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UNIVERSITY OF THE WITWATERSRAND

FACULTY OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

RESEARCH REPORT

TITLE: Household and Individual Level Factors Associated with HIV Infection in KwaZulu-Natal

Oscar Bangre

A Research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg in partial fulfilment of the requirements for the Degree of Master of Science in Medicine in the field of Population-Based Field Epidemiology.

Johannesburg, South Africa. 2009

Declaration

I, Oscar Bangre, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Medicine in the Field of Population-Based field Epidemiology at the University of the Witwatersrand, Johannesburg. This research report has not been submitted before for any degree or examination at this or any other University.



.....[Signature of candidate]

.....21st .....day of ...September.. [Month], 2009.

Research Report for Master of Science in Medicine in the Field of Population-Based Field Epidemiology.

Dedication

I dedicate this work to my beloved wife, Mrs. Mary A. Bangre and my family for their unflinching support, love and enduring my absence for the entire duration of my studies at the University of the Witwatersrand in Johannesburg, South Africa.

Abstract

Background:

Sub-Saharan Africa continues to bear the brunt of the global HIV epidemic, with the epicentre located in Southern Africa. Of all the adult and children living with HIV globally in 2006, two-thirds (63%) were in sub-Saharan Africa.[1] The epicenter of the HIV/AIDS epidemic in South Africa is located in the KwaZulu Natal province, where HIV incidence and prevalence continue to remain high and this has serious implications for HIV prevention and control programmes.

Objectives

i. To profile individuals who sero-converted during the period 2003-2007 in order to better target interventions.

ii. To estimate the incidence rate for HIV during the period 2003 to 2007.

iii. To identify factors associated with HIV infection at individual and household levels in Kwazulu-Natal.

Methods

This involved analysis data of a dynamic cohort study. The follow-up period was 2003-2007, and the study was a household-based HIV sero-prevalence survey of a population in Kwazulu Natal, South Africa, conducted by the Africa Centre for Health and Population Studies. The cohort comprised females aged 15 to 49 and males 15 to 54 years who participated in the baseline HIV sero-prevalence survey in 2003 and/ or subsequent surveys in 2005, 2006 and 2007. Individuals who participated in at least two surveys and had a negative HIV result on first enrolment were included in the analysis.

Selected demographic, socio-economic, behavioural and geographic variables of the participants were obtained from the demographic surveillance system (DSS) database of the Africa Centre Demographic and Information System (ACDIS) for analysis.

Profiles of recently HIV sero-converters were based on these variables and descriptive statistics used to compare the differences in sero-conversion between the different strata of each variable. Multiple logistic regression was used to investigate the association between variables of key interest.

Results

A total of 39, 738 individuals were surveyed for the four annual sero-prevalence surveys conducted from 2003-2007. Of these, 41.5% (n=16,491) were HIV negative on their first enrolment into the study, 11.6% (n=4610) were HIV positive on first enrolment, while 46.9% (n=18,637) had either participated in just one out of the four surveys, or were non-resident at baseline. These two categories of participants as well as those who tested HIV positive on first enrolment were dropped from the analysis.

The final sample size used for analysis was 16,491 individuals and comprised 8,425(51.1%) females aged 15-49 years old and 8,066 (48.9%) males aged 15-54 years old.

The incidence rate for HIV sero-conversion among the 16, 491 individuals included in the final analysis was 11.5 per 1000PYs during the follow-up period. In other words, 539 individuals sero-converted during 46818.15 person-years (PYs) at risk from 2003-2007. This was much higher incidence rates reported for other provinces in South Africa.

A significant proportion of the new HIV acquisitions (69.8%) occurred in households without any recently or previously infected household member, and women had a significantly greater risk of HIV infection(IR= 16.9 per 1000PYs; 95% CI: 15.33-18.640) compared to men(IR=5.9; 95% CI: 4.95-6.94) in this study area.

Conclusion

The younger age bracket (24-30 years old) was associated with significantly higher risk of HIV infection compared to the older age category. However, the age group 20-24 years bears the greatest burden of HIV pandemic in this community. Majority of seroconverters were rural dwellers but peri-urban dwellers had the greatest risk of HIV acquisition.

The study also showed that attendance of a school or a training facility on a full-time basis during the follow-up period was protective for HIV acquisition compared. Also, attainment of standard 10 to 12 level of education was associated with a greater risk of HIV seroconversion. This can be attributed to the age of individuals at these levels of education and the associated high risk profile of this group. Living in close proximity to primary or secondary roads was also associated with a risk of HIV infection compared to those living far from major roads. This could be due to the ease of mobility and potential exposure multiple sex partners. This may be due to a desire for modern social amenities which requires financial wherewithal, which in turn facilitates transactional sex.

Acknowledgement

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Definition of Terms

1. Demographic Surveillance System: This is a set of field and computing operations to handle the longitudinal follow-up of well-defined entities or primary subjects (individuals, households, and residential units) and all related demographic and health outcomes within a clearly circumscribed geographic area (INDEPTH Network).

2. Migrant: An individual who moves from one homestead to another within the demographic surveillance area.
3. Always resident members: These are individuals who are always resident in the demographic surveillance area.
4. Homestead: a bounded structure used for residential purposes only.
5. Household: This is a social group of one or more individual members. They may be related or not related.
6. Sero-converter: an individual with a baseline negative HIV test result and a later or subsequent positive HIV result during the period of follow-up.

Abbreviations and Acronyms

ACDIS: Africa Centre Demographic and Information System

AIDS: Acquired Immune Deficiency Syndrome

DSA: Demographic Surveillance Area

DSS: Demographic Surveillance System

HIV: Human immunodeficiency virus

MDG: millennium development goal

SES: Socio-economic status

Chapter One: Introduction and Literature review, aims and objectives

Introduction:

This chapter provides an overview and update of global, regional and specific national HIV epidemics including HIV prevalence, incidence, trends and burden of the HIV pandemic. In addition, published literature on risk factors for HIV infection is reviewed in relation to the research question being explored.

1.1 Background

The Human Immunodeficiency Virus (HIV) pandemic has become a catastrophic global scourge with dire social, developmental and economic ramifications to all nations. The HIV pandemic has defied all attempts at effective control despite substantial financial and material investments by governments, research institutions and multilateral agencies. This was given credence by former UN secretary General, Kofi Annan, when he stated that, "the global AIDS epidemic is one of the greatest challenges facing our generation. AIDS is a new type of global emergency—an unprecedented threat to human development requiring sustained action and commitment over the long term." [1] In South Africa where the epicentre of this global HIV pandemic is located, the extent of the likely impact of the HIV and AIDS epidemic upon South African society has become clearer in recent years, as results of primary research and modelling exercises have begun to converge upon an increasingly consistent picture, of the probable magnitude and scope of AIDS in this country.[2] Due to HIV/AIDS, South Africa's population will be 44 % smaller in 2050 than it would have been without the epidemic[3]. These Projections should, however, be taken cautiously as demographic changes and socio-economic factors can over-turn these estimates.

1.2 Global view of the HIV epidemic

In 2006, there were 39.5 million people living with HIV globally, and almost two-thirds (63%) of these (adult and children) lived in sub-Saharan Africa (estimated as 24.7 million), with its epicentre in southern Africa. In addition, almost three quarters (72%) of all adult and child deaths due to AIDS in 2006 occurred in sub-Saharan Africa: 2.1 million (1.8 million – 2.4 million) of the global total of 2.9 million (2.5million – 3.5 million).**Error! Reference source not found.** Overall, Sub-Saharan Africa was home to an estimated 24.7 million (21.8 million – 27.7 million) adults and children infected with HIV in 2006, which is 1.1 million more than in 2004.[4]

One third of all people living with HIV globally lived in southern Africa and 34% of all deaths due to Acquired Immune Deficiency Syndrome (AIDS) in 2006 occurred there. The number of newly infected persons was 4.3 million and deaths stood at 2.9 million, for the same period[4, 5].

1.3 HIV trends in sub-Saharan Africa

In sub-Saharan Africa, declines in national HIV prevalence are being observed in some countries, but such trends are currently neither strong nor widespread enough to diminish the epidemic's overall impact in this region. From results of regularly updated trend analysis by UNAIDS/WHO, there is evidence of diminishing or stable HIV spread in most East and West African countries, along with signs of growing epidemics in a few countries. In Southern Africa, only Zimbabwe presents evidence of a strong decline in national HIV prevalence. In several other countries, including South Africa, the epidemics do not yet show signs of abating.[5]

West and Central Africa's smaller epidemics show divergent trends. There are signs of declining HIV prevalence in urban parts of Burkina Faso, Côte d'Ivoire and Ghana, but

in Mali the epidemic appears to be growing[4]. Both HIV prevalence rates and the numbers of people dying from AIDS vary greatly between African countries. In Somalia and Senegal the HIV prevalence is under 1% of the adult population; West Africa has been less affected by AIDS, but the HIV prevalence rates in some countries are creeping up. HIV prevalence is estimated to exceed 5% in Cameroon (5.4%), Côte d'Ivoire (7.1%) and Gabon (7.9%) in 2005.[6, 7]

Until recently the national HIV prevalence rate has remained relatively low in Nigeria, the most populous country in sub-Saharan Africa. The rate has grown slowly from below 2% in 1993 to 3.9% in 2005. However, some states in Nigeria are already experiencing HIV infection rates as high as those now found in Cameroon. Already around 2.9 million Nigerians are estimated to be HIV infected and adult HIV prevalence in East Africa exceeded 6% in Uganda, Kenya and Tanzania in 2005. [6,7]

One recent development in sub-Saharan Africa is the emergence of injecting drug use as a potential risk factor in the HIV epidemic in several countries, notably those of Kenya and Tanzania as well as Nigeria and South Africa[4]. Comparison of HIV trends at the national level is, however, made particularly problematic by the paucity of satisfactory longitudinal data[8].

Across the Sub-Saharan Africa region, women bear a disproportionate part of the AIDS burden: not only are they more likely than men to be infected with HIV, but in most countries they are also more likely to be the ones caring for people living with HIV[5,9]

1.4 Southern Africa HIV Situation

The HIV epidemics in Mozambique, South Africa and Swaziland continue to grow. An estimated one in three (33%) adults in Swaziland were HIV infected in 2005 – the most

intense epidemic in the world[4]. In four southern African countries, the national adult HIV prevalence rates have risen higher than was thought possible and now exceeds 20%. These countries are Botswana (24.1%), Lesotho (23.2%), Swaziland (33.4%) and Zimbabwe (20.1%), while in South Africa and Zambia around 15-20% of adults are infected with HIV.[6,7]

1.5 South Africa's HIV situation

In South Africa, some 3.5million (4.9 million – 6.1 million) people including 240,000 (range: 93,000 – 500,000) children younger than fifteen years, were living with HIV in 2005 and HIV data gathered in the country's extensive antenatal clinic surveillance system suggest that HIV prevalence has not yet reached a plateau.[4,10]

According to Statistics South Africa, HIV/AIDS caused the deaths of 53,185 men aged 15-59 years, 59,445 women aged 15-59 years, and 40,727 children under 5 years old in the year 2000, and increased the mortality by 13% in year 2000. It also projected that, between 2000 and 2015, there will be 9.3 million AIDS deaths, representing a 195 % increase in mortality.[11, 12] By 2045-50, South Africa will have the world's 10th-lowest life expectancy at birth and between 2000 and 2050; life expectancy will be 27 to 41 years lower than it would have been in a no-AIDS scenario. [12] this is based on the assumption that no demographic and socio-economic changes which is most unlikely.

1.6 Kwazulu Natal's HIV situation

KwaZulu-Natal (KZN) is South Africa's largest province situated on the east coast. It has a population of 8.4 million and is about 45% urban. Africans, primarily Zulu-speaking, make up 76% of the KZN population, Indians 14%, whites 7% and 3% mixed race.[13]

The epicenter of South Africa's HIV epidemic is in KwaZulu Natal province, where most communities are being ravaged by a generalized HIV/AIDS epidemic. According to antennal prevalence data, KZN has the highest level of HIV infections in South Africa, with an estimated 36% of antenatal attendees HIV positive in 2000[14]. In 2004, the national HIV prevalence among pregnant women attending public sector antenatal clinics reached approximately 30% while that for KZN rose to 41%.[15]

National survey data from 2001 estimated HIV prevalence among all adults in KZN to be 12%, attributable to widespread labour migration and its association with multiple partners, lack of condom use, the high value men place on multiple partners, high level of poverty and poor health services[16]. Statistics South Africa has also shown that for the period 2001-2006, Life expectancy at birth for females is the highest in the Western Cape (67 years) and lowest in KwaZulu Natal (less than 50 years). This can be attributed largely, to the continued very high prevalence of HIV, 36.2% (95%CI: 33.4 – 39.0) in this Province.[17, 18]

In KZN, where early age of childbearing is common and HIV prevalence is high, adolescents may place themselves at risk of HIV because of positive or ambivalent attitudes towards pregnancy and this in turn reduces their motivation to abstain from sex, have sex less often or use condom.[13]

The theory that socio-demographic factors and socio-economic status constitute risk factors for HIV, in that they lie in the pathway of the natural history of HIV outcome,[10] could partly explain the HIV situation in KZN.

The generalized and intense nature of the HIV/AIDS epidemic in the KZN merits a sustained and comprehensive investigation of all spheres of the disease, both at the

household and individual levels in this community. The findings of such investigations will inform policy makers about optimal placement and targeting of HIV prevention interventions. A comprehensive profiling recently HIV sero-converted persons and an assessment of the household and individual level predictive factors for HIV infection risk in KZN will provide important leads to the fight against HIV in this and other communities.

Literature Review

1.7 Risk factors for HIV infection

Several risk factors for HIV infection have been identified to date. Among Brazilians, injecting cocaine, having an HIV-positive partner and having male-male sexual unions may each significantly increase the risk for HIV infection.[19] In sub-Saharan Africa, the main risk factor for HIV infection in adults is unprotected heterosexual sex. Dorrington et al.[20] established an association between risky sexual behaviour and high socio-economic status in their investigation of demographic impact of HIV/AIDS in South Africa. In Uganda, male circumcision was associated with reduction of HIV risk. [21]

Saurez T and Kauth MR[22] found that Behavioural predictors of HIV infection from unprotected anal intercourse include, multiple anonymous or casual sexual partners, a history of sexually transmitted infection, engaging in sex while under the influence of alcohol or drugs and sex with injection drug users and that HIV/AIDS remains the single largest health problem facing gay and bisexual men today.

1.8 Gender, Partner violence and HIV

A study of women seeking antenatal care in Soweto, South Africa found that the experience of being physically and/or sexually assaulted by a male intimate partner or experiencing one of these a few times or more , was associated with increased risk of HIV infection.[23] This study also found that the Association between high levels of male control in a woman's current or most recent relationship and her HIV risk also persisted after adjustment for risk behaviour and intimate partner violence.[23]

In addition, they found that Women currently in relationships with high levels of male control were more likely to report recent and previous partner violence.

Though this study contributed to expanded evidence that experience of violence and controlling behaviour from male partners is associated with increased risk of HIV infection for women, the results could not be considered definitive since reported frequency of these types of violence was low.

Among young rural South African women, having experienced intimate partner violence is strongly associated with a certain risk factor for HIV infection, according to an observational analysis.[24]

Pettifor AE et al[25], also found that, women who were HIV sero-positive were significantly more likely to have had more than one lifetime sexual partner, to be 20-24 years of age, to have completed high school, to be of black African race, and to be single.

Women with limited sexual power are more likely to be HIV infected because it will increase her risk of HIV infection primarily by compromising her ability to use condom consistently.[26,27]

1.9 HIV infection and socio-economic status

HIV infection is linked to poverty because of poor health care infrastructure, greater social density, social isolation leading to closed sexual networks, alcohol and drug abuse, and engaging in sex in exchange for survival resources.[28]

Poverty related stressors were also associated with alcohol and drug use and it was found that substance use was related to HIV risk behaviour. The limitation of this study was that the data was solely from self reported instruments hence subject to all the limitations of self report bias. Difference in interviewing method could also lead to confounding.

A study in urban Kenya found a higher number of HIV infections in those who had exchanged sex for gifts and who had their first sexual encounter with a partner more than 5 years their senior. These finding are consistent with other data from African settings in which sexual relationships borne out of economic and age asymmetries are associated with poor condom use and higher HIV transmission.[29]

Growing scientific evidence points to the pervasiveness of socio-economic inequalities in health both between and within countries at any stage of development. The relationship between socio-economic status and illness and death is observed to be an inverse one, with morbidity and mortality concentrated in those at the lowest end of the socio-economic scale. Socio-economic inequalities in health manifest in all age groups.[30]

Though a major predictor of heath status at the household and individual level, socio-economic status in rural setting is difficult to measure because of unavailable or inaccurate information on income and expenditure required to compute it.[31,32]

Hence proxy measures such as principal component analysis have been used to assess socio-economic status of household in the absence of income and expenditure data. This technique involves the use of statistical procedure of principal components to determine the weights for an index of the asset variables by extracting from a set of variables, those few orthogonal linear combinations of the variables that capture the common information

most successfully.[33, 34] The main limitation of this measure is its inability to establish the temporality between the time of acquisition of asset and the event of key interest.

In countries like South Africa with high degrees of socio-economic inequality, the existence of morbidity and mortality differentials related to socio-economic status is not unexpected. However, policies aimed at reducing inequities need to be based on a sound\ assessment of the nature, magnitude and determinants of the problem, as policy decisions based on intuition are likely to be misguided.[35]

Consequently, there has been a recent upsurge of interest in socio-economic inequalities in health with the renewed commitment of governments and international organizations to improve the health of the poor.[36]

1.10 HIV infection and age-mixing

A study on adolescents by Jaspan HB, et al.,[37] found that older age was associated with HIV positive status. They found that the HIV positive adolescents had had a significantly larger number of lifetime partners than HIV negative adolescents. In addition females who had experienced coercive sex were three times more likely to be HIV infected, and the average age of sexual debut was 14.6 years (SD 2.0, range 7 -19 years) for the 99/356 (32%) who reported having ever had sex. Of all sexually active adolescents, 25% reported experiencing their sexual debut with someone who was more than five years older (n=26), 24 of whom were females.[37]

In a related study, Luke N[29] found a higher number of HIV infections in those who had exchanged sex for gifts and who had their first sexual encounter with a partner more than 5 years their senior. These finding were consistent with other data from African settings, in which sexual relationships were borne out of economic and age asymmetries, which in turn were associated with poor condom use and higher HIV transmission[29].

In a study on sexual power and HIV risk in South Africa, however, Pettifor AE et al.,[25] reported that no significant associations were found between HIV and recent experience of transactional sex, having an older partner or young age of coital debut.

The practice of anal and sex among people in the younger age group (11-13 years) raises concerns of misconceptions in these youth around risk associated with such sex.[37]

A survey on sexual initiation and childbearing among girls in KZN found that, 796 out of 1695 interviewed, (47%) reported that they had already had sex and of these, the age at first sexual intercourse ranged from 10 to 21 years old with the mean age at 16 years. On average, these girls first had sex with boys who were about four years older than them, but the age of the partners with whom they first had sex ranged from 8 to 42 years.[38]

1.11 HIV and substance (alcohol) use

According to Morojele NK et al.,[39] alcohol consumption has become common and widespread in most communities in South Africa and is most characteristic of unemployed people and those who frequent drinking venues.

Drinking venues are frequented mainly by men in their twenties and thirties and women in the venues are generally younger, with some appearing less than 18 years old and that, women would drink mainly at social gatherings such as parties and jazz concerts. Those who would drink heavily on a regular basis were more likely to attribute their drinking to economic, social and psychological problems.

Most of the men report having two or more serious or regular partners and at least one casual sexual partner. For the men in the city site in particular, having casual partners was described as exciting, pleasurable and risky. To have such relationships seemed to be

an important part of their masculine identity. Younger single women were more likely to frequent the drinking venues and meet and have sex with typically older men.[39]

1.12 HIV and Condom use

In a nationally representative HIV-serostatus survey of men and women 15-24 years old in households, Pettifor et al.,[24] reported that HIV prevalence in 4066 sexually experienced women was 21% and most of these women (71%) reported inconsistent condom use and 12.8% reported having had more than one sexual partner in the past 12 months. Almost 27% reported low relationship control and nearly 4% reported that they had been physically forced to have sex by their most recent partner in this study, the HIV positive women were also significantly more likely to be inconsistent condom users (78.7% versus 69.6%, P=0.01).

1.13 Migration and HIV risk

Several studies have established an association between migration and the spread of HIV and in Southern Africa as well as other places, migrants are very vulnerable to HIV infection.[40],[41],[42],[43],[44]

Migration has become a topical issue in HIV/AIDS discussions worldwide[40]. As Decosas and Adrien[42] put it, the "conditions of life during the voyage and at the site of destination" determines the association between HIV and migration rather than the situation at the origin of the migrant.

The predominantly circular migration in southern Africa has contributed significantly to the spread of HIV in this region.[42]

Karim SA et al.[45], showed that people who have recently migrated or changed their places of residence in Kwazulu-Natal, were three times more likely to be infected with HIV than those always resident. The risk difference was attributed to the higher

likelihood of migrants to have another sexual partner at their new destinations and also engage in unsafe sex and other risky behaviours. Other studies have also shown that returning migrant males may be infected with HIV by their resident female partners in rural areas. Lurie MN, et al.,[46] showed in their study on HIV-1 concordance and discordance among migrant and non-migrant couples in South Africa, that the direction of spread is not only from returning migrant men to their rural partners, but also from women to their migrant partners.

A study on male rural-urban migration in Tanzania and its interaction with sexual behaviour, Coast E.[47], found that both married and unmarried rural- urban migrants were not having sex in town and that the migrant population studied regulated its behaviour in a way that reflected local understandings of the AIDS disease. The phenomenon whereby, migrants are forced to return to their homes of origin due to their advanced state of illness to be care for by close relations[48] may also constitute a risk factor for the care givers in the case of HIV/AIDS.

1.14 HIV and education

In a systematic review, Hargreaves JR and Glynn JR[49] reported that most of the currently available data, predominantly collected before 1996, suggest that increased schooling was either not associated with HIV infection or was associated with an increased risk of HIV infection among men and women from both rural and urban communities in Africa. The association was stronger in rural areas and in older cohorts, but was similar in men and women. Conversely, increased duration of schooling was strongly protective against HIV infection among 21-year-old men in Thailand. A study in Côte d'Iviore found that educated people have a higher risk of HIV infection, because they are more likely to have several sexual partners, however, this effect is partly offset by a higher probability of

condom use relative to less educated people.[50] The link between educational attainment and HIV risk has therefore not been conclusively established and requires further investigation.

1.15 HIV and marriage

In Uganda, men were twice as likely as women to bring HIV infection into a marriage, presumably through extra-marital sexual behaviour. Within sero-discordant marriages, women become infected twice as fast as men, probably because of increased biological susceptibility. Married adults, particularly women, with HIV-positive spouses are at very high risk of HIV infection[51].

A study on marital status and risk of HIV infection in South Africa concluded that the "risk of HIV for married persons is complex. It depends on several socio-demographic and sex behaviour determinants that are related to both marital status and HIV. Demographic variables such as age, sex of the respondent, race, and socioeconomic status nullify the relationship between marital status and HIV status".[52]

Among married couples or persons in consensual unions, lack of knowledge of one's partner HIV status and risk profile predisposes one to a risk of HIV acquisition.

There is, however, limited information from longitudinal studies profiling recently HIV sero-converted persons and for optimal placement of targeted HIV prevention interventions, profiling persons who have recently HIV sero-converted in area with very intense HIV epidemic is urgently required. Besides, the emergence of drug-resistant strains in initial HIV infections and rebounding viral loads, serve as a reminder that the epidemic is far from over. Most especially as, medical approaches to AIDS prevention currently used are minimally effective. Behaviour change interventions remain the most potent weapons we have against the spread of HIV/AIDS.[24]

Hence, this study is to profile recently sero-converted persons in an area in the KwaZulu Natal province of South Africa and to determine the some of the factors associated with HIV acquisition among recently sero-converted person using a truly longitudinal data on HIV sero-prevalence surveys conducted by Africa Centre for Health and Population Study, University of KwaZulu Natal for the period 2003-2007.

1.16 HIV prevention interventions

Several HIV prevention programmes rolled out in most African countries did not yield the needed reduction in new HIV infections. Uganda's HIV prevention interventions are among the most successful in Africa. The proportion of people infected with HIV in this country fell from 15% in the early 1990s to about 5% in 2001. Zimbabwe also achieved a decline in HIV prevalence from 32.1% in 2000 to 23.8% in 2004.[53] Though commendable, these declines may also be partly due increased mortality as well as drop in new infections. Other African countries have attained varying degrees of reduction in HIV incidence but the prevention programmes in Botswana, Namibia and South Africa seem to have little effect on HIV reduction.

In 2000, the South African Department of Health announced plans to provide of two "prevention of mother-to-child transmission" (PMTCT) sites in each province but there was no commitment to the provision of ARVs to pregnant women with HIV. Mass HIV/AIDS awareness campaigns in South Africa started in 1999 with the campaign "LoveLife" with many youth centre providing clinic and counselling services. Other prevention interventions include Soul City and Soul Buddyz) and "Khomanani" meaning 'caring together' have run since 2001.[54]

Condom use and distribution as a prevention strategy has led to a steady rise in condom use from 27% in 2002, 35% in 2005 and 62% in 2008. This partly account for the decline in HIV prevalence and incidence among teenagers and young adults [55]

In 2002, the Wider Life Orientation curriculum was implemented in school which allows pupils to receive HIV and sex education in a formal setting. This programme, however, has serious hindrances ranging from lack of trained teachers to unwillingness to teach the curriculum because of values and beliefs of individual teachers.

1.17 Research Question

The in-depth knowledge on the mode of transmission of HIV infection complemented by a commensurate level prevention education and campaign has not raked in the desired reduction in new HIV infections.

In Africa, the main mode of HIV infections is by unprotected heterosexual intercourse, with commercial sex workers, long distance truck drivers and migrant labour serving as a vehicle for spread[56]

Several HIV prevention programmes such as education on safe sex (evidenced by the popular slogan, ABC of HIV prevention, supply of free condoms) use of peer educators to target the most vulnerable groups have been going on for several years now.

The decentralization of voluntary HIV counseling and testing facilities and provision of antiretroviral drugs (ARVs) are some of the elaborate strategies to contain the HIV epidemic. In some countries in sub-Saharan Africa, HIV is notifiable condition. Others have a national policy of isolation of HIV /AIDS patients.[57]

While some of the prevention strategies have a profound effect on HIV reduction other have a rebound effect. For instance, individuals on ARVs can stay healthier and longer

and may become complacent by engaging in risky behaviour (such as having multiple sexual partners, unprotected sex, etc). This has the potential to spiral new HIV infections and re-infection. In other words, the rebound effect of ARVs on HIV prevalence can potentially fuel an increase in HIV incidence. To date, HIV incidence is clearly the reliable guage for effectiveness of the HIV prevention programmes.

What seems very illusive in the HIV fight is a clear understanding of the precise mechanisms that facilitate HIV sero-conversion. The critical period/minute window which determines whether one stays HIV negative or infected is clearly the missing link in finding a solution to the HIV puzzle.

To understand the dynamics of the HIV epidemic and to target and evaluate HIV prevention interventions, incidence data from Longitudinal HIV surveillance is most appropriate.[58]

The balance between staying negative and sero-converting depends on individual and household level situational factors. A clear understanding of these factors can improve the precision in timing and targeting of HIV prevention

1.18 Hypothesis:

Individual and household level factors of always resident persons are associated with an increased risk of HIV sero-conversion.

1.19 Aim

The aim of this study is to profile individuals who recently HIV sero-converted and identify the factors associated with HIV acquisition among the males ages 15-54 years and the females aged 15 -49 years individuals in KwaZulu-Natal.

1.19Specific Objectives

In females and males aged 15 -49 and 15 -54 years respectively, in Kwazulu-Natal:

i. To profile individuals who sero-converted in the Africa Centre Demographic Information System during the period 2003-2007 for optimal placement of preventive and targeted interventions.

ii. To estimate the incidence rate for HIV during the period 2003 to 2007.

iii. To identify factors associated with the risk of HIV infection at the individual and household levels in Kwazulu-Natal.

Chapter Two: Materials and Methods

This chapter describes the study design, study area and population, the study sample, data sources, data management, analysis plan, and ethical considerations.

2.1 Study Design

A cohort study design was employed in this research and involved the analysis of secondary data from a household-based HIV sero-prevalence survey of a population in KwaZulu-Natal Province. The baseline HIV sero-prevalence survey was started on the 24th June 2003 and subsequently repeated in 2005, 2006 and 2007, by the Africa Centre Demographic Information System (ACDIS). The population in this study area has been under longitudinal demographic surveillance since 1st January 2000 by ACDIS.[59]

The follow-up period of the cohort in this study was from24th June 2003 to 31st December 2007. Individuals who HIV sero-converted or who were lost to follow-up were censored and the amount of person-time they contributed to the at-risk group computed. Individual and household level data on each study participant were obtained from the demographic surveillance system (DSS) database of ACDIS.

2.2 Study Population and Area

The study population for this research project comprised residents (women 15-49 years; men 15-54 years) who consented to participate in the sero-prevalence surveys and provided a finger-prick sample for HIV testing. This population was from the Hlabisa and Mtubatuba municipalities of the Umkhanyakude District of Northern KwaZulu-Natal, South Africa and has been under longitudinal demographic surveillance by ACDIS since 1st January 2000.

The area under surveillance is 438 km^2 in size and includes a population of approximately 85 000 people who are members of approximately 11 000 households. The population is almost exclusively Zulu-speaking. The area is typical of many rural areas of South Africa in that while predominantly rural, it contains an urban township and informal peri-urban settlements. The area is thus characterized by large variations in population densities (20–3000 people/km^2). In the rural areas, homesteads are scattered rather than grouped. Most households are multi-generational with an average size of 7.9 members (SD = 4.7). Despite being a predominantly rural area, the principal source of income for most households is waged employment and state pensions rather than agriculture. In 2006, approximately 77% of households in the surveillance area had access to piped water and toilet facilities. Health services in the district include a district hospital and a network of 12 clinics. [60].

Information on vital events (births and deaths including cause of death), migrations (in and out-migrations), family compositions, conjugal relationships, pregnancies and parental status was collected on residents as well as non-residents who maintained membership of households in the demographic surveillance area (DSA), and was saved in a temporal relational database.[60]

This information was updated six monthly. Data on household economic status such as employment, assets ownership, education, water and sanitation, government grants as well as health status are captured. Key social and health changes are also examined. The DSS site carried out HIV sero-prevalence surveillance of all resident men age 15-54, all resident women age 15-49, as well as 12.5% of non-residents of these ages in 2003/2004 and repeated the surveys in 2005, 2006 and 2007.

Approximately 35% of the female and 40% of male household members, aged at least 18 years are not resident in the area. These non-resident members of households, however, maintain a close link with the resident members and return to the household periodically. This phenomenon is attributed to the high rate of circular migration among the adults in the area.

The possibility of linking data on individual and households to HIV/AIDS data makes the ACDIS database an ideal one to carry out this type of study.

2.3 Study Sample

The sample comprised a cohort of individuals aged 15-49 years for female and 15 -54 years for males, who had a negative HIV test on first enrolment into the HIV sero-prevalence survey, but had a positive test (sero-converted) at a later survey during the period 2003 to 2007

i. **Exclusion criteria:** Individuals aged 15-49 years (females) and 15-54 years (males) who had a positive HIV test result on first enrolment or participated in just one or none of the four annual HIV sero-prevalence surveys.

ii. **Inclusion criteria:** Individuals aged 15-49 years (females) and 15-54 years (males) with a negative HIV test result on first enrolment.

2.4 Data

Measurement:

Household factors include "household socio-economic status, government grant, location of household, distance to nearest primary (1º) or secondary (2º) road

Individual level factors considered were, age, sex, religion, employment, marital status, education and resident status.

The outcome measure is the follow-up HIV serological results for the 2005-2007sero-prevalence surveys.

2.5 HIV Sero-status Data Collection

Trained fieldworkers visited all eligible individuals at home. If necessary, they arranged workplace visits or out of hours appointments. Residents who were away for long periods were visited if the field workers or tracking team had information on their return. Fieldworkers made at least four visits to the household before registering a non-contact. A special tracking team made up to 10 attempts to find subjects who had moved within the area and also tracked non-residents as far as Durban (250 km) and Johannesburg (750 km) for consenting and HIV testing.

Written informed consent was obtained for HIV testing. Blood was collected by finger prick on filter paper (Schleicher and Schuell, 903 Guthrie cards) according to standard operating procedures. HIV status was determined by antibody testing with a broad based HIV-1/HIV-2 ELISA (Vironostika, Organon Teknika, Boxtel, and NL) followed by a confirmatory ELISA (GAC-ELISA, Abbott, Abbott Park, Illinois, USA). Testing was 'linked anonymous' but participants could access their results at any of 19 community-based counseling centres using a secret code system and receive appropriate post-test counselling.[59, 61]

2.6 Household Wealth Index Data

The data used for computing the household wealth index, using Principal Component Analysis (PCA) was obtained from ACDIS household socio-economic status survey database.

The household assets considered were: bed net, bed, bicycle, block-maker, car, car battery, electric stove with oven, electric hot plate, electric kettle, fridge/freezer, gas cooker, lorry/tractor, motorcycle/scooter, radio, sofa/sofa set, sewing machine, table/chair, telephone, cell-phone, television set, video cassette recorder and wheelbarrow. The PCA analysis showed a very significant level of missing information for greater than 60% of the households with sero-converted persons and this requires further investigation.

The data on household location and distance to the nearest primary or secondary road was obtained from the Geographic Information System (GIS) database.

2.7 Data Management

Data Extraction: Microsoft Structured Query Language (SQL) was used for the data extraction. The extracted data was saved as a text file and imported into STATA 10 (College Station, Texas 77845 USA) using "StaTransfer6'" as well as the STATA10 command "insheet".

Data cleaning and merging: This involved the checking of quality of the data for internal consistencies and validity of response as well as the count for each variable. Blank records were coded as "missing" and given a category during the analysis.

The duplicate entries were checked using STATA10 (College Station, Texas 77845 USA) command "duplicates report" and all duplicates removed from unique identifiers. The four HIV survey datasets were then merged to the "Households" and "Individuals" datasets using a project identity number which was unique for every individual. The variables for this research were then selected from the merged data.

Age was generated as a new variable, by calculating the difference in years between the date of birth and date of visit by the fieldworker at first enrolment. The date of sero-conversion was also computed as the midpoint between the last negative and first positive HIV test. Educational attainment and employment status were re-categorized.

2.8 Data analysis

Descriptive data analysis: individuals who recently HIV sero-converted were profiled using selected demographic, socio-economic, behavioural and geographic variables.

In addition, frequency tables and graphical presentations of recent HIV sero-converters were produced to describe the study population.

Inferential Statistics: Chi-square (χ^2) and t-test were used to compare the differences in HIV-infection between the different categories of the covariates. Cox proportional hazard regression technique was also used to quantify the relative risk of HIV infection between males and females, adjusting for other factors. Univariate logistic and multiple logistic regression analyses were used to determine the odds of HIV-sero-converting. The dependent variable is HIV sero-conversion and the explanatory variables are age, sex, residency status, highest educational status, marital status, school attendance, residence type, distance of household to the nearest primary or secondary road and receipt of government grant. Significance level was set at 5%. Potential confounders were controlled for in the multivariate model.

2.9 Ethical considerations

The study protocol was submitted to the Committee for Research on Human Subjects of the University of the Witwatersrand for ethical clearance and was given approval on 26 October 2007 with clearance Certificate Protocol Number M071041. Ethical approval for

the primary study was obtained from the Nelson Mandela Medical School Research Ethics Committee, University of KwaZulu-Natal, Durban. No incentives were provided to participants. Copies of the ethical clearance certificates of this study as well as that of the original study have been attached as appendices to this research report.

In addition, a data user agreement was signed between the investigator and the Africa Centre for Population and Health. The research report conformed to the ethical guidelines of the primary research project whose data was used in this analysis. The dataset used for this research report did not contain any information that would allow the investigator or anyone else to identify an individual respondent (it is anonymous), and the investigator only saw an internal identification number/code that neither he nor any of the other researchers involved in the study could translate into information that would allow one to identify an individual respondent.

Chapter Three: Results

This chapter is divided into two parts, i) descriptive analysis of the data and ii) inferential analysis.

A total of 39,738 individuals aged 15-49 years for females and 15-54 years for male were surveyed during the period 2003 to 2007 and of these, 41.5% (n=16,491) were HIV negative on first enrolment into the study while 11.6% (n=4,610) tested HIV positive on first enrolment and 46.9% (n=18,637) participated in just only one or none of the four annual HIV sero-prevalence surveys or were non-resident at baseline and were therefore, dropped from the analysis. All the individuals with a positive HIV result on first enrolment (n=4,610) were also dropped from the analysis.

The final sample size used for analysis was 16,491 individuals and comprised 8,425(51.1%) females aged 15-49 years and 8,066 (48.9%) males aged 15-54 years old.

Of the 16,491 individuals included in the final analysis, 3.3% (n=539) sero-converted while 15,952, representing 96.7%, did not sero-convert during the follow-up period.

A comparison of baseline sero-negatives and sero-positives in the 2003/2004 survey data in table 3.1 below showed that 16.7 % of females compared to 8.1% of males were sero-positive at baseline. Among resident indent individuals, 12.4% were sero-positive at baseline as opposed to 22.4% among non-resident who were also sero-positive. The highest baseline sero-positives occurred in the 30 -34 year age group in the 2003/04 survey while the least proportion of sero-positives occurred in the 15-19 year age group. These differences were all statistically significant ($p<0.001$)

Table 3.1 Comparison of baseline Sero-positives and sero-negatives in the 2003 HIV sero-prevalence survey

characteristic	Seronegative (n)	%	Seropositive (n)	%	Total	p-value
Sex:						
Female	9, 507	83.3	1, 908	16.7		
Male	8, 535	91.9	756	8.1	20, 706	P<0.001
Age group						
15-19	6, 090	96.2	238	3.8		
20-24	3, 794	87.6	535	12.4		
25-29	2, 113	78.6	575	21.4		
30-34	1, 740	77.1	516	22.9		
35-39	1, 719	81.7	384	18.3		
40-44	1, 725	85.3	297	14.7		
45-49	519	87.7	73	12.3		
50-54	342	88.1	46	11.9	20, 706	P<0.001
Resident status						
Resident	17, 355	87.6	2, 466	12.4		
Non-Resident	687	77.6	198	22.4	20, 706	P<0.001

The pattern of baseline sero-positves in the 2005 sero-prevalence survey (table 3.2) was similar to that of 2003 (table 3.1) except that more resident individuals were sero-postive at base line than non-resident. A greater percentage of peri-urban dwellers were sero-positive at baseline than rural and urban dwellers during the 2005 survey.

Table 3.2 Comparison of baseline Sero-positives and sero-negatives in the 2005 HIV sero-prevalence survey

Characteristic	Seronegative (n)	%	Seropositive (n)	%	Total	p-value
Sex:						
Female	4, 198	74.8	1411	25.2		
Male	3, 339	86.4	524	13.6	9, 472	P<0.001
Age group						
15-19	3, 198	95.7	144	5.3		
20-24	1, 560	80.0	390	20.0		
25-29	521	59.5	354	40.5		
30-34	403	54.5	337	45.5		
35-39	467	62.4	281	37.6		
40-44	567	72.2	218	27.8		
45-49	168	78.1	47	21.9		
50-54	114	79.2	30	20.8	8, 799	P<0.001
Resident status						
Resident	7, 062	79.5	1, 821	20.5		
Non-Resident	475	80.7	114	19.3	9, 472	
Residence type						
Rural	4777	98.1	94	1.9		
Peri-urban	2073	96.8	69	3.2		
Urban	139	99.3	1	0.7	7, 153	P=0.002

The pattern of sero-status of individual who participated in the 2006 (table 3.3) sero-prevalence survey was very similar to those of 2003 and 2005 except for the fairly equal proportion of sero-positives among residents and non-residents, but which was also not significant(p=0.651).

Table 3.3 Comparison of baseline Sero-positives and sero-negatives in the 2006 HIV sero-prevalence survey

Characteristic	Seronegative (n)	%	Seropositive (n)	%	Total	p-value
Sex:						
Female	3, 844	75.2	1, 269	24.8		
Male	2, 938	86.6	454	13.4	8, 505	P<0.001
Age group						
15-19	2, 937	95.5	138	4.5		
20-24	1, 345	79.8	341	20.2		
25-29	499	61.2	316	38.8		
30-34	364	54.2	308	45.8		
35-39	394	62.7	234	37.3		
40-44	496	70.7	206	29.3		
45-49	121	74.7	41	25.3		
50-54	121	82.3	26	17.7	7, 887	P<0.001
Resident status						
Resident	6, 465	79.8	1, 638	20.2		
Non-Resident	317	78.9	85	21.12	8, 505	P= 0.651
Residence type						
Rural	4, 444	97.1	85	2.9		
Peri-urban	1,713	95.3	132	4.7		
Urban	107	96.4	4	3.6	6, 485	P=0.001

In 2007, a relatively higher proportion of migrant individuals the resident persons tested sero-positive in the sero-prevalence survey. The percentage of rural residents who had a

sero-positive status had risen steeply for a low of 1.9 % in 2005, and 2.9 % in 2006 to 5.2 % in 2007. This is almost threefold that of 2005.

Table 3.4 Comparison of baseline Sero-positives and sero-negatives in the 2007 HIV sero-prevalence survey

Characteristic	Seronegative (n)	%	Seropositive (n)	%	Total	p-value
Sex:						
Female	5, 031	78.4	1, 383	21.6		
Male	2, 795	86.6	434	13.4	9, 643	P<0.001
Age group						
15-19	1, 319	94.7	129	5.3		
20-24	1,108	78.1	311	21.9		
25-29	407	58.3	291	41.7		
30-34	303	52.8	271	47.2		
35-39	340	61.4	214	38.6		
40-44	376	64.9	203	35.1		
45-49	82	71.3	33	28.7		
50-54	98	78.4	27	21.6	6, 512	P<0.001
Resident status						
Resident	7, 362	81.5	1, 669	18.5		
Non-Resident	464	75.8	148	24.2	9, 643	P<0.001
Residence type						
Rural	3, 431	94.8	187	5.2		
Peri-urban	1, 406	92.8	109	7.3		
Urban	121	96.8	4	3.2	5, 258	P=0.008

3.0 Summary of HIV Results of Sero-Converted Individuals by Survey Rounds

Table 3.5 presents a summary of results of individuals who sero-converted during the period of follow up (2003-2007).

In this table, (N) represents a negative HIV test result, (P) represents a positive HIV result, and (-) represents a missing HIV test result. Individuals who sero-converted must have had a sero–negative HIV result on first enrollment and a sero-positive HIV result at a subsequent date/survey. Hence all sero-converted persons had participated in at least two of the population-based HIV sero-prevalence surveys conducted by the Africa Centre for Health and Population Studies from 2003 to 2007.

Of the 539 individuals who sero-converted during the follow-up period, 15.0% (n=81) had participated in all four sero-prevalence surveys conducted during this period, while 34.3% (n=185) had participated in three of the four surveys. About 50.6% (n=273) participated in only two of the four surveys conducted during the follow-up period.

Approximately, 30.4 % (n=164) and 29.9% (n=161) of individuals sero-converted in the second and third rounds of the sero-prevalence survey respectively, while 39.7% (n=214) sero-converted in the fourth round. The earliest date of sero-conversion was 18 January 2005 while the latest was 08 December 2007. The earliest individual to have enrolled into the study was recruited on the 24 June 2003.

Table 3.5 HIV Results of Sero-Converters by HIV Sero-prevalence Survey Rounds

HIV results by sero-prevalence survey rounds					
Round 1	**Round 2**	**Round 3**	**Round 4**	**n**	**(%)**
N	N	N	P	38	**7.1**
N	N	P	P	20	**3.7**
N	P	P	P	23	**4.3**
N	N	P	-	30	**5.6**
N	N	-	P	42	**7.8**
N	-	P	P	21	**3.9**
N	-	-	P	43	**8.0**
N	-	P	-	50	**9.3**
N	P	-	-	92	**17.1**
N	-	N	P	11	**2.0**
N	P	P	-	37	**6.7**
N	P	-	P	12	**2.2**
-	N	N	P	22	**4.1**
-	N	P	P	10	**1.9**
-	N	-	P	39	**7.2**
-	N	P	-	30	**5.6**
-	-	N	P	19	**3.5**
Total	**164**	**161**	**214**	**539**	**100**

"N" = Negative HIV test result: "P" = Positive HIV test result: and "-" = Missing result

3.1 Summary of Distribution of Sero-converters survey Households in KZN

Table 3.6 below shows the distribution of households with a single or more than one sero-converted individual. Based on the number of cases of sero-converted persons in any given household, four main categories of households were identified as listed below:

1. Households with more than one sero-converted individuals and no case of baseline HIV positive person
2. Households with a single sero-converter as well as baseline HIV positive cases
3. Households with more than one sero-converters as well as baseline HIV positive cases
4. Households with a single sero-converter and no baseline HIV positive cases

The 539 sero-converters identified, belonged to 523 households from the Africa Centre DSA. Twenty sero-converters (3.7%) came from ten households with multiple sero-converters but no baseline HIV positives. A total of 131 sero-converters (24.3%) were members of 131 households which had a single sero-converter each as well as baseline HIV positive individuals. Twelve sero-converters (2.2%) came from six households with multiple cases of sero-converters as well as baseline HIV positive cases while 376 sero-converters (69.8%) were from 376 households with only a single sero-converter and no baseline HIV positive case.

In each household category, female sero-converters were far greater than male sero-converters. In sum, 26.5% of the sero-converters came from a household with at least one baseline HIV positive individual while 73.5% of sero-converters had no case of baseline HIV positive individuals in their households.

Table 3.6 Sero-conversion for the period 2003-2007 in 523 households in KZN

Household category	**Sero-converters**			**No. of baseline HIV positive individuals**
	Characteristic	**Number**	**%**	
Multiple Sero-converters only per household	Female	17	3.15	-
	Males	3	0.56	-
	Total	**20**	**3.71**	**-**
	Households	10	**1.91**	
Single Sero-converter and baseline positives per household	Female	102	18.92	93
	Males	29	5.38	38
	Total	**131**	**24.30**	**131**
	Households	131	25.05	
Multiple Sero-converters and Baseline Positives per household	Female	11	2.04	7
	Males	1	0.19	3
	Total	**12**	**2.23**	**10**
	Households	6	1.15	
Single Sero-converter and no baseline positives per household	Female	275	51.02	-
	Males	101	18.74	-
	Total	**376**	**69.76**	**-**
	Households	376	71.89	-

3.2 Socio-demographic Profile of Sero-Converted Individuals

Sex

About 75% (n=405) of all individuals who sero-converted during the follow-up period were females and 25% (n=134) were males and this was statistically significant ($p<0.001$). Among the 8,425 females included in the final analysis, 4.8% sero-converted compared to 1.7% sero-conversion among 8,066 of males included in the analysis.

Age

A greater proportion of the sero-converted individuals fell in the younger age bracket. Among those aged 15-19 years, 16.0% sero-converted, 20-24 years 43.4% sero-converted, and among the 25-29 year olds, 16.0% sero-converted. Each of the older age groups (30-34; 35-39; 40-44; 45-49 and 50-54 years) had less than 10% of individuals in these categories sero-converting.

Overall, 75.4% of all the sero-converted individuals were between the ages 15-29 years. The older age categories (i.e 40-54 years) put together, accounted for just 10.6% of all sero-converted cases. All these were statistically significant at the 5% level of significance ($P<0.001$). Figure 3.1 further illustrates the age distribution of the sero-converters.

The median age of the study participants who sero-converted was 24 years. The youngest person to have sero-converted was 16 years while the oldest person was 54 years The interquartile range of the ages of sero-converted was 35 years.

Resident Status

Eighty-four percent (84.0%) of all the sero-converted individuals remained resident members of households within the Africa Centre DSA for the entire follow-up period while 16.0% were resident at baseline but subsequently migrated out of the area during the follow-up period. Among the baseline residents who later migrated (n=2264), 3.8% (n=86) sero-converted while of those who remained resident (n=14227), 3.2% (n=453) sero-converted during the follow-up period. The observed difference was, however, not statistically significant (p=0.127).

Education

With regards to highest educational attainment as well as attendance of a school or a training facility at the time of sero-conversion, the following results were obtained. About 60% of the seroconverters had attained education up to standards 10 and 12 while 17% had attained primary education. Those who never went to school accounted for 3% of the sero-converters. Five percent (n=27) of the sero-converters had missing information regarding their highest educational attainment at the time of sero-conversion.

At the time of enrolment 42% (n=227) of the 539 sero-converted individuals were out of school at the time of sero-conversion. This proportion includes those who have never been to school (n=18) and those who had either completed their studies or dropped out of school. Those who were in school on part-time basis accounted for 0.4% n=2) of sero-converts while 28 % (n=151) were still in school, on full-time basis, at the time of sero-conversion (Table 3.1). 29% of the sero-converters (n=158) had missing information regarding their attendance of a school or a training facility and one refused to respond school attendance. These observed differences were also statistically significant ($p<0.001$).

Among those who have never been to school (n=754), 2.4% sero-converted. Those whose highest educational attainment is primary education (n=3855), 2.4% sero-converted, same as those who had attained up to standard 8 level of education (n=1704). Among those who had attained up to standard 10 level of education (n=4269), 4.0% had sero-converted. Of the 3618 individuals who had attained standard 12 level of education, 4.3% had sero-converted, while3.7% of the 429 individuals who attained tertiary education sero-converted during the follow up period. These observed differences were all statistically significant ($p<0.001$) at the 5% level of confidence.

Table 3.7 Profile of HIV sero-converters by sex, age residency and education (2003-2007)

Characteristics	**Total population**	**Sero-converters**			
		n	**%**	**Total**	**P value**
Sex					
Female	8,425	405	75.0		
Male	8, 066	134	25.0	539	P<0.001
Age group					
15-19	5, 838	86	16.0		
20-24	4, 848	234	43.4		
25-29	1, 104639	86	16.0		
30-34	986	41	7.6		
35-39	942	35	6.5		
40-44	1, 469	39	7.2		
45-49	353	10	1.9		
50-54	416	8	1.5	539	P<0.001
Resident Status					
Resident	14, 227	453	84.0		
Non-resident	2, 264	86	16.0	539	P=0.127
Educational status					
None	754	18	3.3		
Primary	3, 855	92	17.1		
Up to standard 8	1, 704	41	7.6		
Up to standard 10	4, 269	169	31.4		
Up to standard 12	3, 618	156	28.9		
Tertiary	429	16	3.0		
Missing	1, 231	27	5.0		
Don’t know	596	20	3.7	539	P<0.001

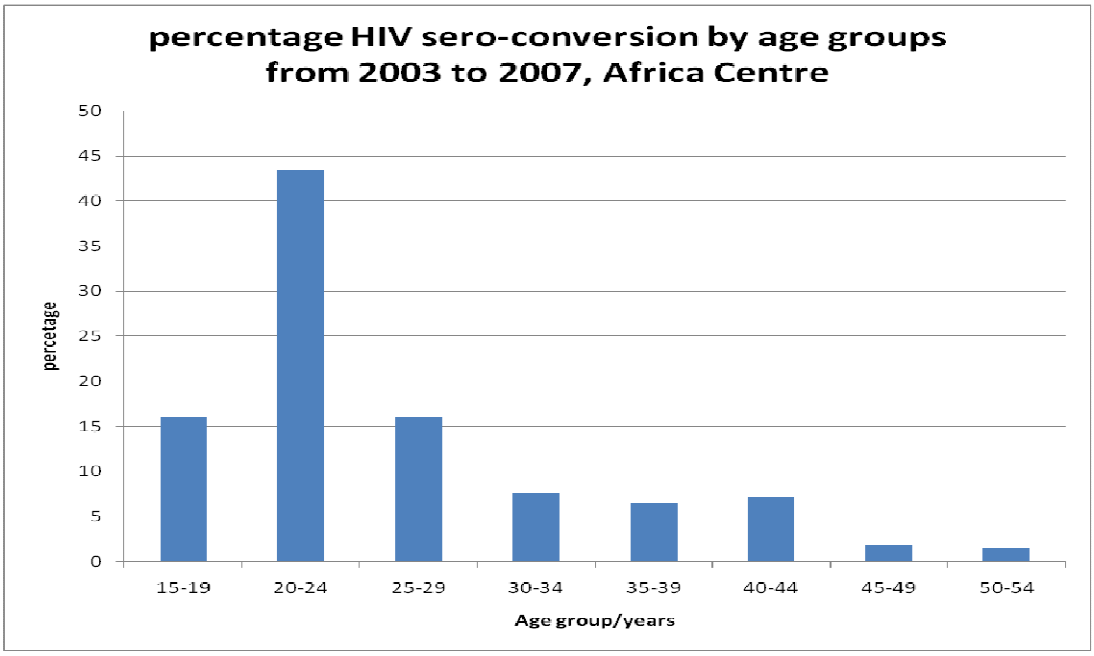


Figure 3.1 Age distribution of HIV sero-converters

Employment

Majority of the sero-converted individuals were unemployed at the time of sero-conversion: 66.2% (n=357) were unemployed, 19.1% (n=103) were employed while 14.7% (n=79) had missing information on their employment status at the time of sero-conversion. All the observed difference were statistically significant ($p<0.001$).

Residence type

In terms of place of residence, rural dwellers accounted for 60.7% (n=327) of all sero-converters, peri-urban dwellers accounted to for 38.0% (n=205) while urban residents represented 1.3% (n=7), and this was also statistically significant ($p<0.001$).

Government grant

Among all the 539 sero-converters, 143 (26.5%) were receiving a government grant. A total of 272 (50.5%) were not recipients of government grants and 22.5% (n=121) had

missing information on grants received, two refused to respond and one responded "don't know". These were all statistically significant ($p<0.001$).

Table 3.8 Profile of HIV sero-converters by school attendance, employment, location and receipt of government grants (2003-2007)

Characteristics	**Total population**	**Sero-converters**			
		n	**%**	**Total**	**P value**
In/out of school					
Out of school	3, 618	227	42.1		
In school part-time	35	2	0.4		P<0.001
In school full-time	7, 504	151	28.0		
Refused	8	1	0.2		
Missing	5, 167	158	29.3	539	
Employment status					
unemployed	2, 526	357	66.2		
Unemployed	7, 205	103	19.1		
Missing	6, 760	79	14.7	539	P<0.001
Residence type					
Rural	11, 283	327	60.7		
Peri-urban	4, 677	205	38.0		P<0.001
Urban	462	7	1.3	539	
Government grants					
Do not receive grant	8, 987	272	50.5		
Receive govt grant	2, 550	143	26.5		
Missing	4, 803	121	22.4		
Refused	74	2	0.4		P<0.001
Don't know	22	1	0.2		
				539	

Marital status

At the time of sero-conversion, 2.8% (n=15) of the sero-converters were currently married, 37.7% (n=208) had never been married, 0.6% (n=3) were widowed while 44.9% (233) had missing information on their marital status at the time of sero-conversion and 15.8% (n=85) were not applicable.

Religion

The observed differences in religious affiliations were also statistically significant ($p<0.001$). Of the 539 sero-converters, 3.3% were Christians ("orthodox"), 32.1% were Pentecostal/charismatic Christians, while 4.3% belonged to other Christian denominations. Spiritualists accounted for 3.7%, Muslim 0%, and those who belonged to no religion accounted for 16.0%. Those whose information on religious affiliations were missing were 219, representing 40.6% of all sero-converters. In all, almost 40% of the sero-converters belonged to the Christian faith.

Distance to road

The nearest distance of a homestead of a sero-converter to a provincial road (secondary roads) was about 1.77m and the farthest, about 64km. The mean distance of a homestead to a provincial road was 15km and the interquartile range was 64.23km

Table 3.9 Profile of HIV sero-converters by marital status, religion, and distance to roads (2003-2007)

Characteristic	**Sero-converters**			
	n	**(%)**	**Total**	**P value**
Marital status				
Never been married	203	37.7		
Currently married	15	2.8		
Missing	233	43.2		
Widowed	3	0.5		
Not applicable	85	15.8	539	P<0.001
Religious denomination				
Christian (Ch'matic/Pentecostal)	173	32.1		
No Religion	86	16.0		
Other Christian	23	4.3		
Spiritualist	20	3.7		
Christian ("Orthodox")	18	3.3		
Muslim	0	-		
Missing	219	40.6	539	P<0.001
Distance to primary road				
>5km	335	62.1		
≤5km	204	37.9	539	P=0.451
Distance to secondary road				
>1.5km	332	61.6		
≤1.5km	207	38.4	539	P<0.001

3.3 The spatial distribution of sero-converters along national and provincial roads

The spatial distribution of sero-converters along the only national road (primary road) passing through the DSA and provincial roads (secondary roads) as illustrated on Figure

3.2 shows a higher clustering along the primary road compared to the secondary road. This pattern was also observed along the secondary roads but the densities of sero-converters tend to decrease with increasing distance away from both primary and secondary roads. Though the spatial distribution of the sero-converters incorporates a random error in the coordinates to safeguard the identity of study participants, the distribution closely mirrors the population densities along these roads as settlements tend to cluster along trunk and major roads.

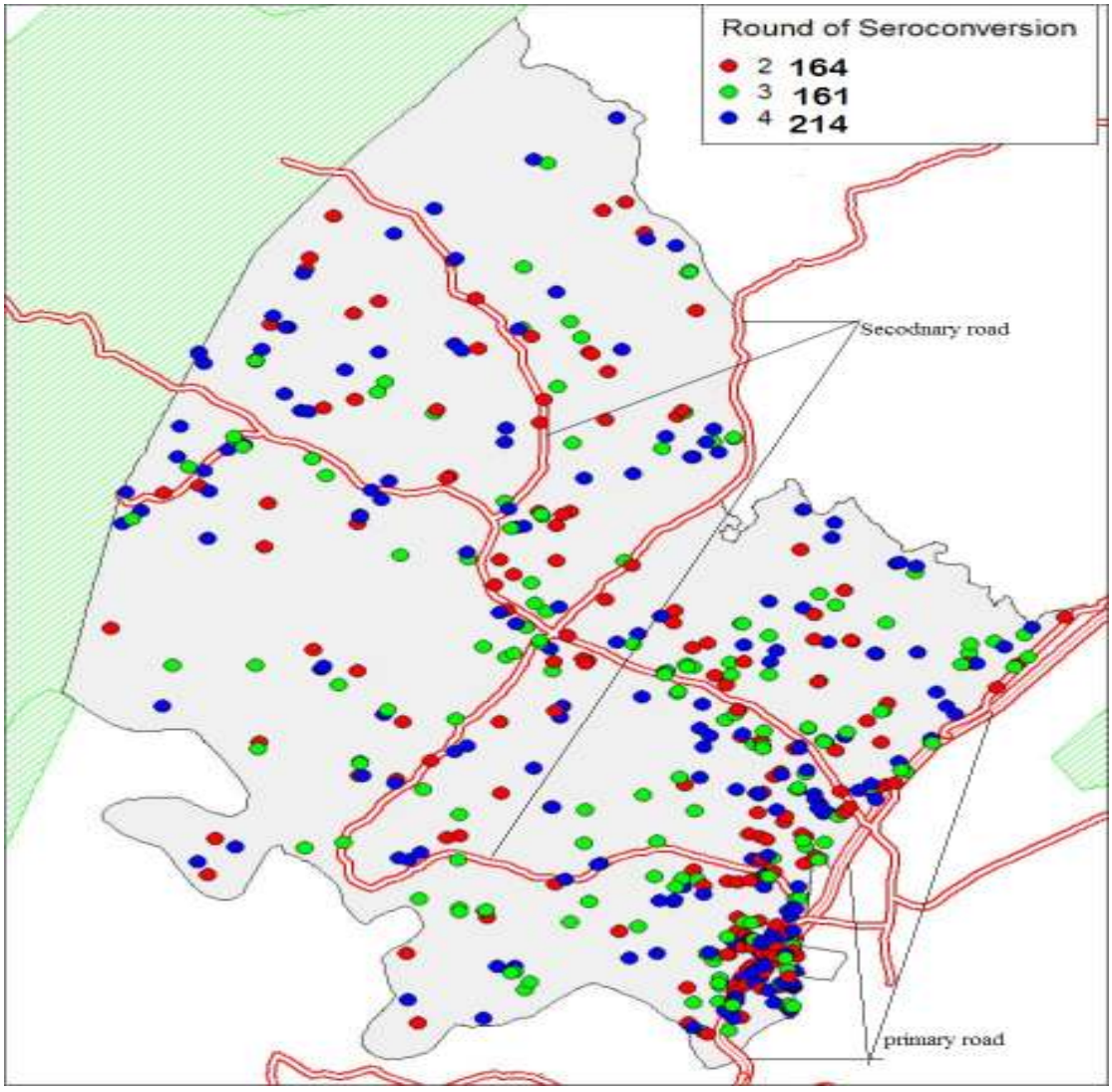


Figure 3.2 Spatial distributions of Seroconverters by round of HIV sero-prevalence
Source: ACDIS

3.4 HIV Incidence Rate Analysis for the period 2003-2007

A total of 539 out of 16, 491 individuals sero-converted during 46818.15 person-years (PYs) at risk from 2003-2007. Females were three times more likely to sero-convert (IR=16.9 per 1000PYs; 95% CI, 15.33-18.64) compared to men (IR=5.9 per 1000PYs, 95% CI, 4.95-6.94) and this is consistent with the findings of another study on the same population.

The highest risk of HIV infection was among the 25-29 year age group (IR=17.7 per 1000 PYs, 95% CI, 14.31-21.83). Generally, the younger age brackets had higher than usual risks of HIV infection during the period of follow up. Relatively, individuals who had migrated during the follow-up period had a slightly higher risk of HIV infection (IR=12.0, 95% CI, 9.73-14.84) than those who remained resident (IR=11.4 per 1000 PYs, 95% CI 10.42-12.52) in the DSA for the entire duration.

Comparatively, unemployed individuals were at higher risk of HIV infection (IR= 14.0 95% CI, 12.65-15.57) than those employed (IR=12.3; 95 %CI, 10.11-14.87). Peri-urban dwellers had a three-fold higher risk of HIV infection compared to urban dwellers. Individuals who had never been married had a relatively higher risk of sero-converting (IR= 15.0; 95% CI, 13.03-17.16) than those who were currently married.

Table 3.10 HIV incidence rate by demographic covariates (sex, age, residency, education)

Characteristic	Group specific PYs	Incidence Rates (per 1000PYs)	95% Confidence Interval
Sex			
Female	23955.24	16.9	15.33-18.64
Male	2862.91	5.9	4.95-6.94
Age group			
15-19	13478.18	6.4	5.17-7.88
20-24	15608.24	15.0	13.19-17.04
25-29	4866.00	17.7	14.31-21.83
30-34	2848.78	14.4	10.60-19.55
35-39	2838.69	12.3	8.85-17.17
40-44	4780.64	8.2	5.96-11.17
45-49	1081.17	9.3	4.98-17.19
50-54	1316.46	6.1	3.04-12.15
Residence status			
Migrant	7157.36	12.0	9.73-14.84
Resident	39660.78	11.4	10.42-12.52
Education			
None	2326.58	7.7	4.87-12.28
Primary	8481.52	10.8	8.84-13.31
Up to standard 8	384.62	11.1	8.19-15.11
Up to standard 10	12292.05	13.7	11.82-15.99
Up to standard 12	12878.36	12.1	10.35-14.17
Tertiary	1197.73	13.4	8.18-21.81
Missing	4037.46	6.7	4.59-9.75
Don’t know	1847.49	10.8	6.98-16.78

Table 3.11 HIV Incidence rate by demographic covariates (employment, location and marital status)

Characteristic	Group specific PYs	incidence rates (per 1000PYs)	95% Confidence Interval
Employment status:			
unemployed	25432.13	14.0	12.65-15.57
employed	8402.02	12.3	10.11-14.87
Missing	12984.000	6.1	4.88-7.59
Residence type			
Peri-urban	13400.98	15.3	13.34-17.54
Rural	32059.46	10.2	9.15-11.37
Urban	1346.83	5.2	2.48-10.90
Marital status:			
Currently married	1298.75	11.6	6.96-19.16
Never been married	1357	15.0	13.03-17.16
Widowed	84.20	35.6	11.49-110.47
Missing	104.57	19.13	4.78-76.48
Not applicable	9049.85	9.39	7.59-11.61

Period Incidence Rates

The period incidence rate increased rapidly from 1.3 per 1000 PYs in 2004-2005 to 15.0 per 1000 PYs and 15.5 per 1000 PYs in 2005-2006 and 2006-2007 respectively. This increase was about three-fold that of 2003-2004. The incidence rate for the entire period (2003-2007) of 11.5 per 1000 PYs was; however, lower than that for 2005-2006 and 2006-2007 respectively.

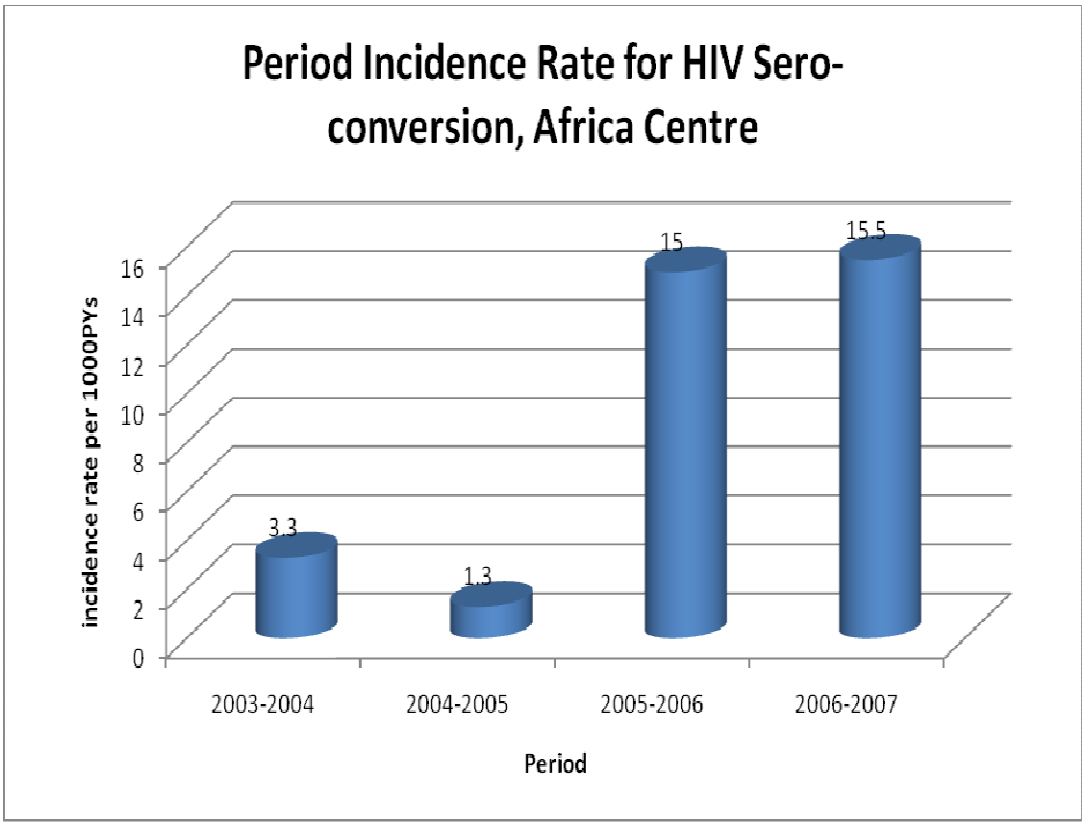


Figure 3.3 period incidence rates for sero-conversion from 2003-2007

Table 3.12 HIV incidence by age group, province and locality type, South Africa, 2005

Variable	HIV Incidence (% per year) (95% CI)
Age group (yrs)	
>2	1.4 (1.0 – 1.8)
2– 14	0.5 (0.0 – 1.2)
15– 24	2.2 (1.3 – 3.1)
>25	1.7 (1.1 – 2.3)
15 - 49	2.4 (2.2 – 2.7)
Province:	
Mpumalanga	2.4 (0.9 – 3.8)
Free State	1.9 (0.4 – 3.4)
Gauteng	1.9 (0.8 – 3.0)
KwaZulu-Natal	1.7 (0.7 -2.7)
Limpopo	1.6 (0.3 – 2.8)
North West	1.0 (0.2 – 1.8)
Western Cape	0.8 (0.2 – 1.5)
Eastern Cape	0.7 (0.1 – 1.2)
Northern Cape	0.2 (0.0 – 0.4)
Locality type	
Urban informal	5.1 (3.2 – 7.0)
Rural formal	1.6 (.7 – 2.5)
Rural informal	1.4 (0.1 – 2.8)
Urban formal	0.8 (0.3 – 1.2

Source: SAMJ 2007

Comparatively, the pattern of HIV incidence reported by Rehle T et al.[62], appears similar to that reported in this study, but our incidence rates are comparatively higher. It also confirms that the epicentre of the HIV epidemic in South Africa is KwaZulu-Natal

province, having the highest HIV incidence and prevalence while the Northern Cape Province has the least.

3.5 The odds of HIV sero-conversion during the period 2003-2007

In the univariate model, being female, younger age group , peri-urban residence and living within 1.5 kilometres of a secondary road, were significantly associated with HIV sero-conversion.

Males were 67% less likely to sero-convert compared to females in the univariate model and this highly was statistically significant (OR =0.33, 95% CI 0.28-0.41; $p<0.001$). Controlling for all other factors in the multivariate model, males were 72% less likely than females to sero-convert (OR=0.28, 95% CI 0.21-0.38) and this was very statistically sginficant ($p<0.001$). In the multivariate model age, residency status and educational attainment do not appear to be significanlty associated with sero-conversion. Marital status, religious affiliation and living within five or more kilometres of a primary road were also not significantly associated with sero-conversion. There was also no significant association between employment and sero-conversion.

In the univariate model investigating the association between highest educational attainment and sero-conversion , individuals who attained standard 10 and 12 education, were 1.69 and 1.84 times respectively, more likely to sero-convert compared to those who never went to school and these were statistically significant ($p=0.038$ and $p=0.015$ respectively).

Table 3.13 Relative risk (Odds Ratio) of HIV Infection: Univariate and Multivariate analysis of Sero-conversion by sex, age, residency and education

	Univariate (Unadjusted) analysis			**Multivariate (Adjusted) analysis**		
variable	Odds Ratio	P-value	95%CI	Odds Ratio	P-value	95%CI
Sex						
Female	1	-		1	-	-
Male	0.33	P<0.001	0.28-0.41	0.28	<0.001	0.21-0.38
Age group						
15-19	1	-	-	1	-	-
20-24	3.39	<0.0001	2.64-4.36	1.51	0.074	0.96-2.39
25-29	3.70	<0.0001	2.73- 5.02	1.27	0.378	0.75-2.14
30-34	2.90	<0.0001	1.98- 4.24	0.79	0.478	0.41-1.51
35-39	2.58	<0.0001	1.73-3.85	0.88	0.700	0.47-1.67
40-44	1.82	0.002	1.24-2.67	0.51	0.043	0.27-0.98
45-49	1.95	0.049	1.00-3.78	1.17	0.786	0.38-3.64
50-54	1.31	0.467	0.63-2.73	0.23	0.152	0.03-1.73
Resident status						
Non-resident	1	-	-	1	-	-
Resident	0.83	0.127	0.66-1.05	0.99	0.967	0.72-1.38
Education						
None	1	-	-			
Primary	1.00	0.999	0.60-1.67			
Up to standard 8	1.00	0.978	0.58-1.77			
Up to standard 10	1.69	0.038	1.03-2.76			
Up to standard 12	1.84	0.015	1.12-3.02			
Tertiary	1.58	0.188	0.80-3.14			
Missing	0.92	0.778	0.50-1.68			

However, the association bewteen attendance of school/training facility at the time of sero-conversion and rate of sero-conversion, showed that individuals who were attending school or a training facility on full time basis were 51% less likely to sero-convert compared to those who were out of school (that is having completed school,or dropped out) or not attending a training facility at the time of sero-conversion and this was significant (p=0.001). Peri-urban reseidents were 1.63 times more likely to seroconvert compared to rurral resident and this was highly significant, p<0.001. unemployed individuals were 1.23 times more likely to sero-cnovert compared to those employed.

Table 3.14 Relative risk (Odds Ratio) of HIV Infection: Univariate and Multivariate analysis of Sero-conversion by school attendance, employment, location, grants, etc

	Univariate (Unadjusted) analysis			**Multivariate (Adjusted) analysis**		
Variable	Odds Ratio	P-value	95%CI	Odds Ratio	P-value	95%CI
Attendance of school						
Out of school	1	-	-	1	-	-
In school part-time	1.22	0.788	0.29-5.17	1.76	0.471	0.38-8.19
In school full-time	0.27	<0.001	0.21-0.36	0.49	0.001	0.33-0.73
Missing	0.59	<0.001	0.48-0.71	0.94	0.714	0.69-1.29
Employment						
Employed	1	-	-	1	-	-
Unemployed	1.23	0.074	0.98-1.53	0.84	0.293	0.61-1.16
Missing	0.28	<0.001	0.21-0.37	0.25	<0.001	0.14-0.43
Residence type						
Rural	1	-		1	-	-
Peri-urban	1.54	<0.001	1.29- 1.84	1.63	<0.001	1.27-2.09
Urban	0.52	0.085	0.24-1.10	0.89	0.822	0.32-2.48
Government grant						
Do not receive grant	1	-	-			
Receive grant	1.90	<0.001	1.55-2.34			
Missing	0.89	0.871	0.22-3.654			
Refused	0.83	0.088	0.67-1.03			
Don't know	1.46	0.714	0.20-10.84			
Marital status						
Currently married	1	-	-	1	-	-
Never been married	1.13	0.651	0.66-1.93	1.38	0.280	0.77-2.49
Widowed	3.04	0.093	0.83-11.13	2.95	0.108	0.79-11.02
Missing	1.49	0.602	0.33-6.78	1.20	0.821	0.25-5.83

Table 3.15Relative risk (Odds Ratio) of HIV Infection in a Univariate and Multivariate analysis of Sero-conversion by religion and distance to primary and secondary roads

	Univariate (Unadjusted) analysis			**Multivariate (Adjusted) analysis**		
Variable	**Odds Ratio**	**P-value**	**95%CI**	**Odds Ratio**	**P-value**	**95%CI**
Religious affiliation						
Christian (“Orthodox”)	1	-	-			
“ Ch’matic/Pentecostal	129	0.358	0.752.23			
Other Christian	1.72	0.131	085-3.49			
Spiritualist	1.30	0.478	0.63-2.69			
No Religion	1.44	0.210	0.81-2.56			
Missing	1.18	0.5324	0.70-2.00			
Distance to primary road						
≤5 Km	1	-	-			
>5 Km	0.93	0.451	0.78-1.12			
Distance to secondary road						
≤1.5 Km	1	-	-	1	-	-
>1.5 Km	1.44	<0.001	1.21-1.72	1.27	0.077	0.98-1.64

Chapter Four: Discussion

The focus of this chapter is to interpret the key findings and their implications for policy on HIV prevention especially for vulnerable groups or those with a higher risk profile. It also assesses the results in the light of current findings on risk of HIV acquisition in the Hlabisa district and other localities in and outside South Africa.

From an epidemiological perspective, it is important to investigate factors associated with HIV incidence in order to identify the most effective interventions to prevent HIV acquisition[63], however, from a health systems perspective it may at times be more important to identify factors that are associated with increased risk of HIV acquisition, but are not necessarily causally related to HIV acquisition, in order to decide on placement and targeting of HIV prevention programs. The high incidence of HIV in the KwaZulu Natal province is a clear indicator that the HIV prevention programmes in this community have failed. The emerging phenomenon where non-migrants are rather more vulnerable to HIV infection compared to migrants needs urgent look.

4.0 Profile of recently HIV sero-converters

The results from this study showed that 70% of all seroconversions occurred in households without any HIV positive member (recently or non-recently infected) during the follow-up period. In other word, this represents new HIV infections. This relatively high proportion of new HIV infections in the study area has dire implications for the prevention efforts by the South African Department of Health and other collaborators. Obviously, the education campaign on HIV prevention is not reaping a commensurate reduction in new HIV infections. The number of studies that have investigated the number of HIV seroconversions in each household over time to establish the time trends and patterns in this locality are limited. Hence the findings of this study need to be

explored further to help understand the underlying factors accounting for this trend to inform HIV prevention interventions.

Though the relative proportion of males to females in the surveyed population was the same, three times as more women compared to men had sero-converted during the five year follow-up period. This extremely high proportion of women who got infected with HIV may be attributable to the greater vulnerability of women in this community. In other words, gender power inequities, [23, 25] having a migrant partner, [44] age-mixing[29] and intimate partner violence [64] may explain the great disparity in seroconversion between men and women. Besides, the cultural norms condones having multiple sexual partners by men but frowns on such a right by women in this community and this further exposes women to a greater risk of HIV acquisition than men and is consistent with the findings of other studies in this locality.

The current trend has serious implications considering the fact that women bear an additional burden of having to care for children and sick household members including HIV/AIDS patients. This important role of women in this locality will be seriously compromised if more women rather get infected with HIV and will have a telling effect on the general health status of the household. However, the conjugal relationships between the recently sero-converted individuals and those previously infected persons in these households were not analyzed to firmly establish the main source of the new HIV acquisitions in these households. The multi-generational nature of many households in this locality, with inadequate parental guidance of young people during their critical formative ages could potentially explain the higher rate of new HIV infection among the youth in this locality. In this regards, programmes that will retain youth in educational

training facility during their critical formative period could eventually help reduce new HIV infections.

One other important household factor that sheds light on the result is household socio-economic gradient. The results of this study demonstrated that rural dwellers were less likely to be infected with HIV compared to peri-urban ones. This may in part be due to the differentials in living conditions in each of these communities and opportunities to engage in risky sexual behaviours.

Most of the sero-converters were unmarried, belonged to Christian faith and did not migrate during the observation period. In the study area, the percentage of people in marital relationships is far lower than unmarried person in consensual sexual unions. This situation further explains the observed results. One plausible explanation for majority of the sero-converters belonging to the Christian faith is that, most people often resort to religious bodies for solace in their times of affliction, rather than people of the Christian faith being the most vulnerable. Consequently, HIV prevention interventions should target and collaborate with religious bodies to reach out to those who seek comfort and healing at these institutions when they become aware of their HIV status.

Another worrisome observation made by this study is that the younger age category (15-30 years) accounted for more than three-quarters of all the sero-conversion during the follow-up period. Being the main source of work force in South Africa the current situation has very serious implications for the sustainable development of the South African Economy. The high mobility of this age category will also pose an enormous challenge to the targeting and placements of HIV prevention activities in this community. It also attests to the fact that the HIV/AIDS epidemic in South Africa is not showing signs of decline yet.

Though the large proportion of youth infected closely mirrors the age distribution in the general population of this locality, there is still a cause for concern given that there is no cure for HIV yet. The vulnerability of the youth in this locality could be partly explained by their relatively high risk profile, high mobility, migrant nature [44] and adventurism.

The results also showed that majority of the sero-converters were rural dwellers and 85% of sero-converters remained resident in the study area for the entire duration of the follow-up. These findings disagree with the assumption that the primary direction of spread of HIV is from returning migrants to their resident partners and is consistent with the results of a study on concordant and discordant couples in this locality.[44] Hence, any HIV prevention intervention in this locality should focus largely on the resident rural population as well as returning migrants. Programmes aimed at reducing the extreme levels of poverty and unemployment in the rural communities in this and other districts in South Africa will have a significant impact on the control of the spread of HIV epidemic, given that three-quarters of the sero-converters were unemployed. Though the area is predominantly rural, the principal source of income is waged employment and government grants rather than agriculture. This further explains the higher levels of unemployment and the attendant risk of HIV infection. Sero-converters also tended to be clustered in proximity to major roads in the DSA. The spatial distribution indicated a greater clustering along the only national road running through the DSA and the population densities tend to be higher here than other locations. This couple with the increased ease of mobility,[63, 65] and social interaction along this major road may account for the higher densities of sero-converters here. Living in close proximity to primary or secondary roads was also associated with a risk of HIV infection compared to those living far from major roads. This could be due to the ease of mobility and potential

exposure to multiple sex partners. This may be due to a desire for modern social amenities which requires financial wherewithal, which in turn facilitates transactional sex.

The placement any HIV prevention intervention in the Hlabisa district and similar communities in KwaZulu-Natal province of South Africa must take this into consideration.

4.1 HIV Incidence during the period of observation

The results from this study showed that HIV incidence continued to be high in this population, compared to other provinces, during the period of observation and this is consistent with the results of other studies in this area[66]. This calls for a more focus and sustained allocation of resources and targeted health services, backed with community driven programmes to reverse the upward trend of the HIV incidence in KZN. Programmes aimed at reducing HIV incidence in this community must give due cognisance to factors such as the high levels of unemployment among the youth, gender inequity and inequalities and the number of unmarried persons in consensual sexual relationships as well as low uptake of HIV preventive education campaign messages. In addition, improving the living conditions in the peri –urban communities by creation of jobs, fighting crime and drug/substance use, provision of formal education and/or artisanship training for the dwellers in these localities can help to reduce HIV incidence. This is informed by the findings that HIV incidence rate in the peri-urban community was three times that of the urban community and also higher than that for rural residents. The incidence rate for HIV sero-conversion of an individual increased with educational attainment from primary to tertiary level. This may be explained by the age distribution

of individuals attaining these levels of education rather than the progression up the educational ladder being the causal factor. Hence, the association between educational attainment and HIV sero-conversion is inconclusive and should be interpreted with caution as other factors such as socio-economic, religious affiliation, gender, among others could effect this association.

4.2 Factors associated with HIV acquisition in the cohort during the observation period.

In the univariate and multivariate analysis of the data from KwaZulu-Natal, sex was highly associated with a very high risk of HIV acquisition but women had a comparatively higher risk of HIV acquisition and statistically significant, hence a one-sided focus of HIV prevention on women does not seem reasonable in rural KwaZulu-Natal. The results from this study also showed that the age bracket 24-39 was highly associated with HIV acquisition. Intervention to reduce HIV acquisition and transmission thus need to reach the middle-aged and old in addition to youth. Living in a peri-urban community was highly associated with HIV acquisition compared to rural and urban dwellers and was statistically significant. The results also demonstrated that it was protective regarding HIV acquisition for individuals who were still in school on a full time basis compared to those out of school and those in school on part-time basis. Hence, programmes aimed at ensuring that persons enrolled in schools and training facilities remain in school for the full duration of the programme should be pursued vigorously. Individuals who had attained standard 10-12 education were at a higher risk of HIV acquisition and this is partly explained by the age bracket at this levels and the associated risk profile of this group.

The results of this study show that people are at higher risk of HIV acquisition, if they lived closer to secondary roads or in a peri-urban rather than in rural areas.

Implications of findings for policy

The findings of this study clearly indicate that the Millennium Development Goal (MDG) on gender equity and health for all may not be attained if the current trends are not reversed. It also suggests that the current approaches to HIV prevention are not yielding the desired results and this may be attributed to some amount of disconnect between research and policy. Hence, new and focused strategies for HIV prevention, based on close collaboration between policy makers/implementers and scientific researchers, need be charted.

The results also points to an increased burden on the under-resourced rural health facilities and if immediate measures are not taken to reverse the trend, these facilities will be overwhelmed very soon.

The age bracket bearing the greatest brunt of the HIV/AIDS scourge in this community constitutes the backbone of the labour force and with this current trend an economic downturn is imminent if pragmatic steps are not taken to halt the epidemic. Besides, a vicious cycle of poverty will be perpetuated in the rural communities if HIV continues to devastate the able-bodied youth at this alarming rate.

Study Limitations:

The temporal relationship between exposure and outcome could not be clearly established using secondary data. Primary data collection would have been ideal for establishment of this temporal relationship, but the period allocated for the study was too short for primary data collection. Data on asset ownership, required for constructing

proxy measures of household socio-economic status, had a high degree of non-response this made it impossible to investigate association between socio-economic gradient and HIV acquisition. Hence socio-economic status may have a confounding effect on the results.

Information on other risk factors for HIV infection such as intravenous drug use, sexual orientation, risky behaviours, occupational exposure to HIV and sharing of sharp/piercing objects as well as health seeking behavior and perceived risk profile were not available for this analysis. This limits the exhaustiveness of the risk factor assessment.

Though this study did not exhaustively investigate all factors associated with the risk of HIV infection in this population, it sought to identify "who is infected", "where they are", "the relative proportions/percentages of new infection" and some of the factors of key interest, associated with HIV infection in this population during the period 2003-2007. This information will help in the evaluation of prevention programmes as well as shape the design, targeting and placement of interventions in this and similar localities or settings, in the light of limited resources and competing demands.

Chapter Five: Conclusions and recommendations

Conclusions

The results from this study clearly indicate that a significant proportion of the new HIV acquisitions occurred in households without any recently or previously infected household member. The very high HIV incidence in the KZN is an indication of failed prevention programmes. In addition, women had a significantly greater risk of HIV infection compared to men in this study area.

The younger age bracket (15-30 years old) was associated with a significantly higher risk of HIV infection compared to the older age category. Majority of the seroconversions occurred among the rural dwellers but in terms of risk of HIV acquisition, peri-urban dwellers had the greatest risk of seroconversion than rural and urban dwellers.

The study also showed that being in school or a training facility on a full-time basis during the follow-up period was protective for HIV acquisition compared to those who were out of school or attended on part-time. Participants who had attained standard 10 to 12 level of education were associated with a greater risk of seroconversion. This may be an artefact of the age bracket at this level of the educational ladder. Living in close proximity to a primary or secondary road in the study area was also associated with a risk of HIV infection compared to those living far from major roads. This may rather be attributed to the high population density along the roads and the associated human interactions than the proximity to the road.

Recommendations

The Design, placement and targeting of HIV prevention interventions in this community should make provision to gainfully engage youth aged 15-30 years in educational, vocational training to reduce possibility of engaging in risk sexual behaviour. Living

condition in peri-urban settlements should be improved through resettlement and provision of livelihood skills to this vulnerable sub-population to make them more productive rather than being a haven for drugs and crime.

The Education Ministry should create more artisan/technical training institutes with boarding facilities in rural communities and also provide financial aid to trainees to enable them reside at the facility on full-time basis as this will equip the youth with employable skills, enhance access to HIV prevention information and curb some of the risk behaviours they tend to engage in at their leisure period. These facilities should actively recruit youth entering their critical formative ages and give them adequate education on risk of HIV acquisition and keen supervision to keep them out of risky sexual behavior.

The South African Government should create "craft-villages" in the rural communities and equip them with the necessary tools and resources to offer internship opportunity in the short term to the trainees from the artisan/technical institutions for eventual employment in the long term

The ministry for culture and education needs to dialogue will traditional leaders to review and abolish some of the cultural practices that promote gender inequity and those also inimical to the institution of marriage such as exorbitant dowry-price ("lobola"). Besides, employment of women in this community is urgently required.

HIV prevention programmes should target the religious congregations and forge a partnership with the religious leader to help in disseminating simple but effective prevention campaign messages to their followers for behavior change to reduce HIV incidence.

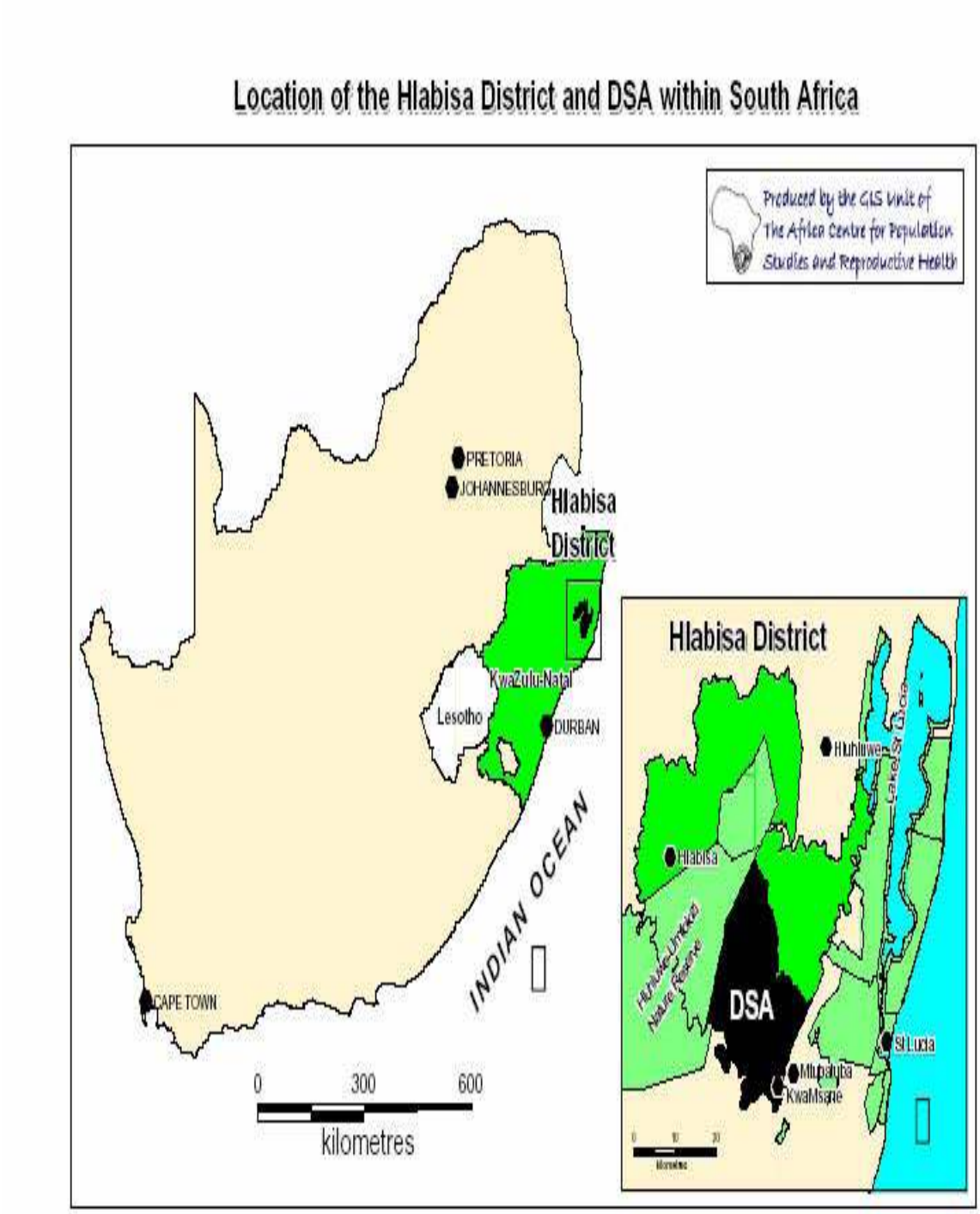
More “youth friendly” voluntary HIV counseling and testing centres should be put up for rural communities and those in close proximity to roads, coupled with free access to anti-retroviral drugs to encourage young people to know their HIV status. Social events targeting the youth should also be organized regularly to reinforce the campaign on abstinence, faithfulness and condom usage.

The health facilities located in the rural communities must be resourced, adequately staffed and the health workers motivated sufficiently to give dedicated service to rural communities.

Further studies focusing on “structure and socio-economic status” of households with new HIV infections but not a single previously HIV infected household member are required to full understand the underlying factors responsible for this trend, to inform future HIV prevention programmes.

APPENDICES

Appendix 1.0



Appendix 2.0

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Bangre

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M071041**
PROJECT	Household and Individual Level Factors Associated with the Risk of HIV Infection in Kwa-Zulu-Natal
INVESTIGATORS	Mr O Bangre
DEPARTMENT	School of Public Health
DATE CONSIDERED	07.10.26
DECISION OF THE COMMITTEE*	APPROVED UNCONDITIONALLY

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 07.10.30 **CHAIRPERSON** .....
(Professors PE Cleaton-Jones, A Dhai, M Vorster, C Feldman, A Woodiwiss)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof K Kahn

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix 3.0

FROM : POSTGRAD ADMIN PHONE NO. : 031 26[illegible]6 JUL. 10 2003 12:19PM P1

UNIVERSITY OF NATAL

Nelson R Mandela School of Medicine
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9 July 2003

Professor A J Herbst
African Centre
Fax : 035 550 7565

Dear Professor Herbst

PROTOCOL : A proposal for the creation of a longitudinal population-based HIV research platform and non-communicable disease surveillance in the Africa Centre Demographic Information System, Hlabisa, South Africa. J Herbst, Africa Centre. Ref.: E029/03

The Research Ethics Committee considered the abovementioned application and made various recommendations. These recommendations have been addressed and the protocol was approved by consensus at a full sitting of the Research Ethics Committee at its meeting held on 3 June 2003.

Yours sincerely

PROFESSOR J MOODLEY
Chairman : Research Ethics Committee

References:

1. UNAIDS. *2004 Report on the global AIDS*; 4th global report.
2. Department of Health September 2001; An Enhanced Response to HIV and AIDS and Tuberculosis in the Public Health Sector – *Key Components and Funding Requirements,* 2002/03-2004/05.
3. Lisa Garbus, MPP HIV/AIDS in South Africa, C10661, *the Country AIDS Policy Analysis Project.* AIDS Policy Research Center, University of California San Francisco , Published June 2002 ; Last Updated October 2003.
4. UNAIDS. *AIDS epidemic update: Special Report on HIV/AIDS*; December 2006.
5. WHO/UNAIDS FACT SHEET, (Last updated December 2006).
6. UNAIDS, '*2007 AIDS Epidemic Update'*.
7. UNAIDS, *'2006 Report on the Global AIDS Epidemic*', Chapter 3: Progress in Countries.
8. Gregson S, Waddel H, ChandiwanaS., School education and HIV control in Sub-Saharan Africa: from Discord to harmony. *Journal of International Development*, 2001; 13:467-485.
9. Kelley AR, Ronald ER, Zekeng L, Sharon SW, Ubald T. Characteristics associated with prevalent HIV infections among a cohort of sex workers in Cameroon, Sex *Transm Inf* 1998; 74: 131-135.

10. Pettifor AE, Rees HV, Steffenson A, Hlongwa-Madikizela L, MacPhail K, Vermaak K, Kleinschmidt I. HIV and sexual behaviour among young south Africans; A national survey of 15-24 year olds. Johannesburg: *Reproductive Health Unit, University of the Witwatersrand*, 2004.

11. Sta tistics South Africa, Mid-year population estimates, South Africa; *2006 Statistical Release P0302.*

12. Vanneste A. Cause-specific mortality in rural South Africa - HIV/AIDS and Violence,.*Int Conf AIDS*. 2002 Jul 7-12; 14: abstract no. C10661.

13. Ruthenberg N, Kaufman CE, Macintyre K, Brown L, Karim A. Pregnant or positive: Adolescent childbearing and HIV risk in KwaZulu Natal, South Africa. *Reproductive Health Matters* 2003; 11(22): 122-133.

14. AIDS Analysis Africa 2000 sero-prevalence rates. *AIDS Analysis Africa* 20001; 11(6): 3.

15. Department of Health. National HIV and syphilis antenatal sero-prevalence survey in South Africa 2004. Pretoria: Soth Africa Department of Health; 2005.

16. Whiteside A. South Africa's 1998 survey shows no let-up. *AIDS Analysis Africa* 1999; 10(1) 1-10.

17. Welz T, Hosegood V, Jaffar S, Bätzing-Feigenbaum J, Herbst K, Newell ML. Continued very high prevalence of HIV infection in rural KwaZulu-Natal, South Africa: a population-based longitudinal study. *AIDS*. 2007; Jul 11; 21(11):1467-1472.

18. Department of Health - Facts and Statistics, *National HIV and syphilis sero-prevalence survey of women attending public antenatal clinics in South Africa*, 2000.

19. Coren C. The Risk of HIV Infection among Brazilian Men Is Twice That among Women. *International Family Planning Perspectives* 2003; 29(3): pp 150-151

20. Dorrington RE, Bradshaw D, Johnson L, Budlender D. The demographic impact of HIV/AIDS in South Africa. National indicators for 2004, Cape Town Centre for Actuarial Research, *South Africa Medical Research Council and Actuarial Society of South Africa,* 2004.

21. Hirozawa A.In Sub-Saharan Africa, Circumcised Men Are Less Likely Than Uncircumcised Men to Become Infected with HIV, *International Family Planning Perspectives* 2001; 27(2): pp. 102-103.

22. Saurez T, Kauth MR. Assessing basic HIV transmission risks and ths contextual factors associated with HIV risk behaviour in men who have sex with men. JCLP/ In Session: *Psychology in Practice* 2001; 57 (5) 655-669.

23. Dunkel KL, Jewkes RK, Brown HC, Gray GE, McIntyre JA, Harlow SD. Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. *The Lancet*, 2004; 363: 1415-1421.

24. Jewkes R, Dunkle K, Nduna M, Levin J, Jama N, Khuzwayo N, Koss M,Puren A and Duvvury N., Factors associated with HIV sero-status in young rural south African women: connections between intimate partner violence and HIV. *International Journal of Epidemiology*, 2006; 35(6)1461-1468.

25. Pettifor AE, Measham DM, Rees HV, Padian NS. Sexual power and HIV risk, South Africa. *Emerging Infectious Diseases* 2004; 10(11): 1996-2004. www.cdc.gov/eid.

26. Pulerwitz J, Amaro H, De Jong W, Gortmaker SL, Rudd R. Relationship power, condom use and HIV risk among women in the USA. *AIDS Care* 2002; 14:789-800.

27..Jewkes RK, Nduna M, Jama PN, Levin JB. Measuring relationship power: adaptation of the SRPS for South Africa. In: *Abstract of the XIV International AIDS Conference; Barcelona, Spain*; 2002 Jul 7-12: Abstract code WeOrD1353.[Available,from,http://www.ias.se/abstract/show.asp?abstract_id=4486. of V=22] [Accessed on 03 Jan 2008].

28. Kalichman SC, Simbayi LC, Kagee A, Toefy Y, Jooste S Cain D, Cherry C. Associations of poverty, substance use, and HIV transmission risk behaviour in three South African communities. *Social Science and Medicine* 2006; 62: 1641-1649.

29. Luke N, Confronting the 'Sugar daddy' stereotype: age and economic asymmetries and risky sexual behaviour in urban Kenya. *International Family Planning Perspectives*, 2005; 31(1): 6-14.

30. Glewwe P: Investigating the determinants of household welfare in Côte d' Ivoire. *Journal of Development Economics* 1991; 35:307-337.

31. Pal S: An analysis of childhood malnutrition in rural India: Role of gender, income and other household characteristics. *World Development* 1999; 27(7):1151-1171.

32. Filmer D, Pritchett LH (1988). Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrolments in States of India. *World Bank Policy Research Paper* No. 1994.

33. Filmer D, Pritchett LH. Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrolments in States of India. *Demography* 2001; 38(1): pp. 115-132.

34. Makinen M, Waters H, Rauch M, et al.: Inequalities in health care use and expenditures: Empirical data from eight developing countries and countries in transition. *Bulletin of the World Health Organization* 2000; 78(1):55-65.

35. Wagstaff A: Socioeconomic inequalities in child mortality: Comparisons across nine developing countries. *Bulletin of the World Health Organization* 2000; 78(1):19-29.

36. Gwatkin DR: Health inequalities and the health of the poor: What do we know? What can we do? *Bulletin of the World Health Organization* 2000; 78(1):3-18.

37. Jaspan HB, Beriwick JR, Myer L, Matheus C, Flesher AJ, Wood R, Bakker LG. Adolescent HIV prevalence, sexual risk and willingness to participate in HIV vaccine trials. *Journal of Adolescent Health* 2006; 39:642-648.

38. Mansini N. Sexual initiation and childbearing among girls in KwaZulu Natal, south Africa. *Reproductive Health Matters* 2001; 9(17): 44-52.

39. Morojele NK, Kaching MA, Mokoko E, Nkoko MA, Nkowane AM, Moshia KM, Saxena S. Alcohol use and sexual behaviour among risky drinkers and bar and shebeen patrons in Gauteng Province, South Africa. *Social Science and Medicine* 2006; 62: 217-227.

40. Lurie MN, 2001. Migration and the spread of HIV in South Afri). *PhD dissertation*, Baltimore: Johns Hopkins University.

41. Decosas J, Kane F, Anafi JK, et al. Migration and AIDS. *The Lancet* 1995; 346(8978): 826-828.

42. Decosas J, and Adrien A. Migration and HIV. *AIDS* 1997, 11 (suppl A): S77-S84.

43. Brummer D. Labour Migration and HIV/AIDS in Southern Africa - *International Organisation for Migration Regional Office for Southern Africa,* September 2002.

44. Lurie MN, Williams BG, Zuma K, Mkaya-Mwamburi D, Garnett PG, Sweat MD, Gittelsohnf J and Abdool Karim S: Who infects whom? HIV-1 concordance and discordance among migrant and non-migrant couples in South Africa: *AIDS* 2003; 17:2245-1152.

45. Abdool Karim S, Singh B, Short R, and Ngxongo S. Seroprevalence of HIV infection in rural South Africa: *AIDS*, 1992; 6, (12):1535-1539.

46. Lurie MN, Harrison A, Walkinson D, and Abdool Karim S. Circular migration and sexual networking in rural Kwazulu-Natal: Implications for the spread of HIV and other sexually transmitted diseases. *Health Transition Review* 1997; 17 (3): 17-27.

47. Coast E. Local understandings of, and responses to, HIV: Rural-urban migrants in Tanzania. *Department of Social Policy, London School of Economics* 2005. http://iussp2005.princeton.edu/download.aspx?submissionId=50485. [Accessed 04 Jan-2008].

48. Knodel, Return Migration in the Context of Parental Assistance in the AIDS Epidemic: The Thai Experience*: Paper for presentation at the XXIV General Population Conference of the IUSSP*, Salvador, Brazil; 18-24th August, 2001.

49. Hargreaves JR and Glynn JR. Educational attainment and HIV, *Tropical Medicine and International Health 2*002; 7(6): pp 489–498.

50. Cogneau D, and Grimm M. Socioeconomic status, sexual behaviour, and differential AIDS mortality: evidence from Côte d'Ivoire. *Population Research and Policy Review,* Volume 25, Number 4, August 2006 , pp. 393-407(15).

51. Carpenter LM, Kamali A, Ruberantwari A, Malamba SS, and Whitworth JAG) . Rates of HIV-1 transmission within marriage in rural Uganda in relation to the HIV sero-status of the partners, *AIDS* 1999; 13:1083–1089.

52. Shisana O, Zungu-Dirwayi N, Toefy Y, Simbayi LC Malik S and Zuma K. Marital status and risk of HIV infection in South Africa. *S Afr Med J.* 2004; 94(7) 537-543.

53 http://www.avert.org/global-hiv-prevention.htm [Accessed on 21/10/2009]

54 . http://www.avert.org/aidssouthafrica.htm [accessed on 20/10/2009]

55. Republic of South Africa (2008, March), 'Progress report on declaration of commitment on HIV and AIDS'

56. Pais P. HIV and India: Looking into the abyss. *Tropical Medicine and International Health* 1996; 1 (3) 295-304.

57. Xueref S, Helianjovoni J, Daniel R, Keroueda D, Fabry J and Vanhems. Low HIV but high STI prevalence in Mdagascar. *Tropical Medicine and International Health* 2003; 8 (1): 60-66.

58. Bärnighausen T, Wallrauch C, Welte A, McWalter TA, Mbizana N, et al. HIV Incidence in Rural South Africa: Comparison of Estimates from Longitudinal Surveillance and Cross-Sectional cBED Assay Testing. *PLoS ONE* (2008) ; 3(11): e3640. doi:10.1371/journal.pone.0003640.

59. Hosegood V, McGrath N, Herbst K, Timaeus I. M . The impact of adult mortatlity on household dissolution and migration in rural South Africa. *AIDS* 2004; 18: 1585 – 1590.

60. Tanser F, Hosegood V, Bärnighausen T, Herbst K, Nyirenda M Muhwava W, Newell C, Viljoen j, Mutevedzi T1 and Newell ML. Cohort Profile: Africa Centre Demographic Information System (ACDIS) and population-based HIV survey. *International Journal of Epidemiology* 2007;1–6

61. Tanya W, Hosegood V, Jaffar S, Bätzing-Freigenbaum J, Herbst K and Newell ML.

Continued very high prevalevce of HIV infection in rural KwaZulu-Natal, South Africa: a population-based longitudinal study. *AIDS* 2007; 21:1467-1472]

62. Rehle T, Shisana O, Pillay V, Zuma K, Puren A and Parker W. National HIV incidence measures - new insights into the South African epidemic. *S Afr Med J* 2007; 97 (3) :194-199 .
63. Samarajalingam S. Epidemiological Perspectives of HIV/AIDS in Tamilnadu, India: identification of major dimensions and attempt on modelling the risk factors. *Int Conf AIDS.* 2000 Jul 9-14; 13: abstract no. TuPeC3418.
64. DIGEST. In South Africa, some HIV risk factors also predict intimate partner violence. *International Family Planning Perspectives* 2007; 33 (2)
65. Tanser F, LeSueur D, Solarsh G and Wilkinson D. HIV heterogeneity and proximity of homestead to roads in rural South Africa: an exploration using a geographical information system. *Tropical Medicine and International Health* 2000;5: 40-46
66. Bärnighausen T, Tanser F, Gqwede Z, Mbizana C, Herbst K and Newell ML. High HIV incidence in a community with high HIV prevalence in rural South Africa: findings from a prospective population-based study. *AIDS* 2008; 22:139-144.