under the current model denoted by $\hat{L}_c$.

This statistic is not useful on its own. It is therefore necessary to compare this current model with the alternative baseline model for the same data. This latter model is taken to be the model for which the fitted values coincide with the actual observations, ie fitting the data perfectly. This model is also called the full or saturated model and the maximised likelihood under it is denoted by $\hat{L}_f$. As well, this full model is not useful on its own, however, by comparing the $\hat{L}_c$ with $\hat{L}_f$, the extent to which the current model adequately represents the data can be judged.

This comparison can be conveniently be done using the deviance statistic which is of the form :

$$D = -2\log(\hat{L}_c / \hat{L}_f) = -2[\log \hat{L}_c - \log \hat{L}_f]$$

When $\hat{L}_c$ is small relative to $\hat{L}_f$, large value of D are encountered, and this shows that the current model is a poor fit. On the other hand, small values of D are encountered if the $\hat{L}_c$ is similar to $\hat{L}_f$ showing that the current model is a good fit. Therefore, the statistic D measure the extent to which the current model deviates from the full model.

(iii) Odds and Odds Ratio (OR)

Odds represent the relative frequency with which different outcomes occur. Odds are sometimes expressed as a ratio of the form a:b. For example, odds of 4:1 in favour of the first outcome means that the first outcome occurs 4 times for each single occurrence of the second outcome. Similarly, odds of 7:2 means that the first outcome occurs 7 times for each 2 occurrences of the second outcome. Odds are directly related to probabilities and can be translated back and forth using these relations:

Probability = $\dfrac{odds}{1+odds}$ **Odds** = $\dfrac{\Pr obability}{1-\Pr obability}$

The concept of the odds is extended to odds ratios. This describes the odds of success (developing a disease) associated with an exposure as opposed to not. When the odds of success in each set of binary data are identical, OR is equal to one. This happens when the two probabilities are equal. As shown in table 2.2, it means the particular exposure is not a risk factor. Values of OR less than one suggets that the exposure reduces the disease risk or has a protective effect. However, if this value is more than one, the exposure increases the disease risk (is a risk factor). The confidence intervals for the odds ratios can be used to assess the significance of the parameters of interest whereby if the confidence intervals contain one (the null value in hypothesis testing), its an indication that there is no significant association between disease and and the explanatory variable (factor)

Table 2.2: Interpretation of odds ratios

Odds (OR)	**OR<1**	**OR =1**	**OR>1**
Exposure as a risk factor	Exposure reduces disease risk (protective effect)	Particular exposure in not a risk factor	Exposure increases disease risk (risk factor)

2. 2.3   Confounding and interaction

Kleinbaum (1998) stated that confounding exists if meaningful different interpretations of the relationship of interest result when an extraneous variable is ignored or included in the data analysis. Its assessment requires a comparison between a crude estimate of an association (which ignores extraneous variables) and an adjusted estimate of the association (which accounts in some way for the extraneous variable). If the crude and adjusted estimates are meaningfully different, confounding is present and one or more extraneous variables must be included in the data analysis.

Koepsell and Weiss (2003) stressed that confounding occurs in epidemiologic research when the measured association between exposure and disease occurrence is distorted by an imbalance between exposed and non exposed persons with regard to one or more other risk factors for the disease. No matter how strongly a variable is related to exposure status, if it is not also related to the occurrence of the disease in question, it cannot be a confounder, (Koepsell and Weiss: 2003).

The nature of that relationship can take several forms:

- The potential confounding variable can be an actual cause of the disease.
- The potential confounder can be associated with a cause of the disease that, in context of the study cannot be measured.
- A variable can be a confounder if it is related to the recognition of the outcome in question, even if it has no relationship to the actual occurrence to that outcome.

Confounding can be controlled at the study design phase of a study and/or at the analysis stage. At the design stage, techniques such as matching, restriction (exclusion) and randomisation can be used. At an analysis stage, techniques such as stratification and multivariable analysis can be employed.

On the other hand, Kleinbaum (1998) defined interaction as a condition where the relationship of interest is different at different levels of the extraneous variable(s). In contrast to confounding, the assessment of interaction does not consider either a crude estimate or an (overall) adjusted estimate; instead, it focuses on describing the relationship of interest at different values of the extraneous variables. Similary, Hosmer and Lemeshow (2000) stated that if the association between the covariate (ie. gender) and the outcome variable is the same within each level of the risk factor (ie, group), then there is no interaction between the covariate and the risk factor.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Design

A cross sectional research design was used for the purpose of this study. This design was chosen since it allowed the researcher to estimate both the prevalence of the disease and the exposure of the VCT clients to various risk factors. Furthermore, it allowed the investigation of possible associations between risk factors (exposures) and disease (outcome). The study was both descriptive and analytic in the sense that it permitted the description of the prevalence of the disease in the population under study and the prevalence of the exposure/risk factors as well as analysing associations between risk factors and the disease and estimating excess risk.

Rothman and Greenland (1998) have named such a study as a prevalence study since they recommend limiting it to the study of exposure and disease outcome simultaneously. However, other authors such as Gordis (2009) as well as Koepsell and Weiss (2003), with caution, have extended such study designs to investigate possible causal relationships between disease and exposure to various factors, thus arriving to etiological conclusions provided it is clear that exposure precedes disease in time. As such, this study used this design to study both the prevalence of exposure and disease outcome and to ascertain the level of association between exposure and disease occurrence and assuming a temporal sequence of events, to draw causal relationships where a strong association existed.

3.2 Population

The population studied is comprised of all the people who got tested at the VCT centres in Namibia from the year 2009 to 2012. These include both male and female adults more than 15 years old.

3.3 The Data

The data analysed in this study was obtained from IntraHealth International, an International Non-Governmental Organisation (NGO) funded by the United States Agency for International Development (USAID). IntraHelath International collected the data from VCT clients who at their own will decided to get tested at the socially marketed VCT centres around the country. It was earmarked that data would come from all the 13 regions of Namibia. However, only five regions out of the 13 have VCT centres that are still functional and have data available and these are Khomas, Oshana, Kavango, Ohangwena and Hardap. Consequently, data was collected from active VCT centres in these regions.

To collect the data at the VCTs, individuals were, after testing requested to answer a set of questions which produced this data set. The data collection tool administered at these centres included variables such as: sex, age, region, language spoken, HIV status, marital status, level of education, condom use the last time had sex, male circumcision, age at male circumcision, alcohol use, amount of alcohol consumed, sexual preference, and number of sexual partners. Data were captured and stored in a file maker database administered by Intra-Health International.

The data set consisted of a total of 84 938 VCT clients who were tested for HIV between 2009 and 2012 in the 5 regions. The data set was checked for completeness and it was found that most of the variables had incomplete data. After cleaning the data, it was found that the following categorical variables had a reasonable amount of data for analysis: HIV status, region, sex, age, marital status, level of education, condom use the last time had sex, male circumcision, and alcohol use. To avoid analysing a data set with missing data, the researcher assumed missing at random and hence deleted all cases with incomplete data to produce the final data set for analysis. Using the unique identification codes of the clients, the researcher also ensured that no duplicate cases of the same client were included in the data set (repeat testers). After the data cleaning process, 14 296 cases remained in the dataset and these were from Oshana (1 114), Kavango (10 478) and Khomas (2 704) regions.

3.4 Sample

Since data used in this study was secondary data, which was easily available, it was not necessary to draw a subset (sample) of this population for analysis, instead, the entire data set (after cleaning) was analysed to enhance the generalizability of the findings to the studied population.

3.5 Data Collection Procedure and Ethical Considerations

The study analysed data of human subjects. As such, permission was sought to conduct the study and to use the VCT data from the ministry of health and social services research and ethical committee via the permanent secretary in order to comply with ethical considerations for studies involving human subjects. At the same time, the researcher also sought permission to analyse the data from USAID Namibia which funds the VCTs responsible for conducting the HIV tests and the collection of the data. After being authorised to carry out this study, the researcher obtained the data from Intra-Health International; the organisation responsible for the VCT centres conducting the tests and collecting the data. The data was stored electronically under a password and was not used of any other purposes except for the academic study.

3.6 Data Analysis

Variables analysed in this study include HIV sero-status, sex, age, level of education, region or residence, condom use the last time had sex, alcohol use, and male circumcision. The study employed descriptive analyses techniques, specifically the frequency procedure to show the prevalence of exposure (to risk factors) as well as the prevalence of the diseases among the VCT clients. Chi-Square tests for association were used to ascertain if associations existed between individual covariates (risk factors) and HIV sero-status. The univariate and multivariate logistic regression technique were then used to model the relationship between HIV sero-status and the various factors (covariates) in an effort to identify significant risk factors of HIV infection in Namibia. Lastly, attributable risk fractions were used to quantify excess risk attributable to risk factors which are known to be amenable to interventions.

3.6.1 Descriptive Analysis

The frequency procedure was used to show the number and proportion of the VCT clients disaggregated by HIV test result, sex, condom use the last time had sex, male circumcision, age, and marital status, region of residence, alcohol use and level of education. This analysis categorised these variables into socio-economic, biological, structural, as well as sexual and behavioural factors which are later in the analysis tested for their significance in predicting one's chances of contracting HIV in Namibia.

3.6.2 Bivariate Analysis

To ascertain if there existed an association between HIV status and exposure to various factors or belonging to a particular group, the study considered using two tests namely: the Fischer's Exact test and the Pearson's Chi- Square (X^2) test for independence. These tests were considered since they are used to test for independence between categorical (nominal or ordinal) variables, (Berenson, Levine & Krehbiel, 2006). The only difference in the application of these tests is that the Fischer's Exact test is used when the expected values for the 2x2 tables are less than 5, a situation which normally occurs when the sample size is small. These tests were performed at the traditional 0.05 level of significance.

The value of the test-statistic $X^2 = \sum_{all-cells} \frac{(f_o - f_e)^2}{f_e} \sim X,^2$ where in the equation f_o is the an observed frequency, and f_e is an expected frequency asserted by the null hypothesis.

These tests were also performed to select variables for univariate and multivariate logistic regression analyses. All variables which were significant at the 0.25 significance level were candidates for these analyses. The value of 0.25 was used based on the recommendation by Bendel and Afifi (1997) as well as Mickey and Greenland (1989) who stated that the use of the traditional level such as 0.05 often fails to identify variables known to be biologically or clinically important. Thus, the study used this approach to allow into the model variables that, by themselves, were not significantly related to the outcome but would make an important contribution in the presence of other variables.

3.6.3 Logistic Regression Analysis

The response variable (y_i), where i = 1…n, used in this study was HIV status whilst sex, age, level of education, region of residence, male circumcision status, condom use last time one had sex, alcohol use and marital status were the explanatory variables (x_i). For analysis reasons, the variable HIV sero-status was recorded into 1 and 0 as follow;

$$y_i = \begin{cases} 1 & \text{if i-th individual is HIV positive} \\ 0 & \text{otherwise} \end{cases}$$

For the explanatory variables; the level of the factor which, based on literature was known to have lowest risk was treated as the reference category. Since some of the explanatory variables in this study had a multiple of levels (categories), index variables were created for each explanatory variable. Numbers were used as identifiers of the levels of the nominal and ordinal scale variables. In general, if the variable had k possible values, then k-1 index variables (I_i) were needed. For instance, for the independent variable marital status which has five categories (married, never married, widowed, cohabiting and divorced), four index variables were created as illustrated in Table 3.1

Table 3.1: Coding of the Index variables for marital status

Factor	**level(category)**	**Index Variable**			
		I_1	I_2	I_3	I_4
Marital Status	Married	0	0	0	0
	Never married	1	0	0	0
	Windowed	0	1	0	0
	Cohabiting	0	0	1	0
	Divorced	0	0	0	1

Two types of logistic regression were performed and these were univariate and multivariate logistic regression as explained in the next section.

(i) Univariate Logistic Regression Analysis

The univariate logistic regression analysis was performed to quantify disease risk associated with each risk factor without controlling for other explanatory variables. In other words, to quantify the relationship between the probability of a 'success' outcome, p, and the explanatory variable, X which were significant at 0.25 level in the Chi-Square tests for association. The result of this analysis was the unadjusted odds ratios.

(ii) Multivariate Logistic Regression Analysis

In an effort to quantify the amount of disease risk associated with each explanatory variable after controlling for other covariates and confounders, the multivaraiate logistic regression analysis was performed. This procedure considered a collection of all the explanatory variables (Xi) significant at 0.25 level in the Chi-Square tests for association.

The study also considered investigating possible combined effects or synergy of risk factors. This was accomplished by including interaction terms in the statistical model only for the main effects. The interaction terms represented the excess risk due to interaction of the exposures. The presence of combined effect was tested by assessing whether the regression coefficients of the product (interaction) terms were statistically significant. It was carefully considered not to assess for interaction in an exploratory manner, instead this process was guided by literature and only did so were literature suspect effect modification.

In an effort to build the multivariate logistic model, the backward stepwise regression method was used. This process involved adding all variables into the model, followed by removing one variable at a time to assess the improvement in fit due to removal of that variable. In order to select the best model, deviances from competing nested models were compared to assess the improvement in fit due to removal of each model term. To achieve this, the likelihood ratio statistic (deviance) was used to compare the larger (L) model with k parameters with the smaller (S) model with k-1 parameters. The difference in deviance between two models reflects the effect of removing a term from the model. This difference follows a Chi-Square distribution with degrees of freedom (df) equal to the difference in the number of parameters in the competing model. If the difference in deviance between the competing models is greater than the Chi-Square critical value at the 0.05 significance level with 1 df, then having that term in the model significantly improves it. In other words, that model fit the data better than the previous one. Terms that did contribute to the model based on the deviance statistic criteria were eliminated from the model and a new model would be fitted. This process was repeated until the model that fit the data best was selected.

Similar to the univariate analysis, the coeficients $\beta_0,...,\beta_k$ were estimated using the Newtom Raphson iteration method. As in most epidemiological studies, the aim of fitting the multivariate logistic regression equation is to find the magnitude of the estimated adjusted odds ratios which are normally used to ascertain whether a disease or condition is associated with exposure factors. The odds ratios were computed. Since parameter estimates are accompanied by standard errors, confidence intervals for the odds ratios were obtained using $\exp(\beta i \pm Z_{1-\alpha/2} S_{\hat{\beta} i})$, where $S_{\hat{\beta}_i}$ are the standard error estimates for the corresponding β_i s.

3.6.4 Attributable Risk Measures

At this stage of the understanding of HIV occurrence, the estimates of attributable risk were considered to be particularly important as they estimate the reduction in disease that could result in the exposed individuals and in the population (exposed and non-exposed) if exposure to the disease is eliminated (Cole and MacMahon 1971). This dictates that attributable risk measures are meaningful only when the association between disease and exposure is believed to be causal. For this reason, these measures were only computed for modifiable risk factors associated with HIV infection and only if they are changeable through interventions.

Furthermore, these measures were computed when the relative risk was more than 1 and were interpreted for the period 2009 to 2012. Attributable risk measures were computed aiming to arrive to conclusions and recommendations that reduce the modifiable risks through behavioral changes and other personality transformations. For risk factors that are surrogates for more proximate exposures such as education attained, marital status, age, region and sex, these measures were not computed. Obviously, it is useless from a public health perspective to estimate such measures when the risk factor is known not to be amenable to intervention (Rockhill et al. 1998). For example, we cannot advice people to leave Kavango region in-order to reduce the risk of HIV infection.

The commonly computed and used measures are Attributable Risk (*AR*), Attributable Rick percent (*AR*%) and Population Attributable Rick percent (*PAR*%). Since this study used existing data collected in a cross sectional manner, there is no way of calculating the disease incidence both in the exposed and unexposed populations. As such, the study does not compute *AR*.

In the computation of the attributable risk measures, the relative risk *(RR)* was approximated by odds ratio (*OR*) from the multivariate logistic regression. This approximation was used based on the recommendation by Viera (2008) which states that if the rare disease assumption holds, the odds ratio is a good approximation to the relative risk. Under the "rare disease assumption," when the probability of an outcome is less than 0.10 or 0.20, the odds ratio and relative risk can be used interchangeably (Grimes and Schulz, 2008).The rare disease assumption was first introduced by Cornfields (1951) asserting that for the odds, which is $\frac{p}{1-p}$, when p moves towards zero, 1 − p moves towards 1, meaning that the odds approaches the risk, and the odds ratio approaches the relative risk as illustrated below.

As in Table 3.2, in a cohort study, we consider,

Table 3.2: Disease and exposure 2X2 table for cohort studies.

	Exposure	
Disease	Exposed	Unexposed
Cases	a	b
Non-cases	c	d
Totals	a+c	b+d

$$RR = \frac{\frac{a}{a+c}}{\frac{b}{b+d}}$$

If the disease prevalence is low, there will be few disease cases, so a $\approx$ 0 and b $\approx$ 0, making c nearly equal to a+c and d nearly equal to b+d. That is,

$$c \approx a + c \text{ and } d \approx b + d$$

Substituting, $RR = \dfrac{\dfrac{a}{a+c}}{\dfrac{b}{b+d}} = \dfrac{\dfrac{a}{c}}{\dfrac{b}{d}} = \dfrac{ad}{bc} = OR$

Thus, the *OR* from the cross-sectional study approximates the *RR* from the cohort study when the disease prevalence is low. Since there is no single widely accepted cut off point of low prevalence, the prevalence of HIV among VCT clients in Namibia was considered as low and thus allowing the approximation of *RR* by *OR*.

Similarly, the percentage of the disease occurrence in the population studied (exposed and non-exposed) that can be attributed to exposure was estimated using the population attributable risk percent (PAR%). This was obtained by multiplying the *AR*% by the proportion of subjects in the population exposed to the risk factor as articulated in section 2.2 of chapter 2. The proportion of infections in the population under study that may be attributed to a risk factor **(***PAR*%) depends upon both the magnitude of the relative risk and the prevalence of the risk factor in the population. Thus, the elimination of a common risk factor with a large relative risk will result in a huge reduction in disease occurrence, whilst elimination of a rare risk factor will result in a small impact on the health of the community. Comparison of the proportions of infections in the population that may be attributed to a risk factor **(***PAR*%) were used to identify risk factors that pose the greatest health threat to the communities. Based on the nature of the risk factors, appropriate recommendations were made.

CHAPTER 4

RESULTS

This chapter presents the results of the analysis of the VCT data from Khomas, Kavango and Oshana regions. The results are divided into five parts which are descriptive analysis of potential risk factors and HIV sero-status, bivariate analysis of HIV sero-status and potential risk factors, modeling of HIV risk factors and excess risks as well as high priority risk factors. The descriptive analysis section shows the prevalence of the disease in the sample studied and the sample characteristics which in the study represents the exposure to risk factors. This is followed by a bivariate analysis between a number of potential risk factors and HIV sero-status which was used to ascertain if there existed an association between HIV sero-status and potential risk factors.

The third component comprises of modelling potential HIV risk factors which was carried out to determine the significant predictors of HIV infection in Namibia using the multivariate logistic regression. This is followed by computations of attributable risk percent and population attributable risk percent which were performed to quantify excess risk associated with modifiable risk factors. Lastly, the magnitudes of the population attributable risks were compared in order to identify risk factors which are of priority for the HIV prevention response. In this section, VCT clients refer to the people who got tested for HIV from the three regions; Kavango, Oshana and Khomas and were included in the study sample as described in chapter 3.

4.1 Descriptive Analysis of HIV Sero-Status and Potential Risk Factors

As discussed in chapter 2, the potential HIV driving factors in this study were divided into four categories namely structural, biological, socio-economic and sexual-behavioral. Therefore, this section presents the descriptive analysis of these potential risk factors and prevalence of HIV among VCT clients showing their frequency of occurrence and percentages.

4.1.1 Prevalence of HIV among VCT Clients

In as far as HIV sero–status among VCT clients is concerned, the results illustrated in Figure 4.1 shows that about 11.1 percent of the clients from the three studied regions were HIV positive. This result differs by 2 percent from the national prevalence rate among adults which stand at 13.1 percent and this deviation is understandable since only three regions were engaged in this study. Furthermore, VCT clients may not be a good representation of the entire Namibia population since testing at the VCT centres is voluntary.

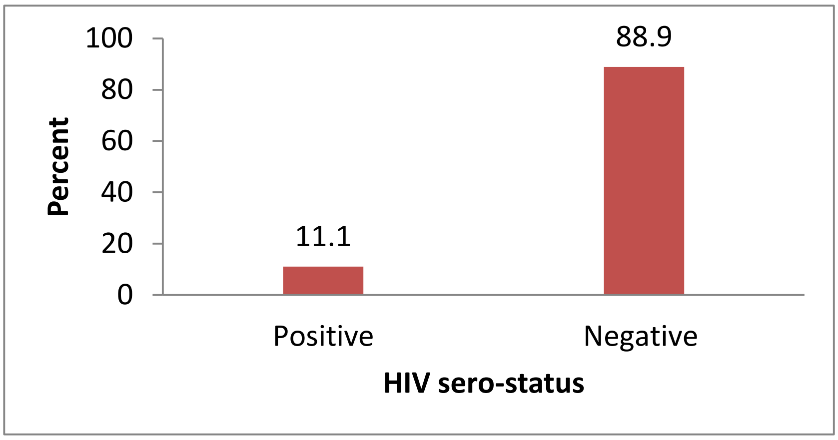

Figure 4.1: Distribution of VCT clients by HIV sero-status

4.1.2 Biological Potential Risk Factors

Among other potential risk factors, this study included three biological variables and these are sex and age of the clients as well as male circumcision. The distribution of the VCT clients within these biological potential risk factors is summarized in Table 4.1. It is evident from the results that the majority (54.5%) of the VCT clients from the three studied regions were females suggesting that females generally seek HIV testing services more than males. The greatest proportion of VCT clients was found to be in the age group of 20 to 29 years with a cumulative percentage of 49.4, whilst the lowest proportion of VCT clients was observed in the age group 45 to 49 years with about 4.4 percent. The results further indicate that a considerable proportion of about 56 percent of the men tested at the VCT centres had not been circumcised.

Table 4.1: Distribution of VCT clients by biological potential risk factors

Potential risk factor	Frequency	Percent
Sex		
Male	6505	45.5
Female	7791	54.5
Age group		
15-19	1551	10.8
20-24	4022	28.1
25-29	3040	21.3
30-34	1967	13.8
35-39	1319	9.2
40-44	769	5.4
45-49	628	4.4
50+	1000	7.0
Circumcised (men only)		
Yes	2747	44
No	3494	56

The distribution of VCT clients by region is presented in Figure 4.2. The result shows that male circumcision practices varied by region with Kavango region having the highest proportion (51.1%) of the male VCT clients being circumcised. The second largest proportion of male VCT clients was observed in the Khomas region with about 25.3 percent circumcision rate whilst Oshana region had the lowest rate of about 23.6 percent.

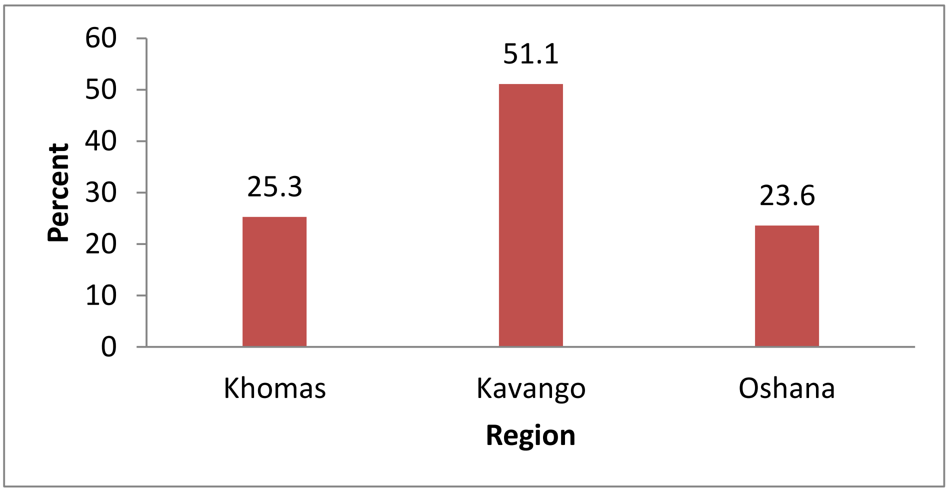

Figure 4.2: Distribution of circumcised VCT clients by region

4.1.3 Structural Potential Risk Factors

Since the drivers of HIV pandemic differ from one region to the other, region of residence was included in this study as a structural potential risk factor. It is shown in Figure 4.3 that 73.3 percent of the VCT clients engaged in this study were from Kavango region whilst about 18.9 percent were from Khomas region and the remaining 7.8 percent being from Oshana region. This distribution was not as a result of a deliberate sampling procedure, instead, it was based on the availability of complete cases for analysis.

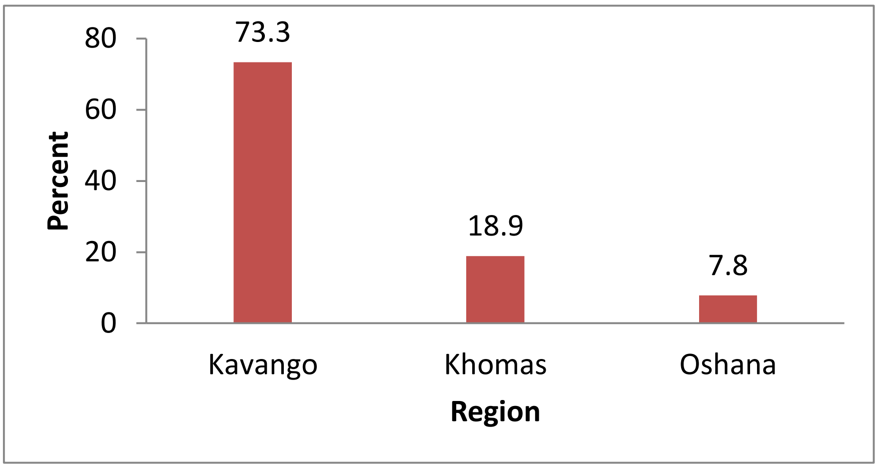

Figure 4.3: Distribution of VCT clients by region

4.1.4 Socio-Economic Potential Risk Factors

In the conduct of this study, two socio-economic variables namely education and marital status were included and the distribution of VCT clients within these factors is presented in Table 4.2. The results indicate that a proportion of about 56.6 percent of the VCT clients have indicated secondary education as their highest level of education whilst 20.6 percent and 17.8 percent of them had primary and tertiary education as their highest level of education respectively. The results also show that only 5 percent of the VCT clients from the 3 regions had not acquired any form of formal education.

With respect to marital status, it is shown that about 57.3 percent of the VCT clients engaged in this study were never married with only 15.5 percent being married.

Equally important, the results indicated that 22.6 percent of the VCT clients were in cohabiting whereas 2.1 percent were divorced.

Table 4.2: Distribution of VCT clients by socio-economic potential risk factors

Potential Risk Factor	Frequency	Percent
Education		
None	708	5.0
Primary	2945	20.6
Secondary	8096	56.6
Tertiary	2547	17.8
Marital Status		
Married	2223	15.5
Never married	8192	57.3
Windowed	357	2.5
Cohabiting	3225	22.6
Divorced	299	2.1

4.1.5 Sexual-Behavioural Potentail Risk factors

The sexual-behavioral variables of interest in the study were alcohol use as well as condom use the last time one had sex. The question on alcohol use was merely to gather if one takes alcohol and not the intensity or frequency of alcohol use. The distribution of VCT clients by these sexual-behavioral potential risk factors presented in Table 4.3 show that over half (53%) of the VCT clients from the three study regions did not use condoms the last time they had sex at the time they visited the VCT centres. The results further show that only 21 percent of the VCT clients reported using alcohol at the time when the test was done. This result contradicts the media reports and public outcry which generally consider Namibia as a nation with high level of alcohol use and or abuse.

Table 4.3: Distribution of VCT clients by sexual-behavioural potential risk factors

Potential Risk Factor	Frequency	Percent
Condom use the last time one had sex		
Yes	6667	46.6
No	7629	53.4
Alcohol use		
Yes	2939	20.6
No	11357	79.4

The results also show that condom use varied with region, marital status and age group as illustrated in Table 4.4. It is evident that 56.4 of the VCT clients from Kavango region did not use condoms the last time they had sex whereas 46.1 percent and 42.1 percent of the CVT clients from Khomas and Oshana regions did not use condoms the last time they had sex at the time of visiting VCT centres respectively.

The table further shows that marital status also plays a role on the use of condoms among VCT clients in the three regions. It can be deduced from the table that the use of condoms the last time VCT clients had sex was lowest among the widowed (15.7%) and divorced (22.1%). On the contrary, about 59% of the VCT clients who never married used condoms the last time they had sex. In addition, it was further observed that the use of condoms varied with age as evidenced by a decreased use of condoms as the age of the VCT clients increased. VCT clients in the age group 15-19 were the most users of condoms (57.8%) whilst those in the category above 50 years were the least users of condoms (13.8%).

Table 4.4: Distribution of condom use by region, marital status and age group of VCT clients

Variable	Condom use the last time one had sex	
	Yes (%)	No (%)
Region		
Khomas	53.9	46.1
Kavango	43.6	56.4
Oshana	57.9	42.1
Marital status		
Married	23.9	76.1
Never married	59.0	41.0
Widowed	15.7	84.3
Divorced	22.1	87.9
Cohabiting	36.7	73.3
Age group		
15-19	57.8	42.2
20-24	55.8	44.2
25-29	52.1	47.9
30-34	47.6	52.4
35-39	37.6	72.4
40-44	25.2	74.8
45-49	27.7	72.3
50+	13.8	86.2

4.2 Bivariate Analysis of HIV Sero-Status and Potential Risk Factors.

The relationship between HIV sero-status and the various potential risk factors of interest is presented in Table 4.8. A Chi-Square test for association was used to ascertain if there existed an association between potential risk factors and HIV sero-status at the 0.25 significance level. In the table, HIV+ (%) and HIV- (%) represents the proportion of VCT clients in a category of a potential risk factor who were HIV positive and negative respectively. P-values give the observed significance level corresponding to the Chi-Square tests for association between the potential risk factors and HIV sero-status.

Table 4.5: Relationship between HIV sero-status and potential risk factors

Potential risk factors	Number	HIV+ (%)	HIV– (%)	Chi-Square value	P-Value
Sex					
Male	6505	9.4	90.6	35.217	<0.001
Female	7791	12.5	87.5		
Age:					
15-19	1551	3.4	96.6		
20-24	4022	9.2	90.8		
25-29	3040	13.2	86.8	168.844	<0.001
30-34	1967	14.7	85.3		
35-39	1319	14.3	85.7		
40-44	769	10.8	89.2		
45-49	628	14.3	85.7		
50+	1000	10.7	89.3		
Marital status					
Married	2223	11.7	88.3		
Never married	8192	7.9	92.1	245.771	<0.001
Divorced	299	21.1	78.9		
Widowed	357	20.7	79.3		
Cohabitation	3225	16.6	83.4		
Education					
None	708	12.3	87.7		
Primary	2945	17.6	82.4	281.462	<0.001
Secondary	8096	11.0	89		
Tertiary	2547	3.4	96.6		
Region					
Khomas	2704	4.6	95.4		
Kavango	10478	13.5	86.5	227.986	<0.001
Oshana	1114	4.2	95.8		
Condom use					
Yes	6667	7.3	92.7	182.480	<0.001
No	7629	14.4	85.6		
Circumcised (men only)					
Yes	2747	8.7	91.3	3.715	0.054
No	3494	10.1	89.9		
Alcohol use					
Yes	2939	11.6	88.4	0.949	0.33
No	11357	10.9	89.1		

From a biological perspective, the study sought to establish if there was an association between sex and HIV sero-status. As shown in Table 4.5, the results indicate that an association existed ($p < 0.001$) between sex and HIV sero-status for VCT clients living in Kavango, Oshana and Khomas regions. About 12.5 percent of the female VCT clients tested HIV positive whilst about 9.4 percent of the male clients tested HIV positive. Therefore, seropositivity was higher for female clients as compared to their male counterparts. Equally important, there was a significant relationship between HIV sero-status and age ($p < 0.001$). Higher seroprevalence above 10 percent was recorded among those VCT clients above 25 years of age and a relative lower seroprevalence less than 10 percent for the clients who were less than 24 years.

Furthermore, it was found that marital status was significantly related to HIV sero-status ($p < 0.001$) as evidenced by higher HIV positivity among the divorced (21.1%), widowed (20.7%) and the cohabiting (16.6%) clients. The lowest HIV prevalence rate was recorded among the never married (7.9%) and a little higher prevalence of 11.7 percent among the married people. This pattern clearly demonstrates that the married and the single are less infected by HIV than the widowed, cohabiting and the divorced VCT clients.

The study also investigated if there was an association between HIV sero-status and the highest level of education attained by VCT clients. Table 4.5 shows that a significant relationship existed between highest level of education attained and HIV sero-status ($p < 0.001$). A lower seroprevalence of about 3.4 percent was found among the most educated whereas the highest seroprevalence of about 17.6 percent was among those with primary education as their highest qualification. There was a clear pattern emerging whereby lower levels of education were associated with higher HIV seropositivity.

Also investigated in the study was the existence of a significant difference in the spatial distribution of HIV among the three studied regions. It is clearly shown in Table 4.5 that there was a significant relationship between the region from where a client was tested and HIV sero-status ($p < 0.001$). Higher HIV seroprevalence was observed in Kavango region (13.5%) followed by Khomas region (4.6%) whilst Oshana region had the lowest seroprevalence rate of about 4.2 percent. In as far as condom use is concerned, the study sought to establish if HIV sero-status depends on condom use the last time one had sex. A higher HIV prevalence rate of about 14.4 percent was among VCT clients who did not use a condom the last time they had sex as compared to 7.3 percent for those who used one in their last sexual act. This relationship was found to be statistically significant with a p-value < 0.001.

Furthermore, among the male VCT clients, a statistically significant association was found between HIV sero-status and circumcision, ($p = 0.054$). In this case, a higher seroprevalence of about 10.1 percent was found among the uncircumcised male VCT clients as compared to the circumcised male clients who had a HIV prevalence rate of 8.7 percent. On the contrary, no significant relationship was found between HIV sero-status and alcohol use (p = 0.33) among the VCT clients. For those who were taking alcohol by the time the test was done, their HIV prevalence rate was found to be 11.6 percent showing no major difference from those not taking alcohol who had a seroprevalence of about 10.9 percent.

4.3 Modelling HIV Risk Factors

4.3.1 Model formulation

In modelling the predictors of HIV sero-status among the VCT clients for the three studied regions, the univariate and multivariate logistic regression models were fitted. The univariate logistic regression analysis was performed to quantify the disease risk associated with individual variables whilst the multivariate logistic regression analysis was performed to quantify the disease risk associated with a variable after controlling for other covariates and confounders. All variables which were significant at the 0.25 significance level in the Chi-Square test for association were included in the models and these were; sex, marital status, age, level of education, male circumcision, region and condom use.

Since male circumcision only applied for male VCT clients, 2 separate multivariate logistic regression models were fitted, one for males and females with a sample size of 14 296 clients without the variable male circumcision and the second model was for male VCT clients only, with a sample size of 6 241 clients including the variable male circumcision. In order to select the model that fitted the data best, the likelihood ratio statistics was used. This approach is based on assessing deviances from competing nested models to assess the improvement in fit due to inclusion/exclusion of model terms. The difference in deviance followed a chi square distribution with degrees of freedom equal to the difference in the number of parameters in the competing model. Of importance in Tables 4.6 and 4.7 is the significance of the log-likelihood ratios. If the value of the log-likelihood ratio is significant, it means that it is important to keep the term in the model.

Model 1: Multivariate Logistic Regression Model without Male Circumcision

The multivariate logistic regression model for both male and female VCT clients without the variable male circumcision is presented in Table 4.6. All the p-values in Table 4.6 show that all the model terms significantly improved the model at the 0.05 significance level. Therefore, the model which was fitted is as follows:

$$\operatorname{logit}(pi) = \beta_0 + \beta_1 Age + \beta_2 MaritalStatus + \beta_3 Sex + \beta_4 Education + \beta_5 Region + \beta_6 Condomuse$$

Table 4.6: Variable Selection for Model 1

Variable	Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Age Group	-4660.230	247.796	7	<0.001
Marital Status	-4549.361	26.058	4	<0.001
Sex/gender	-4547.476	22.286	1	<0.001
Level of Education	-4602.515	132.365	3	<0.001
Region	-4611.234	149.803	2	<0.001
Condom use	-4573.697	74.728	1	<0.001

Model 2: Multivariate Logistic Regression Model with Male Circumcision

The multivariate logistic regression model for male VCT clients after including the circumcision variable are presented in Table 4.7. It is evident from the table that the variable marital status did not significantly improve the model (p = 0.264), and as such, it was omitted. After excluding marital status a new model was fitted and the p-values show that all the variables significantly improved model 2 at the 0.05 level. Thus the model which was fitted is as follows;

$$\log it(pi) = \beta_0 + \beta_1 Age + \beta_2 Condomuse + \beta_3 circumcision + \beta_4 Education + \beta_5 \mathrm{Re}\,gion$$

Table 4.7: Variable Selection for Model 2

Variable		**Model Log Likelihood**	**Change in -2 Log Likelihood**	**df**	**Sig. of the Change**
Step 1	Marital Status	-1722.574	5.231	4	.264
	Level of Education	-1745.478	51.038	3	<0.001
	Condom use	-1742.847	45.776	1	<0.001
	Male Circumcision	-1730.603	21.289	1	<0.001
	Region	-1762.424	84.931	2	<0.001
	Age Group	-1806.761	173.604	7	<0.001
Step 2	Level of Education	-1748.779	52.409	3	<0.001
	Condom use	-1745.431	45.712	1	<0.001
	Male Circumcision	-1733.308	21.467	1	<0.001
	Region	-1775.036	104.923	2	<0.001
	Age group	-1830.831	216.512	7	<0.001

4.3.2 HIV risk factors

To determine the risk factors for HIV infection in Namibia, the above described logistic regression models were used. Specifically, model 1 was used to identify the significant predictors of HIV infection, and model 2 was only used to estimate the risk associated with the circumcision risk factor. The results from the multivariate logistic analysis are presented in Table 4.8. Also presented are the results of the univariate analysis, allowing the comparison of risk associated with different levels of risk factors before and after controlling for other explanatory variables. However, emphasis is placed on the multivariate logistic regression results as they are more useful when more than one explanatory variable is involved.

The point estimates of the odds ratios (OR) and their 95 percent Confidence Intervals (CI) as well as the p-values were reported. Univariate effect refers to the results from a univariate logistic regression which regressed individual factors against HIV status. The risk associated with each risk factor was measured by the odds ratios and the corresponding confidence intervals. Multivariate effect refers to results from a multivariate regression model which similarly measured risk using the odds ratios and the corresponding confidence intervals.

Table 4.8: Univariate and Multivariate Analysis of HIV Risk Factors

Variable (Factor)	Univariate effect			Multivariate effect		
	Odds ratio	95% CI	P-Value	Odds ratio	95%CI	P-Value
Sex						
Male	1.000	-	<0.001	1.000	-	<0.001
Female	1.382*	1.241 – 1.538		1.314*	1.171 - 1.474	
Age						
15-19	1.000	-	<0.001	1.000	-	<0.001
20-24	2.855*	2.128 - 3.831		3.512*	2.608 - 4.729	
25-29	4.307*	3.212 - 5.775		5.736*	4.243 - 7.754	
30-34	4.888*	3.617 - 6.604		6.309*	4.606 - 8.641	
35-39	4.698*	3.431 - 6.434		5.423*	3.883 - 7.574	
40-4	3.420*	2.395 - 4.883		3.288*	2.253 - 4.798	
45-49	4.728*	3.321 - 6.732		4.627*	3.158 - 6.781	
50+	3.387*	2.412 - 4.756		2.755*	1.887 - 4.021	
Marital status						
Married	1.000	-	<0.001	1.000	-	<0.001
Never married	0.648*	0.557 – 0.754		1.203	0.997 - 1.452	
Divorced	2.007*	1.477 – 2.726		1.783*	1.297 - 2.451	
Widowed	2.966*	1.476 – 2.618		1.689*	1.253 - 2.276	
Cohabitation	1.492*	1.272 – 1.749		1.386*	1.164 - 1.649	
Education						
Tertiary	1.000	-	<0.001	1.000	-	<0.001
Secondary	3.539*	2.823 - 4.436		2.173*	2.127 - 3.378	
Primary	6.108*	4.828 - 7.726		3.652*	2.843 - 4.691	
None	4.009*	2.938 - 5.470		2.173*	1.553 - 3.039	
Region						
Khomas	1.000	-	<0.001	1.000	-	<0.001
Kavango	3.208*	2.658 – 3.872		2.655*	2.171 - 3.247	
Oshana	0.909	0.645 – 1.280		0.838	0.592 - 1.186	
Condom use						
Yes	1.000	-	<0.001	1.000	-	<0.001
No	2.141*	1.913 – 2.395		1.702*	1.506 - 1.923	
Circumcision						
Yes	1.000	-	0.054	1.000	-	<0.001
No	1.185*	0.997 – 1.408		1.472*	1.223 - 1.770	

***** Significant at 0.05 level

What follows is detailed discussion of the results from the logistic regression analysis presented in Table 4.8. The discussion focuses on the role of the studied risk factors in predicting one's chances of contracting HIV in Namibia, with reference to the odds ratio. It also compares the risk associated with a risk factor before and after controlling for other risk factors.

The results indicate that sex was a significant predictor of HIV infection among VCT clients from the studied regions ($p < 0.001$). An odds ratio of 1.3 demonstrated that being female increased one's risk of HIV infection among VCT clients. Furthermore, the results show that HIV infection was also associated with age. VCT clients in the age group of 30 to 34 were six times more likely to contract HIV compared to those aged between 15 to19 years (OR = 6.3). The age groups 25-29, 35-39 and 45-49 were about 5 to 6 time more likely to be infected with HIV. Overall, VCT clients aged between 25 and 39 years were at higher risks of HIV infection. The results also show increased risk of HIV infection for the ages between 20 and 39 years after controlling for other factors compared to the univariate estimates.

In addition, marital status was also found to be a significant determinant of HIV infection among VCT clients ($p < 0.001$). Compared to the married, it was shown that VCT clients who were divorced, cohabiting or widowed were at a higher risk of HIV infection. The risk of infection was double among the divorced (OR = 1.8) and the widowed (OR = 1.7). On the other hand, the risk of being infected was slightly lower for those who never married (OR = 1.2) and the cohabiting OR = 1.4). It is interesting to note that the univariate analysis had shown being single (never married) as offering protection to HIV infection, (OR = 0.6) and turned to be a risk factor after controlling for other factors (OR = 1.2). Overall, being married had a protective effect on the risk of contracting HIV among the VCT clients.

The highest level of education attained also proved to be a significant predictor of HIV infection among VCT clients in the study regions ($p < 0.001$). Those who had attained primary education were mostly at risk of HIV infection. They were four times likely to be infected with HIV compared to those with tertiary education (OR = 3.7). As such, having attained tertiary education had a great protective effect on HIV infection. Noticeably, those who had acquired secondary education had a higher risk of contracting HIV (OR = 2.7) than those who had not attained any form of formal education (OR = 2.2). Overall, lower education levels were associated with increased odds of HIV infection among VCT clients.

The results also show that the region where the test was done was significantly associated with HIV infection ($p < 0.001$). Compared to living in the Khomas region, living in Kavango region increased the risk of HIV infection (OR = 2.7) whilst residing in Oshana region had a protective effect (OR = 0.8). In addition, not being circumcised for men also increased their risk of HIV infection (OR = 1.5), thus demonstrating that male circumcision was a significant predictor of HIV infection among VCT clients ($p < 0.001$). This finding is different from that of the univariate analysis which had a week association between male circumcision and sero-status (OR = 1.2).

Similarly, the use of condoms was significantly associated with HIV infection among VCT clients ($p < 0.001$). For those clients who did not use condoms the last time they had sex, their risk of HIV infection was doubled (OR = 1.7), thus bringing to fore that condom use is a significant determinant of HIV infection among VCT clients in the studied regions.

4.4 Analysis of Excess Risk and the Potential for HIV Prevention

After quantifying the disease risk associated the various risk factors, this study also quantified excess risk for the risk factors. The measures of excess risk were only computed for modifiable risk factors with a relative risk more than one (ie when the variable is a risk and not a protective factor). It does not make sense and will not help the society to eliminate a factor which offer disease protection to the people (ie RR<1). In this study, the factors condom use the last time one had sex and male circumcision were the only risk factors amenable to intervention, thus Attributable Risk percent (AR%) and Population Attributable Risk percent (PAR %) were only computed for these two risk factors. The results of these computations are presented in Table 4.9.

Table 4.9: Attributable risk percent and population attributable risk for HIV infection

Risk Factor	Proportion of subjects in the population exposed (p_c) [a]	Relative Risk[b] (RR)	Attributable Risk Percent[c] (AR%)	Population Attributable Risk Percent[d] (PAR%)
No condom use	0.534	1.702	41.246	22.025%
Not circumcised	0.560	1.472	32.065	17.956%

[a]Proportion of subjects in the population exposed to the risk factor (p_c)

[b]Relative risk from multivariate analysis (RR=OR),

[c]AR% = (RR-1)x100/RR,

[d]PAR% = AR% x p_c

The results show that the practice of not using condoms during sexual intercourse had a prevalence of 53.4 percent among VCT clients whilst the strength of the relationship between HIV infection and not using condoms stood at 1.7 (OR). From these two estimates, the AR% was derived and the result shows that, of the VCT clients who reported not to have used a condom the last time they had sex and tested HIV positive, 41.2 percent of them may have contracted HIV because of not a using condom. From a public health perspective, this means that 41.2 percent of the cases of HIV could have been avoided among those who reported not to have used condoms if they had used condoms during sexual intercourse. A corresponding PAR% of 22 for condom use shows that about 22 percent of the HIV burden in the three study regions could have been avoided if every individual used a condom each time they had sex with an individual whose status was not known to him/her assuming all other factors remain the same.

Similarly, the results reveal that the prevalence of male circumcision among VCT clients from the three study regions stood at 44 percent whilst the strength of the association between HIV infection and not being circumcised as measured by odds ratio was 1.5. An AR% of 32.1 shows that among the people who were not circumcised and tested positive, 32 percent of them may have been infected with HIV because they were not circumcised. This therefore means that 32 percent of the HIV burden among the uncircumcised VCT clients in the regions under study could have been avoided if they were circumcised. Taking it to the population of people who got tested in the three regions, a PAR% of 17.96 for circumcision means that approximately 18 percent of the HIV burden in these regions could have been avoided if every male person was circumcised assuming the distribution of the other factors remain unchanged.

4.6 High Priority Risk Factors

In an effort to formulate strategies to respond to the epidemic, it is very useful to understand the risk associated with various risk factors and the prevalence of exposure to those risk factors as is expressed by the Population Attributable Risk Percent. This process helps to identify high priority risk factors for prioritisation in the national HIV response. It follows that the elimination of a common risk factor with a large relative risk (higher PAR%) will result in a substantial reduction in the occurrence of the disease. In this study, both, not using condoms and not being circumcised proved to have reasonably high PAR%. However, it is evident that eliminating the risk of not using condoms can avert a greater proportion of the disease burden (22%) compared to male circumcision (18%).

Even though risk factors such as sex, age, marital status, level of education, and region or residence are not changeable by interventions, it is important to consider the magnitude of their relative risks (odds ratio) in order to correctly channel interventions to the most relevant people. For the risk factor region of residence, an odds ratio of 2.7 for Kavango and 0.8 for Oshana relative to Khomas shows that Kavango region is the high priority region of HIV prevention programmes. In as far as age is concerned all age groups were shown to be equally at risk as evidenced by odds ratios around three and above relative to the age group 15-19 years.

For marital status, the high priority groups are the widowed (OR = 1.7), the divorced (OR = 1.8) and the cohabiting (OR = 1.4). Relative to those with tertiary education, everyone else seem to be a high priority target group for HIV prevention. Lastly, an odds ratio of 1.3 for females relative to males shows that interventions will have the greatest desired impact if they target females since they are the most affected.

CHAPTER 5

DISCUSSION OF FINDINGS

This chapter discusses the findings of the study as presented in chapter 4. It is divided into two sections namely risk determinants of HIV infection as well as high priority risk factors and the potential for HIV prevention in Namibia. The chapter relates the findings of the study to findings of other related studies as discussed in chapter 2.

5.1 Risk Determinants of HIV Infection in Namibia

The study has shown an overall HIV prevalence rate of 11.1 percent among VCT clients from Khomas, Kavango and Oshana regions. Due to the fact that testing at VCT centres is voluntary, it is usually the case that VCT data underestimate the true population HIV prevalence since other people get testing services at other facilities such as public and private hospital and clinics or are not tested at all. It is also believed that people who are associated with risky behaviours do not seek HIV testing services (MoHSS, 2009b). Furthermore, it was documented in the same source that adolescents, the rural population, the married or cohabiting are less likely to seek testing services at the VCT centres.

Also apparent is the fact that most of the VCT clients are females, a situation which was highlighted by the NDHS (2006/7) which recorded that 51 percent of the

Namibian women were ever tested and received results whilst only 32 percent of the men did likewise. The study brought to fore that sex is a significant predictor of HIV infection in Namibia specifically showing that females are more likely to be HIV positive compared to men. This result is consistent with most of the literature pointing to sex as a risk factor for HIV infection in Namibia. This phenomenon can be can be explained in various ways. First is the physiological explanation which states that women are more susceptible to HIV infection because of their greater mucoscal surface exposed to pathogens during sexual intercourse (Ipinge et al. 2004). Second, from a gender perspective, the lack of respect, violence against and low status of women in the Namibia society prevents them from negotiating safer sex such as using condoms (Mba, 2003).

Furthermore, the lack of respect on women undermines their sense of self- worth, their sense of autonomy and ability to feel and act responsibly and hence increasing their chances of getting HIV (Iipinge et al. 2004). As such, some of them end up indulging into the sexual act to be accepted. According to Ganley (2013), the lack of self-esteem among women make them to continue in relationships they are abused. Ganely added that a woman may come to believe that she somehow deserves the abuse to which she has been subjected and this often leads to the belief that she does not deserve anything better. This lack of self-esteem cuts across racial, ethnic, religious and socioeconomic lines. In addition, females are put at risks by wrong beliefs in some Namibian societies as stated by Talavera (2002) that some men believe that HIV can be cured by having sex with a virgin and others believing that young girls are free from HIV .

The study findings also support the findings of Pettifor et al. (2005) who concluded that women are forced to use various economic coping mechanisms which most of the time involve economic dependency on men for a living and to support their families. This in turn puts women at an increased risk of HIV infection since they do not have negotiation power for safer sex and often make women get abused. In light of the high unemployment in Namibia (NSA, 2012), it is feasible that women tend to look up to the well-off men who tend to be older for sustenance. Furthermore, this study has shown that the use of condoms is not common among older people and as such increase the risk of HIV infection for such women.

Equally important, the study proved that VCT clients falling in the age group 25 to 39 were at the highest risk of HIV infection compared to those below 20 and above 40 years. This outcome agrees with the findings of Fox (2010) who shows that there is a positive wealth gradient on HIV infection in Sub Saharan Africa, meaning that as people get richer, their risk of HIV infection increases. In the Namibian situation, it is from the age of 25 that young single people get employed, become financially stable and begin to experiment with life since they can afford to fund social outings. With increased access to resources at these ages, more partners get attracted to them for financial gains and thus increasing their risk of HIV infection.

The study has also shown that marital status is another significant HIV risk determinant in Namibia. It was demonstrated that cohabiting and being single (never married) increased the risk of HIV infection. Even worst, the widowed and the divorced were at a higher risk of HIV infection. This study proves that the use of condoms among the cohabiting, the widowed and the divorced is very low suggesting why their risk of infection is high (Table 4.4). For the widowed and divorced, it may be that the use of condoms becomes unusual after the marriage life which is normally characterized by low use of condoms as shown earlier. This finding agrees with Tenkorang (2014) who found that, compared to never-married women, widowed women were significantly more likely to be HIV positive. Tenkorang added that, in Tanzania and Zimbabwe, divorced women had higher risks of HIV infection, compared to never-married women concluding that specific HIV programs need to be directed at vulnerable women, in particular the widowed.

Furthermore, low risk perception for these groups may inhibit the use of condoms during sexual intercourse especially for a long relationship such as cohabiting. For those who are cohabiting, it maybe because of economic dependency on the other which makes them (the cohabiting) stay together and hence the dependent one risk being abused and failure to negotiate safer sex and hence increasing their risk of HIV infection. This finding is worrisome considering that about 59 percent of Namibians above 15 years were never married with about 8 percent cohabiting, 4 percent widowed and 2 percent being divorced (NSA, 2011).

Contrary to researchers such as Fox (2010), Shapumba et al. (2004), this study has shown that attaining higher levels of education reduces the risk of HIV infection. However, it was also shown that no education at all is a little protective compared to attaining primary or secondary education. The possible explanation to this is that those without education at all are usually in rural remote areas and are protected from HIV infection by cultural practices that discourage promiscuity. This finding contradicts the findings of Fox (2010) who concluded that higher education levels are associated the risk of HIV infection in Sub Saharan Africa adding that professionals are two to three times more likely to be HIV infected than agricultural workers who are usually uneducated. This finding also violate the postulations by Shapumba et al. (2004), Sabone et al. (2007), Iipinge et al. (2004) which states that most education environments are not safe especially for young women and men due to sugar mammies and sugar daddies as well as peer pressure and hence increasing their risk of HIV infection.

The results further show that as one move from primary to secondary and then tertiary education, the risk of HIV infection falls. This result concurs with the NDHS (2006/7) which concluded that education background increases knowledge on HIV and AIDS and literature promoting more access to HIV and AIDS information via internet, pamphlets, journals, books, newspapers and the general media. Anderson and Beutel (2007) also support this finding with their conclusion that people who have completed higher grades in school may have received more information about

HIV and AIDS and that people who are in school have current exposure to HIV education and prevention methods than those who are not.

Furthermore, the study also indicates that living in Kavango region increased the risk of HIV infection whilst residing in Oshana had a more protective effect on HIV infection compared to living in the Khomas region. In Namibia, Kavango is second from Caprivi in terms of HIV prevalence (MoHSS, 2012). One possible reason why it is so high is that Kavango region borders with the Caprivi region. Caprivi region has a border town of Katima Mulilo which has highest HIV prevalence in Namibia thus the disease is easily transmitted since the two communities highly interact. Moreover, Rundu town which is the capital of Kavango region is on the Trans-Kalahali highway which leads to the Katima Mulilo boarder post, making it a transit town and thus putting the residents at an increased risk of HIV infection by truck drivers, cross boarder traders who are generally known to have a high HIV seropositivity. Besides, Kavango region is the poorest region in Namibia and this makes the people especially women devote to dangerous coping mechanisms including exchanging sex for material or financial gains, thus agreeing with the statement made by Van Niekerk and Kopelman (2005) that in some poor families girls will be sold to ensure survival of the families.

In terms of circumcision, the study proved that men who are not circumcised are at an increased risk of HIV infection. This outcome agrees with the scientific explanation by Piot et al. (1990) who noted that lack of circumcision in men appears to potentiate the facilitating role of Haemophilus ducreyi infection, presumably because the prepuce may trap infectious material and /or permit a wider surface area for ulcerative portals of entry of HIV. The finding also concurs with three recent clinical trials which found that men who had been circumcised by trained medical professionals and with appropriate surgical follow-up reduced the risk of acquiring HIV by 60 percent (Auvert et al. 2005, Gray et al. 2007 and Bailey et al. 2007).

In addition, the study found out that condom use is one of the significant predictors of HIV infection in Namibia. Not using condoms increased the risk of HIV among VCT clients. This finding is worrisome since the use of condoms in Namibia remains limited as earlier stated. This study has proved this true especially for those cohabiting, the widowed and divorced and their use of condoms decreases with an increase in age. This concurs with the findings of Pettifor et al. (2005) who concluded that condom use consistency remains low among regular steady relationships thus increasing the risk of contracting HIV.

Furthermore, the use of condoms is complex as alluded by Varga (2000). Even if an individual decides to use a condom as a protective measure, a number of barriers may inhibit the use of it. Low risk perception, past experience and the type of partner or relationship may jeopardise the decision to use a condom. This study also shows that the use of condoms is low in Kavango as compared to Khomas and Oshana agreeing with Desert Soul (2011) who indicated that Kavango has the lowest levels of condom use in the Namibia and the lowest levels of HIV/AIDS knowledge among women. Thus, this habit of having unprotected sex in this region can be one of the major reasons why people in the region are at a higher risk of contracting HIV.

Paradoxically, the study has shown that HIV prevalence is highest in Kavango region yet male circumcision is highest in the same region. It is important to note that even though male circumcision is high, condom use is low in this region. This perfectly agrees with explanations given by authors opposing male circumcision citing the negative effects of circumcision on condom use. Kim and Pang (2007) and Taylor, Lockwood and Taylor (1996) argue that male circumcision removes nerves from the penis and causes significant loss of sexual sensitivity and function. For this reason, many circumcised men are reluctant to use condoms and thus male circumcision may reduce condom usage and have an adverse effect on the overall HIV infection incidence.

The study has proved that alcohol use is not a predictor of HIV infection in Namibia. This finding contradicts with a large body of findings which presents alcohol use as a predictor of HIV infection. Examples of studies that contradict this finding include that of McEwan et al. (1991) who indicated that drinking was associated with failure to use condoms, having sex with a person who would not usually be chosen, and contact with more than one sexual partners and overall, concluding that alcohol and other drugs may be associated with risky sexual behaviour, among both adolescents and older people. Another local study contradicting this finding is that of the government of Namibia and UNICEF (2004) which noted that alcohol use increases risk and makes youth not to control their risky behaviours adding that the influence of alcohol impairs people's ability to remember that condoms can save their lives noting that its excessive use suppresses the function of the superego which is responsible for conscience.

5.2 High Priority Risk Factors and the Potential for Prevention in Namibia

It was shown that 41.2 percent of the HIV burden among those who have not used condoms the last time they had sex is attributable to their risky behavior of not using condoms. This brings to the fore the fact that not using condoms is one of the major risky behaviors which if eliminated will prevent a significant proportion of new HIV infections in Namibia. Specifically, the study has proved that about 22 percent of the HIV burden in Kavango, Oshana and Khomas regions could be eliminated if every individual used a condom each time they had sex with an individual whose status was not known to him/her holding all other factors unchanged.

Similarly, the study revealed that about 32 percent of the HIV burden among the uncircumcised VCT clients could have been avoided if they were circumcised. Inferred to the studied population, this finding informs us that approximately 18 percent of the HIV burden in these regions could have been avoided if every male person was circumcised assuming the distribution of the other factors remain unchanged. A comparison of the aggregate and adjusted AR% and ARP% helps to quantify the effect of adjustment in attributable risk measures. It is therefore recommended that future studied consider computing the aggregate AR and ARP percent and compare with the adjusted ones.

A comparison of the values of population attributable risk percent for selected risk factors can help to identify risk factors that are most important for planning interventions. Therefore, this study reveals that condom use promotion programmes will help reduce a greater burden of HIV in Kavango, Oshana and Khomas compared to male circumcision since PAR% for condom use is higher than PAR% for circumcision. This finding perfectly agrees with Visser (2005) who concluded that HIV and AIDS awareness programs among people that focus on condom use and behavioural change towards safer sexual practices remain a priority and key means of prevention.

Be that as it may, a PAR% of 18 percent for male circumcision cannot be underestimated. This therefore brings to fore the fact that male circumcision is equally important and its scaling up can help to save lives. This finding perfectly agrees with recent evidence suggesting that medical male circumcision can indeed reduce the risk of an individual from contracting HIV by 60 percent (Auvert et al. 2005, Gray et al. 2007 and Bailey et al. 2007)

Even though this study shows that condom use and male circumcision programmes may result in the greatest desired impact, evidence shows that isolated interventions that seek to prevent the further spread of HIV may not achieve the intended results alone. As such, the new and widely acceptable approach is combination prevention which entails rights-based, evidence-informed, and community-owned programmes that use a mix of biomedical, behavioural, and structural interventions, prioritized to meet the current HIV prevention needs of particular individuals and communities, so as to have the greatest sustained impact on reducing new infections (UNAIDS, 2010). It therefore means that, as much as male circumcision and condom programmes may be prioritised, programmes which seek to address other social/structural and biomedical factors must not be neglected. This therefore necessitate that further studies consider estimating the combined PAR% in order to determine the potential prevention that can be achieved if a number of risk factors are addressed at the same time.

5.3 Limitations of the study

The only accessible data that can permit examination of factors associated with HIV sero-status in Namibia is from VCT centres and testing facilities in major hospitals collected from clients voluntarily seeking HIV tests. It is data collected from volunteers who represent only individuals who chose to get tested, and chose to do so at the VCT facilities particularly, and thus may not be a true representation of the Namibian population. Individuals who voluntarily seek testing tend to be older, more educated and residing in urban areas and as such the adolescents, married or cohabitating individuals and rural residents are underrepresented (NDHS, 2006/7). It therefore becomes impossible to ascertain whether those who do not seek testing are more or less likely to have HIV. If it were household surveys, estimates would be more accurate as also noted by Mishra et al. (2008) that non-response and the exclusion of non-household population groups tend to have small, insignificant effects on national HIV sero-prevalence estimates obtained from household surveys.

The fact that data was obtained from VCT databases from the different VCT centres, there is a chance that data may be correlated around VCT centres. As such, the use of methods which do not account for correlation could have produced biased estimates. Further studies should consider analysing this data using methods which take into account the correlation of data. However, the fact that data was drawn from different CVT centres among the three regions induces some heterogeneity in the data thus reducing bias.

Due to the nature of the data set, there could exist some mediator variables. As such this study was limited in that it did not conduct mediation analyses to understand relationships by exploring the underlying mechanism or process by which one variable influences another variable through a mediator. Similarly, there could exist some moderating factors among the variables. The effect of moderation was however tested by the evaluation of interaction terms for significance in the model.

Furthermore, the data collection tool administered at the testing centres is not comprehensive enough to capture all important demographic, social, economic, biological and behavioural factors. Instead, the tool only captures the following variables; age, sex, marital status, education level, place where test was done, condom use, sexual concurrency, presence of TB and STIs, circumcision and alcohol consumption. As a result, this study was limited to these explanatory variables, thus omitting other perceived important driving factors such as employment, level of income, oral/anal/vaginal, forced sex, dry sex, ethnicity, exposure to violence, race, religion, access to health education, knowledge of HIV/AIDS, and perception of HIV risk.

Equally important, limitations in recall and recall bias (rumination bias) are inevitable since this was a cross-sectional study. This is because human beings are limited to varying degrees in their ability to recall information. Some may also not have or know the required information. In addition, the data analysed in this study were secondary data, and therefore inherent errors (if any) that could have been committed in the collection and capturing of the data could not be identified and/or rectified. It was also difficult to ascertain whether an individual was exposed to the risk factor before or after infection and as such there was a great limitation in attributing the infection to the exposure. To draw causal relationships where a strong association existed and to compute attributable risk measures, the study assumed a temporal sequence of events, (ie exposure occurred before disease). However, it cannot not be verified from the analysed data if exposure preceded disease occurrence in time.

It was expected that data from VCTs from the 13 regions of Namibia would be obtained. Unfortunately, data was only available from five regions namely, Kavango, Khomas, Oshana, Hardap, and Ohangwena. Furthermore, only three regions were left for analyses after the data cleaning process swept out all cases with incomplete data. These were Khomas, Kavango and Oshana. Unfortunately, these regions do not provide a fair representation of Namibia at large and as such generalisations of findings will be restricted to the regions under study.

A good number of relevant variables were on the data collection tool which yielded the data analysed in this study and these are as follows: HIV status, region, sex, age, language, marital status, education, condom use the last time the person had sex, condom use in previous three months, number of sexual partners, TB screening, male circumcision, time of circumcision, STIs screening, alcohol abuse, sex for material gain and type of sex. Unfortunately, due to incompleteness of the data, some of the variables were omitted and only the following variables were considered for analyses: HIV status, region, sex, age, marital status, level of education, condom use the last time the person had sex, male circumcision, and alcohol use.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Consistent with many Sub-Saharan Africa countries, gender in Namibia has proved to be a significant predictor of HIV infection. Women are at a higher risk of HIV infection compared to their male counterparts. It is therefore strongly recommended that HIV prevention programmes should prioritise targeting women with HIV information and help them mobilise the knowledge into positive behaviours. Furthermore, programmes may consider empowering women in an effort to transform their societal value to be at par with that of men. Any programmes that seek to empower women economically in Namibia may help reduce the risk of HIV infection among women as this may position them independently other than over relying on men for survival. This may also alleviate other risky coping mechanisms such as exchanging sex for money which increases their risk of infection. The need for such programmes cannot be overemphasised since they do not only do good to reduce HIV infection among women but will also improve the general welfare of Namibia women.

Besides, women are naturally at a higher risk of HIV infection due to their biological make which make them be on the receiving end. As such, it is recommended that programmes should target women to improve their efficacy and ability to negotiate safe sex always. It is essential to create an enabling environment which allows women who are willing to change to do so. This can be enhanced by protecting women from gender based violence and negative gender norms which look down upon women in the society.

People between the age of 25 and 39 years in Kavango, Khomas and Oshana regions who happen to be the most economically active people are at the greatest risk of contracting HIV in Namibia. It therefore becomes imperative that social behaviour change, structural and biomedical prevention programmes should target this age range to achieve the greatest desired change and save the Namibian work force. The age group 15-19 remains the least affected age group in Namibia. However, to maintain an HIV free generation, it is important that correct and accurate information about sexuality and HIV is given to these young ones in schools, colleges and universities to keep them free from HIV.

The role of education in mitigating the risk of HIV infection in Namibia cannot be underestimated. Those who have acquired higher level of education in Kavango, Oshana and Khomas regions were less likely to contract HIV compared to the less or non-educated. This indicates that an increase in the number of years in school increases one’s chances of receiving HIV education and messaging thereby reducing one’s chance of contracting HIV.

In light of the free primary education policy which has just been implemented at the beginning of the year 2013, it is strongly recommended that parents ensure that children attend school as this may help expose children to HIV education and messaging with the hope of raising a HIV free generation. Furthermore, the ministry of education may consider strengthening the life skills education component to allow school children more time on HIV education to consolidate their knowledge on sexuality and HIV realities and mobilise the knowledge into practice. Tertiary institutions in Namibia may also consider incorporating HIV education in their curriculums to continue reinforcing the need for HIV prevention to adult learners.

Marriage has proved to have a protective effect to HIV infection indicating that being married in Namibia reduces the chances of contracting HIV. On the other hand, being single, divorced, windowed and cohabiting increases the risk of being infected with HIV. It therefore becomes necessary to include the divorced and windowed in the key populations HIV programmes to mitigate their risk of contracting the virus. This research has also shown that the practice of marriage is no longer holding in Namibia since the majority of adults are single or cohabiting. Therefore, any initiatives that aim to restore the societal fibre and the practice of stable marriages will go a long way in reducing the risk of HIV infection especially for the next generations. Traditional authorities, spiritual leaders and the central government can play a significant role in this respect by casting influence and becoming role models that can be emulated by the vast majority of the citizens of Namibia.

The use of condoms was shown to be low in the three regions especially in Kavango where the greatest HIV burden is. At the same time the study proved that eliminating the risk of not using condoms will yield the greatest impact on HIV infection. It is therefore recommended that campaigns for condom use should continue in their greatest intensity since an increased use of condoms can save many people from contracting HIV. In light of the Health Extension Workers (HEW) programme under the Ministry of Health and Social Services introduced in the year 2013, it is essential that the HEWs promote the use and distribute condoms to all corners of Namibia including remote rural areas to increase the use of condoms. The cohabiting, divorced and widowed rates of condom use are worryingly too low. It is equally recommended that programmes prioritise them with HIV education and condom distribution.

In Namibia, being circumcised has shown to have a protective effect to HIV infection, an outcome which supports other scientific studies showing the protective effect of male circumcision and the introduction of the medical male circumcision in Namibia. However, its introduction must be treated with caution since people without enough information may take it as a license to have unprotected sex, which is equally a risky behaviour. Already we have seen in this study that HIV prevalence is highest in Kavango region yet the region has the greatest proportion of circumcised men. Therefore, a strong messaging component becomes important to forerun the introduction of the medical male circumcision to ensure that gains in prevention work are not reversed. Since the study has proved that male circumcision may offer the second large impact in preventing onward transmission of HIV, it is essential that the government of Namibia consider prioritising the scaling up of the voluntary medical male circumcision programme to the greater population.

The region where one lives in Namibia plays a role in prediction one's chance of contracting HIV. People staying in Kavango region are at the highest risk of contracting HIV followed by those in Khomas and lastly Oshana region for the three studied regions. This is critical information to policy makers, programme designers and condom distributors to take note of when coming up with policies and or programmes meant for HIV prevention. As such, HIV prevention efforts that are aimed at mitigating the spreads of HIV in Kavango region will save a lot more lives than anywhere else in the three regions. Even though it is essential to target all regions with HIV programmes, it is evident that more resources are needed to reverse the adverse effects and prevent onward transmission of HIV in Kavango region that anywhere else.

According to this study, there was no evidence to say alcohol is a significant predictor of HIV infection. However, this does not nullified other claims by other researchers in other settings which proved that alcohol use is associated with behaviours which increase the risk of HIV infection. In fact, the quantity of alcohol consumed and place where it is normally taken may be the important factors. Further studies may consider investigating the frequency and intensity of alcohol consumption on HIV sero-status.

Attributable risk measures are an essential tool in HIV programming as they help us identify risk factors which have the greatest threat to the population health thus providing us with accurate information to address the real problem and maximise benefit of HIV prevention work. Programme designers and implementers should employ such measures when formulating programmes and interventions for the communities at large. Comparing relative risks is not enough from a public health perspectives since it does not explain the magnitude of damage a risk factor may have on the population and the potential for prevention in the event that exposure to the risk factor is eliminated or alleviated. Thus the use of attributable risk measures becomes more relevant.

Condom promotion programmes continue to be the priority for HIV prevention in Namibia. It is therefore essential that any programme meant for HIV prevention should be coupled by condom promotion and distribution to maximise the use of condoms in Namibia. Furthermore, a combination of HIV prevention is the way to go. As much as other factors may be more important than others, it is essential that prevention work target a number of factors at the same time to maximise the benefit from limited resources. For instance, the introduction of male circumcision in Namibia should be coupled with a strong promotion of condom use while addressing other social/structural, behavioural and biological determinants in order to maximise the benefit of the prevention efforts.

This research has proved that collection of quality data can never be over emphasized. The absence of such data or its availability in poor quality hampers the most needed continuous assessment of data to inform national and organisational policies and the response to the HIV epidemic. As such, it is strongly recommended that the MoHSS, IntraHealth International, LifeLine ChildLine invest more resources towards the collection of accurate and complete data from VCT clients. This can be achieved by building the capacity of those involved in the collection of such data. This data is extremely important for the country since it is the only data which permits direct assessment of associations between HIV sero-status and potential risk factors. The availability of such data in good quality will go a long way in improving policy formulation and evaluation, programme designing and implementation as well as programme evaluations.

REFERENCES

Ackermann L. and de Klerk G. W. (2002). *Social factors that make South African women vulnerable to HIV infection.* Bloemfontein: Department of Sociology, University of Free State.

Anderson, K. G. and Beutel, A. M. (2007). HIV/AIDS prevention knowledge among youth in Cape Town, South Africa. *Journal of Social Science 3*(3), 143 – 151.

Auvert, B., Taljaard, D., Lagarde, E., Sobngwi-Tambekou, J., Sitta R and Puren A (2005). Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial. *PLoS Med*. 2(11):e298.

Bailey R.C., Moses S., Parker C.B., Agot. K., Maclean. I., Krieger J.N., Williams C.F., Campbell R.T and Ndinya-Achola J.O (2007). Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial. *Lancet.*;369 (9562):643-56.

Barnett, T. & Whiteside, A. (2006). *AIDS in the Twenty-first Century*: Disease and Globalization. New York, Palgrave Macmillan.

Bendel, R. B., and Afifi, A.A. (1977). Comparison of stopping rules in forward regression. *Journal of the American Statistical association*, 72, 46-53.

Berenson, M., Levine, D.M., Krehbiel, T.C. (2006). *Basic Business Statistics; Concepts and Applications*. Upper Sandle River: Pearson Education, Inc.

Brown, T., Franklin, B., Macnell, J. & Mills, S. (2001). *Effective prevention strategies in low prevalence setting*. Family Health International.

Campbell, C., Foulis, C. A. Maimane, S. & Sibiya, Z. (2005). The impact of social environments on the effectiveness of youth HIV prevention. A South African case study. *AIDS care, 17*(4), 471-478. Routledge Taylor & Francis Group.

Centre for Disease Control and Prevention (CDC), (2013). Oral Sex and HIV Risk. Retrieved from http://www.cdc.gov/hiv/risk/behavior/oralsex.html on the 23 May 2013.

Chwee, L. C., Eke-Huber, E., Eaddy, S., & Collins, J. K. (2005). Nigerian College students, HIV knowledge, perceived susceptibility for HIV and sexual behaviors. College *Student Journal, Vol. 39* (1).

Cole P . and MacMahon, B . (1971) Attributable risk percent in case-control studies. *British Jounal of Pro re nata Medicine* . 25,242-244.

Collet, D. (1994). *Modelling Binary Data*. (1st ed). London: Champman and Hall.

Cornfields (1951). A method of estimating comparative rates from clinical data. Applications to the cancer of the lung, breast and cervix. *Journal of the national cancer institute.* 11(6):1269-75.

Desert Soul (2011). Fact Sheet; HIV/AIDS in Namibia.

Dzinotyiwei E. (2009). *Psycho-Social Factors In Voluntary Counselling and Testing (VCT) – A Social Work Investigation in Windhoek, Namibia*. Windhoek. University of Namibia.

Fox, A.M (2010). The Social Determinants of HIV Serostatus in Sub-Saharan Africa: An Inverse Relationship between Poverty and HIV? Public Health Reports, supplements 4, Vol 4.

Ganley A.L. (2013). Information on Domestic Violence. Retrieved from http://www.domesticabuseshelter.org/InfoDomestic Violence.htm

Gordis L (2009). *Epidemiology* (4^{rd} ed.) Philadelphia: Elsevier Saunders.

Government of the Republic of Namibia and UNICEF, (2004). *My Future Is My Choice; Life Skills Programme.* Windhoek, UNICEF.

Graham (2004), Social determinants and their unequal distribution: clarifying policy understandings. *Milbank Q.* 82(1):101-24.

Gray, R.H., Kigozi, G., Serwadda, D., Makumbi, F., Watya, S., Nalugoda, F., Kiwanuka, N., Moulton, L.H., Chaudhary, M.A., Chen, M.Z., Sewankambo, N.K., Wabwire-Mangen, F., Bacon M.C., Williams, C.F., Opendi, P., Reynolds, S.J., Laeyendecker, O., Quinn, T.C., Wawer, M.J. (2007). Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial. *Lancet.* 2007 Feb 24;369 (9562):657-66.

Grimes,D.A and Schulz, K.F (2008). Making Sense of Odds and Odds Ratios. *The American College of Obstetricians and Gynecologists*. Vol. 111,(2)

Guy R, Wand H, Wilson D.P, Prestage G, Jin F, Templeton D.J, Donovan B, Grulich A.E and Kaldor J.M (2011). Using population attributable risk to choose HIV prevention strategies in men who have sex with men. BMC Public Health 2011, 11:247

Hagan, H. (2003). The relevance of attributable risk measures to HIV prevention planning. *AIDS* vol.17:911–913.

Henwood, N. (2005). Commentary South Africa’s Industrial Health Research Group comments Journal of Public Health Policy. Palgrave.

Hosmer, D.W and Lemeshow, S (2000). *Applied logistic regression.* (2^{nd} ed). New York: John Wiley and Sons, Inc.

Huba, G. J., Panter, A. T., Melchior, L.A., Trevithick, L., Woods, E. R., Wright, E., Sturdevant, M., Goodman, E., Hodgins, A., Wallace, M., Brady, R.E.,Singer, B. & Marconi, K (2003). Modelling HIV risk in highly vulnerable youth. Structural equation modelling. Lawrence Erlbaum Associates, Inc. 10(4), 583-608.

Iipinge, S. Hone, K. & Friedman, S. (2004). *The relationship between gender roles and HIV infection in Namibia.* Windhoek , University of Namibia.

Indongo, I.N.K (2007). *Contraceptive use among young women in Namibia: determinants and policy implications*. Pretoria. University of Pretoria.

Jackson, H. (2002). *AIDS Africa: Continent in crisis*. Zimbabwe, Harare

Jekel, F,J., Elmore, J.G., Katz, D.L (1996). *Epidemiolgy, Bioststistics and Preventive Medicine*. Philadelphia: W.B Saunders Company.

Kleinbaum, D.G. (1994). Logistic regression: *A self-learning text.* New York: Springer Verlag.

Kim and Pang (2007). The effect of male circumcision on sexuality. *BJU International.* Vol 99, (3) .

Koepsell, T.D., and Weiss,N.S. (2003). *Epidemiologic Methods: Studying the occurrence of illness*. Oxfrod: Oxfrod University Press.

Leigh, B.C. And Schafer, J.C(1993). Heavy drinking occasions and the occurrence of sexual activity. *Psychology of Addictive Behaviour.* **7:** 197-200.

MacLean, A. (2006). *Community involvement in youth reproductive health and HIV prevention. A Review and analysis of the literature*. Family Health International. Arlington, Virginia.

Mackesy-Amiti M.E., McKirnan D.J, and Ouellet L.J (2010). Relationship characteristics associated with anal sex among female drug users. *Sexually Transmitted Diseases*, 37(6):346-351.

MacPhail,C., Williams, B. G., & Campbell, C. (2002). Relative risk of HIV infection among young men and women in a South African township. Auckland Park. South Africa. *International Journal of STD and AIDS,*13.

Mba, C. J. (2003). *Sexual behavior and the risk of HIV/AIDS and other STDs among young people in Sub-Saharan Africa*. A review.

Mbamalu, W.O (2004). *Christian ethics and HIV/AIDS prevention*: A focus on the youth of Gauteng.

McEwan, R.T., McCallum, A., Bhopal, R.S. and Madhok, R (1992). Sex and the risk of HIV infection: The role of alcohol. *British Journal of Addiction*. **87:** 577-584.

Mickey, J., and Greenland, S. (1989). A study of the impact of confounder selection criteria on effect estimation. *American journal of Epidemiology,* 129, 125-139.

Mishra, V., Barrere,B., Hong, R., and Khan,.S. (2008). Evaluation of bias in HIV seroprevalence estimates from national household surveys. Sex Transm Infect 2008;84 (Suppl I):i63–i70.

MoHSS (2012). *Report on the 2012 National HIV Sentinel Survey.* Windhoek, Ministry of Health and Social Services.

MoHSS (2011). *No Namibian Should die from AIDS: Universal access in Namibia, Scale up, Challenges and way forward*. Windhoek, Ministry of Health and Social Services

MoHSS (2010) *Progress Report on the Third Medium Term Plan on HIV/AIDS*. Windhoek, Ministry of Health and Social Services

MoHSS and UNAIDS (2010). *Review of Universal Access Progress in Namibia*. Windhoek, Ministry of Health and Social Services.

MoHSS (2009a). *Estimates and Projections of the Impact of HIV/AIDS in Namibia*. Windhoek, Ministry of Health and Social Services.

MoHSS (2009b). *HIV/AIDs in Namibia: Behavioral and Contextual Factors Driving the Epidemic*.Windhoek: Measure Evaluation

MOHSS, (2008). *Report on National HIV Testing day*. Windhoek, Ministry of Health and Social Services.

MOHSS, (2007a). *National Guidelines for antiretroviral therapy*. (2nd ed). Windhoek, Ministry of Health and Social Services.

MOHSS, (2007b). *National Policy on HIV/AIDS*. Windhoek, Ministry of Health and Social Services.

MoHSS (2007c). *Republic of Namibia National Policy on HIV/AIDS*. Windhoek, Ministry of Health and Social Services.

MOHSS, (2007d). *A guide to HIV and AIDS workplace programmes*. Windhoek, Ministry of Health and Social Services

MOHSS, (2006/7). *Namibia Demographic and Health Survey*. Windhoek, Ministry of Health and Social Services.

MoHSS, (2006). *Guidelines for voluntary counselling and testing*. (1st ed). Windhoek, Ministry of Health and Social Services

MOHSS, (2004). *National strategic plan on HIV and AIDS: Third medium term plan*

2004-2009. Windhoek, Ministry of Health and Social Services

Msiska, R. M. (2003). *Mainstreaming HIV and AIDS into poverty reduction strategies.* Pretoria: University of South Africa.

Namibia Demographic and Health Survey (2006/7). Windhoek, Ministry of Health and Social Services

Namibia Statistics Agency (2012). *Namibia Labour Force Surevy, Report.* Windhoek: Namibia Statistics Agency.

Namibia Statistics Agency (2011). *Namibia Population and Census Basic Report*. Windhoek: Namibia Statistics Agency.

Oguntibeju, O. O. Van Chalky, F. E. & Van Den Heaver, W. M. J. (2003). *Factors responsible for the epidemic and the impact of HIV/AIDS. School of health technology.* Faculty of Health & Environmental Science. Bloemfontein, South Africa.

Otaala, B. (2000). HIV/AIDS. The challenge for Tertiary Institutions in Namibia. *Proceeding of a workshop held from October 9th-11th, 2000*. Windhoek, Namibia.

Parker, W., and C. Connolly. 2008. *Namibia: HIV/AIDS Community Survey Report: Rundu, Walvis Bay, Keetmanshoop. Oshakati*. Windhoek: NawaLife Trust.

Pettifor, A. E., Rees, H. V., Kleinschmidt, I ., Steffenson, A. E., MacPhail, C., Hlongwa-Madikizela, L., Vermaak, K. & Padian, N. S. (2005). Young people's sexual health in South Africa. HIV prevalence and sexual behaviors from a nationally representative household survey. *AIDS* . 19(14), 1525-1534.

Piot, P., Laga, M Ryder R., Perriens, J., Temmerman, M.,; Heyward, W., and Curran, J W. (1990). The Global Epidemiology of HIV Infection: Continuity, Heterogeneity, and Change. Journal of Acquired Immune Deficiency Syndromes: Vol 3(4)

Rockhill, B., Newman, B., and Weiberg, C. (1998). The use and misuse of attributable risk fractions. *American journal of public health,*;Vol 88, No.1.

Rothman,K,J., Greenland,S. (1998). *Mordern Epidemiology*. (2nded). Philadelphia; Lippincott Williams and Wilkins.

Sabone, M., Ntsayagae,. Brown, M. S., Seboni, N. M., Mogobe, K. D. & Sebego, M. (2007). Perceptions of undergraduate students not participating in HIV/AIDS prevention in Botswana. *International Nursing Review*, 54, 332–338.

Salazar, X., Caceres, C., Rosasco, A., Kegeles, S., Maiorana, A., Garate, M., Coates, T. & The NIMH collaborative HIV/STIs prevention trial group (2005). *Vulnerability and sexual risks. Vagos and vaguitas in a low income town in Peru. Culture, Health & Sexuality*. Routledge, Taylor & Francis. 7(4).

Shapumba, T. Apollus, F. Wilkinson, W. & Shifiona, N. (2004). *Socio-cultural and operational research approach to adolescent and youth sexual and reproductive health. Oshana Region*. Windhoek: University of Namibia.

Simbayi, L. C. Kalichman, S. C., Jooste, S. Cherry, C. Mfecane, S. & Cain, D. (2004). Risk factors for HIV-AIDS among youth in Cape Town. South Africa. *AIDS and behavior, Vol 9*,(1)

Talavera, P. (2002). *Challenging the Namibian perception of sexuality. A case study of the Ovahimba and Ovaherero culture-sexual models in Kunene North in an HIV /AIDS context*. Windhoek, Grasberg Macmillan Publishers.

Tenkorang E.Y (2014). Marriage, widowhood, divorce and HIV risks among women in sub-Saharan Africa. Oxford University Press .

Taylor J R., Lockwood A.P. and Taylor A.J.(1996). The prepuce: specialized mucosa of the penis and its loss to circumcision. Br J Urol. Vol77(2):291-5.

UNAIDS (2012). *Report on the global HIV/AIDS epidemic*. Geneva. Switzerland.

UNAIDS (2011). *AIDS epidemic update*. Geneva. Switzerland

UNAIDS (2010).Combination HIV prevention: Tailoring and Coordinating Biomedical, Behavioural and Structural Strategies to Reduce New HIV Infections. *A UNAIDS Discussion Paper.* Geneva. Switzerland.

Van Niekerk, A. A. & Kopelman, L. M. (2005). *Ethics and Aids in Africa: The challenge to our thinking.* South Africa, Claremont.

Varga, C. A. (2000). Condom Dilemmas. Dynamics of protected sex in high risk group in South Africa. In containment of the AIDS epidemic. *Social and behavioral research.* Health transition center. National Center for Epidemiology and Population Health. Canberra: The Australian National University.

Viera AJ (July 2008). "Odds ratios and risk ratios: what's the difference and why does it matter?". *South. Med. J.* 101 (7).

Visser, M. J. (2005). Life skills training as HIV/AIDS preventive strategy in Secondary Schools, evaluation on a large–scale implementation process. *Journal of social aspects of HIV/AIDS,* Volume 2 (1),

Wasserheit J.N (1992). Epidemiological synergy. Interrelationships between human immunodeficiency virus infection and other sexually transmitted diseases. Sex Transm Dis. Vol 19(2):61-77.

Weissman, A. Cocker, J. Sherburne, L. Powers, M. B. Lovich, R. & Mukaka, M. (2006). Cross–generational relationships. Using a Continuum of Volition' in HIV prevention work among young people. *Gender & development Vol. 14*(1)

WHO (2007). *Commission on Social Determinants of Health. A Conceptual framework for action on the Social determinants of health. Discussion paper for the Commission on Social Determinants of Health*

WHO and UNAIDS (2007). *AIDS epidemic update.* Geneva. Switzerland

WHO (2005). *WHO multi-country study on women's health and domestic violence against women: Summary report of initial results on prevalence, health outcomes and women's responses*. Geneva, World Health Organization.

APPENDICES

Appendix 1: Request to conduct research, USAID

UNIVERSITY OF NAMIBIA

Private Bag 13301, 340 Mandume Ndemufayo Avenue, Pionierspark, Windhoek, Namibia

31/05/2012

To: USAID NAMIBIA
Windhoek
Namibia

From: Isak Neema (Dr)
Head: Department of Statistics
Faculty of Science
Tel: 061-2063495 email: ineema@unam.na

Re: Request for permission to collect voluntary counselling and testing (VCT) data for 2010 - 2011 for research purposes

Mr. Richard Chamboko student number: 201127466, is a registered postgraduate student at the University of Namibia and is currently undertaking his research titled: **A statistical analysis of Voluntary Counselling and Testing (VCT) data to determine the HIV risk determinants in Namibia** a research geared toward the fulfilment of the requirement of the Master of Science in Statistics. It is for this purpose that Mr Richard Chamboko is requesting for permission to collect the 2010 - 2011 VCT data for analysis.

As the HoD and his supervisor, I assure you that the data will be treated with strictest confidence and will not be used for any other purposes other than the intended as above without any other additional request and will be deleted upon completion of this study. Please do not hesitate to contact me if I can be of any further assistance in this regard.

Yours faithfully

....

Appendix 2: Request to conduct research, MoHSS

UNIVERSITY OF NAMIBIA

Private Bag 13301, 340 Mandume Ndemufayo Avenue, Pionierspark, Windhoek, Namibia

31/05/2012

To: The Permanent Secretary
Ministry of Health and Social Services
Private Private bag 13198, Windhoek
Namibia

From: Isak Neema (Dr)
Head: Department of Statistics
Faculty of Science
Tel: 061-2063495 email: ineema@unam.na

Re: Request for permission to collect voluntary counselling and testing (VCT) data for 2010 - 2011 for research purposes

Mr. Richard Chamboko student number: 201127466, is a registered postgraduate student at the University of Namibia and is currently undertaking his research titled: **A statistical analysis of Voluntary Counselling and Testing (VCT) data to determine the HIV risk determinants in Namibia** a research geared toward the fulfilment of the requirement of the Master of Science in Statistics. It is for this purpose that Mr Richard Chamboko is requesting for permission to collect the 2010 - 2011 VCT data for analysis.

As the HoD and his supervisor, I assure you that the data will be treated with strictest confidence and will not be used for any other purposes other than the intended as above without any other additional request and will be deleted upon completion of this study. Please do not hesitate to contact me if I can be of any further assistance in this regard.

Yours faithfully

…………………

Appendix 3: Approval from Ministry of Health and Social Services.

9 - 0/0001

REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 13198
Windhoek
Namibia
Enquiries: Ms. E.N Shaama

Ministerial Building
Harvey Street
Windhoek
Ref: 17/3/3

Tel: (061) 2032510
Fax: (061) 222558
E-mail: eshaama@mhss.gov.na
Date: 06 July 2012

OFFICE OF THE PERMANENT SECRETARY

Mr. Richard Chamboko
P.O. Box 21458
Windhoek

Dear Mr. Chamboko

Re: A statistical analysis of Voluntary Counselling and Testing (VCT) data to determine the HIV risk determinants in Namibia

1. Reference is made to your application to conduct the above-mentioned study.

2. The proposal has been evaluated and found to have merit.

3. Kindly be informed that permission to conduct the study has been granted under the following conditions:

3.1 The data to be collected must only be used for completion of your Master's Degree of Science in Statistics;
3.2 No other data should be collected other than the data stated in the proposal;
3.3 A quarterly report to be submitted to the Ministry's Research Unit;
3.4 Preliminary findings to be submitted upon completion of study;
3.5 Final report to be submitted upon completion of the study;
3.6 Separate permission should be sought from the Ministry for the publication of the findings.

Yours sincerely,

MR. ANDREW NDISHISHI
PERMANENT SECRETARY

"Health for All"