A LONGITUDINAL STUDY OF MIGRATION AND ITS RELATION TO AIDS/TB MORTALITY IN RURAL SOUTH AFRICA

BY

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BIO-SKETCH OF SULAIMON A. AFOLABI

Sulaimon Atolagbe Afolabi is a demographer, statistician and information technology specialist with strong technical and practical background. He is self-motivated and industrious, with a good command of English in both writing and speaking.

He completed a Bachelor of Science (honours) degree in Demography and Social Statistics in 2002 from the Obafemi Awolowo University, in Ile-Ife, Nigeria, and Master of Arts in Demography and Population Studies in 2007 from the University of the Witwatersrand, Johannesburg, South Africa. He is currently pursuing a doctoral degree in the field of Demography and Population Studies at the University of the Witwatersrand. The title of his PhD thesis is, "A Longitudinal Study of Migration and Its Relation to AIDS/TB Mortality in Rural South Africa".

He has been employed as a data scientist at the South African Medical Research Council/ Wits Rural Public Health & Health Transitions Research Unit (Agincourt), since 2007. Agincourt is a Health and Demographic Surveillance System located in the Mpumalanga Province of South Africa.

In 2012, he participated in a two-week residential training programme on Population and Development at the Brown International Advanced Research Institute (BIARI) of Brown University, Providence, USA. He is a fellow of the Consortium for Advanced Research Training in Africa (CARTA). Apart from data management, he is interested in studying the components of population change - migration, mortality and fertility and their impact on the health and well-being of people. He is part of the INDEPTH working group on the Multi-centre Analysis of the Dynamics of Internal Migration and Health (MADIMAH). He has received a travel grant to present his work at the annual meeting of the Population Association of America (PAA) that took place in San Francisco, USA, in 2012. He has also been supported by the International Union for the Scientific Study of Population (IUSSP) to present his work at its XXVII conference in Busan, South Korea in 2013.

In the course of his doctoral training, he has gained expertise in the field of population and health and has had various opportunities of interacting with scholars in the field. His future plans entail the application of his skills in population and health research to produce evidence for tackling challenges faced on the continent of sub-Saharan Africa and beyond. In future, he envisages mentoring and nurturing upcoming researchers and dreams of being a recognised researcher in his field.

ABSTRACT

Background: In exploring the relationship between migration and HIV/AIDS, a focus of earlier studies was on the role of the mobile population in the geographical spread of the disease. There has been a shift in this perception and the focus now is on the implications of being a migrant. A body of literature has developed on the risk of migrants contracting HIV, but only a few studies have examined the AIDS/TB mortality risk as a consequence of migration, with the results showing that migrants have higher chance of dying of AIDS/TB compared to their non-migrant counterparts. However, these studies mainly looked at the impact of migration on mortality due to AIDS/TB and did not make provision for the presence of other causes of death. Therefore, this study is geared towards investigating migration as it relates to death caused by AIDS/TB, longitudinally, and in the presence of other causes such as non-communicable diseases, other infectious diseases, and external causes of death, in rural South Africa. Specifically, the study addressed the following questions: (i) What is the risk of dying from AIDS/TB among migrants in rural South Africa in the presence of other causes of death? (ii) How does this relationship compare with the relationship between migration and other causes of death? (3) What are possible predictors of the relationship between migration and AIDS/TB in the presence of other causes of death?

Method: This research project is part of a longitudinal study of the inhabitants of the Agincourt sub-district, situated in the rural north-eastern part of South

Africa. The study utilises the Agincourt Health and Demographic Surveillance System data spanning 12 years, starting from 1st January, 2000 to 31st December, 2011. The main target group for the study is individuals aged 20 to 69 years at the date of analysis. The selected individuals are divided into the following categories: (i) the return migrants who returned after spending a period of time outside the study area; (ii) the in-migrants who moved into the study location for the first time, and (iii) the permanent residents (non-migrants). A six month residence threshold period is used to distinguish participants from ordinary visitors. The migration status categorical variable was further expanded from three to five categories with in-migrant and return migrant categories being split to accommodate short and long-term durations of exposure. In the year 2000, the baseline year, a total of 25,621 individuals who met the entry criteria were recruited into the study.

For data analysis, a Fine and Gray model is used, which is a variant of a Cox proportional hazard model, to estimate the competing risk of dying among the selected participants by sex. The causes of death (CoD) variable was categorised into the following broad categories: “AIDS/TB”, “Non-Communicable Disease”, “External cause” and “Other infectious disease”, with indeterminate causes coded as missing. The five categories of migration serve as the independent variable, with permanent residence acting as the reference group, while the broad Cause of Death categories are the main dependent

variables. Other dependent variables are: period, nationality, education and socio-economic status.

Results: This first set of results aims to address the question on the risk of AIDS/TB mortality among migrants in rural South Africa in the presence of other causes of death. The findings are that male and female short-term return migrants have significantly higher relative risk of dying of AIDS/TB death when compared to their non-migrants counterparts with sub-hazard ratio (SHR) of 4.87 (95% CI 4.17-5.72; P<0.001) and 5.44 (95% CI 4.64-6.38; P<0.001)) reported for both gender group respectively. For male and female long-term return migrants, their SHR was 1.80 (95% CI 1.43-2.26; P<0.001) and 2.06 (95% CI 1.57-2.70; P<0.001) respectively. The results did not reveal significant results for the in-migrants.

The second set of results aims to address the second research question, which is, how does the relationship between migration and mortality caused by AIDS/TB in rural South Africa in the context of other causes of death compare with the relationship between migration and causes different from AIDS/TB. The results show that Short-term return migrants have higher mortality than non-migrants, whatever the four causes of mortality. For instance, the competing risk of death due to AIDS/TB for short-term return migrants compared to non-migrants showed a lower SHR for external cause of death,

namely 8.78 (95% CI 5.86-13.16; P<0.05) vis-à-vis non-migrants. This implies that the difference in the relative risk of mortality between migrants and non-migrants is even higher for external causes than for AIDS/TB. The same is applicable to the risk of death from other infectious diseases for females, which has a SHR of 4.97 (95% CI 2.50-9.89; P<0.05) in the competing risk model. The relative risk of death due to AIDS/TB for male is 4.87 (95% CI 4.14-5.72 P<0.001) while that of female is 5.44 (95% CI 4.64-6.38; P<0.001); respectively.

With regards to the question on the possible predictors of the relationship between migration and AIDS/TB in the presence of other causes of death, it is shown that period is one of the predictors of the relationship between migration and AIDS/TB mortality. And, it is relevant to the study participants who died as a result of AIDS/TB, NCDs and other infectious diseases. In general, the risk dwindles in the latter period when the antiretroviral drugs become available for AIDS/TB. Nationality is also a determinant of the relationship and it is applicable to those who lost their lives due AIDS/TB (female only), NCDs and other infections (female). In all, the Mozambican nationals are less likely to die in comparison with the South Africans. Educational status is a predictor and it relevance cuts across virtually all the causes of death. The dominant pattern that is revealed in this context is that the higher the level of education, the lower the risk of death due to any of the causes. The predictive impact of SES can only

be felt among the respondents whose death was due to AIDS/TB and NCDs (female only).

Conclusion: With circular labour migration in South Africa showing no evidence of declining and with the attendant mortality risks due to AIDS/TB and other causes, and needs to be carefully considered - in policies aiming to control mortality in South Africa. Disease-induced migration creates burdens not only for the left-behind families in terms of their means of livelihood through loss of remittances, but also for the burden on health care facilities in the rural area. With short-term labour migrants being a high risk group, the success of intervention programmes addressing the problem of HIV infection and the resultant mortality implication, such as 'treatment as prevention' programmes, can only be guaranteed by recognising the risks incumbent on this group of people and the influence of the larger communities.

Keywords: Return migrants, AIDS, TB, HIV, South Africa; competing risk; HIV, AIDS, TB, rural and South Africa

PLAGIARISM DECLARATION

I, Sulaimon Atolagbe Afolabi, declare that this thesis is my own original work. It is being submitted for the degree of Doctor of Philosophy in Demography and Population Studies of the University of the Witwatersrand, Johannesburg. To the best of my knowledge, it has not been submitted before in part or in full for any degree or examination at this or any other University.

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DEDICATION

I dedicate this project to God the Father, the Son and the Holy Spirit.

LIST OF ACRONYMS

ABET	Adult Basic Education and Training
AIDS	Acquired Immune Deficiency Syndrome
CI	Confidence Interval
CoD	Cause of Death
CUR	Current
DHA	Department of Home Affairs
DoB	Date of Birth
DoD	Date of Death
DTH	Death
ENU	Enumeration
HDSS	Health and Demographic Surveillance System
HIV	Human Immunodeficiency Virus
ID	Identifier
IMG	In-migrant / In-migration
INTMG	In -Temporary migrant

LINC	Learning, Information Dissemination and Networking with the Community
NCDs	Non-Communicable diseases
NQF	National Qualifications Framework
OMG	Out-migrant/ Out-migration
OUTTMG	Out -Temporary migrant
PWV	Pretoria-Witwatersrand-Vereeniging area
RES	Resident
SES	Socio-Economic Status
SHR	Sub hazard ratio
SQL	Structured Query Language
TB	Tuberculosis
TMIG	Temporary migrant
UNAIDS	Joint United Nations Programme on HIV and AIDS
USA	United States of America
VA	Verbal Autopsy
VIP	Ventilated Improved Pit Latrine

WHO	World Health Organisation

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CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 Background information

Prior to 1994, the regime of apartheid in South Africa forcefully restricted its Black African citizens to the rural or peri-urban areas, which were then called the Bantustans or homelands (Nel 1990, Christie 1997, Owen 1993). These delimited areas were characterised by inadequate infrastructural, health, social and other kind of amenities and high rate of employment. Living in these low-productivity and disadvantageous areas, along with spatial inequalities in economic opportunities, created a pent-up desire among the homelands residents to move to cities for employment and other economic opportunities (Dyson 2003, Kok and Collinson 2006b).

The demise of the regime in 1994 paved the way for unrestricted rural-urban movement in search of better socio-economic opportunities. In post-apartheid South Africa, millions of people have migrated from one delimited area to another either permanently or temporarily. It is noteworthy that migration existed during the apartheid era in form of circular labour migration, though with constraints on where people could go and how long they could stay there (Lurie, Williams, Zuma et al. 2003a-b, Collinson, Wolff, Tollman et al. 2006, Reed 2013). Circular labour migration is a term used to denote individuals oscillating intermittently between their place of employment and residence, often rural, where their left-behind families are located (Lurie, Abigail, David et al. 1997, Bouare 2007, Coffee, Lurie, and Garnett 2007).

In general, migration has been associated with the spread of infectious diseases (Decosas, Kane, Anarfi et al. 1995, Watts 1987, Quinn 1994, Brockerhoff and Biddlecom 1999, Bouare 2007, Coffee, Lurie, and Garnett 2007). HIV[1] and TB are examples of two potentially fatal infectious diseases that have caused the loss of millions of lives across the globe. Various efforts geared towards eradicating them have faltered as they have now synergised, forming one of the most formidable twin pandemics ever recorded in human history. It is interesting to note that "these two diseases are not mutually exclusive, but tend to exacerbate the severity of each other" (Collins, Quinones-Mateu, Toossi et al. 2002).

Communities with high levels of circular labour migration are more at risk, because individuals in marital relationships tend to migrate without their partners to work in environment with a considerable level of vulnerability to the disease (Decosas, Kane, Anarfi et al. 1995, Crush, Williams, Gouws et al. 2005). Sub-Saharan Africa is home to just 15% of the world's population but more than 65% of HIV-positive people lived there in 2009, with South Africa contributing about 25%, that is about 5.3 million HIV-positive adults aged 15 years and above (UNAIDS 2010). Also in 2009 the country reported an estimate of 0.3 million adults that died as a result of AIDS (UNAIDS 2010). This figure represents a quarter of the total AIDS-related deaths reported in sub-Saharan

[1] HIV denotes the viral infection while AIDS represents death resulting from HIV. AIDS/TB implies AIDS and/or TB.

Africa and a 41% increase in the estimated deaths recorded in the previous decade.

In linking migration with HIV infection, the focus of the earlier studies was mainly on the roles of the mobile population in the geographical spread of the infection, that is, the migration of HIV (Quinn 1994, Carswell, Lloyd, and Howells 1989, Hunt 1989). There are certain mobile population groups that have been reported to be instrumental in the transmission of the disease, because of their high tendency to engage in risky sexual practices due to the nature of their employment and the absence of their usual partners. The people in this category include mine labourers (Kok and Collinson 2006b, Crush and James 1995), seasonal migrants (Pison, Guenno, Lagarde et al. 1993, Halli, Blanchard, Satihal et al. 2007), truck drivers (Carswell, Lloyd, and Howells 1989, Ramjee, Gouws, and Eleanor 2002) and road construction workers (Quinn 1994, Liu, Dong, Gao et al. 2013).

The notion of migrant as an HIV-transmitter was based on the premise that when an infected individual migrates they transmit the disease through sexual intercourse with a partner in their host community (Decosas, Kane, Anarfi et al. 1995, Sargent and Larchanche 2007). However, simply perceiving migrants as the transmitter of the infection (i.e. focusing only on the 'pathology of importation), while paying little or no attention to the micro-macro contextual factors (i.e. the 'pathology of acquisition') which their migration status might

expose them to, makes this notion too simplistic a rendition of the complex relationship between migration and HIV. Lalou and Piché (2004) corroborated this by stating that the perception of "the body of migrant as an infected and contagious body, a vehicle for a virus looking to conquer other bodies and territories, (inherently) separate the body from its social and cultural reality".

Subsequent studies have evolved from this conception of migrant as the spreader of disease to investigating the association between migration and HIV from a wider perspective, with the inherent notion that in an HIV-endemic population migration is an important risk factor. For instance, studies have considered the influence of the macro-social environment of the migrants on their contracting the disease (Lalou and Piché 2004, Soskolne and Shtarkshall 2002); socio-behavioural mechanisms (e.g. having multiple sexual partners) that could render them vulnerable to the disease (Brockerhoff and Biddlecom 1999, Hunt 1996); socio-familial disruption accompanying certain forms of migration e.g. lone circular labour migration, which places emotional stress on migrants and thereby increases their likelihood of risky sexual behaviour (Decosas, Kane, Anarfi et al. 1995, Crush, Williams, Gouws et al. 2005); the structure and conditions of migration – such as the type of migration fostered by the former apartheid migrant labour system that allowed adult males to migrate for work in the mines, while inherently placing a barrier on their spouses joining them due to the nature and limit of the provided accommodation (Collinson, Wolff, Tollman et al. 2006, Kok and Collinson 2006b).

Also, studies have raised and addressed the question of “who infects whom?”, with the results indicating the odds of migrants being infected by their left-behind spouses whom are not migrant (Lurie 2006, Lurie, Williams, Zuma et al. 2003b). This suggests that HIV transmission can be bi-directional. Furthermore, literature has shown that the relationship between migration and HIV can include reverse causality, which entails HIV-related illness acting as a determinant of a person migrating to their places of origin for care and to eventually die (Clark, Collinson, Kahn et al. 2007, Welaga, Hosegood, Weiner et al. 2009). This scenario is best summed up using the words of Prothero (1994), "Mobility affects disease and disease (in return) influences mobility".

Although a fair body of literature has grown on the relationship between migration and HIV, only few studies have examined the AIDS/TB mortality risk as a consequence of migration, with the results revealing that the returning migrants have higher chance of dying of AIDS/TB than their non-migrant counterparts (Clark, Collinson, Kahn et al. 2007, Welaga, Hosegood, Weiner et al. 2009, Levira, Todd, and Masanja 2014). However, these studies only looked at the impact of migration on mortality due to AIDS/TB and did not make provision for other causes of death. Hence, this thesis attempts to investigate migration as it relates to deaths caused by AIDS/TB longitudinally in comparison with the other causes such as the non-communicable diseases (NCDs), other infectious and external causes of death in rural South Africa.

1.2 **Problem statement**

In the rural northeast it has been established that returning migrants are more likely to die of AIDS/TB in comparison with the non-migrants (Clark, Collinson, Kahn et al. 2007, Welaga, Hosegood, Weiner et al. 2009, Levira, Todd, and Masanja 2014). In reaching this conclusion, the available studies statistically modelled and compared the probability of occurrence of AIDS/TB mortality among migrants and non-migrants. While this approach is effective, it is important to note that migration is a complex phenomenon exhibiting varying patterns and often characterised by a certain degree of heterogeneity. More importantly, the migrants that are infected with the diseases are likely to die of causes other than AIDS/TB that can either preclude or alter the probability of death occurrence (Gooley, Leisenring, Crowley et al. 1999, Mell and Jeong 2010).

Considering other causes of death is necessary, as a previous study (Mayosi, Flisher, Lalloo et al. 2009) suggests that the high prevalence of AIDS/TB in South Africa may have diverted attention and resources away from the control and treatment of other diseases e.g. non-communicable diseases. This study provides a longitudinal perspective to studying the relationship between migration and AIDS/TB death, in comparison with other causes of death. It is noteworthy that the longitudinal time plane allows the portrayal of a better picture of the temporal influence of migration.

1.3 **Research questions**

1. What is the mortality risk of dying of AIDS/TB among migrants in rural South Africa in the presence of other causes of death?

2. How does the relationship between migration and AIDS/TB mortality in rural South Africa compare with the relationship between migration and causes different from AIDS/TB?

3. What are the possible predictors of the relationship between migration and AIDS/TB in the presence of other causes of death?

1.4 **Research objectives**

1.4.1 Overall objective of the study:

The overall objective is to study the relationship between migration and AIDS/TB mortality in the context of other causes of death in rural South Africa.

1.4.2 Specific objectives:

1. To estimate the mortality risk of dying of AIDS/TB among Migrants in rural South Africa in the presence of other causes of death

2. To examine the relationship between migration and mortality caused by AIDS/TB in rural South Africa compared with the relationship between

migration and causes different from AIDS/TB.

3. To determine the possible predictors of the relationship between migration and AIDS/TB in the presence of other causes of death.

1.5 Definition of Terms

1.5.1 Risky sexual intercourse: This entails engaging in sexual intercourse with more than one partner and/ or without the use of a condom for protection from sexually transmitted infections.

1.5.2 AIDS/TB: This implies Acquired Immune Deficiency Syndrome *(*AIDS) and/or Tuberculosis

1.5.3 Host community: This is the community or population in which the migrant resides after migration.

1.5.4 Competing Risk: This is a term commonly use in event history analysis to denote a situation where a respondent is exposed to many events with each having the capacity of precluding the occurrence of the other event.

1.5.5 Health and demographic surveillance system: This is a regular survey of a geographically-defined area with the intention of collecting health and demographic data.

1.5.6 Circular labour migration: A form of migration that entails migrants looking for employment and/or working outside their origin area, while keeping functional links with their household of origin, including visiting from time to time and returning upon the end of employment.

1.5.7 Migrant labour system: This is a type of regulated migration geared towards the recruitment of the labour, as for example in operation during the South African apartheid regime.

1.5.8 Treatment as prevention: This is a method of preventing HIV by administering anti-retroviral treatment to minimise HIV transmission.

1.5.9 Pathology of Importation: This is a notion that implies that the diseases that are that found in a particular country exists as a result of them being brought into that country from another though mobility.

1.5.10 Pathology of Acquisition: This is a notion on the socio-cultural community that is characterised by certain factors that pre-disposes mobile population to HIV and other types of diseases.

1.5.11 Co-morbidity: This is having two diseases or illness occurring in an individual at the same time.

1.5.12 Correlate: This is a statistical terms to denote a scenario in which two variables are associated with one another.

1.5.13 Push Factor: This includes events or natural disaster (e.g. war, earthquake, flood, cyclone, hurricane, epidemic, civil unrest) that can lead to people leaving their usual places of residence.

1.5.14 Pull Factor: This refers to opportunities in another geographical location that lure an individual to assume the status of a migrant.

1.5.15: Multi-drug resistant TB: This refers to the ability of the tuberculosis bacteria (mycobacterium tuberculosis) to militate against the drugs that are prescribed to cure their hosts.

1.6 **Justification**

Evidence shows that millions of people across the globe lose their lives to human immunodeficiency virus (HIV) and tuberculosis (TB) on an annual basis, with a large proportion residing in sub-Saharan Africa (UNAIDS 2010, WHO 2011). Further evidence shows that South Africa is one of the epicentres of the pandemics (UNAIDS 2010). More importantly, migration in South Africa features circular labour migration which has attendant health consequences for the migrants themselves, the people at the place of destination, and the people left behind, including their partners (Collinson, Wolff, Tollman et al. 2006, Crush, Williams, Gouws et al. 2005, Kok and Collinson 2006a).

Unravelling the link between migration and AIDS/TB mortality requires a longitudinal study that can examine the relationship between these two phenomena. The approach also makes it possible to consider different migration patterns which could influence the relationship between migration and HIV (Deane, Parkhurst, and Johnston 2010). Getting a more fine-tuned understanding of the link between migration and AIDS/TB is important in delineating the group of migrants that should be the target of AIDS/TB interventions with the intention of reducing the burden of disease.

It is possible for migrants including those that are already infected with the virus to die from causes that are different from AIDS/TB. By using an

innovative statistical approach, which will be explained later, the likelihood of experiencing other causes of death by the migrants will be considered.

Health and demographic surveillance system (HDSS) data can be used to address this issue, through capturing the demographic, health and socio-economic experience of people in the surveillance population. The Agincourt HDSS is located in one of the former apartheid homelands, a place that Black Africans were forcefully restricted to during the apartheid era and now acts as a migrant sending community. HDSS data create an opportunity for analysing the dynamics of migration and its mortality consequences. White (2009) notes that:

> "The health and well-being of populations unfold dynamically, often through a sequence of interrelated events and the availability of detailed information to help entangle those interrelationships is difficult to acquire. However, detailed data, such as that collected by health and demographic surveillance systems can help us open a window on this complex interplay of events."

1.7 **Organisation of the thesis by chapter**

The following is the organisation of the thesis by chapter. Chapter 1 focuses on introducing the research with summary information of what is already known; the statement of the problem; and the definition of the terms used in the thesis.

Chapter 2 argues the case for the current study by reviewing past studies carried out on migration and HIV and on AIDS/TB mortality. Furthermore, it highlights the direction which the current study follows to explore the gap in available studies. Chapter 3 has three main sections. The first section contains theories and concepts from different areas of study that are relevant to the study. The second concentrates on the conceptual framework of the project, while the last section lists the hypotheses to be tested.

Chapter 4 provides information on the methodology of the study. This ranges from the study setting to the method of data analysis. Chapter 5 presents information on the profile of the population with a section on descriptive statistics and demographic profiles. Chapter 6 presents the results of the study. Chapter 7 focuses on discussing the results that emanate from the study, while chapter 8 concludes the study and provides recommendation based on the findings.

The HIV pandemic has triggered a surge of interest in the study of migration, including its impact on people's health and well-being. There exists a large literature focusing on the link between migration and HIV infection with insights drawn from diverse data sources and is summarised below. The perspectives range from studies that lay emphasis on the structure and condition of certain forms of migration (e.g. circular labour migration), which create an

enabling environment for HIV transmission, to studies that focus on the health implications for migrants and the non-migrants alike (Decosas, Kane, Anarfi et al. 1995, Quinn 1994, Lalou and Piché 2004, Hunt 1996, Soskolne and Shtarkshall 2002, Lurie and Williams 2014).

These perspectives often span the places of origin and destination of the migrants. This chapter is concerned with critically reviewing some of the existing studies with the aim of delineating the pertinent questions on which further research is needed to advance our knowledge of the relationship between the two phenomena, migration and AIDS/TB mortality. The first section is devoted to exploring the complex nature of migration and how this relates to the measurement and definition of migration. It is important to note that unlike its demographic counterparts, fertility and mortality, migration is a complex phenomenon to quantify, due to its heterogeneous and repeating nature (Yaukey 1990, Quinn 1994, Crush, Williams, Gouws et al. 2005, Moultrie and Dorrington 2004). Secondly, it has been established that TB is a major co-infection with HIV. How these two diseases inter-relate will be the subject of discussion in the following section (Blower and Chou 2004, Collins, Quinones-Mateu, Toossi et al. 2002).

Thirdly, section 2.4 is a discussion about studies that link migration and HIV infection. Of particular interest is the paradigm-shift of migration-HIV

researchers in the way they perceive migrants, bringing attention to the socio-contextual and other distal factors as HIV becomes endemic. Fourthly, section 2.5 reviews studies which consider migrants as vulnerable people that should be welcomed and not stigmatised by their communities at destination. Fifthly, section 2.6 reviews what is known about the connection between migration and AIDS/TB mortality and identifies what needs to be done to better portray this relationship.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The HIV pandemic has triggered a surge of interest in the study of migration, including its dynamics as well as impact on the health and well-being of people across the globe. The attention drawn to HIV vis-à-vis migration has been facilitated by the fact that the disease is infectious and has been directly responsible for the death of many people across the globe. Also, migration has been alleged as an avenue for the 'transportation' of HIV from one place to another. Above all, various efforts and resources allocated to find a cure for HIV has not yielded any curative results. Nevertheless, there are treatment regimens and programmes that have been designed to increase the life span of those already infected with the disease and contain the further spread of the disease e.g. antiretroviral therapy and treatment as prevention programme (Levira, Todd, and Masanja 2014, Ingle, May, Gill et al. 2014). On HIV-migration link, there exists a large literature that focuses largely on the connection between migration and HIV infection with insights being drawn from diverse data sources.

Specifically, the HIV-migration study perspectives, which are critically reviewed in detail later in this chapter, range from studies that lay emphasis on the structure and condition of certain forms of migration (e.g. circular labour migration), which has been acknowledged to create an enabling environment

for HIV transmission; to studies that focus on the health implications of the infection for migrants and non-migrants alike (Decosas, Kane, Anarfi et al. 1995, Quinn 1994, Lalou and Piché 2004, Hunt 1996, Soskolne and Shtarkshall 2002, Lurie and Williams 2014). Furthermore, these perspectives often span the places of origin and destination of the migrants. In summary, this chapter is concerned with critically reviewing some of the existing studies with the aim of delineating the pertinent questions on which further research is needed to advance our knowledge of the relationship between the two phenomena, migration and HIV.

The first section is devoted to exploring the complex nature of migration and how this relates to the conceptualisation and measurement of migration. It is important to note that unlike its demographic counterparts fertility and mortality, migration is a complex phenomenon to quantify and collect data on, due to its spatial, temporal, heterogeneous and repeating nature (Yaukey 1990, Quinn 1994, Crush, Williams, Gouws et al. 2005, Moultrie and Dorrington 2004, Kok 1999). These multifaceted dimensions of migration vary from study to study with the context playing an important role.

Secondly, it has been established that TB is not only a major co-infection of HIV but is its correlate. And both AIDS and TB, as causes of mortality, have registered a very high impact on mortality since their inception many decades

ago (Blower and Chou 2004, Abdool Karim, Churchyard, Abdool Karim et al. 2009, Dolin, Raviglione, and Kochi 1994, Collins, Quinones-Mateu, Toossi et al. 2002, WHO 2011). In section 2.3 and 2.4, how these two diseases inter-relate as co-morbidity will be the subject of discussion with statistics on the extent of their devastation across the globe in general and South Africa in particular being provided.

Thirdly, section 2.5 is all about the discussion of studies that link migration and HIV infection globally and in South Africa. Of particular interest is the paradigm-shift of migration-HIV researchers in the way they perceive migrants, bringing attention to the socio-contextual and other distal factors as HIV becomes endemic. Migrants are vulnerable people that should be welcomed and not stigmatised by their communities at destination.

Fourthly, section 2.6 is geared towards arguing the fact that migration is selective. Migrants possess certain socio-demographic and economic characteristic that predisposes to leave their usual place of residence in search of opportunities. Fifthly, section 2.7 reviews what is known about the connection between migration and AIDS/TB mortality and identifies what needs to be done to better portray this relationship.

2.2 **Migration as a complex phenomenon**

Migration, in its simplest definition, can be construed as a change in the usual place of residence. However, migration goes beyond an ordinary change of residence because not all residential mobility constitutes migration. For instance, the United Nations in its publication on methods of measuring internal migration expressly stipulated that residential mobility that entails moving locally from one apartment to another in the same building or from one house to another in the same locality should not be categorised nor classified as migration (United-Nations 1970).

Furthermore, migration is a complex phenomenon because its definition and quantification requires qualification in terms of time, space and distance, just to mention a few of its complexities (Kok 1999, Yaukey 1990, Moultrie and Dorrington 2004, Quinn 1994). Additionally, collecting data to quantify these attributes of migration is both difficult and tedious. Because of these reasons, demographers and other population researchers tend to perceive migration as a "poor cousin" of demographic research. Apart from migration, the other components of population change in demographic study comprises: fertility and mortality. As it will be seen in the analogy below, the other two are relatively straightforward to conduct studies as they do not possess some of the migration features.

For instance, adopting fertility as a research variable among other things is not as complex as migration based on the following reasons. First, giving birth is limited to females only and this is largely due to the fact males are not biologically and naturally capable of giving birth. Whereas, when it comes to migration, both male and female can migrate. Second, it is only women that belong to certain age category that can procreate. In case of fertility, no infant regardless of sex can have an offspring. The same is applicable to most women that have experienced menopause. Whereas with migration, a day old child can migrate with his or her parents. In the same vain, an aged person can also relocate to his or her country home with the availability of means of transportation.

Third, it will take an ample time for a woman that conceived and just gave birth to a child to give birth to another child when the case of giving births to twins or triplets is not involved. On the other hand, it is possible for an individual to experience another migration event immediately he or she experiences the immediate one. With respect to immediate migration, time may not be a constraint in case of “push factor” such as civil unrest or war. This implies that migrants can move again. Fourth, spatial dimension is not a factor to consider when measuring fertility but it is required in quantifying migration. While a single geographical location is recorded when a birth takes place, migration requires a place of origin and destination most especially when the migration is circulatory in nature.

Like fertility, mortality also has some advantages over migration as a variable. For example, an individual can die only once, while a person can migrate multiple times during their lifetime. Similar to fertility, one single place of death is recorded in the event of death whereas it is the opposite in the case of migration. Most governments either in the developing or developed countries of the world have put in place a number of traditional institutions and facilities (e.g. hospitals, clinics, police stations, department of home affairs, ministry of internal affairs) with the mandate to capture information on fertility and mortality as they occur. On the other hand, apart from migration that involves moving legally from one country to another, there is seemingly no availability of systems allocated for the recording of migration from a place within a country to another, especially in the developing countries. The closest will be an institution that requires you to update your current place of residence fortnightly (e.g. national registration centre). Again, these systems are usually found in the developed countries. The health and demographic surveillance, which are emerging in less developed countries to fill this vacuum. They are limited in terms of coverage and the frequency of data collection, but wherever they are located they provide relatively rich data on the movement of people (White 2009, Sankoh and Byass 2012, Ng, Van Minh, Juvekar et al. 2009) .

In taking into consideration the spatial dimension of migration and the distance covered, the definition of this important component of population change will include moving across a geographical delimited area, which can be a country,

province, state, municipality, local government area, district etc. While it is relatively easy to document migration across international boundaries most especially when it entails using the recognised border or port of entry, the same cannot be said of internal migration, which often go undocumented. Hence, the spatial complexity of migration, to a great extent, is more pronounced in internal migration than international migration as the latter entails the move between countries.

In the context of defining migration to entail crossing boundaries within a country, the question of what spatial boundary needs to be crossed before a move is considered a migration is essential as jurisdictional boundaries often change. In some instances, a move across a street can be considered a migration most especially if a boundary (e.g. local government, state, province, and village) is crossed. Whereas, reverse is the cases where no recognised boundary is crossed. However, an individual can move temporarily to another for non-migration reasons e.g. to go and visit a relative. This is often handled by specifying the duration of time spent in a place when defining migration.

In adding temporal dimension to the definition of migration, it is important to take into consideration the duration of time that must elapse before a person that moved into another geographically delimited area can be considered a migrant. This is necessary in order to avoid confusing a migrant with someone

on a temporary visit. In order to address the aforementioned issue of migration distance, a number surveys and even national censuses are introducing the following question into their questionnaire: "How many months were you present at home in the past 12 months?"; "How many months did you live away from hometown due to work or business in the last 12 months" (Agincourt-HDSS1 2017, Research School of Economics 2017).

Making provision for the collection of data on the duration of residence is a welcome development because researchers are in a better position to classify migration by duration spent outside their usual places of abode. For instance, Brockerhoff and Biddlecom (1999) examined how risky sexual behaviour, an important parameter in the transmission HIV, differs between migrants and non-migrants in Kenya using the 1993 nationally representative Kenyan Demographic and Health Survey, which has information on duration of residence. In the study, they defined migrants as those who moved into their current place of residence from another with those whom have spent six months or more, being considered as permanent migrant. Similarly, Lurie, Williams, Zuma et al. (2003a-a) measured migration by considering male individuals who have been out of their rural places of residence to work in the urban area (the mines) for at least six months and their left-behind partners. It is noteworthy here that the intention here is not to debate whether the threshold of six months adopted by Brockerhoff and Biddlecom (1999) and Lurie, Williams, Zuma et al. (2003a-a) in their respective studies is enough or not but rather to show that

researchers capitalise on the availability of data on duration of residence to quantify migration.

Table 2.1 is an adapted table from Kok (1999) and it shows different classifications of spatial and temporal mobility with a mention of the distance covered. As depicted by the table, it can be seen that not all move necessarily translates into migration and this includes the ones that involves crossing migration defining boundaries. Similarly, not all mobility characterised by moving over a long distance can be categorised as migration e.g. pastoral nomad, tourist trips and so on. This will be expatiated on in the following paragraphs.

It is easily understandable why shopping, tourist and daily work trips do not constitute migration. The main explanation is that they do not possess the minimal requirement for them to be considered as migration, that is, change of residence. Even when the moves entails change of residence (temporary) and crossing of geographically delimited boundaries as in the case of tourist trips, still they cannot be categorised as migration because they are for short-term period of time and the people involved in this kind of move normally undertake them for the purpose of visitation and leisure.

On the other hand, as seen in the table, undertaking journeys regardless of the distance to visit home after a period of stay at the place of destination often for employment purpose either on a short-term or long-term basis constitutes short-term and long-term labour migration respectively. The same is applicable to change of permanent residence (i.e. permanent migration) when a crossing of boundary is involved. It can be argued that since the sort-term in this context has the capacity to prevent the migrants from returning home daily to their left-behind families. Hence, the move is not actually short but long because a trip of more than hour. There may be an exception for cases where the individual is working as a security guard or expected to live in the mines.

However, categorising pastoral nomads by their migration status is not straightforward, unlike trips and the afore-mentioned migration types. The question is, “Who are the nomads?” These are pastoral group of people that move with their cattle and other livestock from one place to another in search of green pasture. This is more than a century old form of mobility tradition that is common among the Fulani ethnic group, which can be found in some African countries namely Cameroon, Chad, Guinea, Niger, Nigeria, Mali, Senegal and Sudan (Appiah and Gates 2010, Levinson 1996, Waters-Bayer and Bayer 1994). Although the increasing rate of urbanisation in the current dispensation implies restriction on their movement and access to grasses for their livestock, the Fulani herdsmen still practice the nomadic pastoral system up till today.

The mobility pattern of this group of people is termed transient because they do not have a permanent place of residence. Also, they do not stay in a single place for a long period of time. Although the Fulani nomadic move has spatial and temporal components, it does not constitute migration because as at the time of leaving their usual place of residence they do not have a particular destination in mind. In addition, the time amount of time they are going to spend or camp in their supposedly destination place is unknown. Furthermore, they are often situated far from the cities and towns. Hence, it is difficult to collect data from them.

Apart from classifying migration into different categories, it is important to specify that it is a phenomenon with varying determinants that can influence the decision of people to migrate. These determinants can either be proximate or distal and they cut across many aspects of human life (i.e. social, financial, physical, culturally, educational, familial etc.) and they have the tendency to interact with one another.

Table 2.1: **A Typology of Spatial and Temporal Mobility Adapted from Kok (1999)**

Broad Category	**Example**	**Temporal Dimension**	**Spatial Dimension**			**Classification**
		Description	**Change in place of residence?**	**Description**	**Migration-defining boundary crossed.**	
Circulation	Pastoral nomads	People with no fixed" place of residence	No	Short or long distance moves	Yes/No	Transient mobility
	Shopping trips & tourist trips	Short-term circular moves into no change of residence	No	Short or long distance moves	Yes/No	Short-term mobility
	Daily work trips					daily commuting
	Trips home to visit, or back to place of employment after a period or stay at the origin of the move.	Short-term circular moves that do entails dual places of residence	Yes	Short or long distance moves	Yes/No	Short-term labour migration
	Long-term migrant labour absences (usually of longer than an a week at a time)	A move taking place at the beginning of end of an extended migrant labour period.	Yes	Short or long distance moves	Yes/No	Long-term labour migration
More permanent moves	Change of permanent residence ("moving home")	Short or long-term residence at place of destination	Yes	Short or long distance moves	Yes	Permanent migration or Residential mobility

Additionally, these factors may change over time and play a double role in the movement of people by acting as a push factor in one context and a pull factor in another. Push factors refer to an occurrence, condition or event that can lead to a person relocating either voluntarily or involuntarily from their usual place of residence to another place. On the other hand, pull factor can be defined as a condition or opportunity that has the potential of making an individual to take on the status of a migrant.

An example of push-pull factor playing a double role includes a person making a decision to migrate to an urban or peri-urban area for employment opportunity, the same individual can move back to his place of origin due to job loss. We can see here that employment has the tendency to play a double role with job opportunity acting as a pull factor in one context and job loss as a push factor in another situation. Another example of a push-pull factor acting as a double agent entails an individual that chose to migrate to an urban area due to positive health status. Negative conditions of health can result in the same person migrating back to his place of origin for care and support (Prothero 1994, Knodel and VanLandingham 2003, London, Wilmoth, and Fleishman 2004, Corno and de Walque 2012).

Migration has varying determinants that can either be proximate or distal. These determinants range across many aspects of human life (i.e. social, financial, physical etc.) and have the tendency to interact with one another. Additionally,

the factors may change over time and play a double role in the movement of the people by acting as a push factor in one context and a pull factor in another. For example, a positive health status can enable an individual to migrate to an urban area for work. Whereas, as negative health status can result in the same person migrating back to his place of origin for care and support (Prothero 1994, Knodel and VanLandingham 2003, London, Wilmoth, and Fleishman 2004, Corno and de Walque 2012).

Furthermore, migration can be voluntary or forced e.g. displacement by war, earthquake, flood, cyclone and so on, which can have multi-faceted implications. Voluntary migration is the most common form of migration, and while not coerced, can be influenced by push or pull factors as previously discussed. Also, migration is not the choice of all people in a given setting and is often selective in who migrates. Previous studies have shown that migrants are often young, male, formally educated and healthy, although this may not hold in certain settings (Palloni and Morenoff 2001, Hervitz 1985, Brockerhoff and Biddlecom 1999, Yang, Qeadan, and Smith-Gagen 2011). Section 2.5 of this chapter discusses the selectivity of migration in more detail.

Migration involves at least two distinct locations, namely, the places of origin and destination. The origin-destination combination can take different forms, such as rural-rural, rural-urban and urban-urban. It is important to note that

urban-rural migration is characterised by certain level of circularity as the migrants return back to their places of origin for visiting or returning. In rural South Africa migrants often do not migrate with their spouses but maintain links with them while they are away. This migration type has been said to influence migrant behaviour negatively and engender vulnerability to HIV infection as will be explained later (Collinson, Wolff, Tollman et al. 2006, Kok and Collinson 2006a) .

2.3 **HIV/AIDS and tuberculosis co-morbidity: the general overview**

Tuberculosis is an airborne respiratory disease caused by a micro-organism called mycobacterium tuberculosis, which mostly affects the lungs, but also has other manifestations. On the other hand, HIV/AIDS is mostly a sexually transmitted disease resulting from the damage to the immune system caused by HIV. TB is 'an ancient enemy' that has plagued mankind for millennia and globally it accounts for more deaths among adults than all other infectious diseases combined (Blower and Chou 2004, Blower and Gerberding 1998).

Unlike HIV, it is not everyone that is infected with TB that develops the full-blown disease. The asymptomatic TB infection, where the carrier does not experience symptoms, is common in TB-endemic areas. However, HIV-positive individuals have a greater probability of progressing from latent to active TB due to the weakening of their immune system by the sexually transmitted infection.

Also, it is interesting to note that the TB bacteria (i.e. mycobacterium tuberculosis) can develop resistance to the drugs that specifically prescribed to treat its host. This makes TB the leading cause of death among HIV infected people and the World Health Organisation (WHO) estimates that TB accounts for a large proportion of AIDS deaths worldwide (WHO 2011). In 2015, the WHO reports that 10.4 million people fell sick due to TB in 2015 worldwide and that 1.8 million died as a result of the disease in the same year inclusive of 400,00 with HIV (WHO 2016). This translates to an estimate of 4,900 deaths per day. Additionally, more than 400 thousands of multi-drug resistant TB countries were also diagnosed. These records can be seen in Figure 2.1, an annotated worldwide map of burden of TB in some high risk TB countries designed by Eybers (2017)

Based on the data from a range of studies, Dolin, Raviglione et al. (1994) estimated that globally about 95% reported cases of TB in HIV infected individuals could be ascribed to the debilitating impact of the HIV virus and that the remaining 5% would develop TB irrespective of their HIV status.

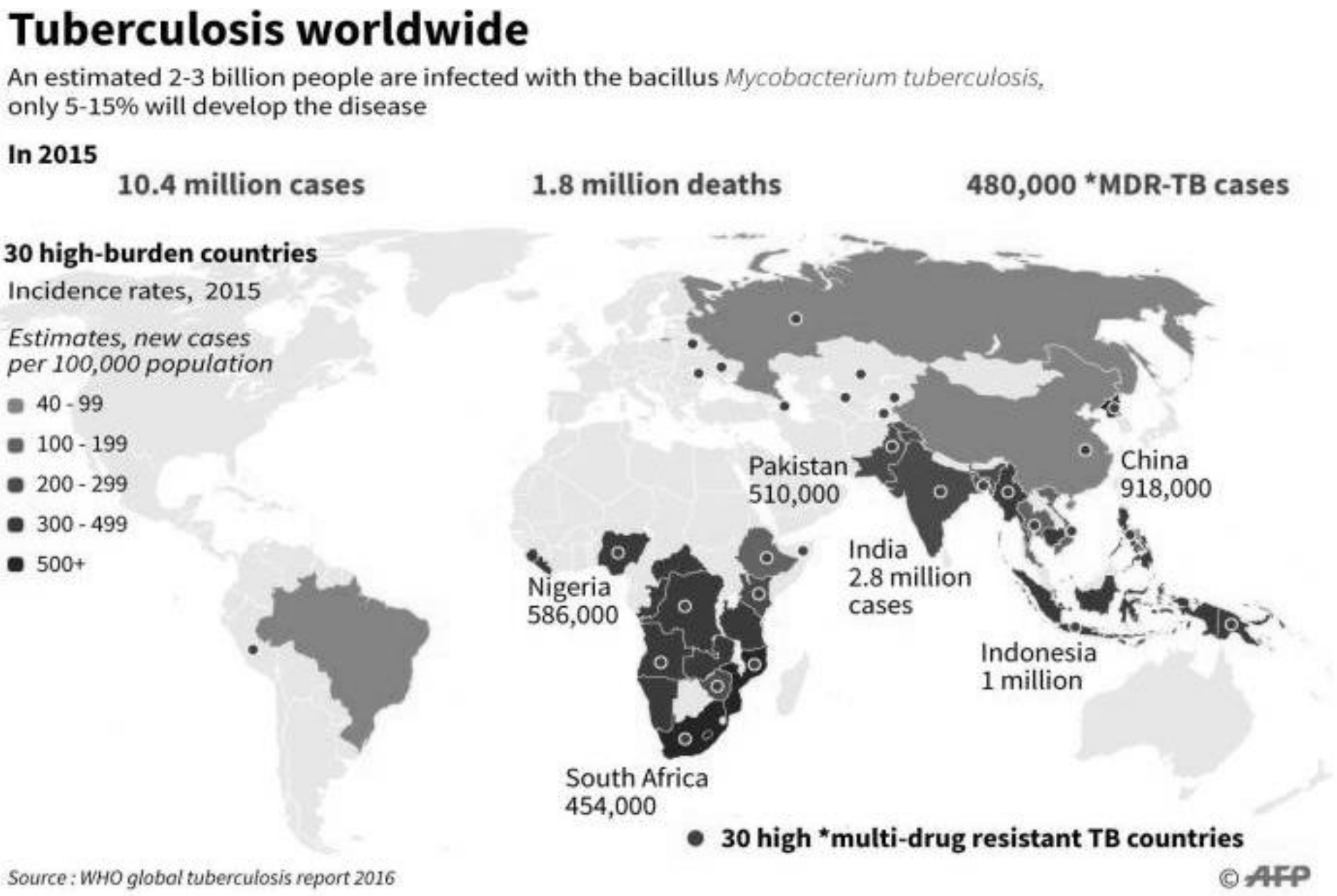


Figure 2.1: Annotated map of tuberculosis in high risk countries (Eybers 2017)

2.4 HIV/AIDS and tuberculosis in South Africa

From more than a decade, South Africa has been on the list of six countries (namely: China, India, Indonesia, Nigeria, Pakistan and South Africa) that contribute over 50% of TB cases globally (WHO 2016, 2015, Abdool Karim, Churchyard, Abdool Karim et al. 2009). Gandhi, Moll, Sturm et al. (2006) reported that around 8 out of every 10 patients diagnosed with TB in KwaZulu-Natal province of South Africa were found to be infected with HIV (Gandhi, Moll, Sturm et al. 2006). This implies that in an HIV endemic area, there is a higher chance of the people who died of TB to have actually died due to the complication of HIV. For this reason, it is deemed a sensible approach to combine the two diseases (HIV and TB) when relating them to migration, as it not straightforward to discriminate between them (Clark, Collinson, Kahn et al. 2007). This is especially the case with mortality as the main outcome of the study, with the cause of death determined by verbal autopsy, the details of which will be described in chapter 5.

2.5 Migration and HIV – A General overview

At the onset of the HIV pandemic, migrants were perceived to be a channel of HIV transmission to their host communities, because of the potential risk to which migration status predisposes them (Quinn 1994, Pison, Guenno, Lagarde et al. 1993, Carswell, Lloyd, and Howells 1989, Hunt 1989). Hence, the early

focus of research on migration and HIV was the spatial spread of the disease. Sub-Saharan Africa, being the epicentre of the HIV/AIDS epidemic was the host of most studies on migration and HIV.

According to Quinn (1994), “Migration of individuals from areas of low endemicity to new uninfected areas was eventually responsible for the dissemination of HIV throughout the world”. This premise of migrant as HIV transmitter resulted in migrants being stigmatised by certain government institutions in their destination countries, whose responsibility was to establish migration control measures with the intention of stopping the spread of disease. Nevertheless, these cordon sanitaire efforts did not alleviate the spread of the infection indicating that the relationship between migration and HIV went beyond the ordinary movement of people from one place to another.

Apart from stigmatising migrants, the argument that HIV infection follows the direction of human movement is fallible without critically evaluating the mode of transmission and the socio-cultural context of the migrants. In corroborating this standpoint, Lalou and Piché (2004) argued that it is incorrect to perceive "the body of a migrant as an infected and contagious body, a vehicle for a virus looking to conquer other bodies and territories”. Similarly, Decosas et al. (1995) affirm that it is actually “... the social disruption which characterises certain types of migration, which determines vulnerability to HIV”.

Emerging studies on migration and health have shifted from perceiving migrants as the “dispensers” of HIV to investigating the conditions and structure of migration process and other factors that engender susceptibility to the infection (Decosas, Kane, Anarfi et al. 1995, Quinn 1994, Lalou and Piché 2004, Hunt 1996, Soskolne and Shtarkshall 2002). For instance, the migrant labour system found in South Africa during the apartheid era, that encouraged adult males to work in mines and be accommodated in hostels, while inherently placing restriction on their spouses from joining them, has been recognised as creating an environment for the spread of HIV (Lurie 2006, Collinson, Wolff, Tollman et al. 2006, Crush and James 1995, Kok and Collinson 2006a, Crush, Williams, Gouws et al. 2005, Hunt 1989).

Migrants in the context of migrant labour system context suffer from emotional instability due to lack of regular contact with their usual partners. Also, they are prone to having extra-marital sexual partners as their hostels were trade routes for commercial sex workers. Furthermore, they have high chance to succumb to the "sexual norms" of their new environment under the influence of their co-miners and consequently, engage in high risk sexual behaviour that might result in HIV infection. Quoting Jochelson et al. (1991), Lurie et al. (1997) supported this premise stating that, "... it is clear that migrants’ frequent and lengthy absences from home can 'disrupt their familial and stable sexual relationships' ". Similarly, Crush et al. (2005) expresses that the "migrant labour system clearly increased the vulnerability of migrants to infection and greatly

facilitated the spread of sexually transmitted diseases, as well as other, infectious diseases".

Another sub-Saharan African example is a scenario portrayed by seasonal migration usually undertaken by Senegalese lone adults for a period of seven months to peri-urban area of the country to harvest farm produce (Pison, Guenno, Lagarde et al. 1993, Quinn 1994). Pison et al. (1993) empirically described the way migration influenced HIV transmission, saying that "HIV is mainly transmitted first to adult men through sexual contacts with infected women met during their period of migration and second to their wives or regular partners once they are back at home". This finding suggests that migrants are the source of HIV infection in their spouses due to their high likelihood of engaging in risky sexual behaviour outside their matrimonial relationship.

Lurie, Williams, Zuma et al. (2003b) has challenged this exclusively migrant-to-spouse channel of HIV transmission, stating that "the direction of spread of the epidemic is not only from returning migrant men to their rural partners, but also from women to their migrant partners". This conclusion originated from his study titled, "Who Infects Whom?- HIV-1 Concordance and Discordance among Migrant and Non-migrant Couples in South Africa" where he discovered that the wives of migrants have 2.1 time higher likelihood of acquiring HIV from outside the marital union. This is not unexpected as the left-behind wife may also fill the "vacuum" created by the long and frequent absence of the migrant husband.

2.6 **Selectivity of migration**

With an estimate of 22.5 million individuals living with HIV in sub-Saharan African in 2009, it is possible that adult HIV infection has reached a stage of saturation or become endemic on the continent, whereby migrants have almost the same risk of dying of the disease as non-migrants (UNAIDS 2010). It is important to reiterate that migration is often selective and that migrant usually fulfils the intrinsic good health condition for being eligible to participate in the migration process. This prerequisite is encapsulated in the "healthy migrant hypothesis", which postulates that migrants constitute a healthy category of people at their place of origin and, thus, their proportion is not usually reflective of the overall health state of their respective population (Palloni and Morenoff 2001). The healthy migrant concept is discussed in detail in the next chapter under theoretical framework.

The returning home of labour migrants when they are ill can imply that conditions at the destination have negatively exposed them to health risks. Empirically, Lurie, Williams et al., (2003a-b) found that the major risk factor for being infected with HIV among male migrants working in the mines was their migration status, with an Odds Ratio of 2.4 compared to non-migrants. Other studies have also established that migrants are more likely to return their place of origin when ill to receive care and with the cause of their illness and death eventually being AIDS/TB (Clark, Collinson, Kahn et al. 2007, Welaga, Hosegood, Weiner et al. 2009). Thus, the initially healthier migrants may

become unhealthy and this could be attributed to the change in residential status.

2.7 **Migration and AIDS/TB mortality**

Clark, Collinson, Kahn et al. (2007) conducted a study on migration and mortality which they titled "Returning home to die: Circular labour migration and mortality in South Africa". Their aim was to find out whether the labour migrants aged between 20 and 80 years returned back to their rural home in north-eastern South Africa to die of AIDS/TB, between 1992 and 2004. By applying a discrete time event history analysis approach to more than a decade of longitudinal data from the Agincourt Health and Demographic Surveillance System, they showed that migrants who moved back to their place of origin in the short term (i.e. 0 – 5 years after return migration) possessed between 1.1 and 1.9 higher odds of dying from AIDS/TB compared to the migrants who had returned more than five years previously or those who had not migrated.

Two years afterwards, Welaga, Hosegood, Weiner et al. (2009) replicated this study in northern rural KwaZulu-Natal using data from the Africa Centre Health and Demographic Surveillance System. This study was based on data collected longitudinally between 2001 and 2005 and used Cox proportional hazard regression analysis. This time the respondents were restricted to those aged 18-

60 years. In their conclusion they discovered that migrants who move into the study area had a 1.28 odds of dying from any cause and 1.79 increased likelihood of dying of HIV related causes, compared to non-migrants.

For HIV-positive individuals the time between the onset of HIV infection and their dates of death can vary widely. Furthermore, the time to death is now hugely increased due to the availability of antiretroviral drugs (Levira, Todd, and Masanja 2014, Ingle, May, Gill et al. 2014).

In a recent study using two rounds of the nationally representative National Income Dynamics Study the authors describe patterns of short-term household change and correlated migration, highlighting differences by race group and associations with employment and socio-economic transitions (Grieger, Williamson, Leibbrandt et al. 2014). During a two-year period, from 2008 to 2010, 10.5% of South Africans moved residence and 61.3% experienced a change in household composition. Among Black Africans who migrated, the profile was highly associated with age, since younger people, aged 18-25 years, were more likely to move. The migration may be largely associated with average gains in income in this sub-group of movers. Also, long distance migration is much more common among Black Africans than other racial groups in the country. From this we can surmise that the pattern of labour migration

from rural Bushbuckridge, being long-distance labour migration of Black Africans, fits well into the national pattern reported by the NIDS study.

CHAPTER 3: THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 Introduction

> "Migration defines neither a condition which in itself involves risks, nor an environment which necessarily produces risks. It is a social reality that is constructed through life histories and situations, as a function of context and social networks. Within this reality, individuals shape their behaviour, make their choices, and manage their risks."
>
> (Lalou and Piché 2004)

This helpful perspective brought in by Lalou and Piché (2004) as described in the previous chapter is a paradigm shift in explaining the health risk tendencies of migration. It entails shifting the perspective from the epidemiological to a psycho-social or sociological perspective, that is, from considering migration as part of an employment strategy to instead focussing on the risk-producing settings and how an individual migrant navigates his or her ways through the perilous landscape. This is helpful because it prevents perceiving the body of the migrant as an "autonomous entity" that can transmit the fatal disease on contact with the residents in the host area. This perception excludes the consideration of the multifarious mechanism or channels of transmission, particularly, through sexual behaviour (Lalou and Piché 2004).

Studies have established the fact that the psycho-social or sociological based theories and concepts are important perspectives for examining the relationship between migration and HIV/AIDS and expand further to highlight the socio-cultural context

and other demographic factors (Decosas, Kane, Anarfi et al. 1995, Lalou and Piché 2004, Hunt 1996, Soskolne and Shtarkshall 2002, Parker 2001, van Blerk and Ansell 2006). In other words, there is an alignment of the psycho-social or sociological perspectives on the migration-health analysis, not only at the individual and household level, but also community level and spatial level. Both micro and macro perspectives are used in this analysis. The Health and Socio-Demographic Surveillance System can offer a good contribution through longitudinal measurement with temporally and spatially determined data. The HDSS is described in more detail in the next chapter

3.2 **Theoretical Framework**

3.2.1 **General overview**

The theoretical perspective is important not only because it shows the gaps in the literature and the contribution that the thesis hopes to make, but it also provides the tools and language to conceptualise, measure and try to understand the relationship between migration and mortality in this setting. The aim of the thesis is to contribute to our understanding of how the migration impacts on mortality in this setting. The link between migration and AIDS/TB mortality is conceptualised from two different perspectives. The first entails the theoretical exploration of migrants' characteristics before they migrate. This can be referred to as the “who migrates?” part of the analysis and is related to selection. The second perspective involves the consideration of conditions at the destination after the migration that can influence behavioural transition. This includes different conditions and considers how these might impact the risk-taking behaviour of the migrant. In the absence of a single theory that captures all these perspectives, we have provided a spatio-temporal model in figure 3.1 and use

this to examine contemporary theories and explain the important perspectives on migration and mobility for governments, policy makers and statistical agencies. Most of the theories adopted in this thesis aligns to a psycho-social or sociological theoretical perspectives.

First, this study posits that migration is socially construed. The appropriate theory to capture the social construction which is built through the life-history of the respondent is the social constructivism, which can be defined as "a sociological theory of knowledge according to which human development is socially situated and knowledge is constructed through interaction with (Berger and Luckmann 1966). Second, there is the belief that migrant possess certain characteristics that often push them to assume the migrant status and this can be captured by the migrant selectivity hypothesis or concept. Migrant selectivity is originally credited to Todaro (1969) and Harris and Todaro (1970). Third, a popular theory in demography that is often employed to explain the relation between migration and fertility called *distruption* was adopted. In addition, health belief model which originated from the work of Janz and Becker (1984) and propose that people normally do not want to get sick and will effort to avoid illness. Locus of control is another theory that was employed.

3.2.2 **Social constructivism**

It is posited in this thesis that migration and the disposition of migrants to the resultant vulnerability are socially constructed. It is believed that both the interest and impact of migration are shaped by the prevailing condition in a particular setting, which

provides the factors in operation, not only at the places where migrants find themselves, but also the places that they originated from. Therefore, this research subscribes to a variant of sociological paradigm called socio-constructivism theory propagated Berger and Luckmann (1966) among other perspectives. Social constructivism as a theory has been applied to a number of field and subject matter. Specifically, the theory has been applied to studying schooling among learners of different socioeconomic and other backgrounds; understanding of children's cognitive development among juvenile counsellors; global partnerships for training the health care workforce in medical field etc. (Au 1998, Russo, Vernam, and Wolbert 2006, Philpott and Batty 2009)

According to social constructivism, as an individual grows from childhood grows and get to a certain level of awareness where he or she begins to learn and imbibe the culture and tradition of the immediate community in which he or she was born into. Also, the theory assumes that the child acquires information from his surroundings and process such with the intention of constructing knowledge based on what happens in his community. Specifically, the environment of the child makes available cultural history, social context, lifestyle and language. Although it is impossible to predict with perfect accuracy how the acquired information will be utilised but it can be inferred that the child will use the knowledge gathered as a survival strategy.

Parents, siblings, teachers and other relatives are often instrumental in passing the culture and norms either consciously or unconsciously to the child. Moreover, with the advancement in technology and advent of myriad sources of electronic

information, the child is now in a better position to source information from wider source. Furthermore, with urbanisation and globalisation happening on a large scale coupled with high level of movement from one place to another (i.e. migration), there is often the need for children to move across local and international boundaries with their parents. This requires them to learn and adjust to their ever changing communities. The same is applicable to an adult migrant.

In applying the notion of social constructivism to migration, previous psycho-social based studies have indicated that migration can alter the identity and perception of migrants (Timotijevic and Breakwell 2000, Zielke and Straub 2008, Ethier and Deaux 1994, van Blerk and Ansell 2006). This is in terms of their values, culture, behaviour, attitude, cognitive, action, feelings, self-esteem just to mention a few. Timotijevic and Breakwell (2000) expresses thus, "Geographical migration will inevitably threaten identity, if an individual moves into a social context so different from their original that the bases (structural and procedural) for continuity, distinctiveness, self-esteem or self-efficacy become unstable or, in the extreme, disappear". While it is true that migration can alter the personality of migrants, it does not take away the fact the individual has to succumb to the identity change or act as an agent to effect the identity change in themselves. However, for the sake of sustaining their livelihood, there may be a pressure on them to change their identity because of the exposure to lifestyle and neighbourhood that is completely different from theirs. It is important to note that change of identity does not necessarily translate to loss of identity. Bhugra (2004) affirms this in the following way, "When people migrate from one nation or culture to another they carry their knowledge and expressions of distress with them and on

settling down in the new culture, their cultural identity is likely to change and that encourages a degree of belonging; they also attempt to settle down by either assimilation (becoming a part of the majority culture), or biculturalism (feeling reasonably comfortable in both the cultures)".

Apart from the change of identity, another impact of migration is the separation from usual partner, which often happens in the case of lone circular labour migrants and often leads to either partner getting involved in extra-relationship affairs. In proffering reasons why lone circular migrants will engage in sexual risk behaviour, social constructivist will first of all try to study and understand what relationship or identity changing values, culture, norms that the migrant has learnt by his exposure to his new communities and strategies he has developed to filling the emotional vacuum created by the absent of his partner. It is essential to reiterate here that social constructivism does not lay too much emphasis on individual behaviour but rather on the impact of what he learns from interacting with his community i.e. socially constructed knowledge. Hence, in the words of Parker (2001), the theory will specifically try to "examine and explicate what new knowledge and information about sexual risk (behaviour that the migrant has obtained prior or by being in his new setting); what sexual (risk) practices meant to the persons involved; the significant contexts in which they take place, the social scripting of sexual encounters and the diverse sexual cultures and subcultures that are present or emergent within different societies".

Ethnographic based evidences are emerging to affirm that knowledge of HIV is not enough to effect behavioural change nor reduce the odd of contracting the disease

simply because the risk in every population group follows a complex set of social, structural, and cultural factors that far beyond the control of an individual migrant (Parker 2001, Carrier and Magaña 1991, Herdt and Boxer 1991).

In a paper on 'Sexuality, Culture and Power in HIV/AIDS research', Parker (2001) uses a social constructivist paradigm to move us from a research approach which highlights individual risk to an approach which highlights social structure creating a risk environment. This also influences the direction of intervention required. Behaviour related interventions at an individual level relate to lowering personal risk for HIV infection and have been a main focus for epidemiological studies. Alternatively, culturally appropriate and structural level interventions highlight the impacts of social inequality and calls for redress at a level of social structure.

This is not coming as a surprise because, despite the high level of awareness of HIV across the countries that are worst affected by the infection, the incidence level of the infection is still very high. Later in this "Theoretical Framework" section there is further discussion on the fact that HIV is on the increase in South Africa.

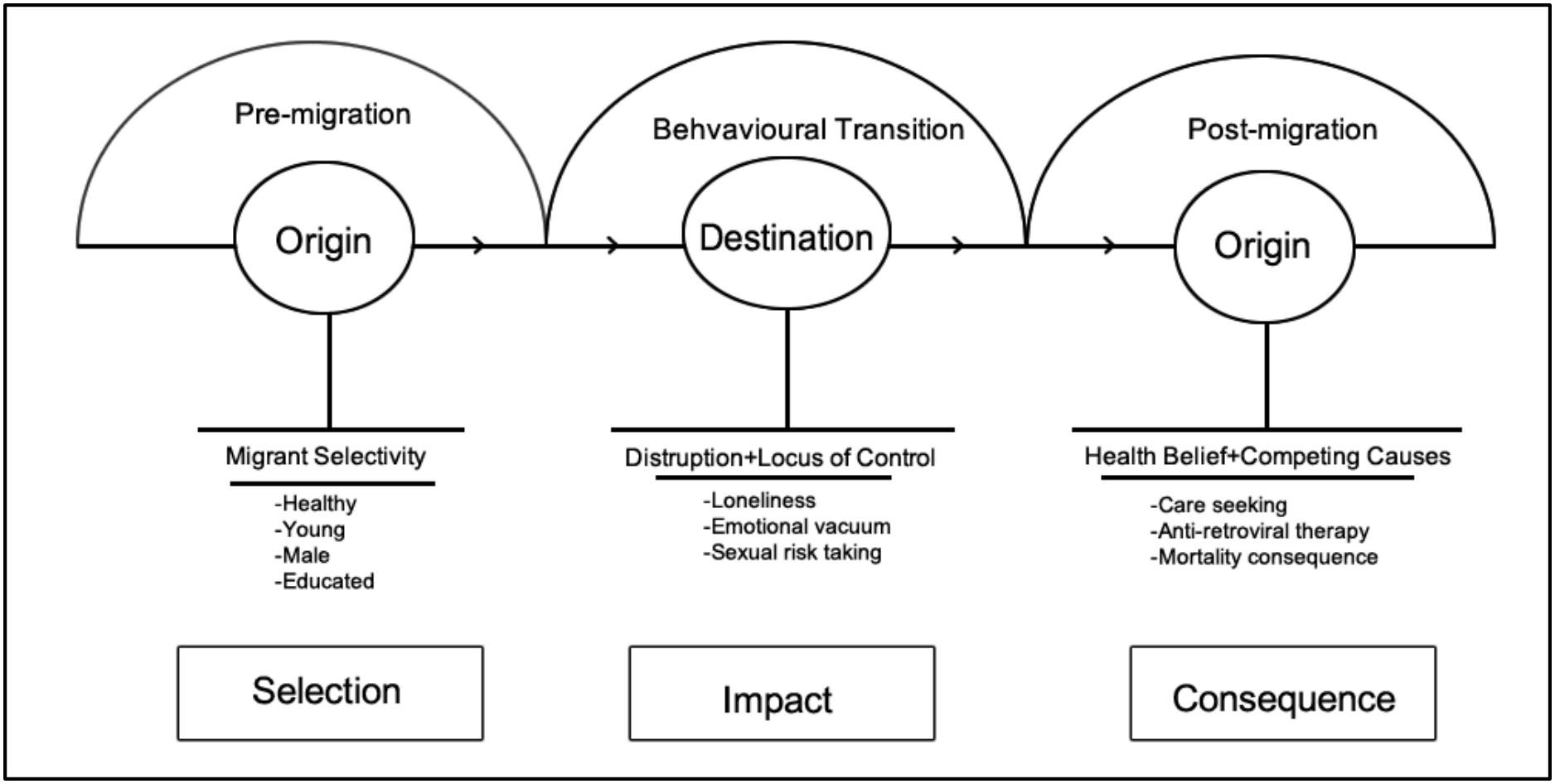


Figure 3.1: **A diagram depicting theories that explain different stages of Circular Migration**

3.2.3 **Migrant selectivity theory**

Studies on the pre-disposing characteristics of the migrants relate to the migrant selectivity theory. The key concept is that "migrants are not a random sample of the population at their place of origin" (Hervitz 1985). In order words, migrants possess certain demographic and socio-economic attributes, which make them different from their non-migrant counterparts at their various places of origin (even at destination) and consequently have a different set of health characteristics. Specifically, migrants are more likely to be young, generally between ages 15 and 30 years old, and this has been observed in southern and eastern parts of Africa (Brockerhoff and Biddlecom 1999). Secondly, they often belong to the male gender though this is gradually changing as women are assuming bread-winning roles in their households (Collinson, Wolff, Tollman et al. 2006).

Hence, the need to migrate to access employment, often in a neighbouring towns (in the case of South Africa), which offer them the opportunity to return more frequently to cater for their family left behind (Collinson 2010, Crush, Williams, Gouws et al. 2005, Lurie, Abigail, David et al. 1997). It is interesting to note, as reported by Collinson (2009), that amongst employed labour migrants, employed female labour migrants remit back to their left-behind families at least as often as their male counterparts (Collinson 2010). This indicates their level of emotional attachment to their left-behind households. Thirdly, migrants usually possess a certain level of formal education, at least

the type needed for communication in English or another official language, as required at the destination. In addition, migrants at the time of departure are healthier than their fellow residents and this is inclusive of residents at their destination (Cunningham, Ruben, and Venkat Narayan 2008, Lu 2008, Yang, Qeadan, and Smith-Gagen 2011). These positive features often contribute to the decision to migrate.

Another characteristic that makes migration more selective is a risk-taking tendency in the migrant. Brockerhoff and Biddlecom (1999) write that "the act of voluntary movement, often over long distances, between radically different socio-cultural environments, and with uncertain consequences, defines migrants, to a greater degree, as risk-takers". It is a feasible step to consider that this risk-taking tendency also predisposes migrants to risky sexual behaviour, which in turn can bring health risks in the form of sexually-transmitted infections. Migrant selectivity factors are generally conceptualised and measured at the individual level, however, the socio-cultural setting can further influence risk-taking behaviour either positively or negatively.

An important feature of migrants prior to their move is that they can be favourably selected on health status when compared to non-migrants. This healthy migrant hypothesis, discussed in the previous chapter, is related to the migrant selectivity theory described above. The theory emphasises that

migrants often constitute a healthier group at the time of their migration and are thus not representative of their origin population in terms of health status.

Cunningham, Ruben et al. (2008) reviewed 71 articles published between 1980 and 2007, traversing a range of methodological approaches, populations, and places, comparing the health status of migrants and non-migrants in the United States of America (USA). They discovered that migrants, at the time of their immigration to the country, were in general healthier than the host population. Specifically, they were less likely to suffer from hypertension, heart disease, obesity and cancer. The only health conditions for which migrants were reported to be more vulnerable included occupational injuries, some infections (not HIV) and diabetes (which is peculiar to certain origins, e.g. Indian migrants). Similarly, Yang, Qeadan et al (2011) carried out behavioural risk factor surveillance between 2004 and 2006 among 8663 respondents in Nevada, USA. They established that recent migrants (i.e. those who moved into their destination place less than one year prior the study) were approximately two times (odds ratio=1.98, 95% CI=1.15–3.40) more likely to indicate that their self-reported health in general was good, despite the fact that long-term residents reported easier access to health care facilities. However, the initial advantage in health status of the migrants can erode over time due to the risks and exposures inherent in the migration process. This aspect will now be discussed further.

3.2.4 **Disruption**

The second node in the spatio-temporal framework, given in figure 3.1, is the migrant's place of destination. A key theory used to characterise the experience of migrants at destination is disruption, which became prominent as an explanatory factor in literature on the relationship between fertility and migration. Disruption postulates two immediate impacts of relocation. The first impact is through the physical and emotional stress of migration and the second entails the separation between migrants and their partners, especially the labour migrants who travel alone. The combination of these factors can be of particular relevance to the relationship between migration and HIV infection. At the destination place migrants can be emotionally vulnerable and therefore seek support in their new environment. Literature on migration and HIV infection report that this disruption and associated emotional stress creates an avenue for the transmission of HIV (Decosas, Kane, Anarfi et al. 1995, Quinn 1994, Lalou and Piché 2004, Hunt 1996, Soskolne and Shtarkshall 2002).

3.2.5 **Health belief model**

Another theory relating to behaviours that can influence migration and HIV is the Health Belief Model. Migrants, like all people, usually make an effort to avoid getting ill, especially with life-threatening diseases. The Health Belief Model, is based on the premise that people have the "desire to avoid illness or,

if ill, to get well; and have beliefs that a specific health action will prevent or ameliorate illness" (Janz and Becker 1984). This produces a conundrum for migration and health scholarship, which is to ask the question, 'why does health-risk behaviour persist?'

An increase in the prevalence of HIV infection was shown in a 2014 report of the Human Science Research Council of South Africa, based on a national survey, which reports the prevalence increasing from 10.6% in 2008 to 12.2% in 2012 (Shisana, Rehle, Simbayi et al. 2014). The report shows that 469,000 newly incident cases of HIV was recorded in 2012, which translates to more than 9,000 new infections per week. These increases occur despite efforts of the South African Department of Health in 2002 embarking on a comprehensive campaign project, called Khomanani, to promote an understanding of the risks of HIV transmission and to mobilise individuals to shield themselves from getting HIV (Department of Health 2005). The project has been re-launched several times and even received awards, but it is not yet properly understood how HIV prevalence is increasing despite nationwide health promotion campaigns.

3.2.6 **Locus of control theory**

The seeming disconnect between the Health Belief Model and increasing HIV prevalence in South African may be as a result of the fact that the sexual

decision-making is based on factors that don't take risks into account, and where the consequences seem to be beyond people's control. A relevant theory to understand this may be the locus of control theory, which postulates that individuals believe that their action is either being controlled by themselves (internal) or community (external) (Rotter 1975). Prior to their move, the migrants might have been socialised into certain lifestyles in their home communities that don't help them make healthy decisions in the destination setting, coupled with the influence of external locus of control, and thus may engage in risky sexual activities at the expense of their own wellbeing. Previous studies have shown that migrants are likely to engage in unprotected sex and may have multiple partners (Crush, Williams, Gouws et al. 2005, Crush and James 1995).

It is noteworthy that AIDS is an incurable disease although national programmes in anti-retroviral treatment can delay the onset of full-blown AIDS. A number of studies have identified societal stigma as an obstacle for the uninfected individuals who require prevention (e.g. the purchase of condoms) and HIV testing to delay testing away until it is too late. Also, HIV-positive individuals in need of care and treatment may delay such by not attending clinics or health centres, especially the ones where they can easily be identified (Bond, Chase, and Aggleton 2002, Chesney and Smith 1999, Mahajan, Sayles, Patel et al. 2008, Kalichman and Simbayi 2003, Sumartojo 2000, Soskolne and Shtarkshall 2002, Glass and McAtee 2006).

Although the influence of the Health Belief Model seems minimal at the stage when the migrants became infected with HIV, in terms of fearing the disease and making efforts to avoid it, the theory may be applicable after they became sick, as many infected migrants make efforts to get well by returning back to their place of origin for care and probably subscribing to the antiretroviral treatment. This perspective is reflected in the third node of the spatiotemporal model in figure 3.1.

A review of the previous studies on HIV impact on migration in South Africa shows that the HIV infected migrants often permanently return to their rural places of residence when they become seriously ill (Clark, Collinson, Kahn et al. 2007, Welaga, Hosegood, Weiner et al. 2009). This affirms the proposition that many migrants get involved in sexual risk behaviour and probably start seeking health care (i.e. become desirous of getting well) when their illness has reached an advanced stage or are too ill to work.

3.3 **Conceptual framework**

From the review of the past studies, it could be deduced that apart from the individual level characteristics of migrants, the socio-cultural context of the area where they find themselves plays a pivotal role in explaining how migration relates to AIDS/TB mortality, and this operates both at the migrant

sending and receiving communities. For instance, the unpleasant situation such as war or civil unrest, abject poverty, political persecution, natural disaster etc. at the migrants' place of origin can act as push factor for people to migrate. Also, the familial and societal norms, values and upbringing of migrants can determine how they manage their lifestyle and risk wherever they find themselves after this initial push. However, a place of destination with diverse forms of sexual allurement can go a long way in altering their behaviour, and the attendant consequence can be contracting HIV, especially if the disease is prevalent in the area. HIV is an incurable disease, so any migrant infected with it faces the inevitability of death, not necessarily from the disease, as it will take time for it to evolve into AIDS/TB.

In this section, the conceptual framework is presented to capture the transition of migrants from the state of being alive to death. The intention here is to conceptualise the relationship between migration and mortality in an empirical way by identifying certain factors or variables that are perceived to be relevant in the quantification of the relationship. Since a number of studies have already operationalised the theories or concepts explaining the migrants' pathway to HIV morbidity (e.g. migrant selectivity, healthy migrant hypothesis, disruption, health belief model) as discussed in the theoretical framework section, the emphasis here is to employ the competing risk theory for a plausible explanation of the path to AIDS/TB mortality competing with other causes of death.

The idea behind the competing risk theory first manifested in the work of Daniel Bernoulli many years ago where he mentioned the fact that his study participants were exposed to the risk of dying from smallpox and at the same time were also exposed to mortality due to causes different from smallpox (Moeschberger 1978). The theory postulates that an individual has certain probability of experiencing an array of events with each of them having the capacity to preclude the others from occurring (Pintilie 2006, Fine and Gray 1999, Gooley, Leisenring, Crowley et al. 1999, Hinchliffe and Lambert 2013, Pintilie 2007). Apart from the perceived competition among the events, another interesting feature of this theory is its "time to event" component. That is, it assumes that it will take migrants time to move from one state to another. It should be noted that the time between an individual embarking on migration and death will vary largely among migrants and it will likely be long.

The construction of the conceptual framework as displayed in Figure 3.2 is based on the competing risk theory. As illustrated, it depicts the mortality outcome of migration with AIDS/TB being the event of primary interest while non-communicable diseases (NCDs), external cause and other infectious diseases constitute the competing causes of death. In general, it can be seen that migrants can die of any of the specified causes. Dying as a result of one disease category automatically precludes them from dying as a result of others. Mortality originating from AIDS/TB is the cause of death of primary interest in this study. Hence, the pathway to it is highlighted first. And, this entails the

migrants getting infected with the disease and dying from it. It should be noted that there is no plan to provide variables to quantify the factors that are associated with the morbidity transition, as previously indicated. This is the main reason for the broken line linking migrants with *HIV+* in the diagram.

The progression from HIV morbidity to AIDS/TB mortality can follow two directions. The first has to do with the migrants dying directly as a result of the disease and the second entails dying of another cause. With regards to the presence of causes of death other than AIDS/TB, it is hypothesised that migrants possess a greater risk of dying of AIDS/TB in comparison with the residents. This hypothesis is based on previous studies that attest the negative health implication of migration (Bocquier, Collinson, Clark et al. 2014, Collinson, White, Bocquier et al. 2014, Collinson 2010).

Still on competing risk of migrants dying of AIDS/TB, it is hypothesised that in the long run the risk will follow a downward trend as the antiretroviral treatments becomes accessible to them. Furthermore, a migrant typology of return migrants and in-migrants will reveal that the former are more likely to experience AIDS/Mortality compared to the latter (i.e. the in-migrants). Also, as the population of women joining the labour market in far and near places increases, it is hypothesised that there will be little or no gender difference in the risk of AIDS/TB mortality. Individual factors e.g. nationality, educational

status and household level factors are likely to predict the direction of the relationship in the context of other causes of death. Finally, apart from AIDS/TB, migrants may also die from other causes such as NCDs, external and other infectious diseases

3.4 **Hypotheses**

The following are the hypotheses to be tested in this study:

1. Due to the social context in South Africa, migrants returning to their homes in rural Mpumalanga, possess a greater risk of dying of AIDS/TB when compared to the non-migrants, when other causes are present;
2. Duration of return matters when it comes to the risk of mortality among migrants;
3. The competing risk of AIDS/TB mortality will go down over time as the antiretroviral treatments becomes available;
4. The risk of AIDS/TB death is more pronounced among the return migrants than in-migrants who move into the rural sub-district for the first time;
5. The in-migrants possess AIDS/TB mortality risk that is similar to that of the non-migrants;
6. Men and women are likely to experience similar AIDS/TB mortality risk;

7. Period, nationality, education and socio-economic status are predictors of the direction of relationship between migration and AIDS/TB death in the presence of other causes of death;

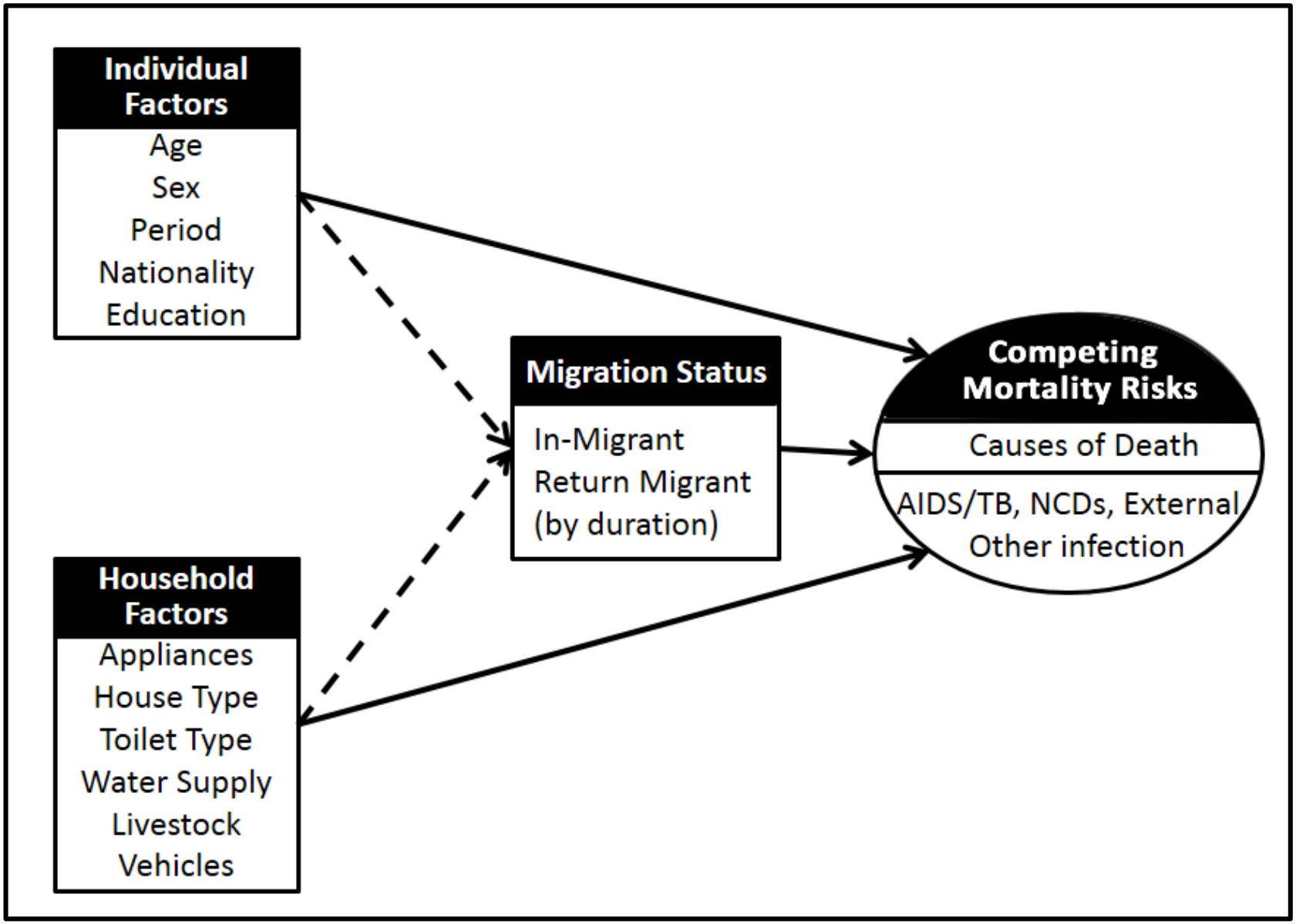


Figure 3.2: Conceptual framework

CHAPTER 4: METHODOLOGY

4.0 Introduction

This chapter discusses the data and the methods used in the thesis. Specifically, it describes the data by discussing its history and the processes involved in data collection and why these are suited for the study of migration and mortality. Additionally, it provides information on the variables and how they have been extracted and recoded for the analysis. This chapter also defines the study population in terms of age, sex, residence and other criteria to be met for the residents of the study population to be eligible for inclusion in the study. It describes how the duration of exposure for individuals at their place of residence was quantified, using the 'person-time' concept. In conclusion, a section is devoted to explaining the specific technique of data analysis, namely an event history analysis with a competing risks framework.

4.1 The study setting and population

As shown in Figure 4.1, 4.2 and 4.3, the study setting is located in the remote north eastern part of South Africa close to the border of the Kruger national park. The setting is in one of the former apartheid homelands called Gazankulu, which is a previously disadvantaged district. In spite of the abolishment of the apartheid system of government in 1994, this community is still socio-

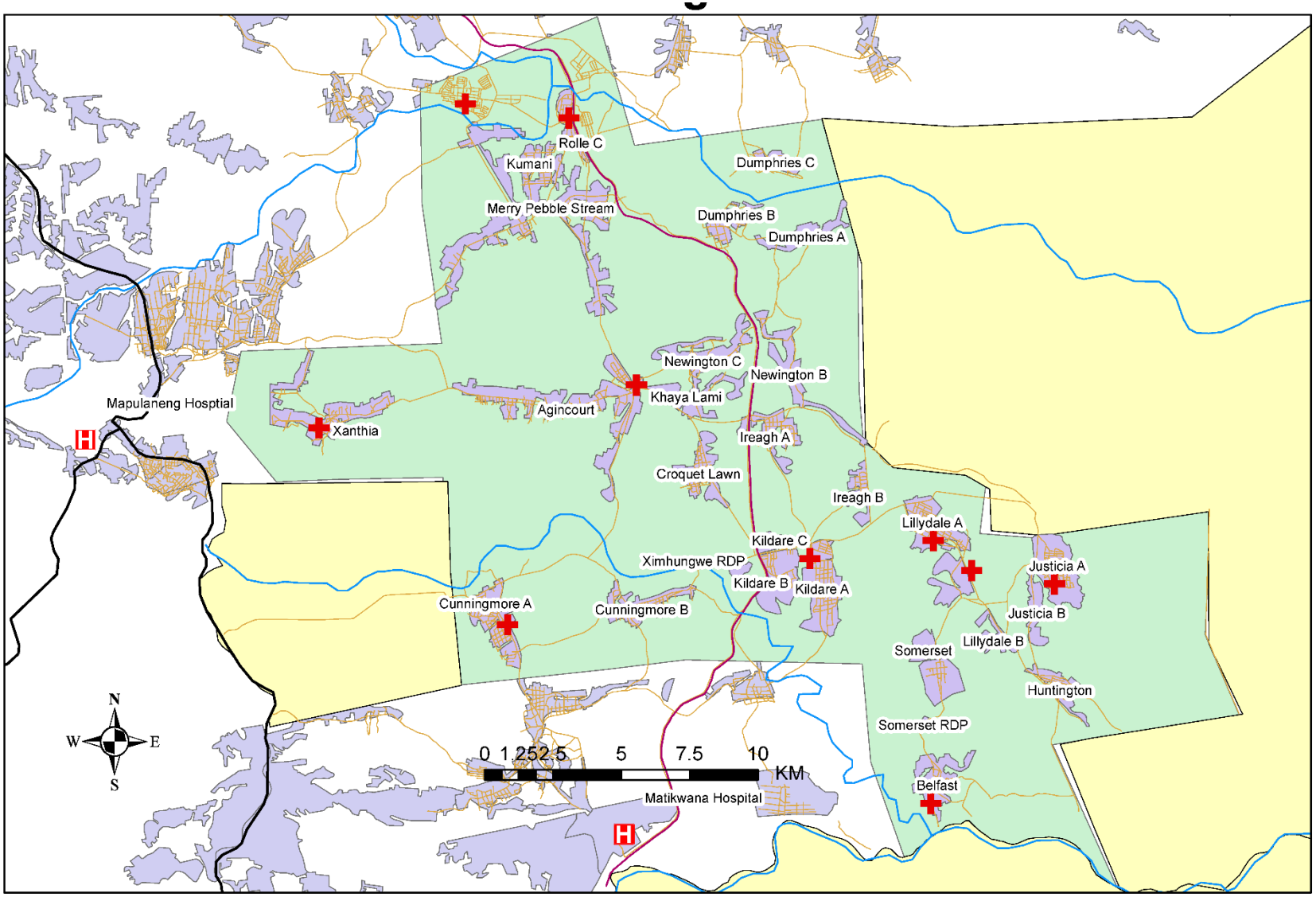


Figure 4.1: Maps showing all the villages and health facilities within the Agincourt field-site

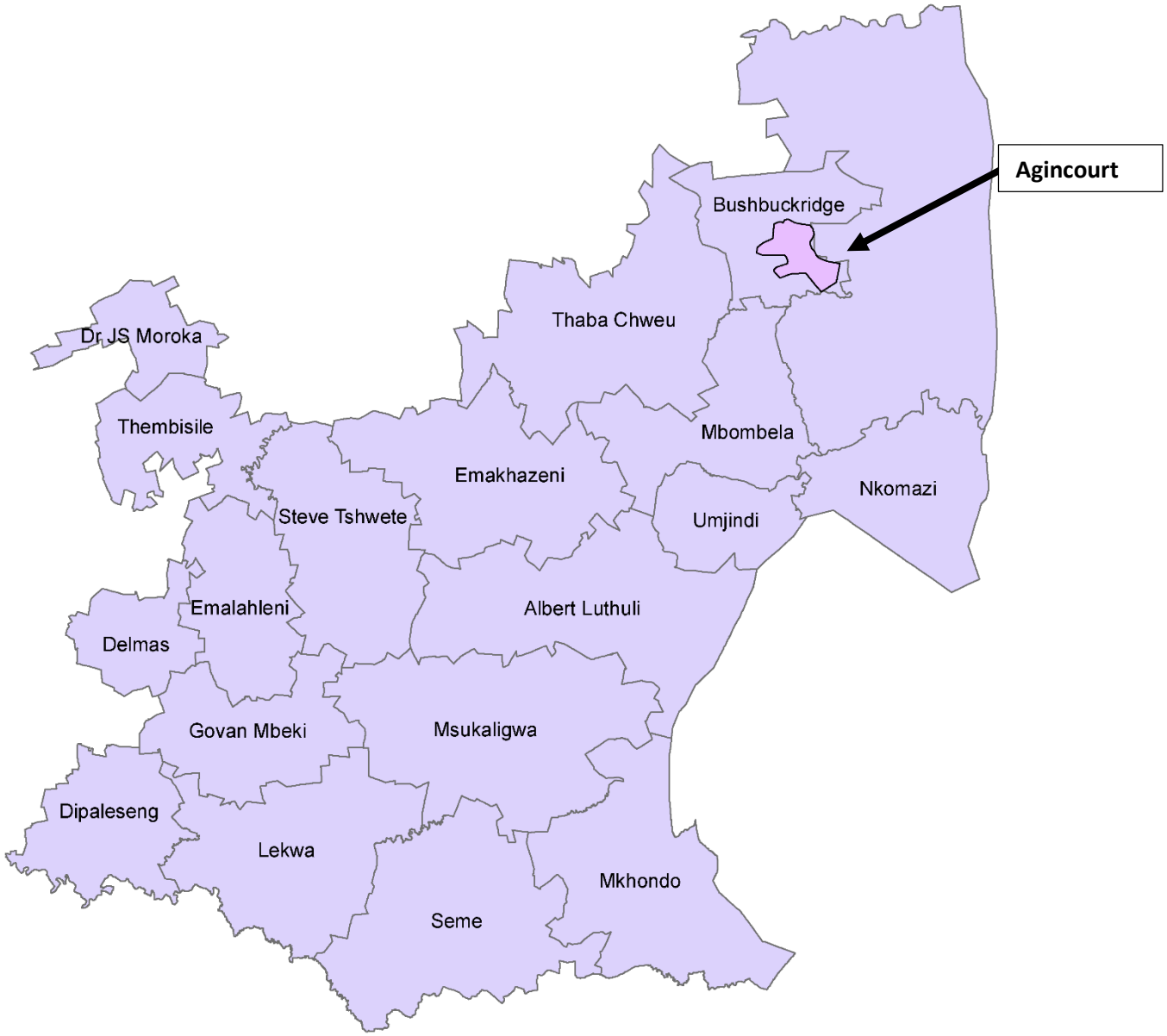


Figure 4.2: A map locating Agincourt field-site within the Bushbuckridge municipality

Figure 4.3: A map locating Agincourt field-site within Mpumalanga Province

-economically vulnerable due to the deleterious legacy of the apartheid government. Also, the area is characterised by inadequate infrastructure, limited tarred roads, and poor public service delivery, such as piped water. There is generally a low socio-economic status and limited access to health or medical facilities.

Although not all households are poor, a sizeable number of households depend on sustenance from the natural environment (Hunter, Twine, and Patterson 2007). Employment and education opportunities are limited, so people often migrate to the nearest town or metropolis for work (Collinson 2009).

As seen in Figure 4.4 to 4.7, the population age structure is changing, with an increase in the number of under-five children compared to older children, and increasing proportion of the population aged greater than 65 years (Kahn, Collinson, Gómez-Olivé et al. 2012). Fertility levels within the area declined until around 2002, rose to a higher level from 2005 to 2008 and declined again after 2008 (Williams, Ibisomi, Sartorius et al. 2013).

Figure 4.4**:** Selected scenes from the study site

4.2 The Agincourt health and demographic surveillance system

This Agincourt Health and Demographic Surveillance System (HDSS) is based in and around the Agincourt sub-district of Bushbuckridge in Mpumalanga Province, north-eastern South Africa. The HDSS began in 1992, is led and run by a team based at the MRC/Wits University Rural Public Health and Health Transitions Research Unit, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand. The surveillance operation is characterised by repeatedly observing socio-demographic and health status of all the inhabitants in a defined geographical area, on an annual basis. The study area is about 500km from the city of Johannesburg, the main economic hub of South Africa. It is about 420 square kilometres in size and consisted of 21 villages at its date of establishment. The study site has a population density of 153 and 183 persons per square kilometre in 1992 and 2010 respectively. The area is also not far from the border of Mozambique, a neighbouring country whose citizens constitute about one-third of the Agincourt population and share the same indigenous language, namely Shangan. The majority of this population arrived as refugees from the Mozambican civil war in the 1980's (Kahn, Collinson, Gómez-Olivé et al. 2012).

The HDSS study site has expanded over the years to include the neighbouring villages. However, the focus of this study is on the original villages to retain temporal continuity in the study population.

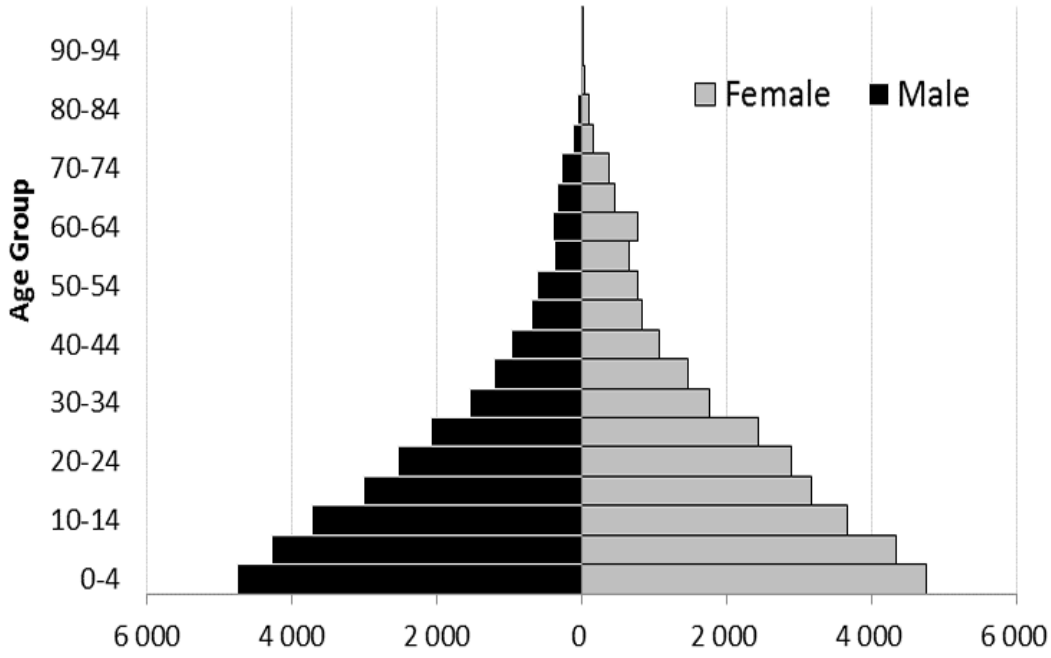


Figure 4.5 Agincourt population pyramid in 1992

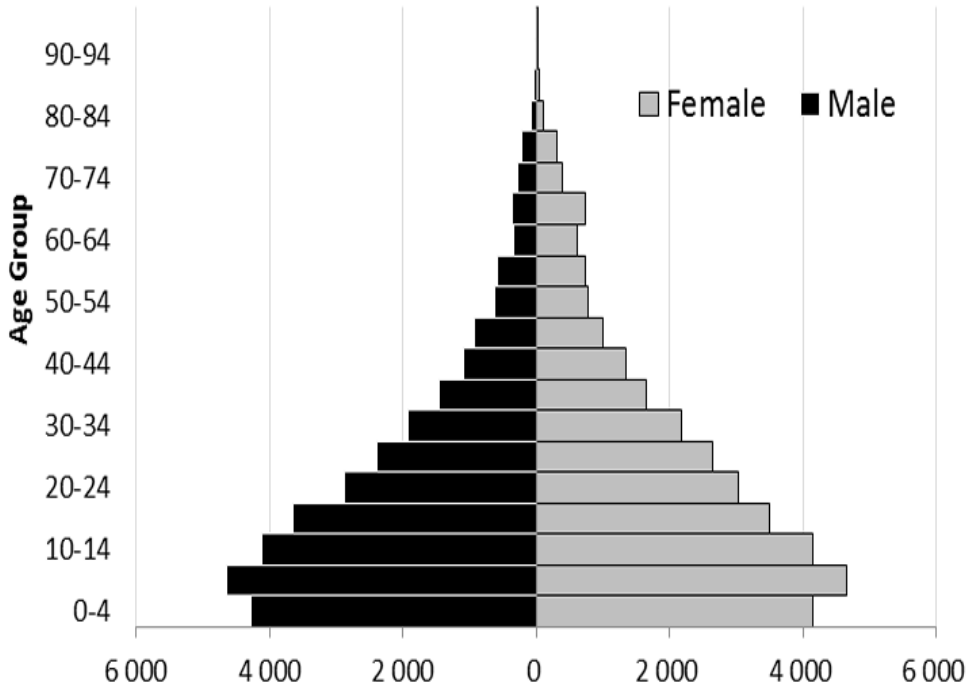


Figure 4.6 Agincourt population pyramid in 1997

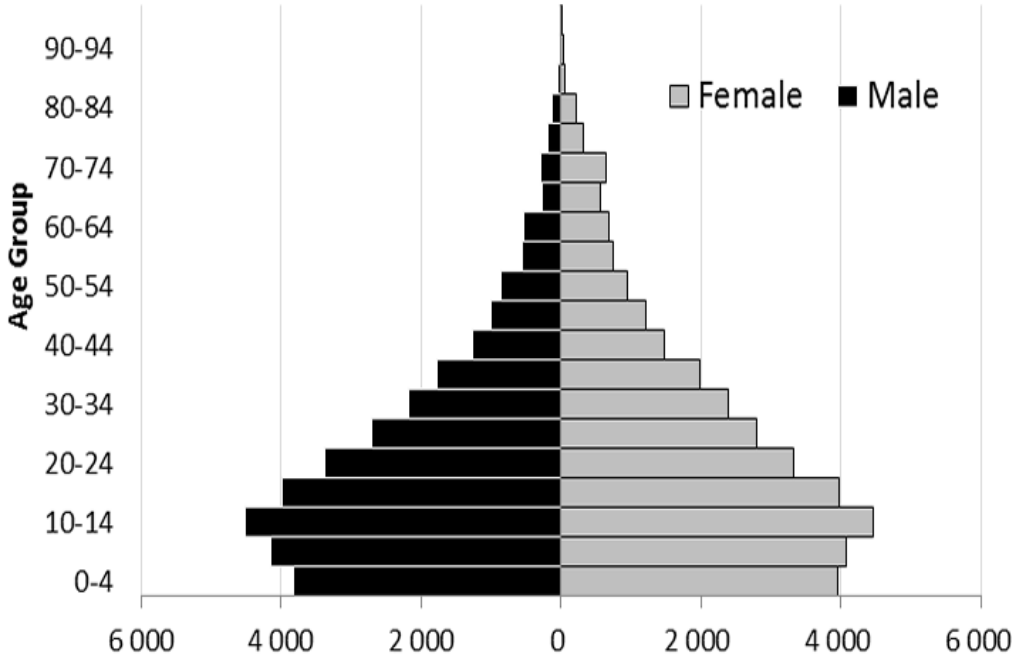


Figure 4.7 Agincourt population pyramid in 2002

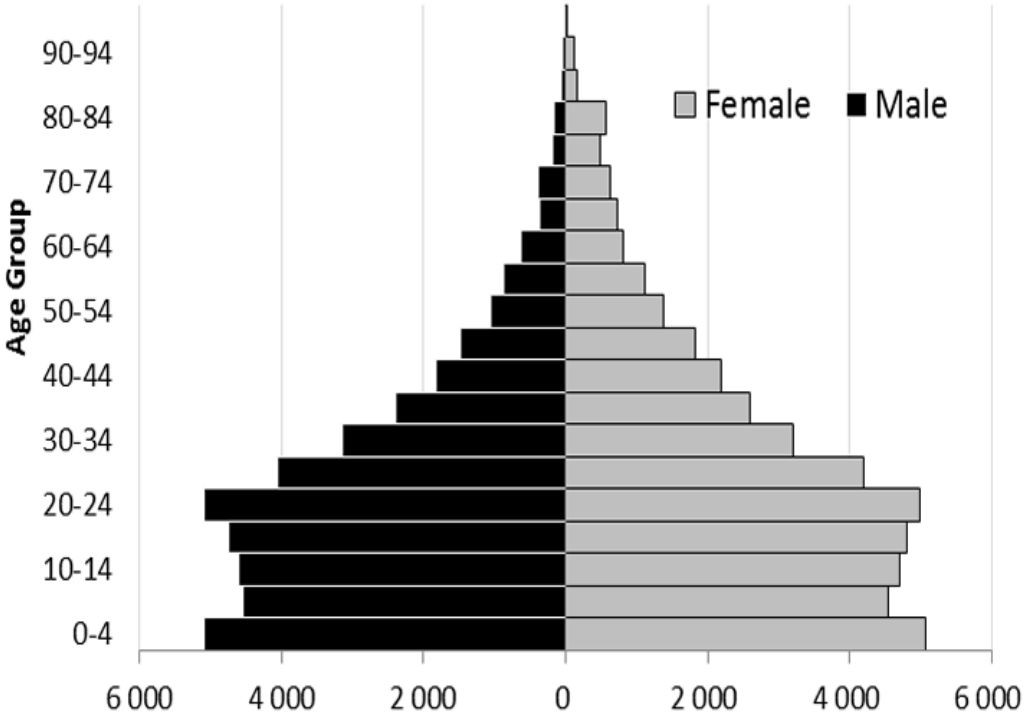


Figure 4.8 Agincourt population pyramid in 2007

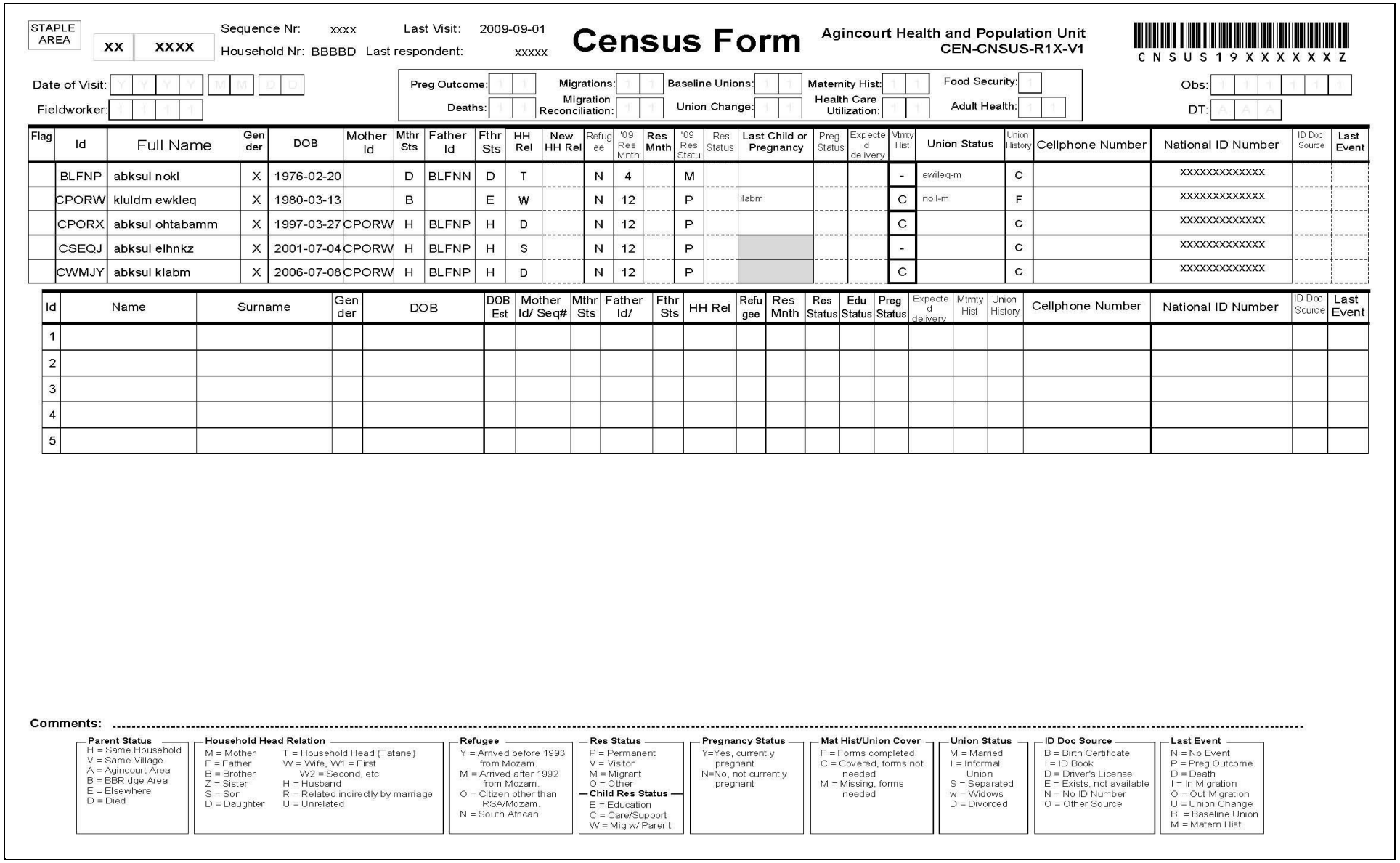
4.3 **Data collection process**

At the time of this research, the Agincourt HDSS has been in operation for around two decades and its first data collection exercise was a baseline conducted in 1992 when the entire population of the Agincourt study area was enumerated. This process led to the on-going acquisition of demographic, health and socio-economic data of the residents, including place of residence, birth, pregnancy, death, marital and labour status. These were entered electronically into the Agincourt HDSS database by a number of dedicated *data typist*s, who were employed and trained to perform this task. After the initial data collection in 1992, there has been consistent surveillance of the Agincourt population using the same census approach, which is put into operation annually to collect data. The newly collected data are employed to update the existing records of the respondents. It is interesting to note that the participation of the entire community members in the surveillance system has been positive with little or no refusal being registered in the field of data collection(Kahn, Collinson, Gómez-Olivé et al. 2012).

The data collection exercise is carried out by *fieldworkers* using paper-based forms. However, in order not to burden the respondents with the same set of questions every year and to ensure consistency in the data collected previously, it is standard practice for the Agincourt HDSS to pre-fill the questionnaire for each housing unit with the information from the immediate past census. This technique ensures consistency in fields such as names, sex, date of birth, etc. Also, it makes provision for the would-be respondents to: (i) verify whether the previously collected information as provided

on the questionnaire is correct; (ii) indicate where changes have occurred in the information previously supplied; (iii) supply new data in case of new people being added to a household, which might have occurred as a result of birth and in-migration. Figure 4.9 shows the data entry room and Agincourt where the census update information is captured onto a central server. Figure 4.10 shows a typical census form used in the annual HDSS update round. The data room is situated at the Agincourt field office and it allows the field workers to return the completed forms on a daily basis.

Figure 4.9: Data entry in progress Agincourt HDSS data entry laboratory



STAPLE AREA

XX XXXX

Sequence Nr: xxxx Last Visit: 2009-09-01

Household Nr: BBBBD Last respondent: xxxxx

Census Form

Agincourt Health and Population Unit
CEN-CNSUS-R1X-V1

CNSUS19XXXXXXXZ

Date of Visit: Y Y Y Y M M D D

Fieldworker:

Preg Outcome: Migrations: Baseline Unions: Maternity Hist: Food Security:

Deaths: Migration Reconciliation: Union Change: Health Care Utilization: Adult Health:

Obs:

DT: A A A

Flag	Id	Full Name	Gender	DOB	Mother Id	Mthr Sts	Father Id	Fthr Sts	HH Rel	New HH Rel	Refugee	'09 Res Mnth	Res Mnth	'09 Res Statu	Res Status	Last Child or Pregnancy	Preg Status	Expected delivery	Mtrnty Hist	Union Status	Union History	Cellphone Number	National ID Number	ID Doc Source	Last Event
	BLFNP	abksul nokl	X	1976-02-20		D	BLFNN	D	T		N	4		M					-	ewileq-m	C		xxxxxxxxxxxx		
	CPORW	kluldm ewkleq	X	1980-03-13		B		E	W		N	12		P		ilabm			C	noil-m	F		xxxxxxxxxxxx		
	CPORX	abksul ohtabamm	X	1997-03-27	CPORW	H	BLFNP	H	D		N	12		P					C		C		xxxxxxxxxxxx		
	CSEQJ	abksul elhnkz	X	2001-07-04	CPORW	H	BLFNP	H	S		N	12		P					-		C		xxxxxxxxxxxx		
	CWMJY	abksul klabm	X	2006-07-08	CPORW	H	BLFNP	H	D		N	12		P					C		C		xxxxxxxxxxxx		

Id	Name	Surname	Gender	DOB	DOB Est	Mother Id/ Seq#	Mthr Sts	Father Id/	Fthr Sts	HH Rel	Refugee	Res Mnth	Res Status	Edu Status	Preg Status	Expected delivery	Mtrnty Hist	Union History	Cellphone Number	National ID Number	ID Doc Source	Last Event
1																						
2																						
3																						
4																						
5																						

Comments:

Parent Status
H = Same Household
V = Same Village
A = Agincourt Area
B = BBRidge Area
E = Elsewhere
D = Died

Household Head Relation
M = Mother
F = Father
B = Brother
Z = Sister
S = Son
D = Daughter
T = Household Head (Tatane)
W = Wife, W1 = First
W2 = Second, etc
H = Husband
R = Related indirectly by marriage
U = Unrelated

Refugee
Y = Arrived before 1993 from Mozam.
M = Arrived after 1992 from Mozam.
O = Citizen other than RSA/Mozam.
N = South African

Res Status
P = Permanent
V = Visitor
M = Migrant
O = Other

Child Res Status
E = Education
C = Care/Support
W = Mig w/ Parent

Pregnancy Status
Y=Yes, currently pregnant
N=No, not currently pregnant

Mat Hist/Union Cover
F = Forms completed
C = Covered, forms not needed
M = Missing, forms needed

Union Status
M = Married
I = Informal Union
S = Separated
w = Widows
D = Divorced

ID Doc Source
B = Birth Certificate
I = ID Book
D = Driver's License
E = Exists, not available
N = No ID Number
O = Other Source

Last Event
N = No Event
P = Preg Outcome
D = Death
I = In Migration
O = Out Migration
U = Union Change
B = Baseline Union
M = Matern Hist

Figure 4.10: Agincourt HDSS pre-filled census form - anonymised

4.4 The HDSS Data Structure

The Agincourt HDSS database has a relational structure, with linked tables made up of data fields. The tables are linked together with common identifiers, and this characterises relational databases. Different relationships types are used in matching records from different tables, e.g. one-to-one, one-to-many or many-to-many relationships.

4.4.1 Individual table

The Individual table holds the bio-demographic information of all individuals that have ever resided in the study area since its inception in 1992. The table is one of the central tables in the Agincourt HDSS database. Table 4.11 shows an overview of some of the fields in the *Individual* table. As shown in the table, the *Individual* table stores information such as identifier, name, surname, sex, date of birth and death, refugee status and so on. The *Id*s (identifiers) field is unique across the tables in the Agincourt HDSS database to the respective individual.

4.4.2 Residence table

The Residence table contains the temporal information on individuals in the HDSS in the form of episodes. Table 4.2 shows the organisational structure of this table. It records the dates at the start and end of each residence episode. The first point, *StartDate,* is the date when an individual starts residing at a place within the site. This date remains constant regardless of the number of times that

the person is observed. When a person moves to another place within the site the residence episode is closed with an end-date, and a new residence episode is generated and a new StartDate given. This table can be linked directly to the *individual* table through an identifier that is common to the two tables. Unlike the *individual* table, this table contains multiple records per individual, since a person can have multiple residences. Also, it has its own unique identifier named *residence* and this allows tables such as *in-migration* and *out-migration* that do not share the same identifiers with the *individual* table to be joined to it. The *EndDate* is the date in which their respective residence episode ends. The variables *StartDate* and *EndDate* are used for computing the length of stay of the respondents.

The field *Initiating-Event-Type* in the Residence table comprises information on the three possible ways that an individual can enter or become part of the population under surveillance namely (a) enumeration, (b) birth and (c) in-migration. On the other hand, a person can exit the study population in two ways namely: (a) death and (b) out-migration, as captured by the variable, *Terminating-Event-Type*. This further makes provision for the people that are still resident by having "Current" as one of its categories.

Table 4.1: Features of individual table

Field	Description	Data Type	Option	Detail
Id	Identifier of the Individual	Numeric		
Surname	Surname of the Individual	Text		
Name	First name of the Individual	Text		
Gender	Sex of the Individual	Text	M F	Male Female
DoB	Date of birth of the Individual	Date		
DoD	Date of death of the Individual	Date		
Refugee	Depicts the nationality or refugee status of the respondent	Text	N Y M O	South African Pre-93 Refugee Post-92 Arrival Other

The table also contain the fields, *StartObservation and LastObservation*. The only field that is regularly updated in this table is *LastObservation* which can be linked to the *Observation* table via a common identifier and indicates the date in which the last HDSS interview took place at that household.

4.4.3.1 **In and out-migration tables**

The in-migration and out-migration tables cover the permanent migration of individuals into, out of or within the surveillance area. In case of out-migration, the information is usually sourced from the left-behind members of the household or neighbours. There is a field named *InternalMigration* in both the *In-Migration* and *Out-Migration* tables indicating whether the movement of the individual is within the study site. Additionally, there is another field labelled *MovePlace* that is similar to both tables and it indicates the name of the place that the respondents migrated to or from. The *MoveType* field is the category of place where the respondents moved to. The variable for *Reason* contains information on why the respondents relocated and these include reasons are related to employment, marriage, family, academics, and household relocation among other reasons. Features of these tables can be found in Table 4.3.

4.4.3 **Migration tables**

The Agincourt HDSS contains three main tables on the movement of individuals from one place to another, namely, in-migration, out-migration and resident status.

Table 4.2**:** **Features of the residence table**

Field	Description	Data Type	Option	Detail
Id	Identifier of the Individual	Numeric		
Residence	Identifier of residence data	Numeric		
StartDate	Start date of an individual in a particular place of residence	Date		
EndDate	End date of an individual in a particular place of residence	Date		
InitiatingEventType	Event that initiates the residency of an individual	Text	A B M	Census Birth In-Migration
TerminatingEventType	Event that terminate the residency of an individual	Text	D M C	Death Out-migration Current
StartObservation	Observation identifier that matches the start of an individual	Numeric		
LastObservation	Observation identifier that matches the end of an individual	Numeric		

4.4.3.2 **Resident status table**

The Resident Status table portrays information on the temporary migration of individuals and how much time he or she spends in the study area during the year preceding the census, that is, 12 months prior the current interview or census date.

The data in the Resident Status table are updated on an annual basis. It contains identifiers - Id and observation - that could be found in the individual and the observation tables respectively. In order words, this table can be linked to the Individual table directly to get the demographic details of the respondents on many-to-one basis. On the other hand, it can be connected to the Observation table to retrieve the observation date of a particular interview.

Table 4.3: **Features of in-migration and out-migration tables**

Field	Description	Data Type	Option	Detail
Residence	Residence identifier	Numeric		
InternalMigration	Indicates intra-site move	Numeric	Y	Yes
			N	No
MovePlace	Reports the place to where the individual moved	Text		
MoveType	Type of move	Text	'-'	Internal migration
			A	Agincourt area
			B	Bushbuckridge area
			M	Mozambique
			O	Other area
			P	PWV* area
			U	Other urban
Province	Name of the province	Text		
Reason	Reasons for migration	Text		

* - PWV - Pretoria-Witwatersrand-Vereeniging area (Gauteng)

The Resident Status table contains the variable ResMonths which is the sum of months that the individual was present at the location, added up over the year prior to the census interview. It also contained another main field, ResStatus that explicitly categorises the individual's residence status. A ResStatus category 'P' (permanent resident) is a person that resided in the area for at least six months of the previous year. Another ResStatus category 'M' (migrant) captures the temporary migrants who were away from the household for more than six months of the previous year for work purposes. A third ResStatus category 'O' (other migrant) captures the temporary migrants who were away from the household for more than six months of the previous year for purposes other than work. Another category is 'V' (visitor) when the person is not a member of the household and has not yet met the residency criteria.

Table 4.4: **Features of resident status table**

Field	Description	Data Type	Option	Detail
Id	Identifier of the Individual	Numeric		
Observation	Observation Identifier	Numeric		
ResMonths	Number of months during the previous 12 months the individual resided in study area	Numeric		
ResStatus	Residency status of the individual	Text	M	Migrant
			O	Other
			P	Permanent
			V	Visitor

4.4.2 **Deaths table**

The Deaths Table captures information on all deaths in the HDSS population. The table contains a field giving the date of death provided by the household respondent. The Death-Local field shows whether the deceased died within the study area or elsewhere. The Death-Local field makes provision for those who died outside the study. This is justifiable as the residents with chronic or life-threatening ailment might die in a health care facility that is located outside the study area while receiving treatment.

Table 4.5: **Features of death table**

Field	Description	Type	Option	Detail
Id	Identifier of the Individual	Numeric		
DeathLocal	Shows whether the death occurred within the site	Text	Y	Yes
			N	No
MainCause	the main cause of death	Text		
DeathRegistration	Shows whether the event was registered or not	Text	Y	Yes
			N	No
ImmediateCause	immediate cause of death	Text		
Contributory1	The first contributory cause of death	Text		

Contributory2	The second contributory cause of death	Text

4.4.3 **Establishing probable cause of death by verbal autopsy**

There is usually certainty about whether or not a person has died, but it can be much less certain what the cause of the death is. This is further complicated by the fact that not all deaths occur in a health facility, and this proportion is higher in rural areas where health facilities and professionals are often limited. In South Africa, the process of generating the death certificate, as stipulated by the Department of Home Affairs (DHA), entails three individuals being asked to complete different sections of the death form, namely: (i) the person who approaches the DHA with the intention of reporting the case of mortality (ii) a representative of the DHA and (iii) a medical practitioner, in whose absence a traditional leader can be eligible to complete the form, which mostly occurs in rural areas (Department-of-Home-Affairs 2013). However, obtaining data from this system of vital registration for research can be cumbersome, as the data are often missing, incomplete or inaccurate (Joubert, Bradshaw, Kabudula et al. 2014).

A number of studies have indicated that attributing probable causes of death by verbal autopsy can be more reliable than death certificates (Chandramohan, Maude, Rodrigues et al. 1998, Gajalakshmi, Peto, Kanaka et al. 2002, Setel, Rao, Hemed et al. 2006). The verbal autopsy method of assigning the cause of

death entails asking the family members or closest care-giver of the deceased to describe the symptoms and circumstances of the death, with allowance in weeks usually being made for the bereaved to mourn their dead (Kahn, Tollman, Garenne et al. 1999, Kahn 2006). This approach has been employed by more than 30 Health and Demographic Surveillance System sites that are in operation in a number of countries namely: Ghana, India, Kenya, Nigeria, South Africa, Tanzania, Thailand, etc. (Soleman, Chandramohan, and Shibuya 2006).

In the Agincourt HDSS the verbal autopsy technique involves sending trained interviewers to the households that reported the death of a household member during the annual census. The questionnaires contain both closed and open-ended questions. The forms are tailored towards information on the circumstances surrounding the reported deaths, and the signs, symptoms and other traits that the deceased manifested at the time of their dying. In case of frequent symptoms, e.g. coughing, the respondents are asked further questions to better characterise the symptom. In addition to establishing the probable main cause of death, the verbal autopsy instrument also attempts to identify contributory causes.

To assign a cause of death based on the verbal autopsy data, an algorithmic-based program is used that incorporates Bayesian probabilistic modelling (Byass, Kahn, Fottrell et al. 2010). For this study, the InterVA version 4 was

used. Physicians and other experts are involved in assessing and evaluating the algorithms. An alternative approach involves the employment of two medical practitioners who go through the verbal autopsy data and assign the probable cause of death. An advantage of obtaining the causes of death using the InterVA system over the manual assignment by medical personnel is that it gives consistent causes over the years (Byass, Chandramohan, Clark et al. 2012, Byass, Kahn, Fottrell et al. 2010, Byass, Calvert, Miiro-Nakiyingi et al. 2013). Additionally, it requires no medical personnel and is faster and cheaper to implement. Table 4.6 shows the categories of cause of death determined by verbal autopsy used in this analysis.

4.5 **Event History Analysis data structure**

So far, this chapter has described the HDSS operation in some detail, with a special focus on the data structure. Now, the focus changes to how this has been transformed for the analysis conducted in this thesis.

Table 4.6: **Cause of death categories based on InterVA**

Cause Category	Specific Cause
AIDS/TB	AIDS Pulmonary tuberculosis (TB)
Other Infectious Diseases	Acute respiratory infection incl pneumonia Diarrhoeal diseases Haemorrhagic fever Malaria Measles Meningitis and encephalitis Neonatal sepsis Other and unspecified infect dis Pertussis Pregnancy-related sepsis Sepsis (non-obstetric)
Non Communicable Diseases (NCDs)	Acute abdomen Acute cardiac disease Anaemia of pregnancy Asthma Birth asphyxia Breast neoplasms Chronic obstructive pulmonary disease Congenital malformation Diabetes mellitus Digestive neoplasms Ectopic pregnancy Epilepsy Liver cirrhosis Neonatal pneumonia Obstetric haemorrhage Oral neoplasms Other and unspecified NCD Other and unspecified neoplasms Pregnancy-induced hypertension Prematurity Renal failure Respiratory neoplasms Severe anaemia Severe malnutrition Stroke Reproductive neoplasms MF
External Causes	Abortion Drowning exposure to smoke fire & flame Poisoning & noxious substance

	Assault Suicide Road traffic accident
Unknown Causes	Other and unspecified maternal CoD Other and unspecified neonatal CoD Indeterminate

4.5.1 **Creating a biographical file for event history analysis**

The Health and Demographic Surveillance System data is transformed into an event history analysis structure. The HDSS is well-suited because it can be used to construct a longitudinal, biographical file for individuals. This has a time-line that shows when individuals enter and when they leave the population. Associated with each individual is a record of their demographic events, namely, migration, fertility, mortality as well as the changing status of socio-economic, educational and labour force experiences. To prepare the data for the biographical file format used in the event history analysis, the relational data model described above has to be transformed from a 'wide' format, in which multiple events are linked to an individual, to a 'long' data format, where multiple records exist for each individual, with each record representing an event that brings a person into or out of the population.

To accomplish this, the variables *StartDate* and *EndDate* were merged into one field called *EventDate*. In the same way, *Initiating-Event-Type* and *Terminating-Event-Type* were combined to produce *EventType variable*. The

outcome of this merger can be seen in Table 4.8 which is made up of hypothetical records, to demonstrate the final data structure obtained, of an individual with *Id* "FMCPT" who in-migrated into the study site on 2003-12-15 and later died in 2009-12-31. The table is transformed from 'wide' to 'long' by collapsing the date and event variables.

Table 4.7: **Hypothetical record of an individual - wide data format**

Id	Location	StartDate	EndDate	Initiating-Event-Type	Terminating-Event-Type
FMCPT	FFFXXX	2003-12-15	2009-12-31	In-Migration	Death

Table 4.8: **Hypothetical record of an individual - long format**

Id	Location	EventDate	EventType
FMCPT	FFFXXX	2003-12-15	In-Migration
FMCPT	FFFXXX	2009-12-31	Death

This study uses Agincourt HDSS data spanning 12 years, starting from 1st January, 2000 to 31st December, 2011, which is a period over which the key socio-economic variables are available, and ending with the last full year of data at the onset of this project, i.e. 2011. The early period marked an era when HIV/TB was very high while the late period fell into a season when anti-retroviral drugs were available.

The target group for this study is male and female migrants aged 20 to 69 years at the date of analysis, representing all migrants captured in the HDSS in this period. Migrants are defined as two types: (i) newly resident people who moved into the study location; (ii) return migrants who originally left the study population and returned after spending time outside the study area. A six months threshold period was used to distinguish between migrants and visitors. That is, if a person stayed in a household for less than six months they are not considered part of the population because are deemed not to have been exposed enough to the prevailing situation in the place of residence. This threshold has been used in other studies, for example, Bocquier, Collinson et al (2014). In the course of the analysis, respondents based on the nature of their migration experience were categorised into return migrant, in-migrant and non-migrant.

4.5.2 **The person-time approach**

The concept of person-time is the span of time that an individual resides in the study population. It can take any form of any time-unit, e.g. person-year or person-month. The person-time approach involves quantifying the time that an individual spends in the study location. It is especially helpful when the study population under consideration is not static, for instance, the resident status of individuals can fluctuate across the period of analysis. Person-time also provides a reliable denominator when rates (e.g. mortality rate) are calculated for a certain period of time (e.g. a specific year). The total person-time at risk is a more accurate measure of a population denominator that the count of people

who are present at a given date regardless of their duration of residence. Alternative methods, such as using the frequency distribution of people regardless of their duration of residence, can distort the measure of the true population at risk.

Another alternative approach to estimating the denominator is to adopt the mid-time population approach, which entails computing the number of people present at a mid-time point of a time interval, e.g. mid-year. This approach is limited by the fact that it is based on the assumption that the entry and exit events or criteria are proportionately distributed throughout the given period and that each resident that leaves the population contributes six months of time i.e. half of a year. This assumption may be false as the exit events are not evenly distributed over the period.

To illustrate the concept of person years, Figure 4.11 shows five hypothetical respondents and the amount time that each of them contributed in a given year, t. The respondent labelled A became eligible to be included in the analysis by in-migration. He became part of the population at the end of the first quarter of year. However, this individual died at the end of the third quarter of the year thereby contributing only a half of the year i.e. 0.5 person-years. This scenario is different for individuals B and D as they existed for the entire year t with each contributing one person-year. Participant C, in the last quarter of the year, became part of the analysis by attaining the age of 20 years and remained

present in the population for the remainder of the period contributing 0.25 in person-years. The same pattern was observed for participant E, who also contributed 0.25 person–years even though he resided in the site in a different quarter of the year. In total, the person-years of the five respondents is 3 which is similar to having three individuals at risk for a year. This approach was implemented using Stata software program later discussed in this chapter.

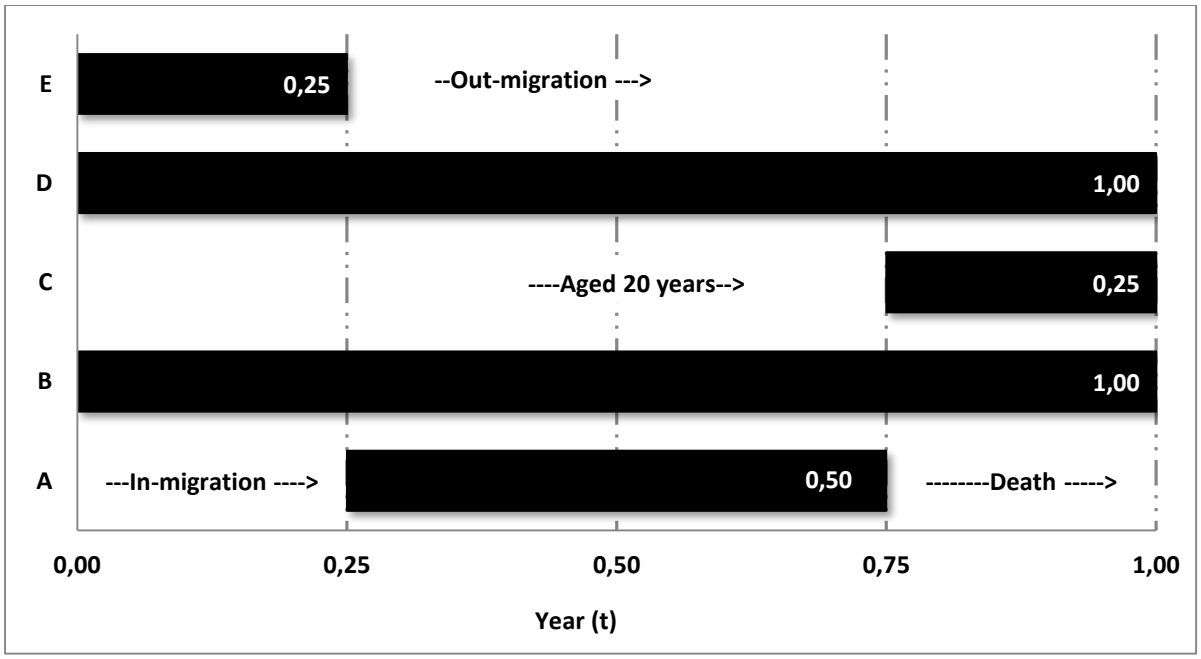


Figure 4.11**:** Hypothetical diagram showing the person-year representation of five respondents

4.6 Data management to get into the EHA data structure

As explained above, the Residence table contains information on the events marking the commencement and termination of the residency episode of every respondent in the study area. Also, the Resident Status table concerns the amount of time in which an individual was resident in the study population in the year preceding the census interview. The subsequent paragraphs entail the steps adopted to create the biographical file and include the migration variable used in this analysis.

The number one step involves the transformation of data in the *residence* table from wide to long format with the aid of the Stata software. As an illustration, an example of data from the *residence* table in wide format was transformed to a long format. The outcome of carrying the transformation exercise is illustrated in Table 4.8. Although the tables show that the individual in question started his residence on 15th December, 2003 as an in-migrant and later concluded his residence episode on 31st December, 2009 as a result of death, there was no information on the movement of this individual on a short term basis. The rural community living in Agincourt HDSS site is known for circular migration. Some residents leave the area temporarily to go and work outside the study area (Collinson, Wolff, Tollman et al. 2006). Hence, there is the need to include the data that from the *residence status* table for information on temporary migration.

The second step to quantifying the migration variable involves the selection of individuals to use for the analysis from the *residence status* table. From the *resident status* table, only people who meet the definition of temporary migrant are selected. The third step involves computing the event dates from the available variables, in a process known as 'flattening the temporary migrations'. Unlike the *residence* table, the *residence status* table is already a status observation table so the data are in long data format already and are updated on an annual basis. Because temporary migrants are circulatory, often in short cycles, i.e. moving frequently to and from a work place and home location there is not usually a clear date at which a migration event has occurred. But for the event history analysis a migration date is needed and must be imputed based on the available data. The solution employed is to use the observation date i.e. the date in which the respective individual was interviewed.

Using '*ObservationDate'* and '*ResMonths'* the key dates can be estimated that determine the duration of residence of individuals. The first set of dates entails the date in which a respondent took on the status of a temporary migrant and this was derived by subtracting 12 months from the *ObservationDate*. This computation led to a date variable being generated named *EventDate*, which is the date of move, as is recorded in the residence episode table. The subsequent date values are generated from this variable. In the event history structure the event type was labelled "TMIG". The next step is to estimate the date of return

migration in which the temporary migrant returned back to the Agincourt HDSS population. This date is estimated by subtracting the value of *ResMonths* from the difference of the *ObservationDate* and six months.

The event type in this case was labelled "INTMG". Also, labelled "OUTTMG" is the event marking the date in which a member a short-term migrant is estimated to depart out of Agincourt HDSS site temporarily. The final step is to label the event type as *"RES"* which is the type of event that aligns to the date in which a temporary migrant becomes a resident again, which matches the last date of observation for the migrant.

The last step entails merging the two datasets originating from the *residence* and *resident status* tables. With this information the following migration status categories were created (i) return migrant, which was further split into short and long-term return migrant and (ii) in-migrant, which was also divided into short and long term durations of the respondents residing in the study population after in-migration. The short-term duration is between 6 months and 5 years while the long-term duration is 5 years and longer.

Table 4.9: **Description of the migration codes**

Status	Description
TMIG	A status denoting an individual who takes on the status of a temporary migrant.
RES	A status denoting a previous temporary migrant who is now a resident.
INTMG	This denotes the start of a temporary migration episode.
OUTTMG	This denotes the start of a temporary migration episode.
IMG	A status denoting an in-migrant
OMG	A status denoting an out-migrant

4.7 Bringing in the time-changing covariates into the Event History Analysis data structure at individual and household levels

4.7.1 Education status

Education status is an independent variable drawn from the *Education status* table of the Agincourt HDSS database. It is similar to the *Resident Status* in that it is a status observation can is repeatedly updated over time. However, the data in this table are collected periodically. For this entity, the baseline collection of data took place in 1992

for all the residents of Agincourt. After 1992, many rounds of education data have been collected specifically in the following years: 1997, 2002, 2006 and 2009. The field is also updated when people in-migrate into the study site. E*ducation* is a field in this table and it refers to the highest level of education attained by the respondents. It is the made up of a range of options as shown in Table 4.11. However, these options were later recoded into four new categories, namely, no education, primary, secondary, tertiary, which can be seen in Table 4.10.

Because education status is not collected annually, provision was made for the missing data points by imputation. This approach entails replacing the missing values for an individual based on the data that have been collected at a point preceding or following the current year of interest. For instance, an individual who reported being in grade 10 in 2002 and grade 12 in 2004 respectively can be assumed to be in grade 11 in 2003. The perceived shortcoming of this approach is that, in reality, the margin can be wider than the one cited in the example and some pupils could repeat classes. However, these issues are not expected to introduce bias into the results of this study, because the respondents are restricted to adult ages who have either completed their studies or are at the advanced stage. Also, the use of broad categories namely: none, primary, secondary and tertiary rather than yearly grade would minimise bias. More importantly, the Agincourt HDSS database has a number of data quality rules that have been programmed into its database to facilitate accuracy and consistency of its data.

Table 4.10: **Recoded education status table**

Category	Description	Previous Category*
0	None	C,N,R,'–'
1	Primary	1,2,3, 4, A, A1, A2, B, M1, M2, M3, M4, M5, M6
2	Secondary	5, 6, 7,8, 9, A3, A4, M7, M8, M9, M10, M11, M12
3	Tertiary	H, L1, L2, N1, N2, N3, N4, T1, T2, U1, U2

*See codes below in Table 4.11

Table 4.11: **Features of the education status table**

Field	Description	Data Type	Option	Detail
Id	Identifier of the Individual	Numeric		
Observation	Observation Identifier	Numeric		
Education	The highest level of education achieved	Text	'–'	Not applicable
			R	Preschool
			C	Crèche
			N	No formal education
			A	Sub-A/Grade 1
			B	Sub-B/Grade 2
			1	Standard 1/Grade 3
			2	Standard 2/Grade 4
			3	Standard 3/Grade 5
			4	Standard 4/Grade 6
			5	Standard 5/Grade 7
			6	Standard 6/Grade 8
			7	Standard 7/Grade 9
			8	Standard 8/Grade 10
			9	Standard 9/Grade 11
			0	Standard 10/Matric
			M1	Mozambican Grade 1
			M2	Mozambican Grade 2
			M3	Mozambican Grade 3
			M4	Mozambican Grade 4
			M5	Mozambican Grade 5
			M6	Mozambican Grade 6
			M7	Mozambican Grade 7
			M8	Mozambican Grade 8
			M9	Mozambican Grade 9
			M10	Mozambican Grade 10
			M11	Mozambican Grade 11
			M12	Mozambican Grade 12
			A1	ABET Level 1
			A2	ABET Level 2
			A3	ABET Level 3
			A4	ABET Level 4
			H	Higher education - deprecated
			L1	Incomplete college diploma
			L2	College diploma in completed
			N1	NQF Level 1
			N2	NQF Level 2
			N3	NQF Level 3
			N4	NQF Level 4
			T1	Incomplete UoT diploma/degree
			T2	Technical completed
			U1	Incomplete university degree
			U2	University degree completed

NQF - National Qualification Framework; ABET - Adult Basic Education & Training

UoT – University of Technology

4.7.2 **Socio-economic Status**

Household Asset Status Table

In this study, the household asset status variables were used to construct an aggregated socio-economic status (SES) variable. The data in *Asset Status* table are collected at the household level biennially. Being a household-level record the assets are considered to be shared by each member of the household. These assets can be categorised into the following groups: modern assets, dwelling or housing structure, sanitation facilities and livestock ownership.

The first category entails the modern assets which consist of home appliances (e.g. stove, fridge); electronics (e.g. TV, video, radio, cell-phone); vehicles (car, motor bike and bicycle). The second category is housing structure which holds data on the structural make-up of the buildings that are occupied by the residents. Specifically, it comprises a variable such as *walls*, which indicates whether the house was built using modern bricks, mud, wood or other materials. It also contains another variable called *roof*, which provides information on the kind of materials used in manufacturing the roof, comprising tiles, corrugated iron, thatch, etc. Similarly, *floor* variable falls under the housing structure category with information on the construction materials used for the floor, namely, tiles, cement, wood, mat, modern carpet etc. While *rooms* and *bedrooms* show the number of living spaces in the dwelling. Lastly, the *construct* variable answers the question on whether the house has reached a completion stage or not.

The third group of assets are in form of facilities that engender cleanliness and convenience in sanitation. There are two variables in the *Asset Status* table that capture sanitation namely: *ToiletType* and *ToiletFac*. The field, *ToiletType* specifies the type of the available toilet and this ranges from modern (i.e. flushable), pit latrine to ventilated improved pit latrine (VIP) and none. Meanwhile, *ToiletFac* indicates the location of the toilet, whether it is in the house, yard, bush or neighbouring house. In the same vein, *WaterAvail* reports on the availability and frequency of water supply while *WaterSupply* contains information on the source of water. Being a rural area, the residents are able to rear livestock. Thus, the fourth category of assets is livestock and it comprises cattle, goats, poultry and pigs. The last group is the supply of electricity.

Table 4.12 contains the details of the Asset Status table in tabular form. It should be noted that in this analysis, the Asset Status data were not used in their raw form but were processed to generate an indicator of household socio-economic status. The following section shows how this was done.

Table 4.12: **Features of the asset status table**

Field	Description	Data Type	Option	Detail
Household	Identifier of the Household	Numeric		
Observation	Observation Identifier	Numeric		
Stove	Modern Assets	Text	Y/N	Yes/No
Fridge				
TV				
Video				
Radio				
CellPhone				
Car				
Motor Bike				
Walls	Housing Structure	Text	1	Brick
			2	Cement
			3	Other Modern
			4	Stabilized mud
			5	Traditional mud
			6	Wood
			7	Other Informal
Roof		Text	1	Tiles
			2	Corrugated iron
			3	Other modern
			4	Thatch
			5	Other informal
Floor		Text	1	Tiles
			2	Cement
			3	Modern carpet
			4	Wood
			5	Other modern
			6	Dirt
			7	Mat
			8	Other Traditional
Rooms		Numeric		
Bedrooms		Numeric		
Construct		Text	Y/ N	Yes/ No
ToiletFac	Sanitary Amenity	Text	1	In house
			2	In yard
			3	Other house
			4	Bush
ToiletType		Text	1	Modern
			2	VIP
			3	Pit Toilet
			4	None
Cart	Livestock	Text	1	None
Cattle			2	1-10

Goats		3	11-40
Poultry		4	more than 40
Pigs		5	Yes, but number unknown
WaterSup	Text		
WaterAvail		Text	

4.7.3 **Computation of socio-economic status indices**

The process of deriving the SES index begins with recoding all the variables in the *Asset Status* from text to numeric where necessary. For the dichotomous variables with yes or no option such as stove, a value of 1 was allocated to 'Yes' while 0 was allocated to 'No'. The other categorical variables were allocated unique values based on their respective weights in terms of quality and relevance that each of their options is perceived to carry. The range varies from variable to variable. For instance, *ToiletFac* is recoded thus: 0 'unknown/missing' 1 'bush', 2 'other house', 3 'in yard' and 4 'in house'. Subsequently, the assets were grouped as follows: - 'modern assets', 'dwelling structure', 'water and sanitation', 'livestock assets' and 'power supply'. Explanation has been provided on the fields that constitute these groupings in the previous section.

The recoded values were then standardised at the level of each variable to fall between 0 and 1, by dividing the observed values by the maximum value observable in each field. Using the *ToiletFac* again as an example, the standardised values would be as follows, 0/0=0 'unknown', 1/4=0.25 'bush',

2/4=0.5 ‘other house’, 3/4=0.75 ‘in yard’ and 4/4=1.00 ‘in house’. This was followed by the aggregation within each of the asset groupings, resulting in the following variables: modern_sum, dwell_sum, sanitation_sum, power_sum and livestock_sum. The five aggregated variables were also standardised using the same approach above, i.e. dividing by the maximum observed value to get a range from 0 -1, and summed to derive the overall SES score, which ranges from 0 - 5. The choice of this approach was based on the fact that a previous study on the dynamics of migration and livelihood in rural South Africa that adopted the same dataset discovered that the indicator substantially correlates with the standing wealth (Collinson 2009)

The *refugee* field denotes whether a resident is a South African or national of another country. There exist two categories for the Mozambicans – one, for the citizens of Mozambique who arrived in South Africa on or before 1992 and the other, for those who came in afterwards. However, in this analysis the *refugee* was recoded to have only two categories South African and Mozambican. There is no appreciable difference between the two categories of Mozambicans. Also, the people from countries other than South Africa and Mozambique constitute a minute proportion of study population. Variable *refugee* was renamed *nationality* to reflect the content of the variable. It is important to note that these variables do not change with time.

4.8 Data quality checks in the EHA data structure

The data was exported from the Microsoft SQL Server database platform to Stata, which is a software program whose main function is to perform data analysis and statistical modelling. This program also possesses the capacity for exploring the quality of data. The data in *residence* table was transformed from wide to long format to allow analysis, as explained above. On the assessment of the quality of the data, since the data originated from a longitudinal survey, it is presumed that date and event could pose challenges to the quality of the data. Therefore, the following subsections explain the approaches or techniques employed to examine the data. They also contain information on how the deficiency in the data was handled.

4.8.1 Date consistency check

In preparing the data for analysis, efforts were made to ensure that the dates are consistent. The main dataset emerged as a result of merging the data in the *residence* and *individual* tables. It is important to reiterate that the relationship between the *residences* and *individuals* tables is one-to-one. Therefore, there is no need to worry about transforming the latter table. The resulting table comprises three date variables namely date of birth (*DoB*) sourced from the *individual* table and residence start date (*StartDate*) and end date (*EndDate*) of the respondents extracted from the *residences* table.

Before the *StartDate* and the *EndDate* were merged to form a single date called *EventDate*, as described in Section 4.9.2, a set of commands was run in Stata to check whether StartDate is equal to EndDate and whether the EndDate is equal to the prior StartDate. By running this command, more than a thousand cases of inconsistent data were generated. However, most of the retrieved cases were legitimate as a child can be given birth to and either died or out-migrated with his parents on the same day. Also, there is the possibility of an individual that out-migrated from a place within the Agincourt HDSS to another within the study area to have his date of out-migration and in-migration being the same. Most statistical software of data analysis, including Stata, would systematically remove these people from the event history analysis as they contribute zero time in the time-to-event analysis.

Because of this scenario, there was the need to make provision for the accommodation of people who experienced two events, which occurred on the same date. In order to handle these cases, six hours in unit of time was added to the case of death or out-migration occurring immediately after birth on the same day while 12 hour was added to the case of out-migration being followed instantaneously by in-migration. The solution was made possible by converting all the date variables from "Day-Month-Year" format to "Day-Month-Year-Hour-Minute-Second" format which is supported in Stata. This approach ensures that the respondents are preserved in the sample. More importantly, the allocation of the time unit was based on the assumption that the people might still incur certain amount of time as they transit from one demographic event to

another and that could take the number of hours added on the average. It is interesting to note that there is no inconsistent case of StartDate greater than EndDate as the Agincourt HDSS has in-built checks in its database mentioned previously to prevent them.

4.8.2 **Event consistency check using a matrix**

The next major consistency check was performed on the demographic events e.g. births, deaths, etc. The aim of carrying out this exercise is to ensure that the events follow an expected pattern of an inward event being followed in time by an outward event, because it would be an error if an inward event is followed by another inward event. This line of reasoning was extended to the entire Agincourt population available at the time (i.e. 1992 to 2011). For some of the respondents their first event was experienced or recorded at the beginning of the surveillance. Thus, introducing the consistency check in the year 2000, more than a decade after the baseline data were collected, would have led to the truncation of some vital information on how their events progressed.

Meanwhile, the event consistency check was aided by the creation of a matrix (in Fugure 4.8) showing a cross-tabulation of a set of event mostly initiating event in row namely: (i) Census Enumeration (ENU), (ii) Birth (BTH), (iii) In-Migration (IMG) and (iv) Out-Migration (OMG) to form *Start Event* variable.

And, the *following* event variable, which comprises mostly the terminating events in column including the following (i) Death (DTH), (ii) IMG, (iii) OMG and (iv) current (CUR) as at cut-off date.

The matrix shown in Figure 4.12 is the tabulation of the Start Event and following events variables. The inclusion of both IMG and OMG in both rows and columns was not an oversight and is useful to identify sequential errors. A respondent has to experience IMG first before OMG. ENU cannot be followed by IMG as both are initiating events. Similarly, a child cannot be born two times, neither can an individual experience death twice. Specifically, the following are the sequences are not tenable and should be rectified.

- ENU followed by IMG or ENU
- BTH followed by IMG or BTH
- IMG followed by IMG
- OMG followed by OMG or DTH or CUR
- DTH followed by DTH or IMG or OMG or DTH or CUR

	Following Event					
Event	**ENU**	**BTH**	**IMG**	**OMG**	**DTH**	**CUR**
ENU	X	X	X	√	√	√
BTH	X	X	X	√	√	√
IMG	X	X	X	√	√	√
OMG	X	X	√	X	√	√
DTH	X	X	X	X	X	X
CUR	X	X	X	X	X	X

Figure 4.12**:** **Event matrix diagram**

Table 4.13 shows the results of applying the matrix to the event data of Agincourt HDSS. A very few number of inconsistent cases were retrieved - nine in total. There was a scenario of OMG being followed by BTH scenario – five cases. Also, there were another situation of DTH being followed by IMG – two cases were observed. Similarly, the matrix shows a single case of OMG being preceded by DTH.

Table 4.13: **Agincourt events matrix (raw), 1992-2011**

	Following Event							
Start Event	**ENU**	**BTH**	**IMG**	**OMG**	**DTH**	**CUR**	**.**	**Total**
ENU	0	0	0	38,386	5,851	17,022	0	61,259
BTH	0	0	0	15,534	1,800	18,631	0	35,965
IMG	0	0	0	45,756	4,104	42,163	1	92,024
OMG	0	5	3,343	0	0	0	96,329	99,677
DTH	0	0	2	1	0	0	11,752	11,755
CUR	0	0	0	0	0	0	77,816	77,816
Total	0	5	3,345	99,677	11,755	77,816	185,898	378,496

Table 4.14: **Agincourt events matrix (corrected), 1992-2011**

	Following Event					
Start Event	**IMG**	**OMG**	**DTH**	**CUR**	**.**	**Total**
ENU	0	38,385	5,851	17,020	0	61,256
BTH	0	15,529	1,800	18,631	0	35,960
IMG	0	45,765	4,102	42,160	0	92,027
OMG	3,348	0	0	0	96,331	99,679
DTH	0	0	0	0	11,753	11,753
CUR	0	0	0	0	77,811	77,811
Total	3,348	99,679	11,753	77,811	185,895	378,486

Lastly, another case of IMG being followed by a dot instead of CUR was seen. In treating these inconsistencies, the Agincourt HDSS analytical database was accessed and the inconsistent values were rectified in consultation with the original instrument of data collection i.e. completed questionnaires.

Table 4.14 contains the cleaned version of the matrix. It should be noted that some of the cases occurred prior to the current year of interest, which justifies the extension of the consistency checks to the year 1992.

4.9 **Method of statistical analysis**

This section is devoted to describing the technique that was adopted in performing data analysis in this research project. In general, taking into consideration the longitudinal nature of the dataset, the Fine and Gray (1999) model of mortality hazard was employed to answer the research questions. The period of observation started on the 1st of January, 2000 and ended on the 31st December, 2011. The outcome of primary interest is AIDS/TB death while categories of migration status are the main predictive variables examined in the study. Although, the subjects of analysis are migrants, for the sake of comparison non-migrants were included in the study.

Although the Cox proportional hazard model is widely adopted in event history analysis, it is not an appropriate tool to employ for the current analysis, as it is

only suitable for studying the transition of an individual from one state to another e.g. from alive to dead. In order words, Cox hazard model is limited when the outcome event is composed of several categories. This requires a competing risk model, which is the main the reason for selecting the Fine and Gray (1999) model to answer this question. Additionally, the Fine and Gray (1999) model, unlike the Cox proportional hazard model does not make any assumption that competing risk events are independent of each other.

In other words, the Cox model applied to competing risk make the implicit assumption that the causes of death are independent of one another. This is because for each specific cause, the other causes are treated as censored observations the same way as true censoring due to the end of follow-up. When treating the cause-specific hazards independently their sum does not add up to the total death hazards.

The Fine and Gray model built on the cumulative incidence function that represent better the proportion of individuals dying of each cause of death. This model does not assume independence between causes. For each specific cause, the other causes are treated not as censored observations but explicitly as competing risks. Also the sum of the cause-specific cumulative incidence functions does add up to the failure function (i.e. the inverse of the Kaplan-Meier survival function for overall death).

Moreover the Fine and Gray model, by making use of the cumulative incidence function (itself based on cause-specific hazards) does not impose any assumptions on the shape of the cause-specific hazards unlike parametric competing risks models that use Weibull or exponential functions to adjust the cause-specific hazards. In other words, the pattern of cause-specific hazards is driven by the data and not by the researcher, which therefore the risks of biases in the analysis.

Causality, although it can never be ascertained, is approached as closely as data allow through careful time control of covariates. The principle of anteriority of the cause on the effect is always respected. For example, the main covariate, the migration status (in-migrant, return migrant, and non-migrant) is defined at the beginning of each exposure episode and therefore precede the (potential) death event. Similarly the duration of exposure is controlled for. For example a return migrant will change status from short-term to long-term once the duration threshold of 5 years is reached. In much the same way a change of education level (e.g. from primary to secondary), the change of SES score, and the entry into a new calendar period (e.g. from 2000-2003 to 2004-2007) are treated with time-varying. That way changes that can be identified in the time dimension are accounted for at the individual level. Of course the high time precision of our data does not mean that causal relationships are unequivocal but at least the respondent status is given with as much time precision as the data can give. The

fixed covariates are limited to sex (models are computed separately by sex) and to nationality of origin (South Africa vs Mozambique).

To apply the Fine and Gray model as a technique of data analysis, the causes of death (CoD) variable adopted for this study was categorised as follows: 'AIDS/TB', 'NCDs', 'external causes' and 'other infectious diseases', with indeterminate causes coded as missing. The CoD was construed as the dependent variable in the analysis. Similarly, a category was created for the migrant status variable and it comprised the following options. Non-migrant is the first option or category and it doubles as the reference category to facilitate the interpretation of the results. The other categories are as follows: 'short-term return migrant', 'long-term return migrant', 'short-term in-migrant' and 'long-term in-migrant'. The short term duration is between 6 months and 5 years while long-term is 5 years and above. The definition of who is a migrant has been stated in Section 4.5.1 under study population.

Furthermore, the dataset was made ready to perform longitudinal analysis by running a set of syntax from Stata, the statistical software package used in carrying out the analysis. It is important to note that firstly the dataset was transformed from a wide format to the long format necessary for event history analysis, as described earlier in this chapter. An excerpt of the syntax with description is as follows. It should be noted that the age criteria has been factored into the dataset.

After the preparation of the data for event history analysis, the second step entails the investigation of the relationship between migration and mortality by running the Fine and Gray model command (*stcrreg*) on data comprising the *migrant status* (dependent variable) and *causes of death* (independent variable) data as sourced from the Agincourt HDSS database. It can be seen from the Stata set of codes labelled Stata (s2) that *stcrreg* makes allowance for the inclusion of the competing causes of mortality, which are denoted by "compete(CoD==2 3 4 5)". Also, it allows for condition of interest to be specified and this resulted in models being fitted separately for male and female in this project. In addition to *migrant status* (main independent variable), the program makes provision for other covariates. The investigation of the relationship between migration and mortality controls for variables such as *nationality* (South Africa or Mozambican), *educational status* (none, primary, secondary and tertiary), *socio-economic status* (quintile 1 to 5) and *period* (2000-2003, 2004-2007 and 2008-2011).

There are two main right-censoring scenarios that were encountered in the course of the analysis. On one hand is the possibility of a number of respondents being unable to stay or live long enough for any of the events of interest to occur. As an example, a study participant could out-migrate out of the study area or might not be able to meet the inclusion criteria of the study by becoming 70 years old or not residing in the area for the duration of time specified as a condition to be included in the study. In this analysis, the category with the highest proportion lost to follow-up is that of the out-migrants. Some out-

migrants may come back at one point or the other during study period i.e. 2000 to 2011 to be part of the population under consideration as the in-migrants who are left-censored. In much the same way, many individuals will be under observation, i.e. left-censored, only at the start of the study period, 1st January 2000. To note a participant might live long enough within the study site and within the study period, and may fulfil all the conditions for being part of the study but might not experience the events of interest as at the cut-off date of the study, in this case, 31st December, 2011.

4.10 **Fine and Gray model specification**

In specifying the Fine and Gray (1999) model, let T denotes time to a respondent experiencing an event of interest i.e. mortality time. It is expected that death time will vary from one study participant to another and the time variable will be in continuous format. In the same model, let C be the mortality cause. Here we are interested in mortality due to four groups of causes. Hence, the cause of death is categorical in terms of format. Again, in the context of this research project, the event is AIDS/TB, NCDs, external causes and other infectious diseases. It is interesting to note that with Cox proportional hazard model three out of the four competing events of interest would have been right censored. That is, they would not be accommodated in the model due to the inability to follow-up because they died of causes that are not of interest. The alternative method would be to apply the Cox proportional hazed model to each cause separately. However, when applying Cox proportional hazed model to a

specific cause by deliberately censoring the other subjects that die of other competing causes, this will lead to the reduction in the number of subjects as the respondents who lose their lives are excluded from the population of those that are subject to a risk which is the opposite of what happens in the Fine and Gray (1999) model. Equation 1 is a cause-specific hazard $\lambda(t, \mathbb{Z})$ of dying of a specific cause k (e.g. NCDs) assuming that the respondent has experience death at time t in the context of all subjects that are predisposed to the same death risk at the time. The cause specific hazard model can also be taken as a joint distribution of (T, C) with the assumption or restriction that an individual can only die of only one cause.

$$\lambda_K(t) = \lim_{\Delta t \to 0} \left(\frac{Pr\{t < T + \Delta\, t, C = K | T \geq t\}}{\Delta\, t} \right) \qquad Equation\ 1$$

Futhermore, let cause of death K be in the list of mortality cause, which comprises cause 1, cause 2, cause, cause 3 up to the nth cause. The aforementioned statement can be expressed mathematically with the following set of notations: $K \in \{1,2,3, \ldots n\}$. In this expression, K depicts a specific cause of death of interest that data can be collected on and it can be any of $1,2,3, \ldots n$ representing a specific cause. Given that $\{X_{i,}\Delta_i, \Delta_i \in_i, \mathbb{Z}_i\}$ are evenly distributed for $i = 1, \ldots, n$, the following $X = \min(T, C)$, $\Delta = \mathrm{I}(T \leq C), and\ \mathbb{Z}$ are observable: characteristics.

$$\lambda_K(t|\mathbb{Z}) = \lim_{\Delta t \to 0} \left(\frac{Pr\{t < t + \Delta t, C = K|\mathbb{Z}, \{T \geq t\} or (T < t \; and \; C \neq K)\}}{\Delta \; t} \right)$$

In building the competing risk model, the interest is in mathematically modelling the cumulative incidence function $F_k(t)$ which can be defined as the probability of dying from cause *K* in the presence of other causes of death by time *t*. Equation 2, denotes the cumulative incidence function corresponding to the the sub-distribution function for the risk *K*:

$$F_K(t) = \Pr(T \leq t, C = K) \qquad \text{Equation 2}$$

Equation 3 is the Fine and Gray (1999) semi-parametric regression model for the sub-distribution hazard function. λ_{K0} in the equation represents the baseline sub-distribution hazard. The notation β_0 denotes the treatement effect:

$$\lambda_K\{t, \mathbb{Z}\} = \lambda_{K0}(t) exp\{\mathbb{Z}^T(t)\beta_0\} \qquad \text{Equation 3}$$

The sub-hazards are defined such that:

$$\lambda_K\{t, \mathbb{Z}\} = -dlog\{1 - F_K(t, \mathbb{Z})\}/dt \qquad \text{Equation 4}$$

4.11 **Ethical issues**

The Agincourt HDSS is ethical in the way it goes about collecting data from the residents as it obtains either written or oral consent at the levels of individual and household, and also at the level of community leadership. Specifically, the Agincourt HDSS has been granted ethical approval by the committee for research on Human subjects of the University of the Witwatersrand, Johannesburg to carry out the study in Agincourt. The reference number is M960720.

For over two decades, the Agincourt HDSS Unit has enjoyed valued support from the host community. This is evident in the high rate of positive consent received from community members. The Unit has a community engagement office called the Learning, Information Dissemination and Networking with the Community (LINC) office, which has a three-fold agenda: imparting knowledge and ideas for personal effectiveness and well-being of community members, sharing of statistics and research results for the community leaders to use in development efforts, for example when contacting the government to request social and infrastructural amenities. Also, it brings the people together for the purpose of networking and partnership (Kahn, Collinson, Gómez-Olivé et al. 2012).

4.12 **Data limitations**

One of the inherent limitations of any migration study is the constraint that originates from the inability of a researcher to obtain data both at the origin and the destination of the migrants. Also, in secondary data analysis, we are restricted to the variables that the Agincourt HDSS has collected. Also, some of the available variables of interest are not collected annually and some are collected at the household level rather than individual. For instance, Asset Status data are collected biennially and at the level of the household. Furthermore, there might be cases of missing data for certain individuals. Just as for any other longitudinal study, certain respondents may be lost to follow up.

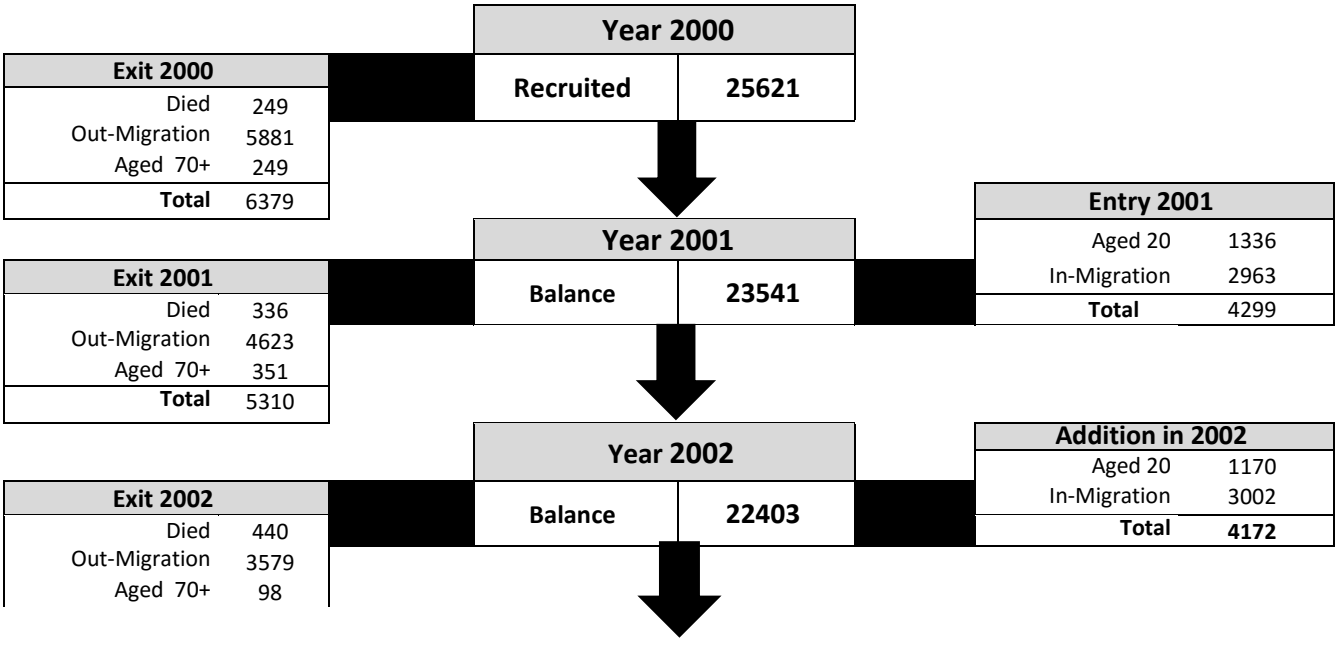
CHAPTER 5: PROFILE OF THE RESPONDENTS

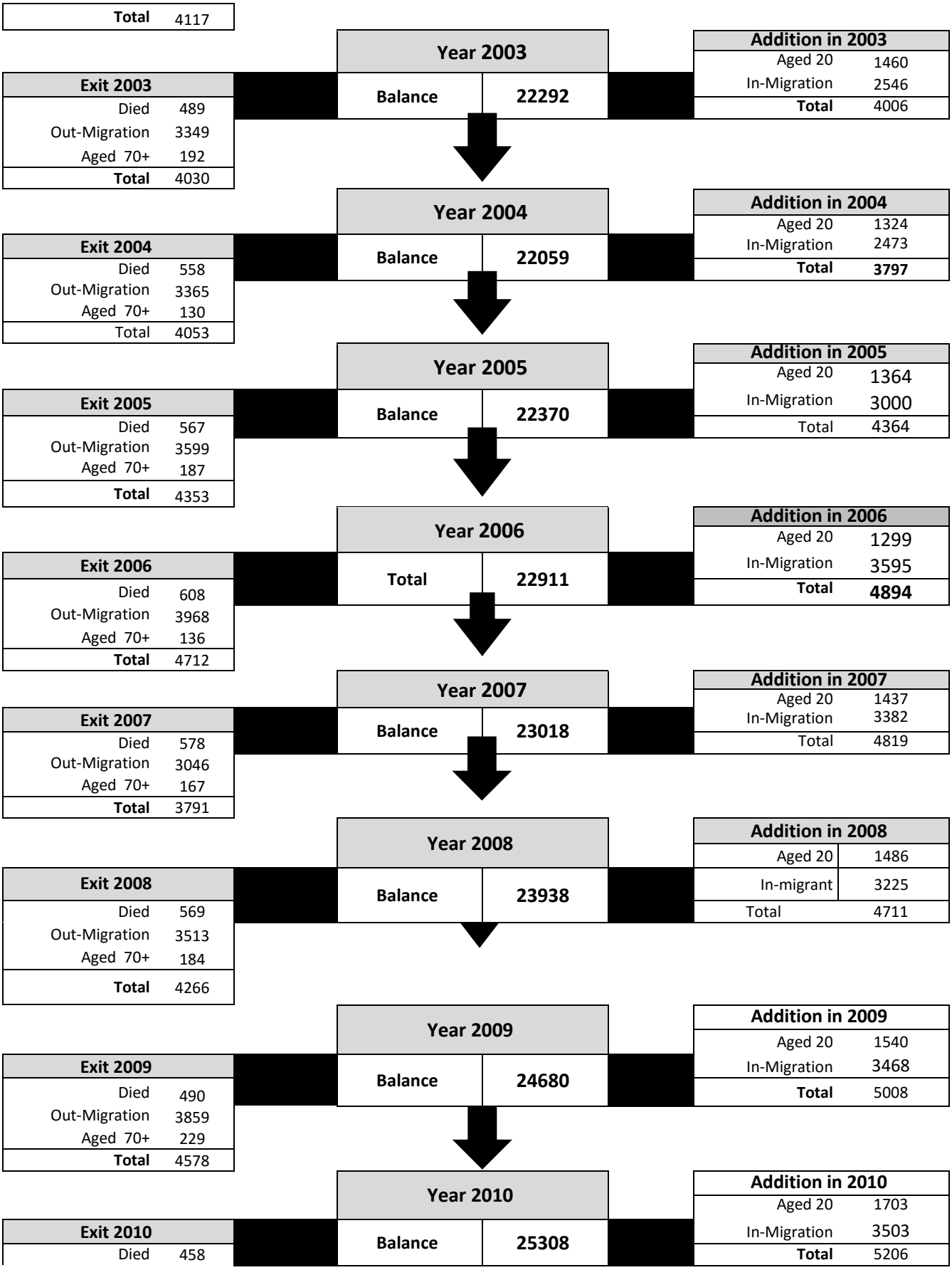
5.1 Cohort profile of the study population

Figure 5.1 is a flow chart of the cohort profile of the study population from 2000 to 2011. The chart shows how people enter and exit the cohort over time. The main source of exit from the cohort is out-migration while in-migration is the major reason why people enter the population. In addition, the study area is characterised by high levels of circular migration (Clark, Collinson, Kahn et al. 2007). The population thus includes in-migrants and return migrants, who return to their rural homes after being circular migrants. In the analysis return migrants and in-migrants are examined separately. Additionally, the analytic approach ensures that the amount of time that each cohort member spends in the rural study population is taken into consideration.

Aging is another important means of entering or exiting the cohort. People are recruited into the study when they become 20 years old, and cease to be part of the population when they reach 70 years. Death also results in exit from the study population. The population under consideration includes male and female individuals. In addition, the inclusion criteria entail limiting the study participants to those who spend at least six months residing in the study area. This is with the intention of distinguishing a migrant from an ordinary visitor.

In the year 2000, the baseline year, a total of 25,621 individuals were recruited for the study, as shown in Figure 5.1. A total of 6,379 of the population could not make it to the following year i.e. 2001. Exactly 249 of them died; 5,881 out-migrated out of the study location; 249 attained the age of 70 years. In summary, there was a total of 8.8% decrease in the number of people in the cohort between 2000 and 2001. Although, the number of the recruited study participants went down in 2000 by 6,379, the study sample got a supplement of 4,299 new recruits to make the number stand at 23,541 in 2001. The increment came into existence as a result of 2,963 people being added by in-migration after meeting the six-month minimum residence criterion to make them qualified for the study. Furthermore, a total of 1,336 people met the age requirement, which was achieved by reaching age 20 years. Exactly the same scenario was replicated in the subsequent years until 2011 with the cohort losing and gaining additional members. The details for each year can be found in Figure 5.1.




Total 4117
Year 2003
Balance 22292
Addition in 2003
Aged 20 1460
In-Migration 2546
Total 4006
Exit 2003
Died 489
Out-Migration 3349
Aged 70+ 192
Total 4030
Year 2004
Balance 22059
Addition in 2004
Aged 20 1324
In-Migration 2473
Total 3797
Exit 2004
Died 558
Out-Migration 3365
Aged 70+ 130
Total 4053
Year 2005
Balance 22370
Addition in 2005
Aged 20 1364
In-Migration 3000
Total 4364
Exit 2005
Died 567
Out-Migration 3599
Aged 70+ 187
Total 4353
Year 2006
Total 22911
Addition in 2006
Aged 20 1299
In-Migration 3595
Total 4894
Exit 2006
Died 608
Out-Migration 3968
Aged 70+ 136
Total 4712
Year 2007
Balance 23018
Addition in 2007
Aged 20 1437
In-Migration 3382
Total 4819
Exit 2007
Died 578
Out-Migration 3046
Aged 70+ 167
Total 3791
Year 2008
Balance 23938
Addition in 2008
Aged 20 1486
In-migrant 3225
Total 4711
Exit 2008
Died 569
Out-Migration 3513
Aged 70+ 184
Total 4266
Year 2009
Balance 24680
Addition in 2009
Aged 20 1540
In-Migration 3468
Total 5008
Exit 2009
Died 490
Out-Migration 3859
Aged 70+ 229
Total 4578
Year 2010
Balance 25308
Addition in 2010
Aged 20 1703
In-Migration 3503
Total 5206
Exit 2010
Died 458

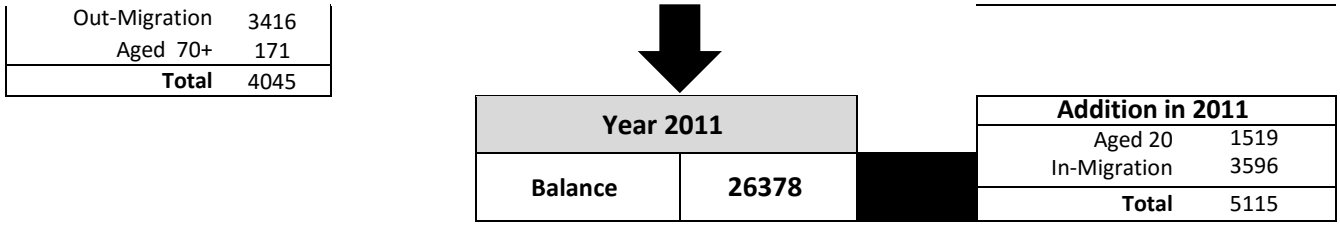


Figure 5.1: Flow chart of the study cohort between 2000 and 2011

5.2 Descriptive characteristics of the study population Table 5.1 also provides information on the migration status of the study participants. As expected, non-migrants constitute the highest proportion of the study participants for the entire period of analysis (i.e. 2000-2011). Approximately half of the respondents were non-migrants for most of the period. This proportion was followed by long-term in-migrants which range between 20.1% and 25.8%. This implies that around two out of every ten participants are long-term in-migrants. This category was followed by the short-term in-migrants whose values fluctuated widely over the 12 year period. This group of migrants started with a frequency of 15.9% in 2000 and peaked at 18% in 2002, Afterwards, it began a decline in 2003 at 17.3% and it reached a minimum in 2005 at 12.8%. This was the lowest value recorded in analysis period. Further oscillation is seen between 2006 and 2011. In 2000, short-term return migrants constituted 2.8% of the study population while the long-term return migrants had a percentage value of 0.1%. This low value is due to the fact that we only started identifying return migrants in 2000 and to be eligible

the person needed to have been previously identified in the database. Thus, the proportion of return migrants accumulates over the period. From 2000 to 2011, the distribution of the short-term return migrants follow an upward trend with the highest and lowest percentages being 2.8% % and 6.2% respectively.

Table 5.1Table 5.1 displays the descriptive characteristics of the study population, including age, sex, education, and nationality and migration status from 2000 to 2011. The person-years computation was computed for those who met the inclusion criteria. Specifically, the calculation of the summary characteristics was done by dividing total person-years at risk by the person-years spent in each category. This was done on a yearly basis. For example, the proportion of male participants in 2000 was 38%, which came as a result of dividing the total person years (23,962) for that year by the person-years incurred by the male participants (9,097).

As shown in the table, the age of the participants is not evenly distributed across the specified five age groups. It can be seen that age group 20-29 constitutes the largest proportion (39.6-44%) of the participants recruited for the study from 2000 to 2011. In spite of the evidence of fluctuation, the proportion was fairly consistent across the period. The highest proportion can be seen in the year 2000 at 44%, while the lowest percentage can be found in 2006 at 39.6%. The percentage distribution of the people in this age group portrays a “U” shape pattern (though not too steep) with the trend going from high to low and high again, ending at 44%. The first age group is followed by age category 30-39 years with the percentage ranging from 21.8 to 24.3% as minimum and maximum values respectively. The distribution is seen to be following a slight

downward trend over the years of the study. Age categories 40-49 (14.2-16.5%) and 50-59 (9.2-11.5%) years show an opposite trend, with the proportion increasing over the years of the study. The same pattern is applicable to those aged 60-69 years with a value range of 8.8-9.8%. In general, it can be seen in that the higher the age category, the lower the proportion of the population. The people in age group 20-29 years constitute the highest proportion, while those in 60-69 years constitute the smallest proportion.

The table also shows the distribution of the participants by sex. From 2000 to 2011, around six out of every 10 of them (62.0-65.9%) are female while close to four out of every 10 (34.1-38%) are male. On education, the proportion of those who reported no education varies widely across the years, with 2000 displaying the highest at 25.0% and 2011 showing the lowest at 11.6%. It can be seen that the percentage of those without formal education decreases over the years. The same pattern can be observed in those with primary school education, with the proportion following a downward trend from 21.1% in 2000 to 14.6% in 2011. The decline that was observed among those with primary and no educational attainment is reflected by increases in those with secondary education. It can be seen that secondary education shows an upward trend from 45.7% in 2000 to 62.6% in 2011. This implies that close to five out of every 10 participants attained secondary educational status in 2000 and this increased to six out of 10 in 2011. The proportion of people that indicated that they have post-secondary education, i.e. tertiary, is 7.3% in 2000 and 7.4% in 2011 with the highest percentage being observed in 2010 at 8.2%.

In terms of nationality, approximately seven out of every 10 participants (69.7-70.9%) are South African while the remainder are Mozambicans (29.1-30.2%). Table 5.1 shows the proportion of the Mozambican participants decreasing from the first year, 2000. However, this pattern reversed in 2007 as the percentage of Mozambicans began to increase.

Table 5.1 also provides information on the migration status of the study participants. As expected, non-migrants constitute the highest proportion of the study participants for the entire period of analysis (i.e. 2000-2011). Approximately half of the respondents were non-migrants for most of the period. This proportion was followed by long-term in-migrants which range between 20.1% and 25.8%. This implies that around two out of every ten participants are long-term in-migrants. This category was followed by the short-term in-migrants whose values fluctuated widely over the 12 year period. This group of migrants started with a frequency of 15.9% in 2000 and peaked at 18% in 2002, Afterwards, it began a decline in 2003 at 17.3% and it reached a minimum in 2005 at 12.8%. This was the lowest value recorded in analysis period. Further oscillation is seen between 2006 and 2011. In 2000, short-term return migrants constituted 2.8% of the study population while the long-term return migrants had a percentage value of 0.1%. This low value is due to the fact that we only started identifying return migrants in 2000 and to be eligible the person needed to have been previously identified in the database. Thus, the proportion of return migrants accumulates over the period. From 2000 to 2011, the distribution of the short-term

return migrants follow an upward trend with the highest and lowest percentages being 2.8% % and 6.2% respectively.

Table 5.1: **Summary statistics of the study population by period using person-years**

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Pearson years*		23962	21890	21111	21122	20840	20858	20443	21270	22411	22576	23318	23924
Age Group (%)	**20-29**	44.0	42.2	41.0	41.1	40.8	40.3	39.6	40.0	41.2	41.3	41.8	41.8
	30-39	23.8	24.3	24.3	24.1	23.4	23.1	23.1	23.0	22.6	22.2	22.1	21.8
	40-49	14.2	14.3	14.9	14.8	15.2	15.6	16.1	16.1	15.8	16.0	16.3	16.5
	50-59	9.2	9.9	10.3	10.6	10.8	11.2	11.4	11.4	11.3	11.5	11.2	11.3
	60-69	8.8	9.2	9.4	9.5	9.8	9.7	9.7	9.5	9.1	9.0	8.6	8.6
Sex (%)	**Male**	38.0	36.0	35.7	34.7	34.5	34.5	34.1	34.5	34.6	34.9	35.3	36.3
	Female	62.0	64.0	64.3	65.3	65.5	65.5	65.9	65.5	65.4	65.1	64.7	63.7
Education (%)	**None**	25.0	23.2	21.9	20.5	18.9	17.5	16.3	15.1	13.9	13.1	12.2	11.6
	Primary	21.1	20.9	20.2	19.7	19.5	19.0	18.1	17.4	16.5	15.7	15.0	14.6
	Secondary	45.7	47.4	49.4	51.5	53.2	54.8	56.2	57.4	58.9	60.8	62.1	62.6
	Tertiary	7.3	7.4	7.5	7.4	7.5	7.4	7.8	7.6	7.7	8.0	8.2	7.4
Nationality (%)	**South African**	69.7	70.1	70.0	70.3	70.7	70.7	70.7	70.9	70.4	70.2	69.6	69.2
	Mozambican	30.2	29.8	29.9	29.7	29.3	29.2	29.1	29.0	29.4	29.6	30.1	30.5
Migration Status	**Non-migrant**	54.5	49.6	45.9	46.9	47.5	47.4	45.8	45.0	44.9	45.8	45.1	45.1
	Return Migrant (ST)	2.8	2.7	2.8	3.9	4.2	4.6	4.9	5.0	5.4	5.8	5.9	6.2
	Return Migrant (LT)	0.1	1.2	2.3	2.4	3.0	3.9	4.5	5.1	5.2	5.3	5.9	6.6
	In-Migrant (ST)	15.9	17.0	18.0	17.3	15.1	12.8	12.9	14.8	16.7	15.7	15.3	15.4
	In-Migrant (LT)	21.9	23.3	24.9	24.0	25.0	25.8	24.6	22.8	21.4	21.0	21.1	20.1

Note: Percentage total is greater or less than 100 for some of the variables due to rounding and the removal of "others" or "unknown" categories.

* The person-years computation takes into consideration the study inclusion criteria e.g. the participants must be age 20-69 years and resident for > 6months

ST – Short Term

LT – Long Term

5.2 Demographic profile of the study population

5.2.1 Mortality rates

Table 5.2 and 5.3 display the mortality rates, per 1000 person-years, by age and sex from 2000 to 2011. The rates were computed and presented to show the overall mortality pattern of the population as well as the age-, sex-, and period-specific rates. The mortality rates were computed by dividing of the number of deaths in each category by the total number of person-years in that category, multiplied by 1000. It is important to reiterate that the population under consideration consists of migrants and non-migrants, who fulfilled the inclusion criteria previously specified.

The tables show that the mortality rates among male participants in the age group 20-69 years (the overall age-group) is higher than their female counterparts across the period of analysis. The mortality rate for males aged 20-69 years in 2000 was 14.2 per 1000. The rate increased over time with a temporary decrease in 2005 to 41.2 per 1000. Nonetheless, the mortality rate for this category of people reached a peak in 2006 of 46.3 per 1000 and after that it starting reversing. The downward trend was observed until the end of the analysis period, 2011, at 25.2 per 1000. The mortality rates among females in the same broad age category, 20-69 years, followed the same pattern. Specifically, the rate for the females was 8.1 per 1000 in 2000; almost half of the rate of the males in the same year. The rate made an annual increase until

2006 at 21.2 per 1000, when it declined until 2010, to 13.6 per 1000, after which an increase to13.9 per 1000 was observed in the final year. The downward trends observed both for male and female might be pointing to the impact of anti-retroviral drugs curbing mortality from HIV/AIDS in the rural communities (Levira, Todd, and Masanja 2014).

Table 5.2 and 5.3 show the distribution of mortality rates by 10 year age group. It can be seen that age group 20-29 years has the lowest mortality of the specified age-groups. The low rates are seen among the males as well as the females in the base year. The mortality rate among males aged 20-29 years was 4.1 per 1000, while the rate recorded among women of the same age was 4.6 per 1000. In the same year, it could be observed that the mortality rate for females is greater than for males. The same scenario could be seen in the later year, 2010, when the rates for females (i.e. 7.9 per 1000) exceeded that of male (5.6 per 1000). Apart from 2000 and 2010, the mortality rates among males aged 20-29, was greater than that for females.

For people in age category 30-39 years, there is no overlap in the mortality rates displayed for the male and female throughout the period of analysis. It can be seen that the rates in this age category are more than double the rates computed for the people age 20-29 years. The mortality rate for males in 2000 was 17.7 per 1000 (more than 300% increase) for participants aged 30-39 years. Similarly

in the same year and age group, female mortality rate was 4.6 per 1000 registering, about a 93% increase. The gap increases over time. At the peak of male mortality in 2006, it can be seen that this is where the widest gap was recorded between the gender groups, as depicted in Table 5.4. The highest mortality rate reported for males was, in 2006, at 66.8 per 100 and for females 27.4 per 1000, in 2005. The pattern of mortality as reported in age group 30-39 years between 2000 and 2011. These results suggest that the age group 30-39 marks the onset of the age at which the mortality impact of HIV is felt.

The pattern observed at 30-39 age years can also be seen in the higher age-groups as shown in Figures 5.4 to 5.7. At age 40-49 years, for instance, the highest mortality rate among men was 78.0 per 1000 in 2005 and the rate for women was 25.6 per 1000, in 2004 and 2005. Also, in the age-group 50-59, the rate peaked at 78.9 per 1000 for men in 2004, and at 28.8 per 1000 for women in 2006. For age category 60-69 years, the highest rate can be seen in 2008, at 76.3 per 1000 and at 28.9 per 1000 for male and female respectively.

Table 5.2: **Mortality rate by age and sex per 1000, 2000-2005**

Categories		2000			2001			2002			2003			2004			2005		
		M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF
Age Group	**20-29**	4.1	4.6	4.4	9.4	8.0	8.6	11.6	8.6	9.8	12.5	11.5	11.9	15.8	12.8	14.0	13.7	10.7	11.9
	30-39	17.7	8.9	11.9	20.6	13.1	15.6	38.7	15.3	23.0	52.5	17.7	28.5	56.4	21.4	32.2	52.4	27.4	35.3
	40-49	33.7	10.3	17.7	35.4	14.3	20.8	55.7	17.8	29.2	54.1	17.6	28.2	75.0	25.6	39.5	78.0	25.6	40.9
	50-59	25.7	11.6	16.3	39.2	19.0	25.4	64.7	18.2	33.0	64.1	19.6	33.6	78.9	22.3	40.7	70.5	25.5	39.7
	60-69	30.7	13.0	18.5	35.2	22.6	26.7	58.1	26.0	36.8	68.6	23.5	38.9	55.5	19.5	31.9	64.3	19.0	35.0
Overall	**20-69**	14.2	8.1	10.4	19.8	12.8	15.3	32.3	14.5	20.8	36.4	16.1	23.2	42.0	18.8	26.8	41.2	19.8	27.2

M- Male F-Male MF- Male and Female

Table 5.3: **Mortality Rate by Age and Sex per 1000, 2006-2011**

Categories		2006			2007			2008			2009			2010			2011		
		M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF
Age Group	**20-29**	15.7	14.9	15.2	12.7	9.8	10.9	17.7	8.7	12.3	9.7	8.0	8.7	5.6	7.9	7.0	9.4	7.0	8.0
	30-39	66.8	26.3	39.1	65.9	24.3	37.2	47.6	20.7	29.1	55.4	15.4	27.9	40.3	16.9	24.4	26.6	15.9	19.5
	40-49	73.3	21.9	37.0	77.4	21.3	38.3	74.5	19.8	36.1	59.0	17.5	30.1	73.1	15.1	32.6	43.8	17.4	25.8
	50-59	73.6	28.8	42.9	78.0	22.8	40.0	70.1	26.4	40.2	46.0	27.3	33.1	61.4	17.2	31.0	53.8	16.0	27.5
	60-69	70.5	22.5	39.3	52.3	28.9	37.1	76.3	18.6	38.6	64.8	22.3	36.6	45.9	21.5	29.5	49.5	28.4	35.4
Overall	**20-69**	46.3	21.2	29.7	43.4	18.6	27.2	42.3	16.4	25.4	34.2	15.0	21.7	30.8	13.6	19.6	25.2	13.9	18.0

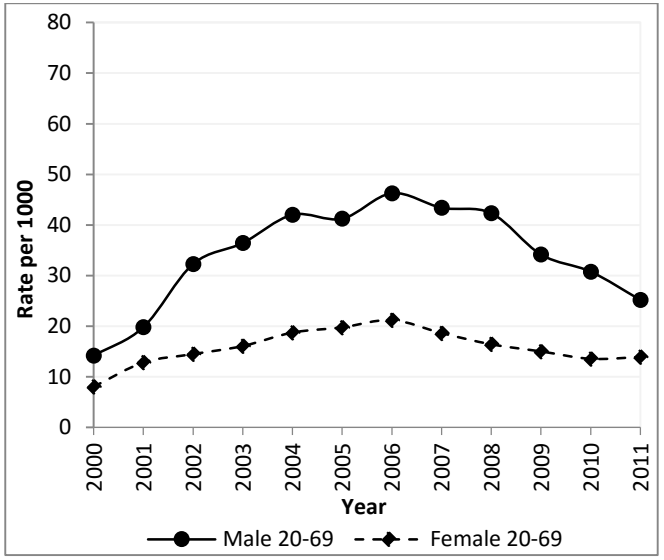


Figure 5.2: Mortality rate of people aged 20-69 years by sex and period

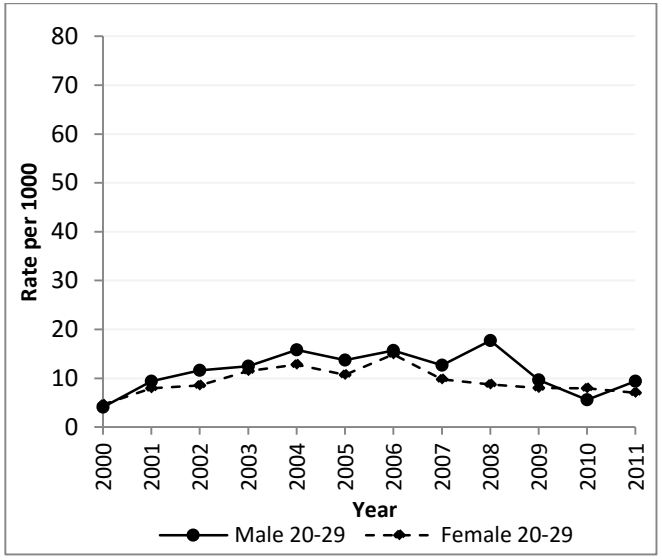


Figure 5.3: Mortality rate of people aged 20-29 years by sex and period

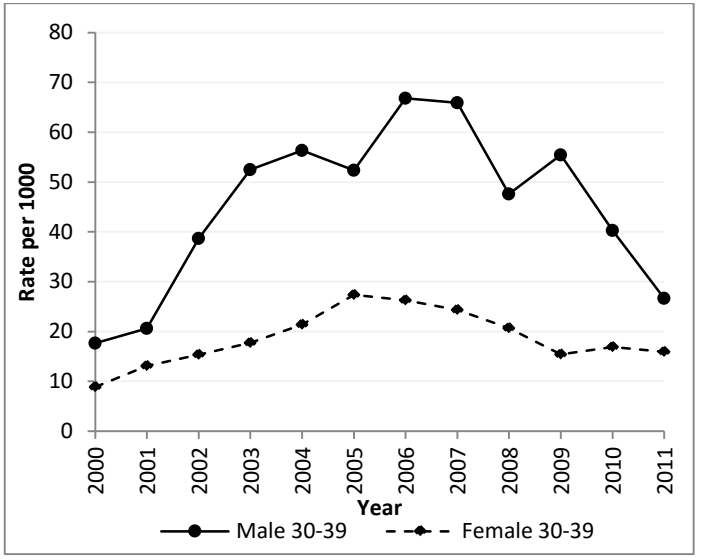


Figure 5.4: Mortality rate of people aged 30-39 years by sex and period

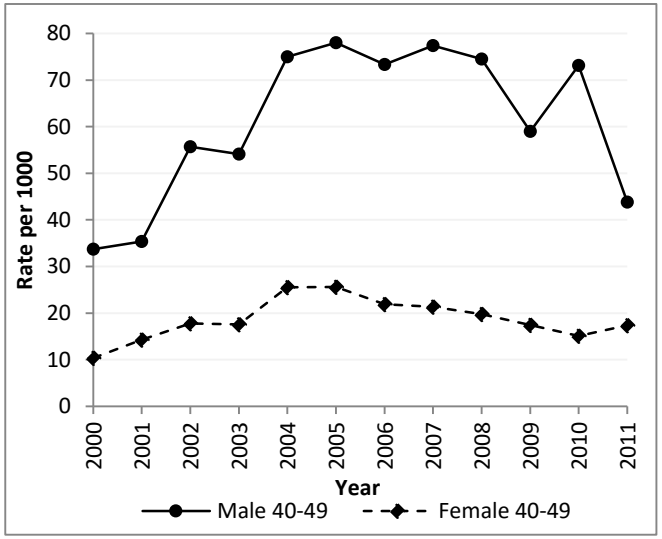


Figure 5.5: Mortality rate of people aged 40-49 years by sex and period

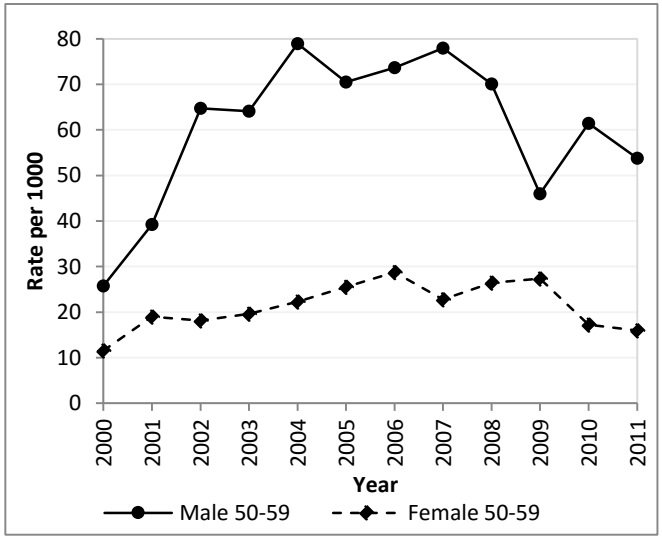


Figure 5.6: Mortality rate of people aged 50-59 years by sex and period

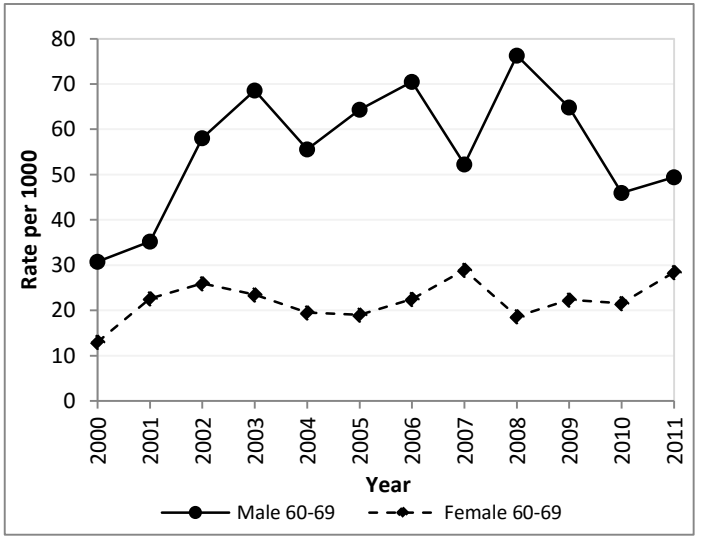


Figure 5.7: Mortality rate of people aged 60-69 years by sex and period

5.2.2 **In-migration rates**

Table 5.4 and Table 5.6 show the rate at which people move into the study site by age and sex, per 1000 person-years, between 2000 and 2011. The in-migration rates at the base year, 2000, for males and females aged 20-69 years, are 92.1 and 98.3 per 1000 respectively. In 2000, it can be seen that the rate among the women is greater than that of the men. However, this trend changed in the following years as in-migration rates went up to 109.2 per 1000 for males while that of the females went down to 112.8 per 1000. As illustrated in Figure 5.8, the in-migration rates for male and female overlap greatly throughout the period of analysis leaving little or no gap between the gender groups. This suggests that there is not much difference in the in-migration pattern of males and females aged 20-69 years.

Furthermore, Figure 5.8 depicts the in-migration rate reaching a peak in 2006 for males, at 135.7 per 1000; and in 2007 for female, at 131.6 per 1000. It can be observed that the in-migration rate remained stable over the years with the final rate at the end of the analytic period (i.e. 2011) standing at 101.9 and 111.5 per 1000 for males and females respectively. The broad age category, 20-69 years, was split into 10-year age groups, namely: 20-29, 30-39, 40-49, 50-59 and 60-69 years. The explanation of how the in-migration rates evolved in each of the age group is given in the following paragraphs.

In Figure 5.99, the in-migration rate for males was 171.6 per 1000 at age 20-29 years in 2000, while for females was 80 per 1000 in the same year. Male in-migration was more than twice that of female and the gap remained consistent in subsequent years. This tends to support the popu.lar notion that male are more likely to be involved in migration related activities. The highest in-migration rate was recorded in 2006 at 266.5 per 1000 and 2009 at 97.8 per 1000 for males and females respectively.

For males and females belonging to age group 30-39 years, in 2000, the in-migration rate was 215.5 and 122.8 per 1000 respectively as shown in Figure 5.10. The pattern exhibited is almost the same as that of people aged 20-29 years though with noticeable increments in the rates. This age category has the highest in-migration rates. It attained a peak of 382.4 per 1000 in 2006 for males, which is double the rate for females in the same year, at 186.3 per 100. From Figure 5.9 and 5.10, it can be seen that age-groups 20-29 and 30-39 years possess the widest gap between genders. While the in-migration rates increased steeply among the male population, the reverse is the case for the female population, for whom the increase was rather marginal.

Figure 5.11 shows in-migration rates for male and female aged 40-49 years between 2000 and 2011. The margin between male and female in-migration

rates is very small compared to that was observed in age-groups 20-29 and 30-39 years. It is interesting to note that the in-migration rate for females (136.7 per 1000) in this age category is greater than for males (83.5 per 1000) in 2000. The female in-migration rate moved from 136.7 per 1000 in 2000 to attain a height at 170.7 per 1000 in 2002, after which it began to decline until reached a minimum rate of 132.7 per 1000 in 2004. After two years, the rate ascended to 192.2 per 1000. This 2006 rate is the highest rate recorded, after which the trend remains fairly stable with some fluctuation until it reached 180.6 per 1000 in 2011.

The trend of in-migration rate in the age category 50-59 years is similar to that of age group 40-49 years. As shown in Figure 5.12, the curve is fairly smooth with no sharp peak as the rates were steady from 2000 to 2011. It can be seen in that the in-migration rate for men is lower than for women. Apart from age group 20-29 years, it is the age category with the lowest in-migration rate for females. However, their male counterparts reported the lowest rate out of all the age groups. It started with an in-migration rate of 63.4 per 1000 in 2000. As it progressed, two peaks were shown at 71.1 per 1000 in 2000 and 2006. On the other hand, a number of lowest points could also be seen. The first took place in 2004 at 48.3 per 1000; the second was in 2008 (exactly four years after) at 54.5 per 1000 while the last existed in 2011 at 50.1 per 1000. The values of the minimum points are indication of the fact that the slopes are not steep.

Figure 5.13 presents the in-migration rate of last age group, 60-69 years, by sex and year. A great deal of overlapping was noticed in this age group among the gender groups from 2000 to 2011. The gap between the male and female in-migration rates is so narrow that it appears as if it is only one gender that is being considered. Starting with the rates of 86.5 and 83.5 per 1000 for male and female respectively, a minimal increment is seen in the following year. The increase was short-lived as the rate experiences its first peak in 2002 at 100 for male and 103 per 1000 for female. Similarly, this was followed immediately by a downward trend to reach a minimum point of 89.2 and 81.1 per 1000 in 2004 for males and females respectively. Looking back, it can be seen that virtually all the age groups experience their first lowest point in the year 2004. In the last age group, after the short descent, the rate increased at the same speed both for male and female to attain a maximum height of 126.7 and 131.2 per 1000 respectively in the year 2007. Afterwards, another decline began and the last set of in-migration rates shown was 85.6 per 1000 for male and 81.8 per 100 for female. In general, the in-migration rates for people aged 60-69 years being greater than those in category 50-59 years (i.e. a younger age group) could indicate that people are moving in after their retirement.

Table 5.4: **In-migration rate by age and sex per 1000, 2000-2005**

Categories		2000			2001			2002			2003			2004			2005		
		M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF
Age Group	**20-29**	171.6	80.0	108.4	215.6	94.3	131.3	223.4	95.4	134.1	175.7	68.9	99.9	192.9	64.7	100.9	241.5	78.9	127.3
	30-39	215.5	122.8	155.4	255.4	136.7	175.8	254.7	133.4	173.3	229.8	120.0	154.6	233.5	123.5	157.8	282.4	141.7	186.6
	40-49	83.5	136.7	112.3	123.2	158.0	143.1	128.7	170.7	152.9	110.4	150.5	133.8	104.0	132.7	120.9	129.4	172.0	154.6
	50-59	63.4	81.1	72.3	71.1	91.4	81.3	63.8	88.3	76.0	54.2	79.1	66.6	48.3	67.8	58.0	54.4	75.4	64.8
	60-69	86.5	83.5	85.0	97.6	99.7	98.7	100.0	103.0	101.5	93.7	89.5	91.7	89.2	81.1	85.2	92.9	97.6	95.2
Overall	**20-69**	92.1	98.3	95.4	109.2	98.3	111.2	108.0	112.8	111.6	94.4	114.6	97.7	89.9	100.4	90.4	104.2	90.9	106.9

M- Male F-Male MF- Male and Female

Table 5.5: **In-migration rate by age and sex per 1000, 2006-2011**

Categories		2006			2007			2008			2009			2010			2011		
		M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF
Age Group	**20-29**	266.5	91.8	143.9	230.1	91.0	133.1	230.8	84.5	128.6	224.6	97.8	136.3	224.4	84.3	127.5	198.9	87.3	123.0
	30-39	382.4	186.3	247.9	343.3	175.3	227.6	316.5	150.2	201.8	351.1	164.3	223.7	337.1	160.3	217.6	276.9	175.3	209.7
	40-49	177.3	192.2	186.3	140.3	181.5	164.5	127.2	170.4	152.6	131.9	174.3	156.5	135.3	179.9	160.8	125.1	180.6	156.4
	50-59	71.1	97.1	84.1	68.1	95.3	81.7	54.5	75.9	65.2	61.3	77.5	69.4	54.1	70.5	62.4	50.1	71.4	60.8
	60-69	118.7	116.3	117.5	126.7	131.2	128.9	90.9	97.6	94.3	92.4	88.0	90.2	87.1	90.9	89.0	85.6	81.8	83.7
Overall	**20-69**	135.7	109.0	133.4	126.9	131.6	129.6	106.2	131.8	109.1	113.1	111.5	113.2	110.1	113.2	110.9	101.9	111.5	107.5

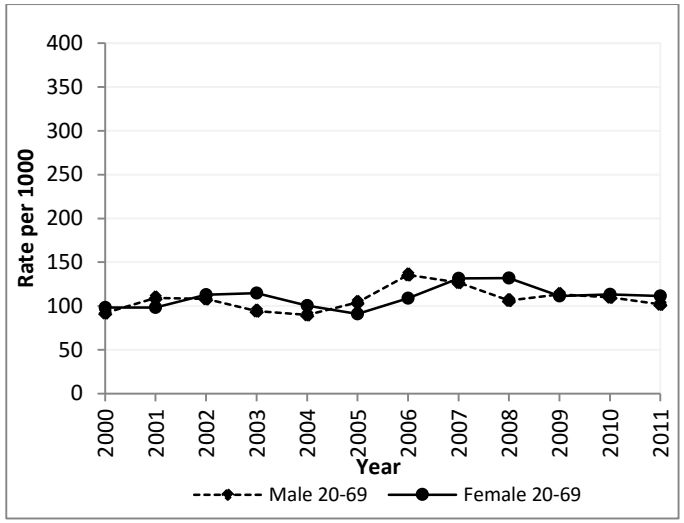


Figure 5.8: In-migration rate of people aged 20-69 years, 2000-2011

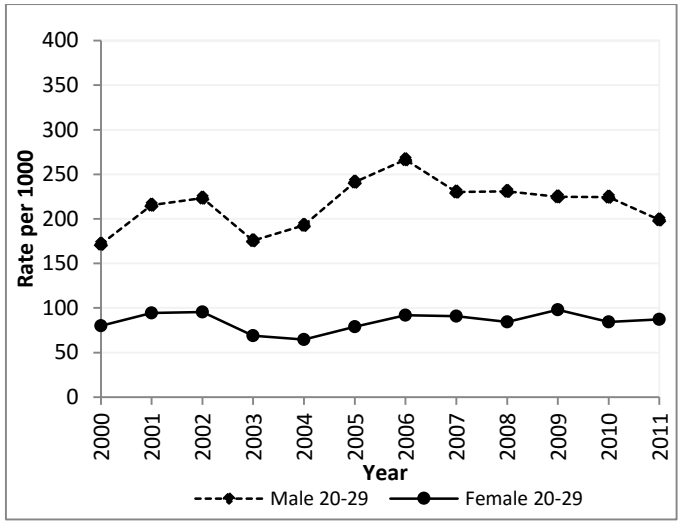


Figure 5.9: In-migration rate of people aged 20-29 years by sex and period

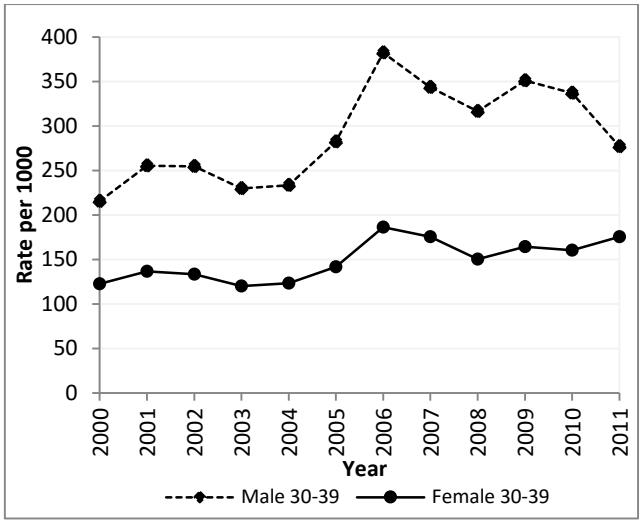


Figure 5.10: In-migration rate of people aged 30-39 years by sex and period

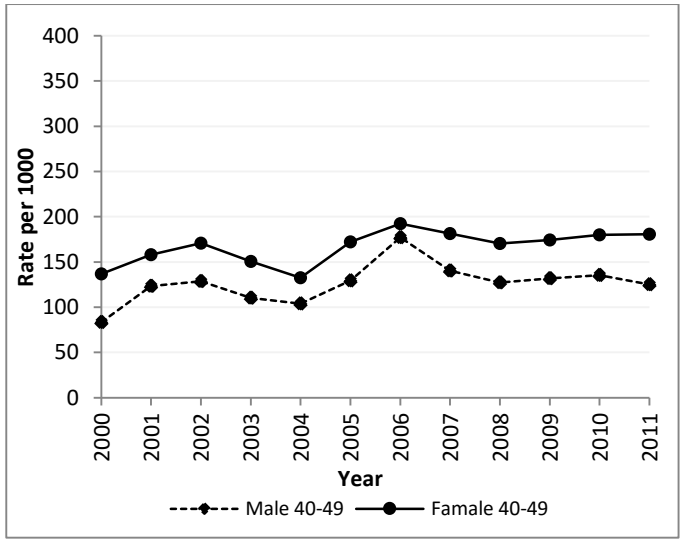


Figure 5.11: In-migration rate of people aged 40-49 years by sex and period

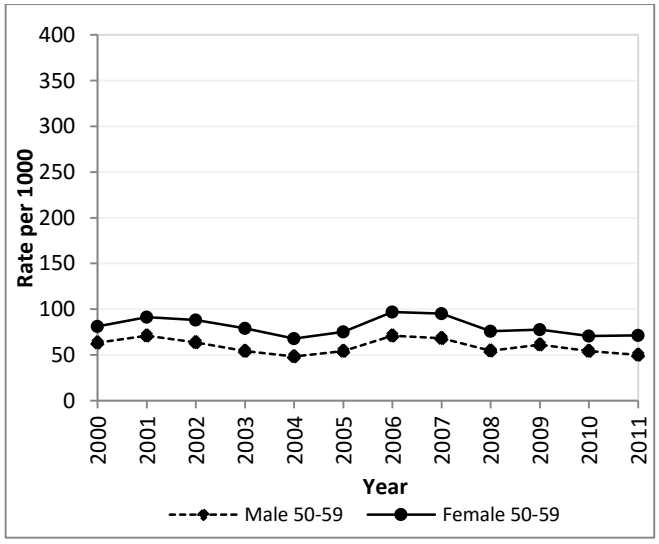


Figure 5.12: In-migration rate of people aged 50-59 years by sex and period

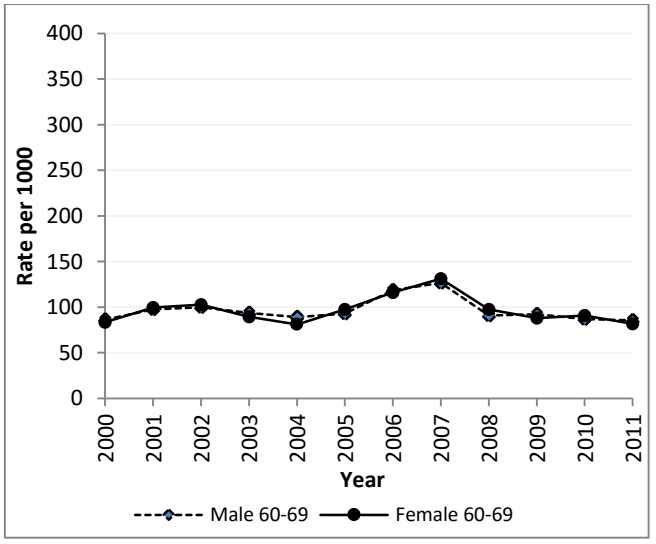


Figure 5.13: In-migration rate of people aged 60-69 years by sex and period

5.2.3 **Out-migration rates**

The rate at which people move out of the study area between 2000 and 2011, by sex and age, is displayed in Table 5.6 and Table 5.6. For the broad age-group, 20-69 years, the out-migration rate was 343.7 per 1000 for males and 191.7 per 1000 females in 2000. The gap between the gender groups clearly indicates that males are more likely to move out of the study site than their female counterparts. There is no evidence of the male out-migration rate overlapping or crossing that of female throughout the period of analysis. As years passed, the rate began to go down, at a faster pace for male than female to reach a lowest point in 2003 at 214.4 per 1000 and 131.4 per 1000 for females in 2004. The sudden decline in the out-migration rate, especially for females, implies that they are also involved in migration-related activities though at a lower level.

As portrayed in Figure 5.14, there is a fluctuation in the rates across the years. After about four years of decline, the out-migration started following an upward trend and it eventually peaked in 2006 for males at 272.7 per 1000 and 156.1 for females in the following year. It is interesting to note that in the year 2006 when the female out-migration rate was at the peak coincides with the year when the male out-migration rate was at its lowest. The same pattern was repeated in 2010 as the rates for the two gender groups almost crossed each other. This may predict that the rates eventually intersect again in the future. From all indications, the rate at which males and females are moving out of the

study area is going down. From 343.7 per 1000 in 2000 to 165.7 per 1000 in 2011, the male population has seen 107.4 percent reduction in out-migration. Similarly, the female rate went down from 191.7 per 1000 in 2000 to 133.8 per 1000 in 2011, which is a 43.3 percent decrease.

Figure 5.15 shows the trend for people in age group 20-29 years. A similar pattern could be observed as the out-migration rates started going down for a short period of time, after which it changed direction and started increasing. This pattern of movement was repeated twice. Furthermore, in comparison with the overall age group, a higher rate of out-migration can be seen among males and females. In this age category, the rates began with 386.9 per 1000 for males and 254.9 per 1000 for females. As predicted in the preceding paragraph, the out-migration rate for males (i.e. 209.2 per 1000) crosses that of female (i.e. 210.5 per 1000) in 2010.

For the age group 30-39 years, the out-migration rates for males and females is presented in Table 5.6 and 5.7 and the plots by age group can be seen in Figure 5.16. On average, the age category 30-39 years has the highest out-migration rates for males in the five age-groups specified. For instance, there is no age group that recorded as high as 414.9 per 1000 in 2000 as in this age group. Also, it is the age group that has the widest margin between the gender groups. The out-migration rates reported for female migrants in this group is lower than the

ones computed for females aged 20-29 years. In Figure 5.16, two peaks can be noticed in rate of male migrants denoting a sharp increase. The first one occurred in 2006 with the out-migration rate of 322.1 per 1000, while the second one took place in 2009 with a rate of 298.8 per 1000. Meanwhile, the out-migration rate reported among the female migrants is fairly stable throughout the year with minimal increase. The female out-migration rate ends at 141.4 per 1000 in 2011 from 216.8 per 1000 in 2000 which implies 53.3 per cent increase. This is unlike that of male migrants whose rate started at 414.9 per 1000 in 2000 to close at 141.4 per 1000 in 2011, indicates almost three times increase (i.e. 193.3%).

Figure 5.17 to 5.19 presents the out-migration rates for the remaining age groups: 40-49, 50-59 and 60-69 years. The three age-groups reveal the case of out-migration rates decreasing as age increases. Out of the three age categories, the biggest out-migration activity was observed among those aged 40-49 years. The trend in the three age groups for female is steady, with little or no fluctuation. For their male counterparts, the out-migration decline continues until the last age group where the trend line is almost straight. In spite of the fluctuation in the rate, there was no sharp increase noticed unlike what was discovered in the previous age groups. The last year of analysis showed the lowest out-migration rate among those age 60-69 years for male and female at 14.5 and 16 per 1000 respectively.

Table 5.6: **Out-migration rate by age and sex per 1000, 2000-2005**

Categories		2000			2001			2002			2003			2004			2005		
		M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF
Age Group	**20-29**	386.9	254.9	313.2	340.4	252.7	289.0	261.0	209.5	230.5	264.7	196.9	223.9	285.9	206.0	237.5	294.4	228.9	254.5
	30-39	414.9	216.8	285.5	327.5	181.5	229.4	293.9	154.2	199.9	258.5	143.0	178.9	257.2	143.7	178.8	273.6	148.0	187.8
	40-49	282.5	161.9	199.9	232.0	114.7	150.7	178.5	93.0	118.8	180.0	80.8	109.5	135.4	71.8	89.8	186.6	81.2	112.0
	50-59	188.2	58.5	101.9	158.4	58.2	90.1	107.8	44.4	64.6	81.2	45.2	56.5	88.4	40.1	55.8	100.3	57.2	70.8
	60-69	95.3	54.2	66.8	68.9	43.8	51.9	59.5	42.0	47.9	40.9	25.7	30.9	49.8	27.7	35.4	50.3	31.9	38.4
Overall	**20-69**	343.7	191.7	249.4	285.9	191.7	213.1	225.8	172.2	172.1	214.4	142.3	160.2	218.0	131.4	161.9	231.7	132.4	175.2

Table 5.7: **Out-migration rate by age and Sex per 1000, 2006-2011**

Categories		2006			2007			2008			2009			2010			2011		
		M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF	M	F	MF
Age Group	**20-29**	367.1	254.3	297.1	227.4	192.8	206.2	254.5	216.0	231.0	267.9	238.0	249.9	209.2	210.5	210.0	203.7	208.2	206.3
	30-39	322.1	171.4	219.1	255.1	142.4	177.4	267.1	145.4	183.3	298.8	157.3	201.6	229.8	155.0	179.1	226.1	141.4	170.0
	40-49	196.2	75.0	110.6	140.3	62.8	86.2	144.2	66.5	89.8	155.2	86.9	107.7	128.8	70.6	88.2	108.3	63.3	77.6
	50-59	96.8	40.6	58.3	54.2	40.2	44.6	85.1	37.9	52.8	91.9	39.0	55.4	67.6	28.3	40.6	57.5	33.6	40.9
	60-69	41.7	25.6	31.2	39.6	15.2	23.8	25.4	21.6	22.9	35.4	23.8	27.7	18.4	13.4	15.0	14.5	16.0	15.5
Overall	**20-69**	272.7	145.3	195.9	184.8	156.1	144.5	203.6	123.4	158.7	220.3	135.0	174.1	172.9	149.3	147.6	165.7	133.8	142.0

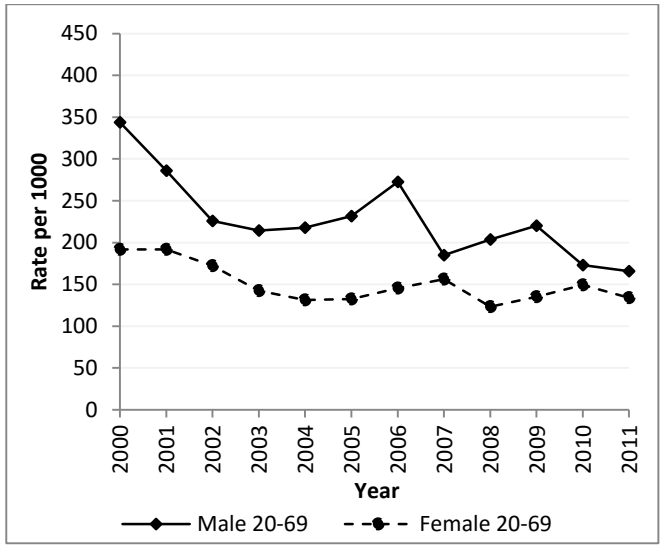


Figure 5.14: Out-migration rate of people aged 20-69 years by sex and period

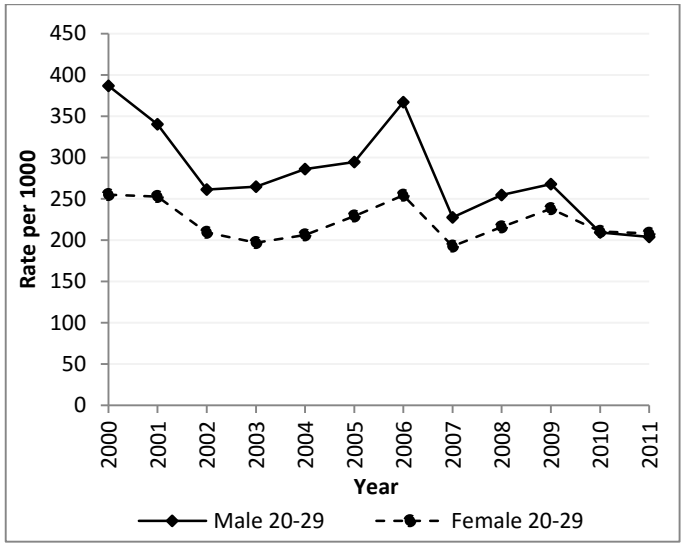


Figure 5.15: Out-migration rate of people aged 20-29 years by sex and period

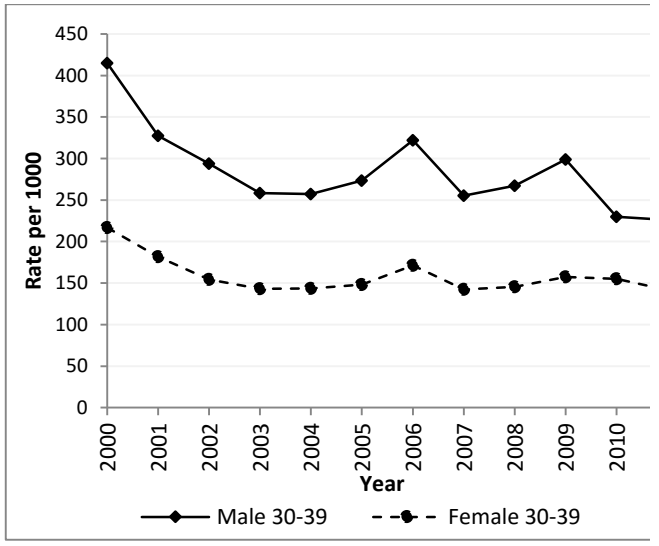


Figure 5.16: Out-migration rate of people aged 30-39 years by sex and period

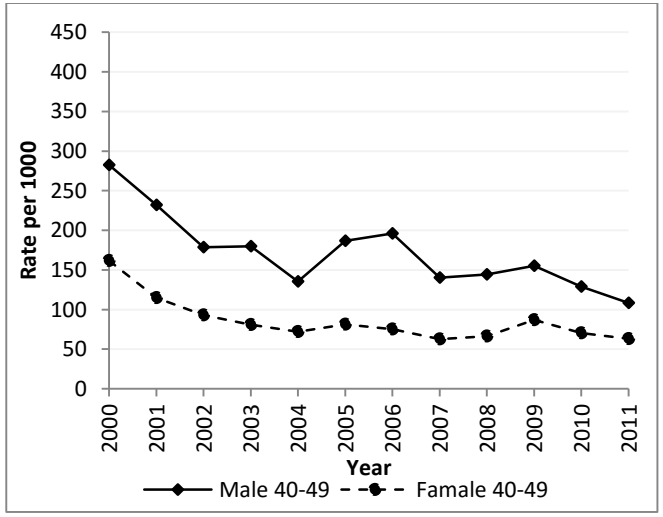


Figure 5.17: Out-migration rate of people aged 40-49 years by sex and period

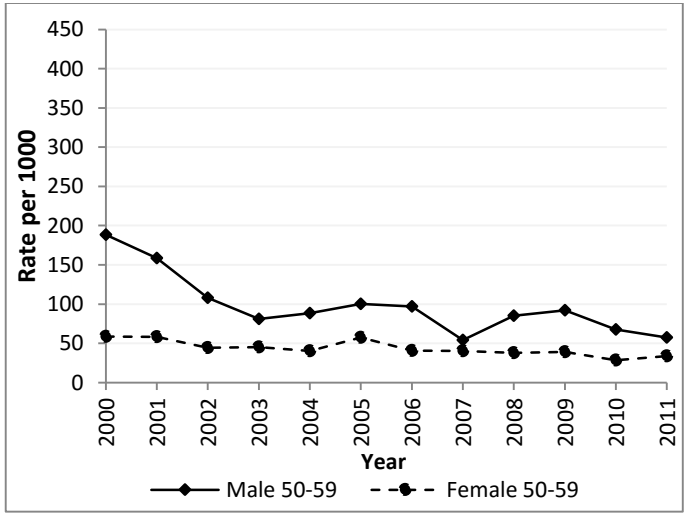


Figure 5.18: Out-migration rate of people aged 50-59 years by sex and period

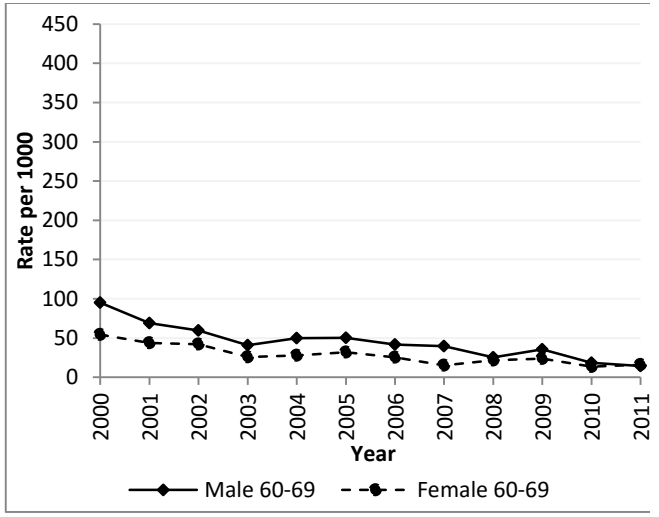


Figure 5.19: Out-migration rate of people aged 60-69 years by sex and period

5.2.4 **Cause specific and overall mortality rate by sex and migration status**

Table 5.8 shows the cause-specific and all-cause mortality rate by sex and migration status. For death due to AIDS/TB, at 70.1 and 48.1 deaths per 1000 person-years respectively for males and females, short-term return migrants possess the highest rate of dying in comparison with other migration categories. The same trend of higher risk can be seen amongst male (27.3 per 1000) and female (14.7 per 1000) short-term return migrants who died as a results of non-communicable diseases (NCDs). Short-term migrants who lost their lives due to external causes (14.1 and 2.3 per 1000 for male and female respectively) and other infectious causes (10.1 and 6.3 per 1000 for male and female respectively), exhibit similar pattern. In addition, all-cause mortality rates present almost the same dimension, as the death rates among short-term return-migrants for males (145 per 1000) and females (78.5 per 1000) are the highest, compared to other groups of migrants. In all the cause categories, wide gaps can be seen between the two gender groups – AIDS/TB (31.4%), NCDs (46.2), external (83.2%), other infectious diseases (37.6%) and all-cause (45.9%).

The rates reported among the short-term return-migrants are distantly followed by that of the long-term return migrants, who were second most likely to die from each of the causes and all-cause mortality. For AIDS/TB, the rates are 21.1 per 1000 for males and 14.6 per 100 for females. The following rates are reported for the other causes of death category: NCDs (14 and 5.3 per 1000 for male and female respectively), external (3.3 and 0.9 per 1000 for male and

female respectively), other infection ((4 and 1.9 per 1000 for male and female respectively) and all-cause (46.5 and 25 per 1000 for male and female respectively). Like short-term return-migrants, the gender difference in the rates between male and female are also high among the long-term return migrants.

In short- and long-term in-migrant categories, minimal disparity can be seen in their mortality rates. For instance, there is about 8% of difference in the rate of male short-term in-migrants (19.9 per 1000) in comparison with male long-term in-migrants (18.3 per 1000). A smaller difference (2%) can be noticed when comparing the mortality rate of female short-term in-migrants (12.5 per 1000) with female short-term in-migrants (12.5 per 1000). Across the four broad cause-of-death categories, the rates for the two migration categories overlap and this leads to their positions varying greatly. There are also cases where the mortality rates among migrants are lower than those of non-migrants e.g. for NCDs. The AIDS/TB mortality rates among short and long-term in-migrants occupied third and fourth positions respectively. The rate for male short-term in-migrants at 10.4 per 1000 is approximately 9% greater than that of male long-term in-migrants at 9.5 per 1000. Similarly, the rate for female short-term in-migrants at 8.6 per 1000 is about 16% greater than that of male long-term in-migrants at 7.2 per 1000. With regards to NCDs, the reverse is the case with long-term in-migrant mortality rates (male=3.6 per 1000 and female=2.4 per 1000) being greater than for the short-term in-migrants (male=3.5 per 1000 and female=2.1 per 1000). For the external cause-of-death, two scenarios were

noteworthy. First, a situation where the death rates of short-term in-migrants (2.1 per 1000) is higher than for long-term in-migrants (1.2 per 1000) for males. On the other hand, female short-term in-migrants have a rate (0.3 per 1000) which is lower than that of their female long-term in-migrants (0.4 per 1000). Unlike short- versus long-term in-migrant rates under external cause-of-death, causes due to other infectious diseases show a consistent rate. However, death rates among male and female long-term in-migrants, at 1.4 and 0.8 per 1000 respectively, is larger than that of the short-term in-migrants at 1.8 and 1 per 1000 respectively.

When all the causes are put together, non-migrants have the lowest rate of dying, with males possessing a higher rate of 15.1 per 1000, compared to 12.8 per 1000 for females. This is slightly different when cause-specific rates were examined. For instance, the non-migrants possess the lowest rate of dying due to AIDS/TB. Specifically, rates of 6.4 and 6.5 per 1000 mortality are reported among male and female migrants respectively. Though minimal, it is interesting to note that the rates for male are lower than for females. In comparison to the two categories of in-migrants, non-migrant rates of dying due to NCDs among the two gender groups are higher at 4.2 and 4.1 per 1000; and the disparity of the rate between male and female is minimal. Unlike the reported rates among those who died of AIDS/TB, male rates are greater than their female counterparts. The rates of mortality among non-migrants who died from external causes are 1.25 and 0.3 per 1000 for males and females respectively.

Here, there is a wide margin between males and females with males having the greater proportion. Similarly, a big difference is noticed in the rates computed for males (1.1 per 1000) and females (0.7 per 1000) among non-migrants who died as a result of other infectious diseases. Figure 5.20 provides a graphical display of the all these results.

In summary, this chapter presents information on the cohort profile of the study population from 2001 to 2011. Here, we see the total number of respondents going in down in the early years (2003-2004) of the analysis and later going up in the later years (2005-2011). This indicates that the study population is dynamic. The fluctuation in the size of the study population is largely due to the following: mortality, out-migration, in-migration and the inability of certain to meet the eligibility criteria of the study.

In addition, mortality, in-migration, out-migration rates are also presented in this chapter by sex, age and year. Across the years and age-groups, male mortality rates are higher than that of their female counterparts with the gap dwindling as the male mortality rates began to follow a downward trend in the later years (2008-2011). Furthermore, the rate of male in-migration is not too different from that of female for the entire period of analysis when the broad age group (20-69 years) was considered. The margin only becomes evident with regards to the in-migration rates of the two gender groups when the lower age

groups (20-29 and 30-39) were taken into consideration. The other age-groups still maintain the high male-female high margin disparity in the rates. Also, males are more involved in out-migration related activates, as their out-migration rates across the years and age groups are higher than that of females. The data and charts provided in chapter depict a consistent pattern of male out-migration rate exceeding that of female over the period.

Additional, the cause-specific as well as the all-cause mortality rates are presented in this chapter by sex, migration status and year. Both male and female short-term return-migrants have the highest rate of mortality resulting from AIDS/TB, NCDs, external and other infectious cause of death as well as the all cause of death. The rates reported among Short-term return-migrants are followed by that of male and female long-term return-migrants originating from cause-specific and all-cause mortality rates. The all cause-specific and all-cause mortality rates provided in this chapter among short-term in-migrant, long-term in-migrant and non-migrants are relative low in comparison to the version report among the two categories of return migrants.

Table 5.8: **Cause specific mortality rate by sex and migration status, 2000- 2011**

	AIDS/TB		NCDs		External		Other Infect		All Cause	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Non Migrants	6.4	6.6	4.2	4.1	1.5	0.3	1.1	0.7	15.1	12.8
Short-Term Return-Migrant	70.1	48.1	27.3	14.7	14.1	2.3	10.1	6.3	145.0	78.5
Long-Term Return-Migrant	21.1	14.6	14.0	5.3	3.3	0.9	4.0	1.9	46.5	25.0
Short-Term In-Migrant	10.4	8.6	3.5	2.1	2.1	0.3	1.4	0.8	19.9	12.5
Long-Term In-Migrant	9.5	7.2	3.6	2.4	1.2	0.4	1.8	1.0	18.3	12.3

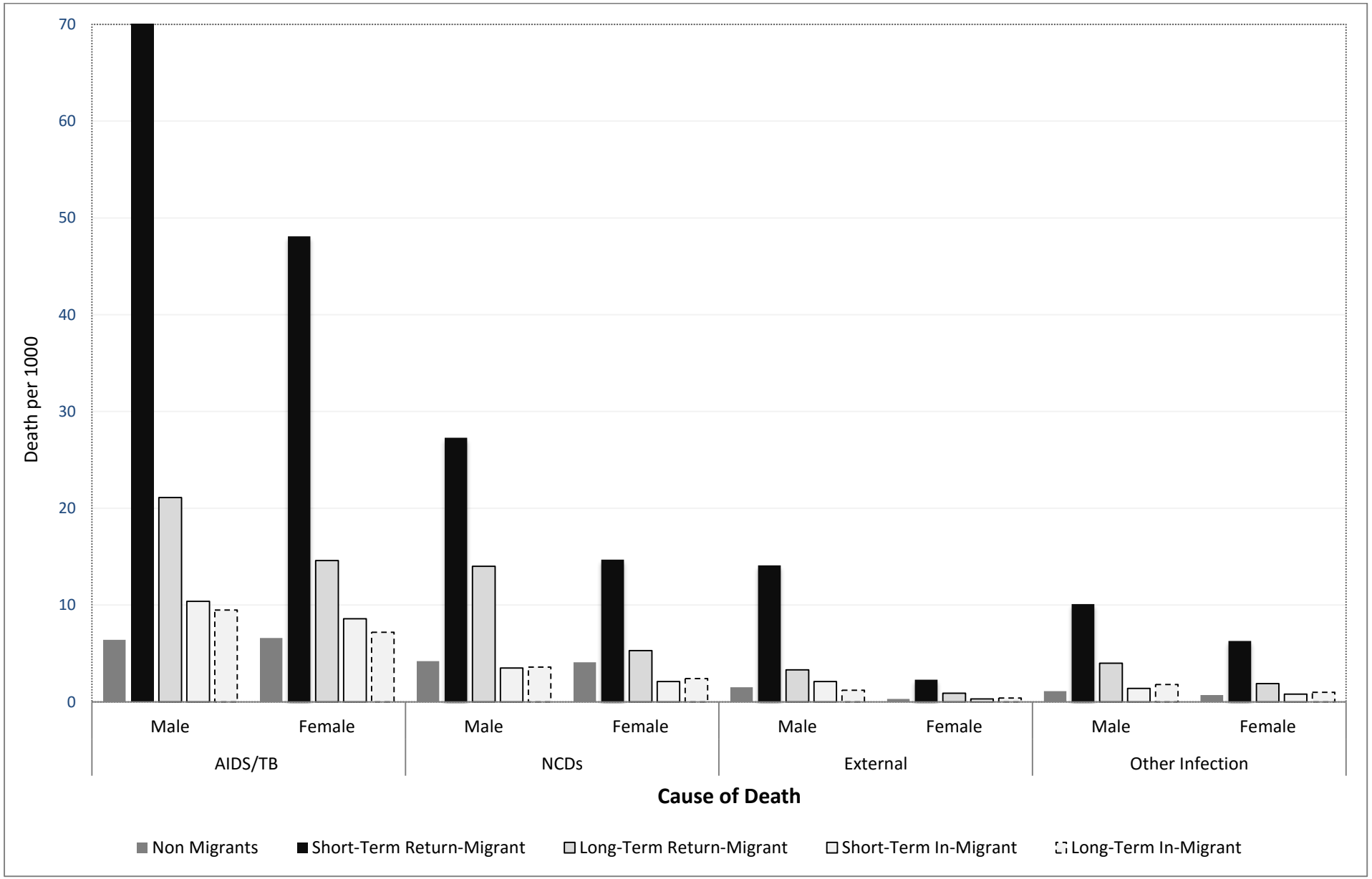


Figure 5.20: Cause-specific mortality rate by sex and migration status

CHAPTER 6: COMPETING RISK OF DYING OF AIDS/TB AND OTHER CAUSES

6.0 Introduction

As discussed in earlier chapters, a number of studies have shown known that migration has contributed to the spatial spread of HIV (Quinn 1994, Carswell, Lloyd, and Howells 1989, Hunt 1989). More importantly, studies have argued that the transmission should not be ascribed to migrants alone, but rather to the macro-social context which can pre-dispose migrants as well as others to contracting the disease (Lalou and Piché 2004, Soskolne and Shtarkshall 2002). Other studies have pointed out a risk among migrants which is to have extra-marital sexual partners without the use of any form of protection that can make them susceptible to the transmission (Brockerhoff and Biddlecom 1999, Hunt 1996). It has also been established that the disruption in the family due to one of the spouses migrating to work in a distant location can create an emotional vacuum that could lead to either of the partners seeking an extra-marital partner and thereby increasing the chance of getting HIV (Decosas, Kane, Anarfi et al. 1995, Crush, Williams, Gouws et al. 2005). Consequently, the familial disruption has brought about the question of 'whom infects whom?' The answer is uncertain since the source of HIV in couples could be traced to either their left-behind partner or the migrant (Lurie 2006, Lurie, Williams, Zuma et al. 2003b).

Furthermore, it has been established that HIV infected migrants return home to seek support from their left-behind families in order to survive the terminal disease and that the returned migrants have higher chance of losing their lives to AIDS/TB in comparison with the non-migrants (Clark, Collinson, Kahn et al. 2007, Welaga, Hosegood, Weiner et al. 2009). There is already a literature on the relationship between migration and AIDS/TB mortality. This study hopes to add to what is already known about the relationship by investigating the relationship between migration and AIDS/TB mortality in rural South Africa in the presence of other causes of death, between 2000 and 2011, and also categorising migration by duration away from home and duration since return. Also, how the burden of AIDS/TB mortality compares with deaths from other causes in relation to migration. This chapter is mainly for the presentation of the results while the next chapter will discuss the results and provide plausible reasons for the levels, trends and differentials observed in the risks reported.

6.1 **Competing risk of dying of AIDS/TB among migrants**

This section aims at answering the following question, "What is the relationship between migration and mortality caused by AIDS/TB in rural South Africa in the presence of other causes of death?" In this section, results are presented for different migration categories namely: return migrant (short- and long-term), in-migrant (short- and long-term) with non-migrants included as a category for comparison. It is assumed that the migration and AIDS/TB relationship would

show differentials by sex. Therefore, the results are presented for males and females separately.

Table 6.1 displays the results of AIDS/TB mortality among migrants of different categories using non-migrant as a reference group with a value one (1). The results derive from the Fine and Gray model which incorporates the impact of other causes of death. These results are displayed and labelled Model 1a, 1b, 1c and 1d in Table 6.1. The columns labelled Models 1a and 1c contain the results of modelling the relationship between migration and AIDS/TB death for male and female individuals but with no adjustment for additional explanatory variables. On the other hand, Models 1b and 1d control for the variables period, nationality, educational and socio-economic status.

Furthermore, Table 6.1 reports the results in the form of sub-hazard ratios (SHR), p-value and 95% Confidence interval (95% CI) for male and female individuals separately. The sub-distribution hazard ratio (SHR) quantifies the relationship between migration and AIDS/TB mortality in the context of other causes of death. In the estimation of the SHR, other causes of death were included as competing risks in the analysis. The interpretation of the SHR is similar to that of the hazard ratio with a value of one for the reference group (e.g. non-migrants). For example, an SHR of 4.87 for short-term return migrant with non-migrant as the reference category implies that the return migrants have 4.87 times greater

chance of dying of AIDS/TB compared to the non-migrant. In case of a SHR of 0.86 values for the return migrant, the risk would be interpreted as being 14% less than the risk for non-migrants. Another statistical measure reported in Table 6.1 is p-value, which indicates the statistical significance of the SHR. In this study, an SHR estimate with p-value of less than 0.05 is considered to be statistically significant. The 95% confidence interval (CI) gives the range of SHR values with the chosen confidence threshold of 5%.

The results that are shown in the second row of columns, titled Model 1a and 1b in Table 6.1, show that male short-term return migrants have significantly greater risk of dying of AIDS/TB death when compared to their non-migrant counterparts with an SHR of 5.19 (95% CI 4.44-6.06; P<0.001) and 4.87 (95% CI 4.14-5.72; P<0.001), before and after adjustment for other variables. The results for female short-term return migrants (second row of Table 6.1 under Model 1c and 1d) show an SHR of 5.55 (95% CI 4.76-6.48; P<0.001) before adjustment and 5.44 (95% CI 4.64-6.38; P<0.001) after adjustment. The results for short-term return migrants are similar for females and males: the risk of dying of AIDS/TB is approximately 5 times that of non-migrants, independently of other covariates. These results are both statistically significant with p-values less than 0.001.

It can be observed from the results that the SHR for a male short-return migrant versus non-migrants (i.e. 5.19) is less than the version reported for their female

counterparts versus non-migrants (i.e.5.55). A similar trend was observed after other independent variables were controlled for. Sub-hazard ratios for the short-duration return migrants were similar for males and females.

For male long-term return migrants (Table 6.1 third row of Model 1a column) the unadjusted SHR is 1.90 (95% CI 1.52-2.37; P<0.001), which implies that their risk of experiencing AIDS/TB mortality is two-fold that of non-migrants. The risk is also higher, and significant after adjustment for other factors (Model 1b: SHR of 1.80 (95% CI 1.43-2.26; P<0.001). With regards to the female long-term return migrants, similar pattern could be observed with SHR of respectively 1.98 (95% CI 1.53-2.58; P < 0.001 unadjusted) and 2.06 (95% CI 1.57-2.70; P<0.001 adjusted). The risk of AIDS/TB induced mortality is reduced by more than 60% as the duration of residence of the return migrants changes from short to long term. Also, it can be seen that the value of SHR of the male long-term return migrants went down from 1.90 to 1.80 while that of female went up from 1.98 to 2.06 after controlling for the effect of other variables.

Table 6.1: **AIDS/TB mortality risk in the presence of NCD, infectious and external causes of death, by sex**

	Male						Female					
	SHR	***P*-value**	**95% CI**	**SHR**	***P*-value**	**95% CI**	**SHR**	***P*-value**	**95% CI**			
Migrant Category												
Non-migrant	1.00			1.00			1.00			1.00		
Return-Migrant (Short-Term)	5.19	0.000	(4.44-6.06)	4.87	0.000	(4.14-5.72)	5.55	0.000	(4.76-6.48)	5.44	0.000	(4.64-6.38)
Return-Migrant (Long-Term)	1.90	0.000	(1.52-2.37)	1.80	0.000	(1.43-2.26)	1.98	0.000	(1.53-2.58)	2.06	0.000	(1.57-2.70)
In-Migrant (Short-Term)	1.27	0.026	(1.03-1.57)	0.97	0.802	(0.76-1.23)	1.26	0.004	(1.08-1.48)	0.97	0.773	(0.82-1.16)
In-Migrant (Long-Term)	1.20	0.068	(0.99-1.45)	1.02	0.873	(0.83-1.25)	1.00	0.977	(0.86-1.16)	0.90	0.180	(0.78-1.05)
Nationality												
South African				1.00						1.00		
Mozambican				0.95	0.468	(0.81-1.10)				0.76	0.000	(0.66-0.87)
Educational Status												
None				1.00						1.00		
Primary				0.80	0.019	(0.67-0.96)				0.66	0.000	(0.56-0.79)
Secondary				0.55	0.000	(0.45-0.68)				0.58	0.000	(0.49-0.70)
Tertiary				0.24	0.000	(0.17-0.36)				0.21	0.000	(0.15-0.31)
Socio-economic Status												
Quintile 1				1.00						1.00		
Quintile 2				0.97	0.719	(0.80-1.17)				0.85	0.054	(0.71-1.00)
Quintile 3				0.95	0.639	(0.79-1.16)				0.73	0.000	(0.61-0.86)
Quintile 4				0.80	0.034	(0.65-0.98)				0.69	0.000	(0.57-0.82)
Quintile 5				0.65	0.000	(0.53-0.81)				0.52	0.000	(0.43-0.63)
Period												
2000-2003				1.00						1.00		
2004-2007				1.60	0.000	(1.37-1.87)				1.85	0.000	(1.60-2.13)
2008-2011				1.16	0.079	(0.98-1.37)				1.15	0.082	(0.98-1.35)

Similar to the return migrants, the results for in-migrant was split into two categories based on their short- or long-term duration of residence. It is only the unadjusted models (fourth and fifth row, Model 1a and 1c, Table 6.1) that show significant SHR values of 1.27 [95% CI 1.03-1.57; P<0.001 unadjusted] for male and 0.97 [95% CI 0.76-1.23; P <0.001 unadjusted] for females . However, all effects disappear after adjustment for other covariates.

Figure 6.1 summarizes the adjusted risk of AIDS/TB mortality among different categories of migrants by sex. In general, the chart reveals that the risk is concentrated among the return- migrants and that it reduces with duration of residence.

The risk among the long-term return migrants versus non-migrants is lower than that of the short-term return migrants, as quantified by their respective SHRs. This is regardless of whether they are male or female. This implies that the short-term return migrants are more at risk of AIDS/TB death in comparison with the other group of migrants. This result adds weight to the previous finding that migrants often return home to die when they are infected with HIV, to die of AIDS/TB (Clark, Collinson, Kahn et al. 2007, Welaga, Hosegood, Weiner et al. 2009). Furthermore, it can be observed in the chart that the gap between short and long-term in-migrant is very small. This indicates that the risk of in-migrants dying of AIDS/TB is similar regardless of their short- or long-term duration of

stay within the study site. It interesting to note that the odds of dying of AIDS/TB in the presence of other competing causes for the category of return migrants is higher than that of the in-migrants regardless of their duration.

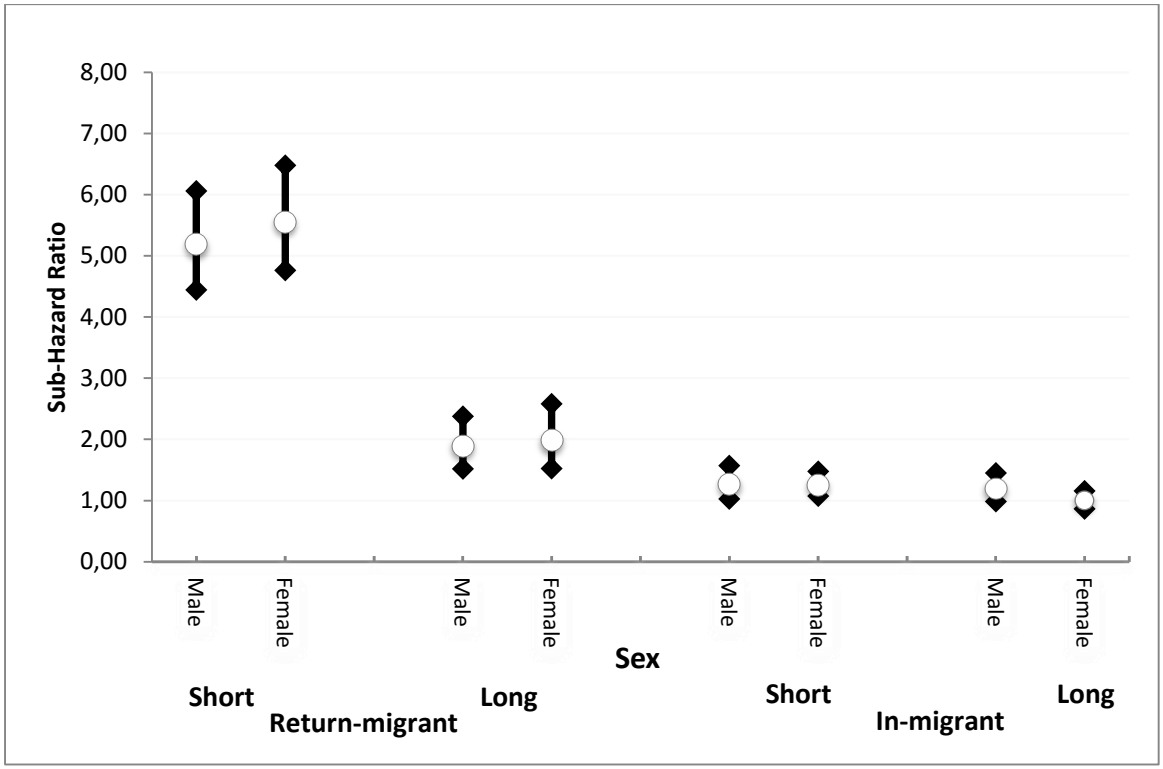


Figure 6.1: Relative risk of a migrant dying of AIDS/TB in the presence of other causes

6.2 Differentials in AIDS/TB mortality risk by period, citizenship, education and SES

The impact of period, nationality, education and SES on the risk of male and female individuals experiencing AIDS/TB mortality, when other causes are considered, can be seen in Table 6.1. Relative to period 2000-2003, the risk of

dying of AIDS/TB increased significantly in period 2004-2007 for males (SHR=1.60 [95% CI 1.37-1.87; P < 0.05]) and females (SHR=1.85 [95% CI 1.60-2.13; P < 0.05]) as shown in Model 1b and 1c. The observed increases came down in 2008-2011, though not significantly for male and females. Year 2004-2007 was the period when people were more likely to die as a result of the disease.

With regards to nationality, the risk of a female Mozambican national dying as a result of AIDS/TB mortality is lower than that of South African citizen at SHR of 0.76 (95% CI 0.66-0.87; P < 0.05). The differential risk is not significant for their male counterparts.

On educational status, people with higher level of education are significantly less likely to die of AIDS/TB compared to those who reported none as their educational status. This is regardless of whether they are male or female, as shown Table 6.1. For instance, the individuals with primary educational status have significant and low risk ratio of 0.80 (95% CI 0.67-0.96; P< 0.05) and 0.66 (95% CI 0.56-0.79); P < 0.05) for males and females of dying from AIDS/TB, when controlling for the other factors. Also, the same pattern can be observed for those with secondary level of education, as the risk became lower in relation to those without educational attainment with significant SHR of 0.55 (95% CI 0.45-0.68; P <0.05) and 0.58 (95% CI 0.49-0.70; P<0.05) for males and females respectively. As expected, the higher the level of literacy the lower the risk of

contracting the disease and dying from it. This hypothesis is supported by the results of those with highest level of education (i.e. tertiary) which are significant as their SHR of 0.24 (95% CI 0.17-0.36; P < 0.05) for male and 0.21 (95% CI 0.15-0.31; P < 0.05) for female remain the lowest.

With regards to the Socio-economic Status (SES), it is shown in Model 1b and Id of Table 6 that risk of mortality from AIDS/TB reduces even in the context of other causes of death at higher levels of SES. It can be seen in the table that males with quintile 4 and 5 of SES are 0.80 (95% CI 0.65-0.98) and 0.69 (95% CI 0.57-0.82) times less likely to die from AIDS/TB respectively in comparison with those in quintile 1. Similarly, Quintile 2 and 3, though not significant, indicate the same direction of relationship. Similarly, in relation to quintile 1, the risk of female individuals experience mortality due to AIDS/TB decreases as the quintile level goes up. For example, Model 1d of Table 6.1 display significant SHR exhibiting a downward trend of 0.73 (95% CI 0.61-0.86) for Quintile 3; 0.69 (95% CI 0.57-0.82) for Quintile 4 and 0.52 (95% CI 0.43-0.63). There has been a debate about whether AIDS is a disease of poverty or whether being wealthier is associated with higher risk. Here we see a higher risk of AIDS/TB mortality in poorer households.

6.3 **Competing risk of NCDs mortality among migrants**

Table 6.2 displays the results of dying from a Non-Communicable Disease for migrants compared to non-migrants in the presence of other causes, namely, AIDS/TB, other infectious diseases and external causes of death. It is shown that in the study area where the respondents are faced with competing causes of mortality, the male short-term return migrants are about three times more likely to die of NCDs (SHR=2.70 [95% CI 2.18-3.35; P<0.05]) in comparison with non-migrants. This is before adjustment was made to the model for the other independent variables. After the adjustment, the estimated SHR declined to 2.67 (95% CI 2.13-3.35; P <0.05), which indicates that the change in the risk of the disease category is minimal. For female short-term return migrants, the SHR of 3.03 (95% CI (2.36-3.91; P < 0.05) and 2.92 (95% CI 2.24-3.80; P < 0.05) are reported before and after the adjustment respectively. The results imply that the chance of the female migrants, who returned back to the study area short time ago, of dying of from a non-communicable disease, is approximately three times the risk of a usual resident losing their lives due to the same cause.

Table 6.2 reports a SHR of 1.42 [95% CI 1.08-1.87; P <0.05] for male long-term return migrants with no adjustment being made for the other covariates. The SHR stands at 1.38 [95% CI 1.04-1.84; P<0.05] after adjustment was made to the competing risk model for the other independent variables. These results indicate that the risk of death caused by NCDs among male migrants who returned a long time ago is greater than that of the left- behind residents. Although not statistical

significant, the same trend can be observed among their female counterparts, whose NCDs mortality risk is also higher than that of the non-migrants. The results of the other categories of migration i.e. short- and long-term in-migrant are not significant at the specified level.

Table 6.2**: The mortality risk of NCDs in the presence of AIDS/TB, other infections and external causes of death, by sex**

	Male						Female					
	Model 2a			Model 2b			Model 2c			Model 2d		
	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI
Migrant Category												
Non-migrant	1.00			1.00			1.00			1.00		
Return migrant (Short-Term)	2.70	0.000	(2.18-3.35)	2.67	0.000	(2.13-3.35)	3.03	0.000	(2.36-3.91)	2.92	0.000	(2.24-3.80)
Return migrant (Long-Term)	1.42	0.013	(1.08-1.87)	1.38	0.027	(1.04-1.84)	1.01	0.980	(0.66-1.54)	0.97	0.883	(0.63-1.48)
In-Migrant (Short-Term)	0.85	0.327	(0.61-1.18)	0.64	0.034	(0.42-0.97)	0.88	0.376	(0.66-1.17)	0.70	0.037	(0.49-0.98)
In-Migrant (Long-Term)	0.84	0.239	(0.63-1.12)	0.88	0.404	(0.65-1.19)	0.85	0.173	(0.68-1.07)	0.85	0.176	(0.66-1.08)
Nationality												
South African				1.00						1.00		
Mozambican				0.64	0.000	(0.50-0.80)				0.64	0.000	(0.51-0.80)
Educational Status												
None				1.00						1.00		
Primary				0.63	0.000	(0.49-0.80)				0.70	0.004	(0.55-0.89)
Secondary				0.59	0.000	(0.46-0.77)				0.73	0.023	(0.56-0.96)
Tertiary				0.28	0.000	(0.16-0.49)				0.54	0.012	(0.33-0.87)
Socio-economic Status												
Quintile 1				1.00						1.00		
Quintile 2				1.00	0.995	(0.74-1.38)				0.90	0.439	(0.68-1.18)
Quintile 3				0.92	0.580	(0.68-1.25)				0.66	0.005	(0.49-0.88)
Quintile 4				1.14	0.388	(0.85-1.52)				0.86	0.304	(0.65-1.14)
Quintile 5				0.95	0.731	(0.70-1.28)				0.69	0.018	(0.51-0.94)
Period												
2000-2003				1.00						1.00		
2004-2007				2.02	0.000	(1.56-2.58)				1.28	0.034	(1.02-1.60)
2008-2011				1.72	0.000	(1.38-2.29)				1.50	0.000	(1.21-1.87)

Figure 6.2 shows the graphical plots of the SHR values comparing the mortality risk NCDs across the categories of migrants. It can be seen that the chart shows risk patterns similar to the AIDS/TB mortality risks. All categories of migrant other than the short-term return migrant are neutral with respect to NCD mortality for both sexes. In other words, the risk of migrants who returned back to the study area short time ago is high compared to those who returned a long time before. Similarly, the risk of NCDs mortality is lower among the short-term in-migrant than the long-term in-migrant irrespective of their sex. However, these results are not statistically significant.

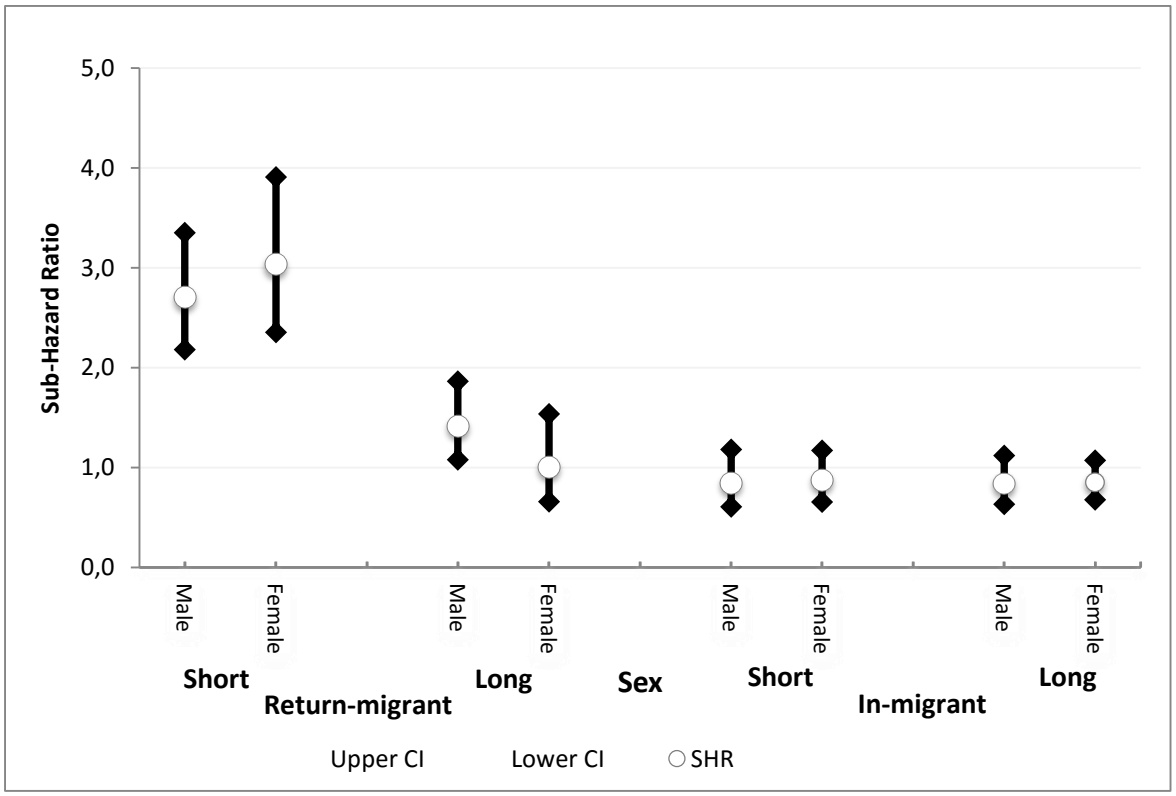


Figure 6.2: Relative risk of a migrant dying of NCDs in the presence of other causes

6.4 Differentials in non-communicable diseases mortality risk by period, citizenship, education and SES

In addition to providing results on the risk of migrants dying as a result of NCDs, Table 6.2 displays results on the differentials of dying due to NCDs by period, citizenship, education and SES. With period 2000-2003 being the reference group for the period variable, it can be seen that the risk of a participant dying as a result of NCDs was 2.01 [95% CI 1.56-2.58; P < 0.05] and 1.28 [95% CI 1.02-1.60; P<0.05] for males and females respectively, in the period 2004-2007. While the differential mortality risk (SHR value) for males (SHR=1.78 [95% CI 1.39-2.29; P < 0.05]) went up in the next period, i.e. 2008-2011, the reverse is the case for females (SHR=1.50 [95% CI 1.21-1.87; P < 0.05]) which went down in the same period. These results are statistically significant.

With regards to the variation in the mortality of NCDs by nationality, the results show that Mozambicans are significantly less likely to die of NCDs when compared to South Africans. The sub-hazard ratio is the same for male (SHR=0.64 [95% CI 0.50-0.80; P < 0.05]) and female (SHR=0.64 [95% CI 0.51-0.80; P < 0.05]). On the divergence by educational status, the risk of male respondents with primary education (SHR=0.63 [95% CI 0.49-0.80; P < 0.05]) dying of NCDs is less than that of those who declared “none” as their level of education i.e. the reference group. The same pattern is shown among those who reported secondary (SHR=0.59 [95% CI 0.46-0.77; P < 0.05]) and tertiary education (SHR=0.28 [95% CI 0.16-0.49; P < 0.05]). It is interesting to note that

as the level of education increases, the risk decreases in relation to the reference category. The same trend is being portrayed among the female participants as their risk of NCDs death for all the categories of education status is less than the values those who indicated “none”. All the results are significant and they are as follows: primary (SHR=0.70 [95% CI 0.55-0.89 P < 0.05]); secondary (SHR=0.73 [95% CI 0.56-0.96; P < 0.05]) and tertiary SHR=0.54 [95% 0.33-0.87; P < 0.05]). With respect to SES, it can be noted that only the differential mortality risk (SHR value) for SES quintile 3 for females is significant and implies that female respondents who report Quintile 3 as their SES level are less likely to die than those who reported Quintile 1, controlling for the other factors. For males, the fourth SES quintile has the direction of a wealth disadvantage for NCD mortality risk (controlling for the other factors), but it has not reached significance.

6.5 **Competing risk of external causes of mortality among migrants**

The risk of both return migrants and in-migrants dying of external causes of death (e.g. accident, drowning, assault etc.) in the context of AIDS/TB, NCDs and other infectious diseases are displayed in Table 6.3. The remarkable results displayed for male short-term return migrant category are: SHR=6.88 (95% CI 4.77-9.94; P<0.05 unadjusted) and SHR=8.78 (95% CI 5.86-13.16; P<0.05 adjusted). The reported statistically significant results can be interpreted as migrants who returned back to the research area for a short-term duration have between seven and nine times the risk of dying of external factors in comparison

with the non-migrants. The difference in the mortality risk between return migrants and non-migrants is high. However, the risk of death resulting from the same cause is lower among female short-term return migrants than their male counterparts. The reported risk for females is as follows: 4.92 (95% CI 2.50-9.70; P<0.05). Similarly high differential risks were observed when adjustment was made for the selected covariates. The adjusted SHR for female is 4.97 (95% CI 2.50-9.89; P<0.05). It can be noticed that after the adjustment to other factors in the multi-level model the risk of death from external causes among male and female short-term return migrants went up.

For male migrants with a long-term duration since return to their rural household, their differential mortality risk (SHR) is 2.77 (95% CI 1.62-4.71; P<0.05) and 3.63 (95% CI 2.07-6.35; P<0.05) before and after adjustment respectively. These high ratios suggest that male long-term return migrants possess approximately three to four times risk of dying of external factors in comparison with the non-migrants. The results of the remaining migration category are not statistically significant. Apart from the fact that females with secondary (SHR=0.37 [95% CI 0.17-0.80; P<0.05]) and tertiary (SHR=0.27 [95% CI 0.08-0.93; P<0.05]) educational status are less likely to die when compared to those with no formal education, there is no evidence of differentials in the risk of death by external cause of death as the p-values of the covariates are not statistically significant.

For external causes of death to have a high difference between migrants and non-migrants in a rural household, in addition to the mortality experienced from accidents and injuries that occur in the local setting, there are also injuries that are life-threatening and occur to the people at their work place environment and the person returns to their rural household for care after the accident or injury. A large proportion of mortality from external causes comes from motor vehicle accidents.

Figure 6.3 contains a diagrammatical display of the SHR values on the risk of migrants dying as a result of external factors. Again, the results point to the fact that the risk of mortality among short-term return migrants, in this case, external cause remains the highest among the specified category of migrants. There is the evidence of the SHR value among in-migrants going below one, which indicates that the risk of dying of the cause of death under consideration (i.e. external cause) is higher among non-migrants than the in-migrant regardless of their short or long-term duration. However, this result is not statistically significant.

Table 6.3: **Risk of external causes of mortality in the presence of AIDS/TB, NCDS and infectious causes of death, by sex**

	Male						Female					
	Model 3a			Model 3b			Model 3c			Model 3d		
	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI
Migrant Category												
Non-migrant	1.00			1.00			1.00			1.00		
Return-Migrant (Short-Term)	6.88	0.000	(4.77-9.94)	8.78	0.000	5.86-13.16	4.92	0.000	(2.50-9.7)	4.97	0.000	(2.50-9.89)
Return-Migrant (Long-Term)	2.77	0.000	(1.62-4.71)	3.63	0.000	2.07-6.35	2.41	0.102	(0.84-6.95)	2.42	0.105	(0.83-7.07)
In-Migrant (Short-Term)	1.22	0.387	(0.77-1.93)	0.84	0.572	0.46-1.54	0.96	0.918	(0.44-2.08)	0.92	0.837	(0.41-2.07)
In-Migrant (Long-Term)	0.76	0.269	(0.47-1.24)	0.78	0.376	0.46-1.34	1.34	0.357	(0.72-2.50)	1.14	0.694	(0.60-2.18)
Nationality												
South African				1.00						1.00		
Mozambican				0.79	0.203	0.55-1.13				0.81	0.454	(0.47-1.40)
Educational Status												
None				1.00						1.00		
Primary				1.00	0.988	0.58-1.70				0.54	0.103	(0.26-1.13)
Secondary				0.71	0.186	0.43-1.18				0.37	0.011	(0.17-0.80)
Tertiary				0.54	0.106	0.25-1.14				0.27	0.038	(0.08-0.93)
Socio-economic Status												
Quintile 1				1.00						1.00		
Quintile 2				1.09	0.746	0.65-1.81				0.75	0.514	(0.32-1.78)
Quintile 3				1.00	0.992	0.59-1.68				1.00	0.998	(0.46-2.16)
Quintile 4				1.16	0.570	0.70-1.92				0.99	0.983	(0.45-2.19)
Quintile 5				1.22	0.441	0.73-2.05				1.27	0.552	(0.58-2.81)
Period												
2000-2003				1.00						1.00		
2004-2007				0.98	0.919	0.69-1.40				1.72	0.096	(0.91-3.24)
2008-2011				0.73	0.095	0.50-1.06				1.43	0.283	(0.75-2.74)

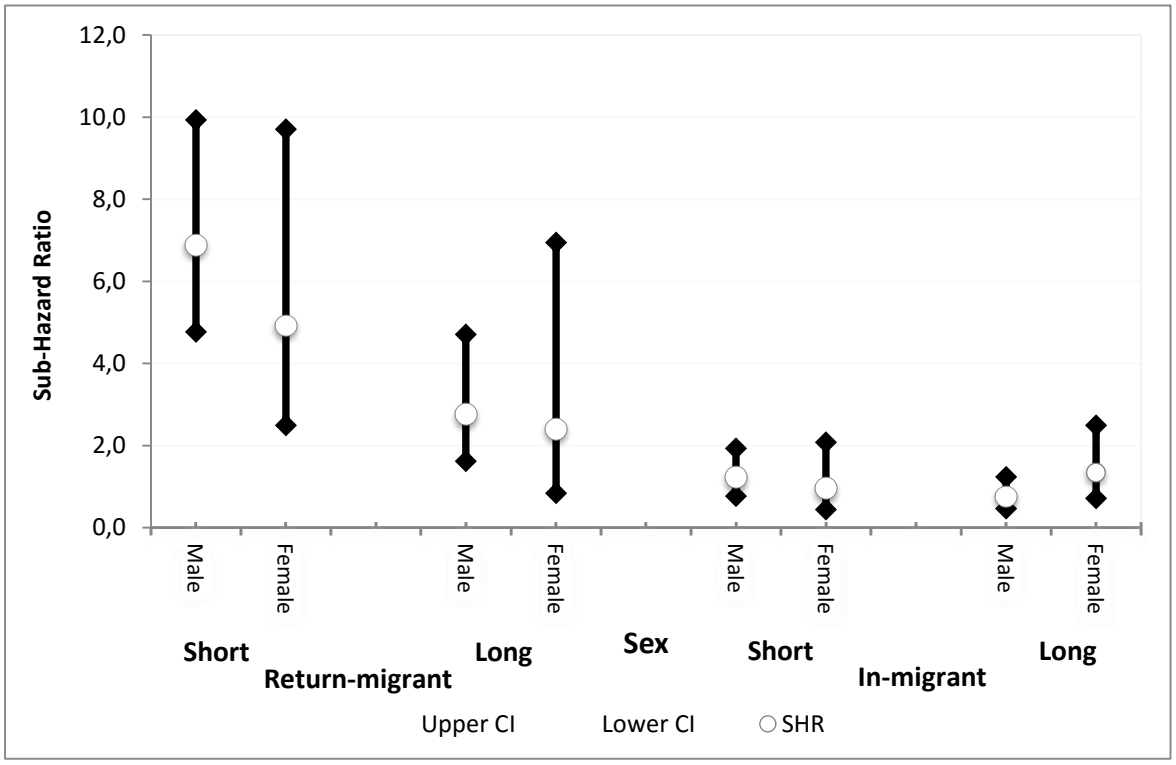


Figure 6.3: Relative risk of a migrant dying of external causes in the presence of other causes

6.6 **Competing risk of dying of other infectious diseases among migrant**

Table 6.4 provides the results on the risk of a migrant experiencing mortality that originates from other infectious diseases with AIDS/TB, NCDs and external causes of death in competition. For male short-term return migrants, p-values of 3.67 (95% CI 2.52-5.35; P<0.05) and 3.43 (95% CI 2.33-5.05; P<0.05) were estimated before and after adjustment was made for other covariates respectively. These show that migrants who fall into this category possess about four times risk of experiencing mortality when compared to non-migrants. This risk increased significantly for their female counterparts. As displayed in the

table, the SHR for female short-term return migrants is 6.18 (95% CI 3.99-9.57; P<0.05) before adjustment, which indicates about 40.6% increase when compared to what was reported for males, i.e. 3.67. The SHR stood at 5.71 after the effect of other covariates was controlled for. This is 39.9% of the SHR value of 3.43 estimated for males. The risk of female short-term return migrants of dying of infectious diseases other than AIDS/TB is about six times the risk of non-migrants experiencing death due to the same cause-category.

The risk of male long-term return migrants dying from other infectious diseases is nearly twice the risk of the same disease among non-migrants. The details of the mortality risk as quantified by their respective SHRs are as follows: 1.80 (95% CI 1.07-3.05; P<0.05 unadjusted) and 1.65 (95% CI 0.96-2.83; P<0.05 adjusted). Similar levels of risk were estimated for the female long-term return migrants with the SHR of 2.31 (95% CI 1.10-4.84; P<0.05 unadjusted) and 2.09 (95% CI 0.98-4.46; P<0.05 adjusted).

Table 6.4: **Risk of other infectious causes of mortality in the presence of AIDS/TB, NCDS and external causes of death, by sex**

	Male						Female					
	Model 4a			Model 4b			Model 4c			Model 4d		
	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI	SHR	*P*-value	95% CI
Migrant Category												
Non-migrant	1.00			1.00			1.00			1.00		
Return migrant (Short-Term)	3.67	0.000	(2.52-5.35)	3.43	0.000	2.33-5.05	6.18	0.000	(3.99-9.57)	5.71	0.000	(3.63-8.99)
Return migrant (Long-Term)	1.80	0.028	(1.07-3.05)	1.65	0.070	0.96-2.83	2.31	0.027	(1.10-4.84)	2.09	0.057	(0.98-4.46)
In-Migrant (Short-Term)	1.07	0.809	(0.62-1.85)	0.59	0.178	0.28-1.27	1.10	0.718	(0.65-1.86)	0.90	0.724	(0.51-1.61)
In-Migrant (Long-Term)	1.46	0.100	(0.93-2.29)	1.42	0.143	0.89-2.28	1.41	0.111	(0.92-2.15)	1.36	0.168	(0.88-2.10)
Nationality												
South African				1.00						1.00		
Mozambican				0.71	0.10	0.48-1.06				0.63	0.029	(0.42-0.96)
Educational Status												
None				1.00						1.00		
Primary				0.65	0.05	0.42-1.01				0.67	0.133	(0.40-1.13)
Secondary				0.52	0.01	0.33-0.83				0.58	0.030	(0.35-0.95)
Tertiary				0.17	0.00	0.06-0.46				0.65	0.284	(0.30-1.43)
Socio-economic Status												
Quintile 1				1.00						1.00		
Quintile 2				1.40	0.19	0.85-2.32				0.55	0.039	(0.31-0.97)
Quintile 3				0.79	0.41	0.45-1.39				0.75	0.283	(0.44-1.27)
Quintile 4				1.43	0.15	0.87-2.35				0.80	0.365	(0.48-1.31)
Quintile 5				1.09	0.76	0.64-1.83				0.49	0.019	(0.27-0.89)
Period												
2000-2003				1.00						1.00		
2004-2007				1.56	0.05	0.99-2.46				1.54	0.087	(0.94-2.53)
2008-2011				2.42	0.00	1.57-3.74				2.31	0.001	(1.43-3.72)

Table 6.4 also shows the risk of in-migrants dying of non-AIDS/TB death. The results displayed for all categories of in-migrants are not statically significant. Figure 6.4 depicts how the estimated SHRs vary by the four categories of migrant with the non-migrants as a comparative group. It can be seen that female short-term return migrants are the group with the highest risk of dying from other infectious diseases. For each migration category the mortality risk among females exceeds that of males. The male in-migrants who returned back on a short-term duration basis have the lowest risk, but this is not significant.

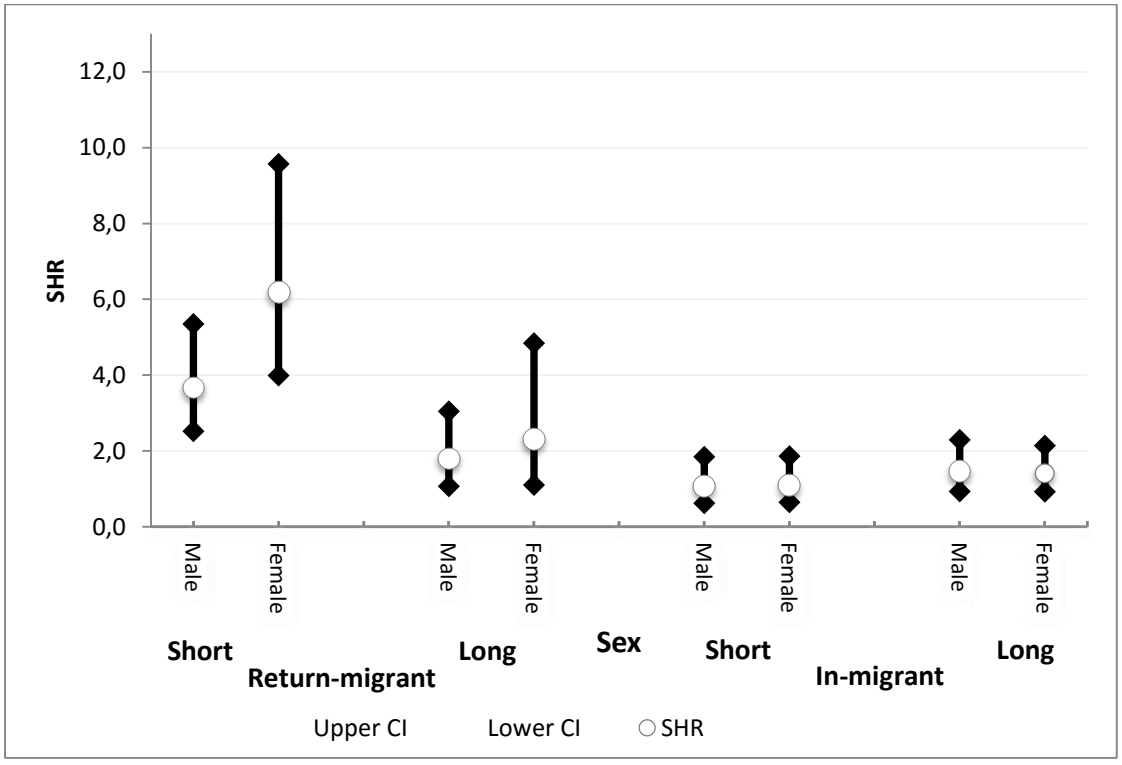


Figure 6.4: Relative risk of a migrant dying of other infections in the presence of other causes

6.7 Differentials in mortality risk due to other infectious diseases by period, citizenship, education and SES

Table 6.4 shows that males (SHR=2.55 [95% CI 0.99-2.45; P<0.05]) and females (SHR=2.31 [95% CI 1.43-3.72; P<0.05]) possess a significant greater risk of dying due to other infections in period 2008-2011 in comparison to those in the period 2000-2003. The SHR values for the second period, 2004-2007, are not significant. Furthermore, the risk of the nationals of Mozambique (SHR=0.67[95% CI 0.40-1.13; P<0.05]) experiencing death from other infectious diseases are less than that of the South Africans. However, this scenario is only applicable to females as the SHR value of males is not significant.

The differentials in mortality risk by education status are shown in table 6.4, with male (SHR=0.51 [95% CI 0.32-0.81; P<0.05]) and female (SHR=0.58 [95% CI 0.40-1.13; P<0.05]) having secondary level of education at the time of their death are less likely to have their lives terminated by the other infections compared to those with no education. This pattern holds for males and females with secondary education (SHR=0.17 [95% CI 0. 0.06-0.45; P<0.05] male). On socio-economic status (SES), it is shown that female with Quintile 2 possess lower risk of death due to other infection when compared to those in Quintile 1 at SHR of 0.55 (95% CI 0.31-0.97; P<0.05). The SHRs of the other categories including that of male are not significant. The results presented and described in this chapter will be further discussed in the following chapter.

6.8 Comparing the Competing Risks of AIDS/TB, NCDs, External and Other infectious Causes of Death among Migrants

This section compares the adjusted mortality risks of dying as a result of AIDS/TB, NCDs, external and other infectious causes of death among different categories of migrants. Specifically, it is geared towards addressing the second research question of this study, which is, "How does the relationship between migration and mortality caused by AIDS/TB in rural South Africa in the context of other causes of death compare with the relationship between migration and causes different from AIDS/TB". This comparison use on the competing risk results presented for each cause of death category, in Tables 6.1 to 6.4. Furthermore, Figures 6.1 to 6.4 display graphically the competing mortality risks among different categories of migrants grouped by cause of death and sex.

6.8.1 Comparison of differences in mortality risk among return migrants (short-term) vis-à-vis non-migrants

Short-term return migrants have higher mortality than non-migrants, whatever the four causes of mortality. As shown in Figure 6.5, the highest risk of death was reported among short-term male returnees who died due to external cause (SHR=8.78 [95% CI 5.86-13.16; P<0.05]). This is distantly followed by the risk of female death caused by other infectious diseases (SHR=4.97 [95% CI 2.50-9.89; P<0.05]). The risk of death due to AIDS/TB took number three and four

position for female (SHR=5.44 [95% CI 4.64-6.38; P<0.05]) and male (4.87 [95% CI 4.14-5.72; P<0.05]) respectively. Although the values of the risk reported for AIDS/TB short-term return migrants are quite high (i.e. more than five times that of the non-migrants), they are not as high as the version reported for male and female migrants who lost their lives due to external and other infectious diseases respectively.

In comparing male AIDS/TB with external cause of mortality risk, it can be seen that mortality risks for both are significant at the specified level. Apart from this, the two causes have mortality risks that are much greater than of the non-migrants. However, the relative risk of dying due to external cause almost doubles that of AIDS/TB. This implies that for men the difference in relative risk for short-term return migrants as compared to non-migrants is greater for external cause than for AIDS/TB. A further exploration of the data as presented in Appendix 12 shows that external cause of death among this category of return migrant was mostly caused by assault and road traffic accidents. Unlike AIDS/TB, most deaths due external causes happened soon after return.

Furthermore, when the competing risk of female short-term migrants dying of AIDS/TB is compared to external causes an opposite trend was noticed. Unlike the pattern observed for males for AIDS/TB versus external cause risk, it can be seen that for women the difference in relative risk for short-term return

migrants as compared to non-migrants is greater for AIDS/TB than for external cause. Additionally, gender divergence is pronounced in the distribution of the external cause death risk by sex. Figure 6.6 provides a graphical display showing the comparison of the mortality risk for AIDS/TB and external cause among the short-term return migrants.

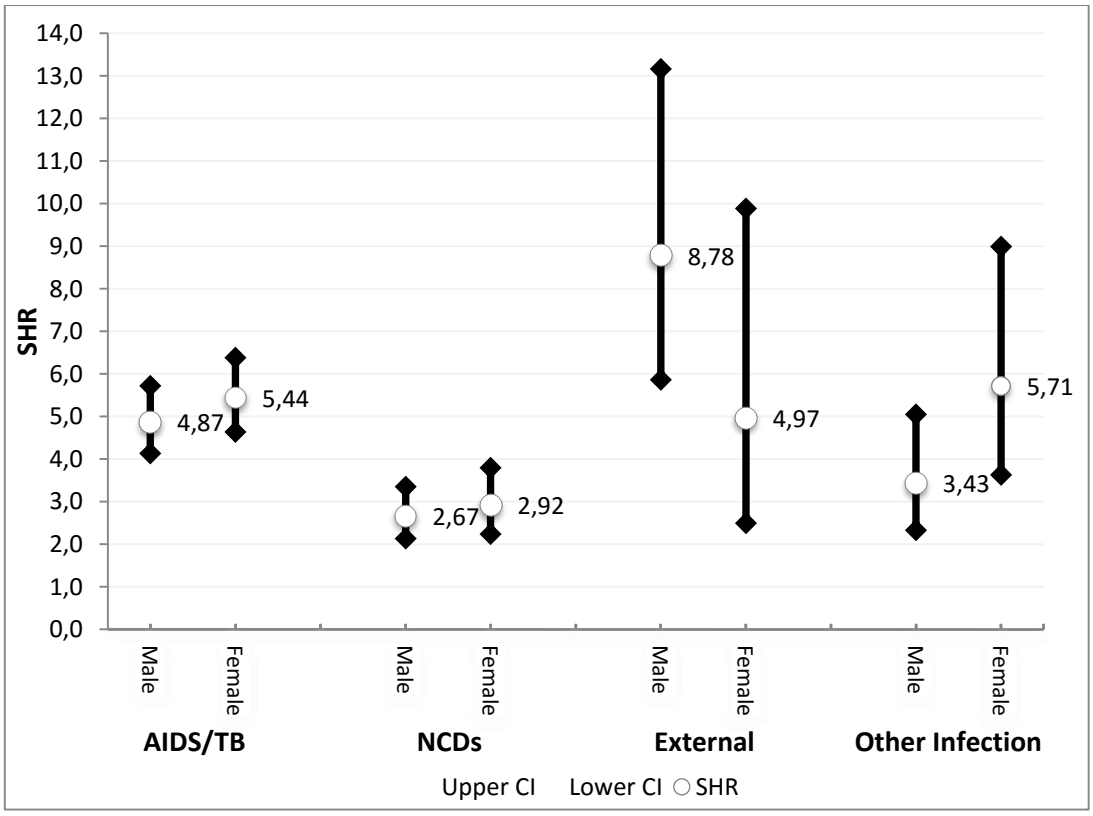


Figure 6.5**:** Relative risk of mortality among short-term return migrants compared to non-migrants by cause-category and sex

The comparison of the risk of AIDS/TB mortality with other infectious diseases reveals the risk of male short-term return migrants vis-à-vis non-migrants is

higher than the risk of the same group of migrants vis-à-vis non-migrants experiencing death resulting from other infectious diseases. This trend is anticipated as the AIDS and TB are perceived to be the largest killers when all the infectious diseases are considered. However, a different pattern was discovered for female migrants versus non-migrants dying as a result of AIDS/TB, which is lower than the infectious diseases. An further examination of the data shows that acute respiratory infection (including pneumonia) constitute the largest proportion of the infectious disease mortality as shown in Appendix 13. It appears that this disease is emerging as another major opportunistic infection of HIV especially among short-term migrant women.

The male and female return migrants (short-term) NCDs mortality risks are both significant and greater than the version reported for their non-migrant counterparts who died of other causes. With SHR of 2.67 (95% CI 2.13-3.35; P <0.05) for male and 2.92 (95% CI 2.24-3.80; P < 0.05) for female, NCDs is the cause of death category that migrants are least prone to die from. The distribution of their risk between male and female are almost identical with the female short-term return migrants in this context showing little difference from their male counterparts. The NCDs, unlike the other cause-categories, is lifestyle-based and the risk can be increased by behavioural change towards eating more high-calorie foods and engaging less in physical activity.

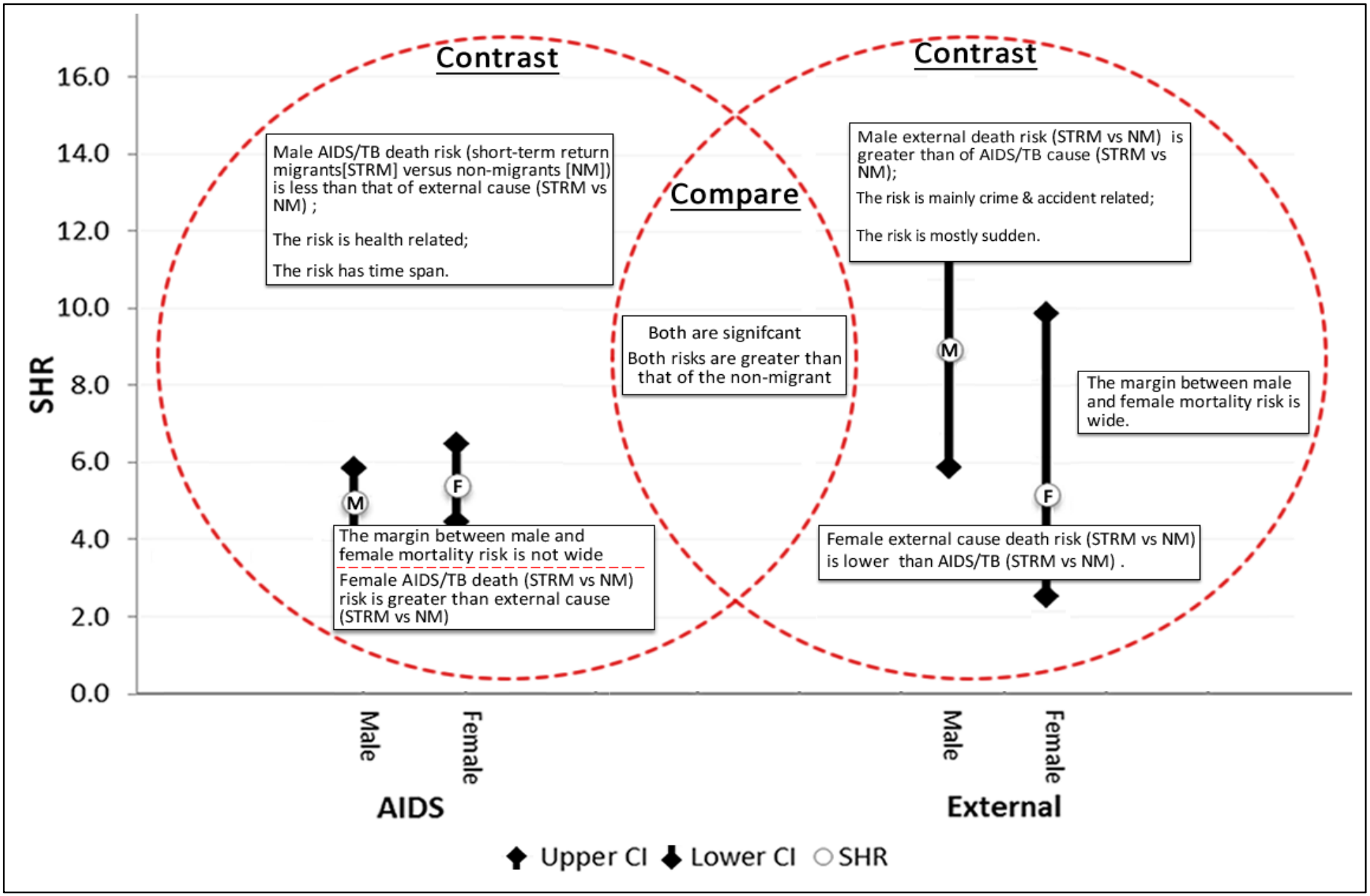


Figure 6.6**:** Comparison of AIDS/TB and external cause risks (short-term return migrants versus Non-Migrants)

6.8.2 **Comparison of mortality risk among return migrants (long-term)**

For the return migrants who returned back on long-term basis, a mortality risk pattern that follow the pattern displayed for short-term return migrants was noticed, though with low SHR values for the equivalent cause of death category as seen in Figure 6.7. Here, death due to external cause still has the highest SHR value of 3.63 (95% CI 2.07-6.35; P<0.05) for males. The value estimated for their female counterparts is not significant. The male SHR value is close to 60% reduction from that estimated for the short-term migrant versus non-migrants. This trend depicts an inverse relationship between duration of return and risk of death which means that as the duration of return of the migrants' increases from short to long their mortality risks tend go down. The female and male risk of death due to AIDS/TB at 2.06 (95% CI 1.57-2.70; P<0.05) and 1.80 (95% CI 1.43-2.26; P<0.05) respectively indicate approximately 60% reduction from the values reported for male and female short-term return migrants. However, a close distance between male mortality risk due external cause and other infectious disease was noticed unlike the results obtained for the short-term return migrants. The fourth most important risk is shown for male migrants who died of NCDs. The results of the other categories are not significant.

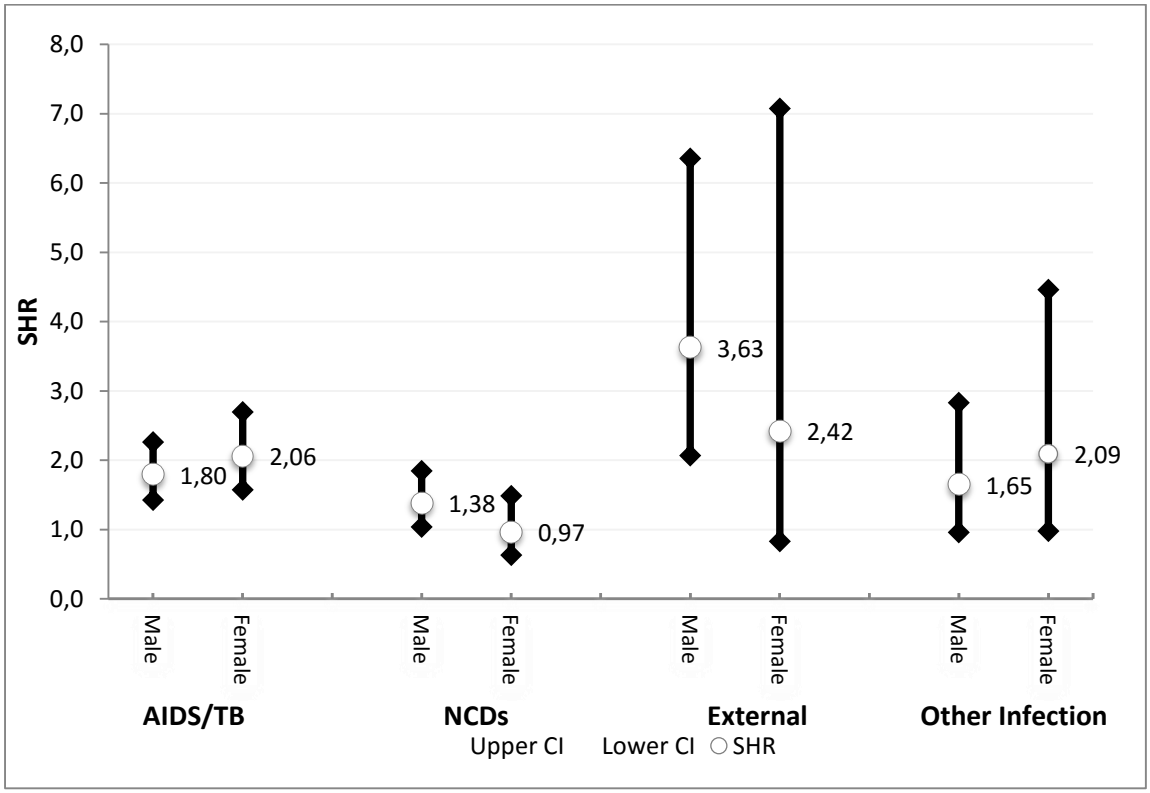


Figure 6.7: Competing relative risk of long-term return migrant mortality by causes

CHAPTER 7: DISCUSSION

7.0. Introduction

The results shown in this study are that in the rural northeast of South Africa migration is related to AIDS/TB mortality, but also to other causes of death. This chapter discusses the findings highlighted in the previous chapter. Specifically, the aim is to synthesise the results and provide plausible explanation for the observed trends and risks. Also, the findings will be compared with the results of previous studies and where possible to evaluate the findings and discover the emerging trends and dimensions. Using more than a decade of longitudinal data, i.e. between 2000 and 2011, this study has shown the fact that in the context of NCDs, external and other infectious causes of death, return migrants regardless of their classification are more likely to die of AIDS/TB, when compared to non-migrants and in-migrants. Hence, the at-risk group are the people who have been temporary migrants and have stopped circulating and returned back to the rural home.

7.1 High risk of death due to AIDs/TB and other causes of death among short-term return migrants

This study shows that the mortality risk from AIDS/TB in the presence of other causes of death is more pronounced among short-term return migrants in comparison with non-migrants. The same pattern can be seen in other causes of death examined, namely, NCDs, external cause and other infectious diseases. It

has been established that male and female migrants who returned for a short-term duration to their place of origin exhibits AIDS/TB mortality risk that is approximately five times greater than that of the non-migrants. For the other migration categories, the risk of one to two times that of their non-migrant counterparts is reported. An implication of the finding that migrants are more likely to die of AIDS/TB compared to non-migrants is that levels of mortality of non-migrants is lower, hence the epidemic is not as advanced in the rural based populations compared to the migrants, If both the migrants and non-migrants had similar risks of mortality then the relative risk associated with short-duration return migration would be lower.

For short-term return migrants who died of NCDs, the relative risk is approximately three times that of non-migrants for both males and females. Although the highest level of relative risk was reported among migrants who returned on short-term basis, the relative risk is closer to the risk level reported among the other categories of migrants which is around double that for the non-migrants. For mortality due to external causes, short-term return migrants recorded the highest level of relative risk for males and females having a relative risk that is nine and five times that of the non-migrants respectively. The same group of migrants possess the relative risks of dying of other infectious disease that are approximately three and six times the risk for non-migrants.

This finding aligns strongly with the hypothesis that return migrants possess greater risk of dying of AIDS/TB when compared to the non-migrants. It is also commensurate with literature, where, for example, Clark, Collinson, Kahn et al. (2007) and Welaga, Hosegood, Weiner et al. (2009), show that the risk of AIDS/TB mortality among migrants who moved back to their rural households in two rural settings in South Africa is higher than that of the left-behind residents. A plausible explanation for this occurrence is that this category of migrants engaged in sexual risk behaviour at their place of destination. In addition, many of them likely did not go to or have access to health facilities to know their HIV status until the disease progressed to AIDS. This ultimately led them back to their rural homes to receive care as they became too sick to work and to support themselves. This has implication for their left- behind family as they have to bear the attendant consequences of losing one of their sources of financial support and also have to take care of their loved ones. It also implies a large gap between the migrants and non-migrants therefore the risk of AIDS deaths in the non-migrants must be low.

Specifically, Clark, Collinson, Kahn et al. (2007) estimates a risk level of around two i.e. double the risk, for migrants who have recently returned home from being a labour migrant. However, this risk has grown over the years as the present study estimates the risk to be six times higher. Regardless of the difference in the period of analysis, it can be said that the higher mortality risk reported among short-term return migrants in this study can partly be attributed

to the analytical method used in this study where provision is made for other causes of death. A migrant can die of causes other than AIDS/TB, hence, the key feature of this study is to adopt a competing risk method of data analysis to better estimate the relative risk of AIDS/TB mortality that incorporates the probability of migrants dying of other causes.

Moreover, there is the indication that the relative risk has come down as a result of antiretroviral drugs becoming available on a large scale in the later period of the analysis. It is not clear whether access to ART differs by migration status and this can be a subject for further research. The study made provision for the effect of period in the analysis by distributing the values of the period variable into the following categories: 2000-2003, 2004-2007 and 2008-2011. The evidence emerging from this study is that the risk of death reported in period 2008-2011 is less than the version estimated for period 2004-2007 signifying a downward trend in the risk. This lends credence to the following hypothesis, "The competing risk of AIDS/TB mortality will go down overtime as the antiretroviral drugs becomes available". Given the homogeneity of the South African return migrant population as evidenced by the two studies conducted Clark, Collinson, Kahn et al. (2007) and Welaga, Hosegood, Weiner et al. (2009) cited above, there is the possibility of obtaining similar results , if this study is replicated in other rural areas of South Africa.

7.2 Low risk of AIDS/TB mortality among long-term return migrants

This study has shown that long-term return migrants have a risk of mortality from AIDS/TB that is greater than that of the non-migrants. Based on the assumption that this category of migrants was not very sick at the time of their return back to their place of origin, unlike the short-term return migrants, it is expected that after a long period since return migration living with their previously left-behind family members and home community, that the AIDS/TB mortality risk of these returned would be closer to the risk for non-migrants, but this is not the case. This can be for the following reasons. It is highly possible that this group of migrants acquired the disease prior their return back to their rural homes without their knowledge, given the pre-symptomatic period of the illness. Then the symptoms started to manifest in later years. The association of AIDS/TB mortality of long-duration return migrants with the onset of AIDS symptoms after some years cannot be examined right away with this dataset but it would be a good question to explore if it could be known what is the HIV status of the respondent as at the time of their return. This could be an important area for further study.

Since the migrants' previous exposure may have AIDS/TB mortality implications many years after returning back to their place of origin, it follows that that risk of the disease currently reported among short-term return migrants may remain high in the longer term. This can be anticipated by the fact that migrants are not taking necessary precaution to avoid contracting the disease,

which the Health Belief Model theory would have predicted, . Another factor that can lead to high levels of HIV prevalence is that the cure for HIV remains elusive and the antiretroviral palliative therapy has become widely embraced by the population including the migrants.

7.3 **Minimal exposure of in-migrants to the risk of AIDS/TB mortality**

Unlike short- and long-term return migrants, in-migrants, regardless of the duration since in-migration, have certain levels of mortality risks that are not too different from that of non-migrants. The difference observed for short- and long-term in-migrants became non-significant when controlling for other explanatory variables. This indicates the absence of significant difference between first time in-migrants and non-migrants. This result supports the hypothesis that AIDS/TB mortality risk of first time in-migrants does not differ significantly from that of the non-migrants. The in-migrants are not a high risk group when it comes to the relationship of migration to AIDS/TB mortality in rural South Africa. This can be ascribed to the fact that first-time in-migrants have a greater tendency to conform to the behaviour and lifestyle of their host communities, including their norms and values. The distance travelled by short-term migrants is shorter than for labour migrants. The socio-cultural context from which the in-migrants originate is different from the return migrants which mostly return from urban and peri-urban areas.

In general, life in this rural setting is modest, as the main livelihood objective of its dwellers is to meet their basic needs such as food, clothing and shelter. The rural residents exhibit a certain level of homogeneity in terms of their socio-economic status, with evidence of remittance making a difference in the lives of families with labour migration (Collinson 2009). Employers of labour are often scarce in the rural areas and the motivation for migration can be something other than employment e.g. marriage for women. Marriage was identified by Collinson, Tollman, and Kahn (2007) in their study on migration, settlement change and health in post-apartheid South Africa as the main reason why people, especially women, move into the study area. It is a tradition for a woman to relocate to their husband's place of residence at the onset of the marriage. In addition to marriage, Crush, Frayne, and Grant (2006) noted a move into a new dwelling unit is another motive for in-migration. They also recognised that moving in to stay with another member of extended family is another reason for migration. The different geographies of migration are associated with different reasons from migration and show a corresponding difference in risk related behaviour. This results in different mortality levels associated with the different types of migration.

7.4 **Differential in male versus female mortality of AIDS/TB**

The results portray a convergence rather than divergence in the AIDS/TB mortality relative risk for male migrants versus female migrants across the four

migrant categories. This suggests that they possess similar levels of migration exposure, and may experience similar behavioural modification that leads to mortality risk. In the past, the migration was more prevalent among males. However, this pattern is changing as an increasing numbers of female becoming parts of the labour force (Collinson, White, Bocquier et al. 2014, Lurie and Williams 2014, Collinson 2010). Hence, the concept of migrant selectivity by sex is seemingly being challenged in this context. The male-female rate of out-migration computed for individuals aged 20-69 years by 12 year period, as shown in Figure 5.2, shows that as time progressed the gap in migration prevalence between the two genders is closing. In future, it is not impossible that these rates will overlap.

7.5 I**mpact of socio-political environment**

Migration itself is a structural issue, especially bBlack African labour migration from rural parts of South Africa, which is the main issue highlighted by this thesis. The political and industrial incentives of the apartheid regime created the ‘homelands’ whereby densely settled Black African populations were forced to live and migrate long distances to a workplace. The social structure of this migration is such that particular risks emerge, e.g. the risk of extra marital partnerships, and risky sexual behaviour, i.e. not using condoms for protection. Secondly, when labour migrants get sick they are far from home and more than likely to return home for care and eventually to die there. This has led to the situation highlighted in this study whereby return migration is highly associated

with increased levels of mortality, from AIDS/TB, but also from non-communicable diseases, other infectious diseases and external injuries. The risks that arise from specific behaviours are different for different causes of death, i.e. risky sexual behaviour does not necessarily change the risk of dying from external causes or non-communicable illness. Yet, for all the causes of death examined, with fine-grained longitudinal data, the mortality risks for short-term return migrants was higher than for non-migrants. The study therefore supports the social constructivist paradigm that social structures create a health risk associated with migration, rather than individual behaviour alone.

Shifting the focus from individual behaviour to the social structure, as recommended by Parker (2001), implies tackling structural interventions as well as individual. This means making sure that migrants are not systematically excluded from health promotion and risk-prevention campaigns, and crucially, making sure that health care options are available for labour migrants near their workplace.

CHAPTER 8: CONCLUSION AND RECOMMENDATION

8.1 Conclusion

Previous studies on the health implications of migration were more concerned with the association of HIV infection with migration rather than the mortality risk. In this study, the main objective has been to understand the relationship between migration and AIDS/TB mortality in the context of other causes of death in rural South Africa between 2000 and 2011. The analysis has been tailored towards addressing the three research questions separately for male and female using Fine and Gray (1999) model, which is a competing risk analysis technique. In the course of addressing the research objectives and questions, migration was divided into two categories namely: return-migration and in-migration with further divisions being made by splitting the two categories into two to accommodate the short or long-term duration of migration.

The first question is, "What is the mortality risk of dying from AIDS/TB among migrants in rural South Africa in the presence of other causes of death?" The overall answer to this question is that in the context of other causes of death migration is associated with a risk of mortality from AIDS/TB that is greater than the risk for non-migrants. Mortality risk is especially pronounced among the short-term return migrants in comparison to other categories of migration. There is no evidence of disparity in the finding by sex.

With respect to the second question, “How does the relationship between migration and mortality caused by AIDS/TB in rural South Africa in the context of other causes of death compare with the relationship between migration and causes different from AIDS/TB?” The answer is that, in general, male and female migrants show a relative risk of dying from external causes and other infectious diseases that is higher than for AIDS/TB. This scenario is peculiar to the return migrants as the results of the in-migrants are not significant.

“What are the possible predictors of the relationship between migration and AIDS/TB in the presence of other causes of death?” The time period is one of the predictors of the relationship between migration and AIDS/TB mortality with the results suggesting a decline in the mortality risk towards the end of analysis period i.e. 2008 to 2011. This predictor is relevant to the study participants who died as a result of AIDS/TB, NCDs and other infectious diseases. Nationality is also a determinant of the relationship and it is applicable to those who lost their lives due AIDS/TB (female only), NCDs and other infections (female). In summary, the relative risk of a South African dying is greater than that of the Mozambicans. Educational status is a predictor and it relevance cuts across virtually all the causes of death. The dominant pattern that is revealed in this context is that the higher the level of education, the lower the risk of death due to any of the four causes. The predictive impact of SES can only be felt among the respondents whose death was due to AIDS/TB and NCDs (female only). This effect is minimal among those in the highest SES quintile.

8.2 Implications and recommendations

8.2.1 Unabated labour migration will keep fuelling mortality

With circular labour migration in South Africa showing no evidence of declining and with the attendant mortality risks due to AIDS/TB and other causes, there is no doubt that migration will remain an important factor when it comes to controlling mortality in South Africa. Labour migration in the country mostly takes place from rural to urban or semi-urban areas. Mining is no longer the key driver of migration that it was in the Apartheid era. Furthermore, infrastructure has seen significant improvements in the rural areas. The fact is that there are many people in the rural possess certain features that may them eligible to migrate. And, this is a testament to the concept of migrant selectivity, which posits that "migrants are not a random sample of the population at their place of origin" (Hervitz 1985). Thus, the government can capitalise on the availability of these infrastructural improvements by identifying goods and services that are in demand by the rural dwellers and introduce incentives for industries to be setup in the rural areas. This may eventually reduce such extensive movement of people to distant places to work and provide employment in rural areas (Bouare 2007).

8.2.2 **High mortality risk implies the absence of community level social control in the migrants place of destination**

One source of disparity or divergence in mortality relative risk among in-migrants vis-à-vis return migrants is the place they move to, that is their socio-cultural context. The exposure of in-migrants to AIDS/TB other illnesses that can cause mortality is lower because they move to rural area where there is certain level of community social control. The notion of “distruption” does not play significant roles in their move as they are likely to move for reasons other than employment. Hence, there is the possibility of them moving with their partners as discussed earlier in this thesis. On the other hand, the inadequacy of community level social control results in high risk of mortality among return migrants. Wolffers, Fernandez, Verghis et al. (2002), expresses that “community level social control is dependent on how well people know each other, how close the community is and the repercussions of deviant behaviour”. These characteristics may be reduced for labour migrants, who also have a high probability of migrating without their normal sexual partners.

Here, it is seen that the Health Belief Model, which states that people "desire to avoid illness or, if ill, to get well; and have beliefs that a specific health action will prevent or ameliorate illness" (Janz and Becker 1984) does not fully hold as the circular labour migrants make little or no efforts to void HIV related illness. Of course, it is believed that there sexual risk behaviour that their action might have either being controlled by themselves or community as postulated

by the locus of control theory (Rotter 1975). Nonetheless, the other part of the Health Belief Model (i.e. people desire to get well) holds because there is the evidence that the migrants often return when ill to seek care from their left-behind family members.

8.2.3 **Disease induced migration create burdens on the health facilities in the rural area**

The thesis describes how illness due to HIV can be a determinant of people moving back to their rural homes to receive familial and medical support (Clark, Collinson, Kahn et al. 2007, Welaga, Hosegood, Weiner et al. 2009, Vearey 2011). This morbidity-induced migration creates an unplanned for burden not only for the left-behind families who may lose the migrant remittance, but also for the health care facilities in the rural area. Unlike in the urban area, the health care facilities such as hospitals, clinics and health centres in rural areas face a number of particular challenges. Chief among the problems is the inadequacy of health care professionals such as doctors and nurses, who may prefer to work in the urban areas (Kotzee and Couper 2006). This is compounded by the fact that ill migrants are returning home to use the health care resources planned for permanent rural dwellers. The migrants may have been originally "budgeted" to be part of the urban population. Therefore, the rural health authorities should make provision for migrants returning home sick.

8.2.4 **Intervention programmes need to recognise labour migration**

With short-term labour migrants being a high risk group, the success of intervention programmes addressing the problem of HIV infection and the resultant mortality implication, such as treatment as prevention programmes, can only be guaranteed by recognising the risks incumbent on this group of people.

Bärnighausen, Tanser, and Newell (2009) in their study of the lack of a decline in HIV incidence in rural communities, between 2003 and 2007, highlight the failure of various intervention programmes aimed at reducing the rate of HIV infection due the fact that such programmes did not reach the target group. Labour migrants may not know their HIV status until it is too late. This could be responsible for them dying on a short-term basis after returning home, as shown in this study. Hence, in rolling out treatment as prevention programme on a large scale by the South African Department of Health or other non-governmental institutions, migrants could be a main target group. An electronic linkage system should be put in place to monitor not only their initiation and adherence to medication but also their residence at any point with the country throughout the country. This is to ensure the health centres at their place of destination can be able to access their records and ensure continuity of care.

8.3 **Frontiers for further research**

Having explored the relationship between migration and mortality due to AIDS/TB and other causes of death, it is important to suggest frontiers for further research, which originate from the limitations of this study. One such shortcoming is the unavailability of data on the HIV status of the return migrants as at the time of coming back to their place of origin. This study employed a novel approach to investigate AIDS/TB mortality, while making provision for other causes of death; however, future research could collect data on the HIV status of the migrants at the time of their return to better understand the impact of their exposure to the prevailing condition at their place of origin.

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REFERENCES

Abdool Karim, Salim S., Gavin J. Churchyard, Quarraisha Abdool Karim, and Stephen D. Lawn. 2009. "HIV infection and tuberculosis in South Africa: an urgent need to escalate the public health response." *Lancet* 374 (9693):921-933. doi: 10.1016/s0140-6736(09)60916-8.

Agincourt-HDSS1. 2017. "Overview of data collection procedures."

Appiah, Kwame Anthony, and Henry Louis Gates. 2010. Encyclopedia of Africa. Oxford University Press.

Au, Kathryn H. 1998. "Social Constructivism and the School Literacy Learning of Students of Diverse Backgrounds." *Journal of Literacy Research* 30 (2):297-319. doi: doi:10.1080/10862969809548000.

Bärnighausen, Till, Frank Tanser, and Marie-Louise Newell. 2009. "Short Communication: Lack of a Decline in HIV Incidence in a Rural Community with High HIV Prevalence in South Africa, 2003–2007." *AIDS Research and Human Retroviruses* 25 (4):405-409. doi: 10.1089/aid.2008.0211.

Berger, Peter L., and Thomas Luckmann. 1966. *The Social Construction of Reality*. United States: Anchor Books.

Bhugra, Dinesh. 2004. "Migration, distress and cultural identity." *British Medical Bulletin* 69 (1):129-141. doi: 10.1093/bmb/ldh007.

Blower, S. M., and Julie L. Gerberding. 1998. "Understanding, predicting and controlling the emergence of drug-resistant tuberculosis: a theoretical framework." *Journal of Molecular Medicine* 76 (9):624-636. doi: 10.1007/s001090050260.

Blower, Sally M., and Tom Chou. 2004. "Modeling the emergence of the 'hot zones': tuberculosis and the amplification dynamics of drug resistance." *Nat Med* 10 (10):1111-1116. doi: http://www.nature.com/nm/journal/v10/n10/suppinfo/nm1102_S1.html.

Bocquier, Philipe, Mark.A. Collinson, Saamuel .J. Clark, Annette .A.M Gerritsen, Kathleen Kahn, and Stephen M. Tollman. 2014. "Ubiquitous burden: The contribution of migration to AIDS and Tuberculosis mortality in rural South Africa." *African Population Studies* 28 (1):691-701. doi: 10.11564/28-0-525.

Bond, Virginia, Elaine Chase, and Peter Aggleton. 2002. "Stigma, HIV/AIDS and prevention of mother-to-child transmission in Zambia." *Evaluation and Program Planning* 25 (4):347-356. doi: http://dx.doi.org/10.1016/S0149-7189(02)00046-0.

Bouare, Oumar. 2007. "Internal Migration and the Spread of HIV/AIDS in South Africa." *The Social Sciences* 2 (4):405-411.

Brockerhoff, Martin, and Ann E. Biddlecom. 1999. "Migration, Sexual Behavior and the Risk of HIV in Kenya." *International Migration Review* 33 (4):833-856.

Byass, Peter, Clara Calvert, Jessica Miiro-Nakiyingi, Tom Lutalo, Denna Michael, Amelia Crampin, Simon Gregson, Albert Takaruza, Laura Robertson, Kobus Herbst, Jim Todd, and Basia Zaba. 2013. "InterVA-4 as a public health tool for measuring HIV/AIDS mortality: a validation study from five African countries." *2013* 6. doi: 10.3402/gha.v6i0.22448.

Byass, Peter, Daniel Chandramohan, Samuel J. Clark, #039, Lucia Ambruoso, Edward Fottrell, Wendy J. Graham, Abraham J. Herbst, Abraham Hodgson, Sennen Hounton, Kathleen Kahn, Anand Krishnan, Jordana Leitao, Frank Odhiambo, Osman A. Sankoh, and Stephen M. Tollman. 2012. "Strengthening standardised interpretation of verbal autopsy data: the new InterVA-4 tool." *2012* 5. doi: 10.3402/gha.v5i0.19281.

Byass, Peter, Kathleen Kahn, Edward Fottrell, Mark A. Collinson, and Stephen M. Tollman. 2010. "Moving from Data on Deaths to Public Health Policy in Agincourt, South Africa: Approaches to Analysing and Understanding Verbal Autopsy Findings." *PLoS Med* 7 (8):e1000325. doi: 10.1371/journal.pmed.1000325.

Carrier, Joseph M, and J. Raúl Magaña. 1991. "Use of Ethnosexual Data on Men of Mexican Origin for HIV/AIDS Prevention Programs." *The Journal of Sex Research* 28 (2):189-202.

Carswell, J. Wilson, Graham Lloyd, and Julian Howells. 1989. "Prevalence of HIV-1 in east African lorry drivers." *AIDS* 3 (11):759-61.

Chandramohan, Daniel, Gillian H. Maude, Laura C. Rodrigues, and Richard J. Hayes. 1998. "Verbal autopsies for adult deaths: their development and validation in a

multicentre study." *Tropical Medicine & International Health* 3 (6):436-446. doi: 10.1046/j.1365-3156.1998.00255.x.

Chesney, Margaret A., and Ashley w. Smith. 1999. "Critical Delays in HIV Testing and Care: The Potential Role of Stigma." *American Behavioral Scientist* 42 (7):1162-1174. doi: 10.1177/00027649921954822.

Christie, Kenneth. 1997. "Security and Forced Migration Concerns in South Africa." *African Security Review* 6 (1):42-48. doi: 10.1080/10246029.1997.9627695.

Clark, Samuel J., Mark A. Collinson, Kathleen Kahn, Kyle Drullinger, and Stephen M. Tollman. 2007. "Returning home to die: circular labour migration and mortality in South Africa." *Scandinavian Journal of Public Health Supplement* 69:35-44.

Coffee, Megan, Mark N. Lurie, and Geoff P. Garnett. 2007. "Modelling the impact of migration on the HIV epidemic in South Africa." *AIDS* 21 (3):343-350. doi: 10.1097/QAD.0b013e328011dac9 [doi]

00002030-200701300-00008 [pii].

Collins, Kalonji R., Miguel E. Quinones-Mateu, Zahra Toossi, and Eric J. Arts. 2002. "Impact of Tuberculosis on HIV-1 Replication, Diversity, and Disease Progression." *AIDS Reviews* 4 (3):165-176.

Collinson, Mark A. 2009. "Striving against adversity. : the dynamics of migration, health and poverty in rural South Africa." Epidemiologi och folkhälsovetenskap.

Collinson, Mark A. 2010. "Striving against adversity: the dynamics of migration, health and poverty in rural South Africa." *Glob Health Action* 3. doi: 10.3402/gha.v3i0.5080 [doi].

Collinson, Mark A., Stephen M. Tollman, and Kathleen Kahn. 2007. "Migration, settlement change and health in post-apartheid South Africa: Triangulating health and demographic surveillance with national census data." *Scandinavian journal of public health. Supplement* 69:77-84. doi: 10.1080/14034950701356401.

Collinson, Mark A., Michael J. White, Philippe Bocquier, Stephen T. McGarvey, Sulaimon A. Afolabi, Samuel J. Clark, Kathleen Kahn, and Stephen M. Tollman. 2014. "Migration and the epidemiological transition: insights from the Agincourt sub-district of northeast South Africa." *Global Health Action* 7 (23514).

Collinson, Mark., B. Wolff, S. Tollman, and K. Kahn. 2006. "Trends in internal labour migration from the rural Limpopo Province, male risk behaviour, and implications for spread of HIV/AIDS in rural South Africa." *Journal of ethnic and migration studies* 32 (4):633-648.

Corno, Lucia, and Damien de Walque. 2012. "Mines, Migration and HIV/AIDS in Southern Africa." *Journal of African Economies*. doi: 10.1093/jae/ejs005.

Crush, Jonathan, and Wilmot James. 1995. *Crossing Boundaries: Mine Migrancy in a Democratic South Africa*. Cape Town: Institute for Democracy in South Africa.

Crush, Jonathan, Brian Williams, Eleanor Gouws, and Mark Lurie. 2005. "Migration and HIV/AIDS in South Africa." *Development Southern Africa* 22 (3):293-318.

Crush, Jonathan., Bruce. Frayne, and Miriam. Grant. 2006. "Linking Migration, HIV/AIDS and Urban Food Security in Southern and Eastern Africa." *International Food Policy Research Institute (IFPRI)*:49.

Cunningham, Argeseanu Solveig, Julia D. Ruben, and K. M. Venkat Narayan. 2008. "Health of foreign-born people in the United States: A review." *Health & Place* 14 (4):623-635. doi: http://dx.doi.org/10.1016/j.healthplace.2007.12.002.

Deane, Kevin D., Justin O. Parkhurst, and Deborah Johnston. 2010. "Linking migration, mobility and HIV." *Tropical Medicine & International Health* 15 (12):1458-1463. doi: 10.1111/j.1365-3156.2010.02647.x.

Decosas, J., F. Kane, J. K. Anarfi, K. D. R. Sodji, and H. U. Wagner. 1995. "Migration and AIDS." *The Lancet* 346 (8978):826-828.

Department-of-Home-Affairs. 2013. "South African Department of Home Affairs - Death Certificates." DHA, accessed 23-12-2013. http://www.dha.gov.za/index.php/civic-services/death-certificates.

Department of Health, SA. 2005. *Moving the nation to act: a research report on The Khomanani Campaign 2001-2004*, *Khomanani Campaign 2001-2004*. Pretoria: [Department of Health?

Dolin, P. J., M. C. Raviglione, and A. Kochi. 1994. "Global tuberculosis incidence and mortality during 1990-2000." *Bull World Health Organ* 72 (2):213-20.

Dyson, Tim. 2003. "HIV/AIDS and urbanization." *Population and Development Review* 29 (3):427-442.

Ethier, Kathleen A., and Kay Deaux. 1994. "Negotiating social identity when contexts change: Maintaining identification and responding to threat." *Journal of Personality and Social Psychology* 67 (2):243-251. doi: 10.1037/0022-3514.67.2.243.

Eybers, Christa. 2017. The global tuberculosis situation, an infographic. http://ewn.co.za/2017/03/24/the-global-tuberculosis-situation. Eyewitness new website.

Fine, Jason P. , and Robert .J. Gray. 1999. "A Proportional Hazards Model for the Subdistribution of a Competing Risk." *Journal of the American Statistical Association* 94 (446):496-509.

Gajalakshmi, Vendhan, Richard Peto, Santhanakrishnan Kanaka, and Sivagurunathan Balasubramanian. 2002. "Verbal autopsy of 48 000 adult deaths attributable to medical causes in Chennai (formerly Madras), India." *BMC Public Health* 2:7.

Gandhi, Neel R., Anthony Moll, A. Willem Sturm, Robert Pawinski, Thiloshini Govender, Umesh Lalloo, Kimberly Zeller, Jason Andrews, and Gerald Friedland. 2006. "Extensively drug-resistant tuberculosis as a cause of death in patients co-infected with tuberculosis and HIV in a rural area of South Africa." *The Lancet* 368 (9547):1575-1580.

Glass, Thomas A., and Matthew J. McAtee. 2006. "Behavioral science at the crossroads in public health: extending horizons, envisioning the future." *Social science & medicine* 62 (7):1650-71. doi: S0277-9536(05)00462-4 [pii]

10.1016/j.socscimed.2005.08.044 [doi].

Gooley, Ted A., Wendy Leisenring, John Crowley, and Barry E. Storer. 1999. "Estimation of failure probabilities in the presence of competing risks: new representations of old estimators." *Statistics in medicine* 18 (6):695-706.

Grieger, Lloyd, April Williamson, Murray Leibbrandt, and James Levinsohn. 2014. "Evidence of short-term household change in South Africa from the National Income Dynamics Study." *Development Southern Africa* 31 (1):146-167. doi: 10.1080/0376835x.2013.851022.

Halli, Shiva S., James Blanchard, Dayanand G. Satihal, and Stephen Moses. 2007. "Migration and HIV transmission in rural South India: An ethnographic study." *Culture, Health & Sexuality* 9 (1):85-94. doi: 10.1080/13691050600963898.

Harris, John R., and Michael P. Todaro. 1970. "Migration, Unemployment and Development: A Two-Sector Analysis." *The American Economic Review* 60 (1):126-142.

Herdt, Gilbert, and Andrew M. Boxer. 1991. "Ethnographic Issues in the Study of AIDS." *The Journal of Sex Research* 28 (2):171-187.

Hervitz, Hugo M. 1985. "Selectivity, Adaptation, or Disruption? A Comparison of Alternative Hypotheses on the Effects of Migration on Fertility: The Case of Brazil." *International Migration Review* 19 (2):293-317.

Hinchliffe, Sally R., and Paul C. Lambert. 2013. "Flexible parametric modelling of cause-specific hazards to estimate cumulative incidence functions." *BMC Medical Research Methodology* 13:13-13. doi: 10.1186/1471-2288-13-13.

Hunt, Charles W. 1989. "Migrant Labor and Sexually Transmitted Disease: AIDS in Africa." *Journal of Health and Social Behavior* 30 (4):353-373.

Hunt, Charles W. 1996. "Social vs biological: theories on the transmission of AIDS in Africa." *Social science & medicine* 42 (9):1283-96. doi: 0277953695002197 [pii].

Hunter, Lori M., Wayne Twine, and Laura Patterson. 2007. "“Locusts are now our beef”: Adult mortality and household dietary use of local environmental resources in rural South Africa." *Scandinavian journal of public health. Supplement* 69:165-174. doi: 10.1080/14034950701356385.

Ingle, Suzanne M., Margaret T. May, M. John Gill, Michael J. Mugavero, Charlotte Lewden, Sophie Abgrall, Gerd Fätkenheuer, Peter Reiss, Michael S. Saag, Christian Manzardo, Sophie Grabar, Mathias Bruyand, David Moore, Amanda Mocroft, Timothy R. Sterling, Antonella D'Arminio Monforte, Victoria Hernando, Ramon Teira, Jodie Guest, Matthias Cavassini, Heidi M. Crane, and Jonathan A. C. Sterne. 2014. "Impact of Risk Factors for Specific Causes of Death in the First and Subsequent Years of Antiretroviral Therapy Among HIV-Infected Patients." *Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America* 59 (2):287-297. doi: 10.1093/cid/ciu261.

Janz, Nancy K. , and Marshall H. Becker. 1984. "Health Belief Model: A Decade Later." *Health Education Quarterly* 11 (1):1-47.

Jochelson, Karen, Monyalola Mothibeli, and Jean-Patrick Leger. 1991. "Human Immunodeficiency Virus and migrant labor in South Africa." *International Journal of Health Services* 21 (1):157-173.

Joubert, Jané, Debbie Bradshaw, Chodziwadziwa Kabudula, Chalapati Rao, Kathleen Kahn, Paul Mee, Stephen Tollman, Alan D Lopez, and Theo Vos. 2014. "Record-linkage comparison of verbal autopsy and routine civil registration death certification in rural north-east South Africa: 2006–09." *International Journal of Epidemiology* 43 (6):1945-1958. doi: 10.1093/ije/dyu156.

Kahn, Kathleen. 2006. "Dying to make a fresh start : mortality and health transition in a new South Africa." Folkhälsa och klinisk medicin.

Kahn, Kathleen, Mark A Collinson, F Xavier Gómez-Olivé, Obed Mokoena, Rhian Twine, Paul Mee, Sulaimon A Afolabi, Benjamin D Clark, Chodziwadziwa W Kabudula, Audrey Khosa, Simon Khoza, Mildred G Shabangu, Bernard Silaule, Jeffrey B Tibane, Ryan G Wagner, Michel L Garenne, Samuel J Clark, and Stephen M Tollman. 2012. "Profile: Agincourt Health and Socio-demographic Surveillance System." *International Journal of Epidemiology* 41 (4):988-1001. doi: 10.1093/ije/dys115.

Kahn, Kathleen, Stephen M. Tollman, Michel Garenne, and John S. S. Gear. 1999. "Who dies from what? Determining cause of death in South Africa's rural north-east." *Tropical Medicine & International Health* 4 (6):433-441. doi: 10.1046/j.1365-3156.1999.00415.x.

Kalichman, S C, and L C Simbayi. 2003. "HIV testing attitudes, AIDS stigma, and voluntary HIV counselling and testing in a black township in Cape Town, South Africa." *Sexually Transmitted Infections* 79 (6):442-447. doi: 10.1136/sti.79.6.442.

Knodel, John, and Mark VanLandingham. 2003. "Return migration in the context of parental assistance in the AIDS epidemic: the Thai experience." *Social science & medicine* 57 (2):327-342. doi: S0277953602003611 [pii].

Kok, Pieter. 1999. "The definition of migration and its application: Making sense of recent South African census and survey data." *Southern African Journal of Demography* 7 (1):19-30.

Kok, Pieter, and Mark Collinson. 2006a. Migration and urbanisation in South Africa. Report 03-04-02: Pretoria: Statistics South Africa.

Kok, Pieter, and Mark Collinson. 2006b. Migration and urbanisation in South Africa. Report 03-04-02. Pretoria: Statistics South Africa.

Kotzee, TJ, and ID Couper. 2006. "What interventions do South African qualified doctors think will retain them in rural hospitals of the Limpopo province of South Africa." *Rural Remote Health* 6 (3):581.

Lalou, Richard, and Victor Piché. 2004. "Migrants and AIDS: Risk Management versus Social Control An Example from the Senegal River Valley." *Population-E* 59 (2):195-228.

Levinson, David. 1996. "Fulani": Enyclopedia of World Cultures: Africa and the Middle East, Volume 9. G.K. Hall.

Levira, Francis, Jim Todd, and Honorati Masanja. 2014. "Coming home to die? The association between migration and mortality in rural Tanzania before and after ART scale-up." *Global Health Action* 7:10.3402/gha.v7.22956. doi: 10.3402/gha.v7.22956.

Liu, Dan, Si-Ping Dong, Guang-Ming Gao, Ming-Yu Fan, Zong-Jiu Zhang, and Peng-Qian Fang. 2013. "The study of KBP of road construction workers of highway AIDS prevention project before and after intervention." *Asian Pacific Journal of Tropical Medicine* 6 (10):817-822. doi: http://dx.doi.org/10.1016/S1995-7645(13)60144-3.

London, A. S., J. M. Wilmoth, and J. A. Fleishman. 2004. "Moving for care: findings from the US HIV cost and services utilization Study." *AIDS Care* 16 (7):858-875. doi: 10.1080/09540120412331290149.

Lu, Yao. 2008. "Test of the 'healthy migrant hypothesis': A longitudinal analysis of health selectivity of internal migration in Indonesia." *Social science & medicine* 67 (8):1331-1339. doi: http://dx.doi.org/10.1016/j.socscimed.2008.06.017.

Lurie, M. N., B. G. Williams, K. Zuma, D. Mkaya-Mwamburi, G. Garnett, A. W. Sturm, M. D. Sweat, J. Gittelsohn, and S. S. Abdool Karim. 2003a-a. "The impact of migration on HIV-1 transmission in South Africa: a study of migrant and nonmigrant men and their partners." *Sexually Transmitted Diseases* 30 (2):149-56.

Lurie, Mark , Harrison Abigail, Wilkinson David, and Abdool Karim Salim. 1997. "Circular migration and sexual networking in rural KwaZulu/Natal: implications for the spread of HIV and other sexually transmitted diseases." *Health Transition Review* 7 (Supplement 3):17-27.

Lurie, Mark N. 2006. "The Epidemiology of Migration and HIV/AIDS in South Africa." *Journal of Ethnic and Migration Studies* 32 (4):649 - 666.

Lurie, Mark N., and B.G. Williams. 2014. "Migration and health in Southern Africa: 100 years and still circulating." *Health Psychology and Behavioral Medicine*:34-40. doi: 10.1080/21642850.2013.866898.

Lurie, Mark N., Brian G. Williams, Khangelani Zuma, David Mkaya-Mwamburi, Geoff P. Garnett, Michael D. Sweat, Joel Gittelsohn, and S. Salim Karim. 2003b. "Who infects whom? HIV-1 concordance and discordance among migrant and non-migrant couples in South Africa." *AIDS* 17 (15):2245-52.

Lurie, Mark., Brian G. Williams, Khangelani Zuma, David Mkaya-Mwamburi, Geoff P. Garnett, Adriaan W. Sturm, ichael. D. Sweat, Joel Gittelsohn, and S. Salim Abdool Karim. 2003a-b. "The impact of migration on HIV-1 transmission in South Africa: a study of migrant and nonmigrant men and their partners." *Sexually Transmitted Diseases* 30 (2):149-56.

Mahajan, Anish P, Jennifer N Sayles, Vishal A Patel, Robert H Remien, Sharif R Sawires, Daniel J Ortiz, Greg Szekeres, and Thomas J Coates. 2008. "Stigma in the HIV/AIDS epidemic: a review of the literature and recommendations for the way forward." *AIDS* 22:S67-S79 10.1097/01.aids.0000327438.13291.62.

Mayosi, Bongani M., Alan J. Flisher, Umesh G. Lalloo, Freddy Sitas, Stephen M. Tollman, and Debbie Bradshaw. 2009. "The burden of non-communicable diseases in South Africa." *The Lancet* 374 (9693):934-947.

Mell, Loren K., and Jong-Hyeon Jeong. 2010. "Pitfalls of Using Composite Primary End Points in the Presence of Competing Risks." *Journal of Clinical Oncology* 28 (28):4297-4299. doi: 10.1200/jco.2010.30.2802.

Moeschberger, M. L. 1978. "A review of the existing methodology in competing-risk theory." *Environment International* 1 (6):309-312. doi: http://dx.doi.org/10.1016/0160-4120(78)90005-3.

Moultrie, Tom A., and Robert Dorrington. 2004. "Demography." In *Encyclopedia of Actuarial Science*. John Wiley & Sons pp 448-459.

Nel, Etienne-Louis. 1990. "Mdantsane, East London's homeland township: Municipal neglect and apartheid planning 1949–1988." *GeoJournal* 22 (3):305-313. doi: 10.1007/bf00711342.

Ng, Nawi, Hoang Van Minh, Sanjay Juvekar, Abdur Razzaque, Tran Huu Bich, Uraiwan Kanungsukkasem, Ali Ashraf, Syed Masud Ahmed, and Kusol Soonthornthada. 2009. "Using the INDEPTH HDSS to build capacity for chronic non-communicable disease risk factor surveillance in low and middle-income countries." *Global Health Action* 2:10.3402/gha.v2i0.1984. doi: 10.3402/gha.v2i0.1984.

Owen, Crankshaw. 1993. "Squatting, Apartheid and Urbanisation on the Southern Witwatersrand." *African Affairs* 92 (366):31-51.

Palloni, Alberto, and Jeffrey D. Morenoff. 2001. "Interpreting the Paradoxical in the Hispanic Paradox." *Annals of the New York Academy of Sciences* 954 (1):140-174. doi: 10.1111/j.1749-6632.2001.tb02751.x.

Parker, Richard. 2001. "Sexuality, Culture, and Power in HIV/AIDS Research." *Annual Review of Anthropology* 30:163-179.

Philpott, Jane, and Helen Batty. 2009. "Learning best together: social constructivism and global partnerships in medical education." *Medical Education* 43 (9):923-924. doi: 10.1111/j.1365-2923.2009.03436.x.

Pintilie, Melania. 2007. "Analysing and interpreting competing risk data." *Statistics in medicine* 26 (6):1360-1367. doi: 10.1002/sim.2655.

Pintilie, Melanie. 2006. *Competing Risks: A Practical Perspective*: Chichester, UK: Wiley.

Pison, Gilles, Bernard Le Guenno, Emmanuel Lagarde, Catherine Enel, and Cheikh Seck. 1993. "Seasonal Migration: A Risk Factor for HIV Infection in Rural Senegal." *Journal of Acquired Immune Deficiency Syndromes* 6 (2):196-200.

Prothero, R Mansell. 1994. "Forced Movements of Population and Health Hazards in Tropical Africa." *International Journal of Epidemiology* 23 (4):657-664. doi: 10.1093/ije/23.4.657.

Quinn, Thomas C. 1994. "Population migration and the spread of types 1 and 2 human immunodeficiency viruses." *Proceedings of the National Academy of Sciences of the United States of America* 91 (7):2407-14.

Ramjee, Gita, Gouws, and Eleanor. 2002. "Prevalence of HIV Among Truck Drivers Visiting Sex Workers in KwaZulu-Natal, South Africa." *Sexually Transmitted Diseases* 29 (1):44-49.

Reed, Holly E. 2013. "Moving Across Boundaries: Migration in South Africa, 1950–2000." *Demography* 50 (1):71-95. doi: 10.1007/s13524-012-0140-x.

Research School of Economics, Australia National University. 2017. "Rural -to- urban Migrants Survey Questionnaire ".

Rotter, Julian. 1975. "Some problems and misconceptions related to the construct of internal versus external control of reinforcement." *Journal of Consulting and Clinical Psychology* 43 (1):56-67. doi: 10.1037/h0076301.

Russo, Mary Frances, Jody Vernam, and Amanda Wolbert. 2006. "Sandplay and storytelling: Social constructivism and cognitive development in child counseling." *The Arts in Psychotherapy* 33 (3):229-237. doi: http://dx.doi.org/10.1016/j.aip.2006.02.005.

Sankoh, Osman, and Peter Byass. 2012. "The INDEPTH Network: filling vital gaps in global epidemiology." *International Journal of Epidemiology* 41 (3):579-588. doi: 10.1093/ije/dys081.

Sargent, Carolyn, and Stephanie Larchanche. 2007. "The Muslim Body and the Politics of Immigration in France: Popular and Biomedical Representations of Malian Migrant Women." *Body & Society* 13 (3):79-102. doi: 10.1177/1357034x07082253.

Setel, Philip W., Chalapati Rao, Yusuf Hemed, David R. Whiting, Gonghuan Yang, Daniel Chandramohan, K. G. Alberti, and Alan. D. Lopez. 2006. "Core verbal autopsy procedures with comparative validation results from two countries." *PLoS Med* 3 (8):e268. doi: 10.1371/journal.pmed.0030268.

Shisana, Olive, Thomas Rehle, Leickness Simbayi, Khangelani Zuma, Sean Jooste, Nompumelelo Zungu, Demetre Labadarios, and Dorina Onoya. 2014. South African National HIV Prevalence, Incidence and Behaviour Survey 2012. Cape Town, HSRC Press.

Soleman, Nadia, Daniel Chandramohan, and Kenji Shibuya. 2006. "Verbal autopsy: current practices and challenges." *Bull World Health Organ* 84:239-245.

Soskolne, Varda, and Ronny A. Shtarkshall. 2002. "Migration and HIV prevention programmes: linking structural factors, culture, and individual behaviour--an Israeli experience." *Social science & medicine* 55 (8):1297-1307.

Sumartojo, E. 2000. "Structural factors in HIV prevention: concepts, examples, and implications for research." *AIDS* 14 Suppl 1:S3-10.

Timotijevic, Lada, and Glynis M. Breakwell. 2000. "Migration and threat to identity." *Journal of Community & Applied Social Psychology* 10 (5):355-372. doi: 10.1002/1099-1298(200009/10)10:5<355::aid-casp594>3.0.co;2-y.

Todaro, Michael P. 1969. "A Model of Labor Migration and Urban Unemployment in Less Developed Countries." *The American Economic Review* 59 (1):138-148.

UNAIDS. 2010. Report on the Global HIV/AIDS Epidemic. In *Joint United Nations Programme on HIV/AIDS (UNAIDS)*. Geneva.

United-Nations. 1970. "Methods of measuring internal migration. Manuals on methods of estimating population." *Manual VI (Population studies, No. 47).* (No. 47).

van Blerk, Lorraine, and Nicola Ansell. 2006. "Children's Experiences of Migration: Moving in the Wake of AIDS in Southern Africa." *Environment and Planning D: Society and Space* 24 (3):449-471. doi: 10.1068/d65j.

Vearey, Jo. 2011. "Learning from HIV: Exploring migration and health in South Africa." *Glob Public Health*:1-13. doi: 934028216 [pii]

10.1080/17441692.2010.549494 [doi].

Waters-Bayer, Ann, and Wolfgang Bayer. 1994. "Coming to Terms: Interactions between Immigrant Fulani Cattle-Keepers and Indigenous Farmers in Nigeria's Subhumid Zone (Relations entre éleveurs immigrants peuls et paysans autochtones dans la zone subhumide du Nigeria)." *Cahiers d'Études Africaines* 34 (133/135):213-229.

Watts, Susan J. 1987. "Population mobility and disease transmission: The example of guinea worm." *Social science & medicine* 25 (10):1073-1081.

Welaga, Paul, Victoria Hosegood, Renay Weiner, Caterina Hill, Kobus Herbst, and Marie-Louise Newell. 2009. "Coming home to die? the association between migration and mortality in rural South Africa." *BMC Public Health* 9 (1):193.

White, Michael J. 2009. "Migration and Demographic surveillance: An Overview of Opportunities and Challenges." In *The Dynamics of Migration, Health and Livelihoods.*, edited by Health and Livelihoods: INDEPTH Network Perspectives. The Dynamics of Migration. Ashgate.

WHO. 2011. Global Tuberculosis Control.

WHO. 2015. Global Tuberculois Report 2014.

WHO. 2016. Global Tuberculois Report 2015.

Williams, Jill, Latifat Ibisomi, Benn Sartorius, Kathleen Kahn, Mark Collinson, Stephen Tollman, and Michel Garenne. 2013. "Convergence in fertility of South Africans and Mozambicans in rural South Africa, 1993–2009." *Global Health Action* 6:10.3402/gha.v6i0.19236. doi: 10.3402/gha.v6i0.19236.

Wolffers, Ivan, Irene Fernandez, Sharuna Verghis, and Martijn Vink. 2002. "Sexual behaviour and vulnerability of migrant workers for HIV infection." *Culture, Health & Sexuality* 4 (4):459-473. doi: 10.1080/13691050110143356.

Yang, W., F. Qeadan, and J. Smith-Gagen. 2011. "Examination of health behaviours in a dynamic population." *J Epidemiol Community Health* 65 (12):1140-4. doi: 10.1136/jech.2009.089342.

Yaukey, David. 1990. *Demography: The Study of Human Population*: Prospect Heights IL: Waveland Press.

Zielke, Barbara, and Jürgen Straub. 2008. "Culture, Psychotherapy, and the Diasporic Self as Transitoric Identity: A Reply to Social Constructionist and Postmodern Concepts of Narrative Psychotherapy." In *Meaning in Action: Constructions, Narratives, and Representations*, edited by Toshio Sugiman, Kenneth J. Gergen, Wolfgang Wagner and Yoko Yamada, 49-72. Tokyo: Springer Japan.

APPENDICES

AGINCOURT Health & Population Unit
School of Public Health - University of the Witwatersrand
MRC/Wits Rural Public Health and Health Transitions Research Unit

Death Form

Village: 1 1
Dwelling: 1 1 1 1 A
Fieldworker: 1 1 1 1
Visit Date: Y Y Y Y M M D D

1	Deceased's Name and Surname	Name: 1a Surname: 1b	A A A A A A A A A A A A A A A A A A A A A A A A A A A A	
2	Deceased's Census Id		2 1 1 1 1 1 1	
3	Date of death		3 Y Y Y Y M M D D	
4	Date of death estimated?		Y = Yes; N = No	4 A
5	Death in Agincourt area?		Y = Yes; N = No	5 A
6	Died at		H = Home→Q10; C = Clinic→Q10; N = Health Centre→Q10 + = Hospital→Q7; V = Accident site→Q10; O = Other→Q8	6 A
7	Which hospital?		T = Tintswalo→Q9; MP = Mapulaneng→Q9; MT = Matikwane→Q9; RF = Rob Ferreira→Q9; PM = Pietersburg-Mankweng→Q9; O = Other→Q8	7 A A
8	Specify place of death	8		
9	Province of death	NP = Limpopo; MP = Mpumalanga; GT = Gauteng; KN = KwaZulu-Natal; FS = Free State; EC = Eastern Cape; NW = Northwest; NC = Northern Cape ; WC = Western Cape		9 A A
ASK Q10 ONLY IF DECEASED IS A FEMALE AGED 12 TO 50 YEARS				
10	Was/did the woman		P = Pregnant at time of death D = Die during delivery B = Die within 42 days of delivery O = None of the above	10 A
ASK Q11 FOR ALL DEATHS				
11	Was the death registered?		Y = Yes; N = No	11 A

Not for Data Entry: Information for VA Interviewer

12	Deceased's date of birth		12 Y Y Y Y M M D D	
13	Age at death		Years	13a 1 1
			Months	13b 1 1
			Days	13c 1 1
14	Deceased gender		M = Male F= Female	14 A
15	VA best respondent's name	Name: 15a Surname: 15b	A A A A A A A A A A A A A A A A A A A A A A A A A A A A	
16	Comments:			

Agincourt Health and Population Unit • PO Box 2 • Acornhoek 1360
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S N

Appendix 1: **Agincourt HDSS death questionnaire**

AGINCOURT Health & Population Unit
School of Public Health - University of the Witwatersrand
MRC/Wits Rural Public Health and Health Transitions Research Unit

Migration Form

Village: I I
Dwelling: I I I I A
Fieldworker: I I I I
Visit Date: Y Y Y Y M M D D

If individual migration

1	Migrant's Name and Surname	Name:	1a	A A A A A A A A A A A A A A
		Surname:	1b	A A A A A A A A A A A A A A
2	Migrant's Census ID		2	I I I I I I

If entire household migration

3	Household Head Name and Surname	Name:	3a	A A A A A A A A A A A A A A
		Surname:	3b	A A A A A A A A A A A A A A
4	Household Head Census ID		4	I I I I I I

Both individual and household migration

5	Did the individual/HH move IN or OUT of the dwelling?	**I** = moved into this household **O** = moved out of this household	5 A
6	Moved to/from	**A** = Agincourt Area; **B** = BBR area; **P** = PWV; **U** = Other urban/industrial; **M** = Mozambique; **O** = Other	6 A
7	Move date	7	Y Y Y Y M M D D
8	Move date estimated?	**Y** = Yes; **N** = No	8 A
ASK Q9 ONLY IF Q5 = "I" AND Q6 NOT EQUAL "A"			
9	Has the individual lived in the study site since 1992?	**Y** = Yes; **N** = No	9 A
FILL IN Q10 AND Q11 IF Q6 = "A"			
10	Village		10 I I
11	Household Head Name and Surname	Name: 11a Surname: 11b	A A A A A A A A A A A A A A A A A A A A A A A A A A A A
FILL IN Q12 AND Q13 IF Q6 IS NOT EQUAL TO "A"			
12	Place Name	12	
13	Province	**NP** = Limpopo; **MP** = Mpumalanga; **GT** = Gauteng; **KN** = KwaZulu-Natal; **FS** = Free State; **EC** = Eastern Cape; **NW** = Northwest; **NC** = Northern Cape ; **WC** = Western Cape	13 A A
FILL IN 14 FOR ALL MIGRATIONS			
14	Main reason for migration	**AF** – Accompanying family member; **CF**- Child returning to parent; **DI** – Divorce; **JF** – Job found; **JL** – Job lost; **LW** – Looking for work; **NH** – New house; **NM** – New marriage; **NR** – New Mozam/refugee; **OM** – Other marriage reason; **OT** – Other reason; **OW** – Other work related reason; **PD** – Pregnancy/delivery; **RR** – Returning Mozam/refugee; **SE** – Separated; **SS** – School/study; **WI** – Widowed; **DR** – Duplicate resident; **ND** – Never Resident; **MS** – Missed Individual; **NF** – No census form	14 A A
IF QUESTION 14 = "JF" OR "JL" FILL IN NEXT QUESTION			
15	If migration job related, sector of work	**M** – Mining; **I** – Industry; **A** – Agriculture; **G** – Game reserve; **S**- Shop/store personnel; **B** – Business person; **P** – Public service; **E** – Self employed (informal sector); **O** - Other	15 A
IF QUESTION 14 = "DR" FILL IN NEXT TWO QUESTIONS			
16	Duplicate Resident Name	Name: 16a Surname: 16b	A A A A A A A A A A A A A A A A A A A A A A A A A A A A
17	Duplicate Resident Census ID	17	I I I I I I
IF Q6 = "A" OR Q9 = "Y" FILL IN A MIGRATION RECONCILIATION FORM			
IF Q14 IS "MS", "NF", "DR" OR "ND" SEND CENSUS PACKET TO PROBLEMATIC FORMS			

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Appendix 2**: Agincourt HDSS migration questionnaire**

AGINCOURT Health & Population Unit
School of Public Health - University of the Witwatersrand
MRC/Wits Rural Public Health and Health Transitions Research Unit

Temporary Migration Form

Village: | | |
Dwelling: | | | | | |
Fieldworker: | | | | |
Visit Date: | Y | Y | Y | Y | M | M | D | D |

1	Respondent's Census ID		1
2	Respondent's relationship to migrant	**H** = Household head; **M** = Household member; **N** = Neighbor	2
3	Migrant's Name and Surname	Name: 3a	A A A A A A A A A A A A A A A
		Surname: 3b	A A A A A A A A A A A A A A A
4	Migrant's Census ID		4
5	For how many years has this person been a temporary migrant?		5
6	What is the place where s/he lived the most in the last 12 months when s/he is away?	Place 6a	
		Town or City 6b	
		Province — **NP** = Limpopo; **MP** = Mpumalanga; **GT** = Gauteng; **KN** = KwaZulu-Natal; **FS** = Free State; **EC** = Eastern Cape; **NW** = Northwest; **NC** = Northern Cape ; **WC** = Western Cape	6c
		Country — **ZA** = South Africa; **MZ** = Mozambique; **ZW** = Zimbabwe; **SZ** = Swaziland; **BW** = Botswana; **LS** = Lesotho; **NA** = Namibia; **MW** = Malawi; **ZM** = Zambia; **AO** = Angola	6d
7	What is the place where s/he lived the second most in last 12 months when away?	Place 7a	
		Town or City 7b	
		Province — **NP** = Limpopo; **MP** = Mpumalanga; **GT** = Gauteng; **KN** = KwaZulu-Natal; **FS** = Free State; **EC** = Eastern Cape; **NW** = Northwest; **NC** = Northern Cape ; **WC** = Western Cape	7c
		Country — **ZA** = South Africa; **MZ** = Mozambique; **ZW** = Zimbabwe; **SZ** = Swaziland; **BW** = Botswana; **LS** = Lesotho; **NA** = Namibia; **MW** = Malawi; **ZM** = Zambia; **AO** = Angola	7d
8	What is the place where s/he lived the third most in the last 12 months when away?	Place 8a	
		Town or City 8b	
		Province — **NP** = Limpopo; **MP** = Mpumalanga; **GT** = Gauteng; **KN** = KwaZulu-Natal; **FS** = Free State; **EC** = Eastern Cape; **NW** = Northwest; **NC** = Northern Cape ; **WC** = Western Cape	8c
		Country — **ZA** = South Africa; **MZ** = Mozambique; **ZW** = Zimbabwe; **SZ** = Swaziland; **BW** = Botswana; **LS** = Lesotho; **NA** = Namibia; **MW** = Malawi; **ZM** = Zambia; **AO** = Angola	8d
9	Has s/he lived in more than three places in the last 12 months?	**Y** = Yes; **N** = No	9
10	What are the most and second most important reasons for the person being away?	**1** = Looking for work; **2** = Employed; **3** = School/studies; **4** = Training to be a sangoma/FH; **5** = Live with another spouse/ partner; **6** = Visit family; **7** = Visit friends; **8** = Holiday; **9** = Hospital/ clinic; **10** = Getting healed at a sangoma/FH; **11** = Escaping from unfavorable situations; **12** = Prison; **13** = Other	Most important 10a; Second most important 10b
	If Other, please specify		10c
ASK Q11 ONLY IF Q10a = 1 OR Q10b = 1			
11	Did s/he find a job?	**F** = Yes, Formal sector job; **I** = Yes, informal sector job; **N** = No job found	11
ASK Q12 ONLY IF Q10a = 2 OR Q10b = 2 OR IF Q11 = "F" OR "I"			
12	Type of work	**1** = Farm work; **2** = Domestic work; **3** = Construction work; **4** = Security work; **5** = Cleaning work ; **6** = Small business owner; **7** = Mine work; **8** = Teacher; **9** = Traditional healer; **10** = Health sector (formal); **11** = Game farm; **12** = Driver; **13** = Skilled worker; **14** = Cook/chef/ catering; **15** = Unskilled worker; **16** = Artisan; **17** = Waiter/ barman; **18** = Informal selling; **19** = Small business assistant; **20** = Clerical and office work; **21** = Cattle herder; **22** = Sewing, hairdressing, baking, brewing; **23** = Police, soldier, fireman; **24** = Petrol attendant; **25** = Timber, sawmill, poles; **26** = Gardening services; **27** = Fieldworker - NGO; **28** = Art, craft, photography, fashion design; **29** = Senior Administrator, manager, professional; **30** = Priest; **32** = Unknown	12
13	What pattern best describes the time he or she returned home in the last 12 months?	**1** = Christmas only; **2** = Christmas and Easter only; **3** = Month ends; **4** = Month ends plus a holiday; **5** = Most weekends; **6** = One long period/holiday; **7** = Two holidays/periods; **8** = School holidays; **9** = An irregular pattern; **10** = Other	13a
	If other, please specify, or enter multiple codes		13b
14	When was s/he last in the dwelling?	(Estimate if unsure)	14 Y Y Y Y M M D D
15	When was the most recent communication between the migrant and somebody in the household?	(Estimate if unsure)	15 Y Y Y Y M M D D
16	What mode was used for the previous communication?	**1** = Spoke in person at home; **2** = Spoke in person at work; **3** = Spoke by telephone; **4** = Verbal message; **5** = Written message/letter; **6** = Other	16a
	If other, please specify		16b
17	Does he or she send anything back to this household?	**Y** = Yes; **N** = No	17

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Appendix 3**: Agincourt HDSS temporary migration questionnaire –Page 1**

IF Q17 = "N", SKIP TO Q24

18	Does the migrant usually send back:	Money?	(If yes, fill circle completely)	18a ○
		Clothing?	(If yes, fill circle completely)	18b ○
		Food?	(If yes, fill circle completely)	18c ○
		Other?	(If yes, fill circle completely)	18d ○
	If other, please specify	18e		
19	Are there any major items in this dwelling that the migrant bought, by cash or credit, in the last year?		Y = Yes; N = No	19a A
	If yes, please specify	19b		

ASK Q20 AND Q21 ONLY IF Q18a = "Y"

20	Who is the money given to?		(Use census ID)	20 1 1 1 1 1 1
21	Is the money usually spent on:	House?	(If yes, fill circle completely)	21a ○
		Cattle?	(If yes, fill circle completely)	21b ○
		Food?	(If yes, fill circle completely)	21c ○
		Clothes?	(If yes, fill circle completely)	21d ○
		Business/trade?	(If yes, fill circle completely)	21e ○
		Electricity?	(If yes, fill circle completely)	21f ○
		Communication?	(If yes, fill circle completely)	21g ○
		Transport?	(If yes, fill circle completely)	21h ○
		Healthcare?	(If yes, fill circle completely)	21i ○
		School?	(If yes, fill circle completely)	21j ○
		Other?	(If yes, fill circle completely)	21k ○
	If other, please specify	21l		
22	What is the amount/value of goods sent home last month?		(Enter value in Rand)	22 1 1 1 1 1 1
23	What is the amount/value of goods sent home in the last year?			23 1 1 1 1 1 1
24	As a result of this person moving, is/are there	children who move to another place?	(If yes, fill circle completely)	24a ○
		children who move with the migrant?	(If yes, fill circle completely)	24b ○
		a child carer that moves in?	(If yes, fill circle completely)	24c ○
		a partner accompanying the migrant on return?	(If yes, fill circle completely)	24d ○
		a partner that visits the migrant in the work place?	(If yes, fill circle completely)	24e ○
		other moves in or out of the household?	(If yes, fill circle completely)	24f ○
	If other move, please specify	24g		
25	Does s/he have any children under 18 that do not migrate with her/him?		Y = Yes; N = No	25 A

Child Census ID (Repeat Child ID if more than one place)	Where does the child stay when the migrant is away? H = In this HH; R = with a relative; N = with a neighbor; O = Other (If R, give relation; if O, specify)		If the child is ill, who decides to take him/her to get treatment? (If H, give Census ID; if R, give relation to child; write "N" for neighbor; write "O" for other and specify)	On a daily basis, who prepares food for the child?
26	27a	27b	28	29
1 1 1 1 1 1	A			
1 1 1 1 1 1	A			
1 1 1 1 1 1	A			
1 1 1 1 1 1	A			
1 1 1 1 1 1	A			

30 Comments:

[redacted]

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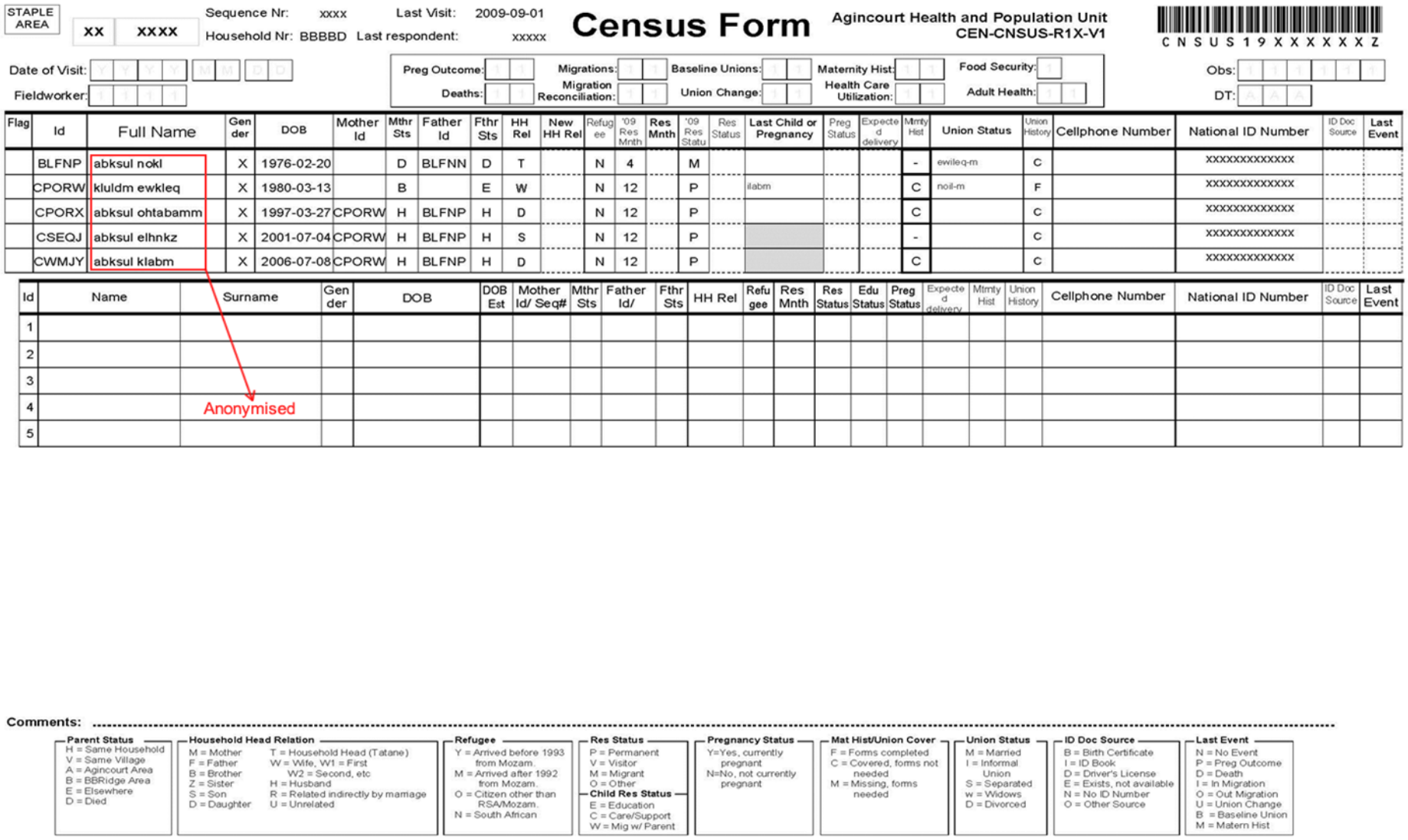
Appendix 4**: Agincourt HDSS temporary migration questionnaire - Page 2**



STAPLE AREA

XX XXXX

Sequence Nr: xxxx Last Visit: 2009-09-01

Household Nr: BBBBD Last respondent: xxxxx

Census Form

Agincourt Health and Population Unit
CEN-CNSUS-R1X-V1

CNSUS19XXXXXXXZ

Date of Visit: Y Y Y Y M M D D

Fieldworker:

Preg Outcome: Migrations: Baseline Unions: Maternity Hist: Food Security:

Deaths: Migration Reconciliation: Union Change: Health Care Utilization: Adult Health:

Obs:

DT:

Flag	Id	Full Name	Gender	DOB	Mother Id	Mthr Sts	Father Id	Fthr Sts	HH Rel	New HH Rel	Refugee	'09 Res Mnth	Res Mnth	'09 Res Statu	Res Status	Last Child or Pregnancy	Preg Status	Expected delivery	Mrrty Hist	Union Status	Union History	Cellphone Number	National ID Number	ID Doc Source	Last Event
	BLFNP	abksul nokl	X	1976-02-20		D	BLFNN	D	T		N	4		M					-	ewileq-m	C		xxxxxxxxxxxx		
	CPORW	kluldm ewkleq	X	1980-03-13		B		E	W		N	12		P		ilabm			C	noil-m	F		xxxxxxxxxxxx		
	CPORX	abksul ohtabamm	X	1997-03-27	CPORW	H	BLFNP	H	D		N	12		P					C		C		xxxxxxxxxxxx		
	CSEQJ	abksul elhnkz	X	2001-07-04	CPORW	H	BLFNP	H	S		N	12		P					-		C		xxxxxxxxxxxx		
	CWMJY	abksul klabm	X	2006-07-08	CPORW	H	BLFNP	H	D		N	12		P					C		C		xxxxxxxxxxxx		

Id	Name	Surname	Gender	DOB	DOB Est	Mother Id/ Seq#	Mthr Sts	Father Id/	Fthr Sts	HH Rel	Refugee	Res Mnth	Res Status	Edu Status	Preg Status	Expected delivery	Mrrty Hist	Union History	Cellphone Number	National ID Number	ID Doc Source	Last Event
1																						
2																						
3																						
4		Anonymised																				
5																						

Comments:

Parent Status
H = Same Household
V = Same Village
A = Agincourt Area
B = BBRidge Area
E = Elsewhere
D = Died

Household Head Relation
M = Mother
F = Father
B = Brother
Z = Sister
S = Son
D = Daughter
T = Household Head (Tatane)
W = Wife, W1 = First
W2 = Second, etc
H = Husband
R = Related indirectly by marriage
U = Unrelated

Refugee
Y = Arrived before 1993 from Mozam.
M = Arrived after 1992 from Mozam.
O = Citizen other than RSA/Mozam.
N = South African

Res Status
P = Permanent
V = Visitor
M = Migrant
O = Other

Child Res Status
E = Education
C = Care/Support
W = Mig w/ Parent

Pregnancy Status
Y=Yes, currently pregnant
N=No, not currently pregnant

Mat Hist/Union Cover
F = Forms completed
C = Covered, forms not needed
M = Missing, forms needed

Union Status
M = Married
I = Informal Union
S = Separated
w = Widows
D = Divorced

ID Doc Source
B = Birth Certificate
I = ID Book
D = Driver's License
E = Exists, not available
N = No ID Number
O = Other Source

Last Event
N = No Event
P = Preg Outcome
D = Death
I = In Migration
O = Out Migration
U = Union Change
B = Baseline Union
M = Matern Hist

Appendix 5: **Agincourt HDSS census questionnaire – front page**

Visit Attempts	Date	General Comments	
Attempt #1	Y Y Y Y M M D D		Fieldworker Code I I I I
Attempt #2	Y Y Y Y M M D D		Fieldworker Code I I I I
Attempt #3	Y Y Y Y M M D D		Fieldworker Code I I I I
Field check 1	**Date**	**Comments**	**Checked**
Fieldworker	Y Y Y Y M M D D		Fieldworker Code I I I I
Supervisor	Y Y Y Y M M D D		Supervisor Code I I I I
QC	Y Y Y Y M M D D		QC Code I I I I
Field check 2	**Date**	**Comments**	**Checked**
Fieldworker	Y Y Y Y M M D D		Fieldworker Code I I I I
Supervisor	Y Y Y Y M M D D		Supervisor Code I I I I
QC	Y Y Y Y M M D D		QC Code I I I I
Data room:	Y Y Y Y M M D D		Data Room: A A A
Field check 3	**Code**	**Comments**	**Checked**
Fieldworker	Y Y Y Y M M D D		Fieldworker Code I I I I
Supervisor	Y Y Y Y M M D D		Supervisor Code I I I I
QC	Y Y Y Y M M D D		QC Code I I I I
Data room	Y Y Y Y M M D D		Data Room: A A A

VILLAGES:

00 = Unknown village; **01** = Agincourt; **02** = Croquetlawn; **03** = Cunningmore A; **04** = Cunningmore B; **05** = Huntington; **06** = Ireagh A; **07** = Ireagh B; **08** = Justicia A; **09** = Kildare A; **10** = Kildare B; **11** = Lillydale A; **12** = Lillydale B; **13** = Newington B; **14** = Newington C; **15** = Somerset A; **16** = Xanthia; **17** = Rholane; **18** = Kildare C; **19** = Justicia B; **20** = Somerset B; **21** = Khaya Lami; **23** = Belfast; **24** = Dumphries A; **25** = Dumphries B; **26** = Dumphries C; **27** = Ireagh C; **28** = Somerset C

EDUCATION:

N = None; **C** = Creche; **R** = PreSchool; **A** = Sub-A/Grade 1; **B** = Sub-B/Grade 2; **1** = Std 1/Grade 3; **2** = Std 2/Grade 4; **3** = Std 3/Grade 5; **4** = Std 4/Grade 6; **5** = Std 5/Grade 7; **6** = Std 6/Grade 8; 7 = Std 7/Grade 9; **8** = Std 8/Grade 10; **9** = Std 9/Grade 11; **0** = Std 10/Matric; H = Higher; **L1** = College - Incomplete; **L2** = College-Incomplete; **T1** = Technicon - Incomplete; **T2** = Technical-Incomplete; **U1** = University - Incomplete; **U2** = University complete; **A1** = Adult Basic Education and Training Level 1 (ABET 1); **A2** = ABET 2; **A3** = ABET 3; **A4** = ABET 4; **N1** = National Qualification Framework Level 1 (NQF 1); **N2** = NQF 2; **N3** = NQF 3; **N4** = NQF 4; **M1** = Mozambican Grade 1; **M2** = Mozambican Grade 2; **M3** = Mozambican Grade 3; **M4** = Mozambican Grade 4; **M5** = Mozambican Grade **5**; **M6** = Mozambican Grade 6; **M7** = Mozambican Grade 7; **M8** = Mozambican Grade 8; **M9** = Mozambican Grade 9; **M10** = Mozambican Grade 10; **M11** = Mozambican Grade 11; **M12** = Mozambican Grade 12

Appendix 6: **Agincourt HDSS census questionnaire – back page**

Verbal Autopsy Tool
Child & Adult

CEN-VADLT-R20-V2

AGINCOURT Health & Population Unit
School of Public Health - University of the Witwatersrand
MRC/Wits Rural Public Health and Health Transitions Research Unit

Village: | |
Dwelling: | | | | | A |
Fieldworker: | | | | |
Visit Date: Y Y Y Y M M D D

Instructions: *Use this verbal autopsy tool for all deceased children aged four weeks and older, and ALL adults. Note: there are a number of skips based on age, sex, symptoms, and previously known medical conditions.*

Section 1: Questions regarding the interview start time and the respondent

1	What time did the interview start?		1				
2	Was there a suitable respondent?	**Y** = Yes → Q4a **N** = No → Q3 (then end interview)	2	A
3	If NO, what was the reason?	3		
4 a	What is the relationship of the respodent to the deceased?	**F** = Father **M** = Mother **P** = Spouse **S** = Sibling **G**= Grandmother **N** = No relation **O** = Other → Q3b	4a	A
b	If OTHER, please specify.	4b		
5	Did the respondent live with the deceased in the period leading to her/his death?	**Y** = Yes; **N** = No; **D** = Don't know	5	A

Section 3: Questions regarding the deceased

6	Was the deceased male or female?	**M** = Male; **F** = Female	6	A
7	Was the deceased a refugee?	**Y** = Yes; **N** = No	7	A
8	What was the deceased's date of birth?	8	Y Y Y Y M M D D	
9	What was the deceased's date of death?	9	Y Y Y Y M M D D	
10	Age of deceased (in years)		10			
11	What was the day of death?	**M** = Monday **T** = Tuesday **W** = Wednesday **R**= Thursday **F** = Friday **S** = Saturday **U** = Sunday **D** = Don't Know	11	A
12	What was the deceased's South African ID number (for adults)/ birth certificate (for children)?													

Section 4: Registration of the Death

13	**Xana una xona xitifiketi xa rifu kumbe fomo ya rifu?** Do you have a death certificate or death registration form?	**A** = Yes, avilable → Q14 **Y** = Yes, not available → Q16 **N** = No → Section 5a	13	A
14	Date of Death recorded on the certificate/registration form:	14	Y Y Y Y M M D D	
15 a	Cause of death recorded on death certificate/registration form:	15a		
15 b	Contributing causes:	15b		
15 c	Underlying causes:	15c		
16	**Loko xitifiketi mi ri xona, kambe xi nga ri kona sweswi, xana xi kwihi?** If you have death form, but unavailable, where is it?	16		

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Appendix 7: **Agincourt verbal autopsy questionnaire**

Section 5a: History of disease/accident leading to death open narrative (A)

Instructions: *Ask the following section for ALL deceased. Do not ask specific questions. You may guide the respondent with questions such as: 'What happened next?'; 'Is there anything more to tell?'; 'What happened first?', etc.*

Hlamusela leswi nga humelela hi nkarhi kuvabya ka mufi kumbe ngozi le yi yi nga vanga rifu. Loko aku ri na swikombiso swa mavabyi swo hlawuleka, kombela muhlamuri ku hlamusela swi kombiso leswi. Eka vuvabyi byi n'wana na byi n'wana kombela muhlamuri kuri a boxa hi ku kongomisa ku pfuneka loku nga kumiwa hi mufi hi ku landzelelana ka le swi nga fambisa swona.

Give the chronology of events that occurred during the illness period (or after the accident) leading to death. In case of special symptoms, ask the respondent to describe or mimic the symptom. Always specify the treatment received and the order in which events occurred.

17	**Cause of death declared by respondent/ family (#1)**	17	
18	**Cause of death declared by respondent/family (#2)**	18	

Section 5b: Context and History of Previously Known Medical Conditions

I would like to ask you some questions concerning the context and previously known medical conditions the deceased had. Please bear with me and answer all the questions. They will help us to get a clear picture of all possible illnesses that the deceased had.

19	**Xana u byeriwile leswaku u na vuvaybi bya rifuva?** Was there any diagnosis of Tuberculosis?	**Y** = Yes; **N** = No; **D** = Don't know	19	A
20	**Xana a nga va a byeriwile leswaku u na mavabyi ya HIV/AIDS?** Was there any diagnosis of HIV/AIDS?	**Y** = Yes; **N** = No; **D** = Don't know	20	A
21	**Xana wanuna kumbe wansati a nga va a ha ku byeriwa leswaku u na malaria?** Did s/he have a recent positive test for Malaria?	**Y** = Yes → Q23 **N** = No → Q22 **D** = Don't know → Q22	21	A
22	**Xana wanuna kumbe wansati a nga va a ha ku byeriwa leswaku a nga na wona malaria?** Did s/he have a recent negative test for Malaria?	**Y** = Yes; **N** = No; **D** = Don't know	22	A
23	**Xana anga va a byeriwile leswaku u na mavabyi ya swimungwamungwana?** Was there any diagnosis of Measles?	**Y** = Yes; **N** = No; **D** = Don't know	23	A
24	**Xana a nga va a byeriwile leswaku u na mavabyi ya ku tlakuka ka mabelo ya mbilu?** Was there any diagnosis of High Blood Pressure?	**Y** = Yes; **N** = No; **D** = Don't know	24	A
25	**Xana u byeriwile leswaku u na mavabyi ya mbilu?** Was there any diagnosis of Heart Disease?	**Y** = Yes; **N** = No; **D** = Don't know	25	A
26	**Xana u byeriwile leswaku u na mavabyi ya chukele?** Was there any diagnosis of Diabetes?	**Y** = Yes; **N** = No; **D** = Don't know	26	A
27	**Xana u byeriwile leswaku u na mavabyi ya xifuva?** Was there any diagnosis of Asthma?	**Y** = Yes; **N** = No; **D** = Don't know	27	A
28	**Xana u byeriwile leswaku u na mavabyi ya ku wa?** Was there any diagnosis of Epilepsy?	**Y** = Yes; **N** = No; **D** = Don't know	28	A
29	**Xana u byeriwile leswaku u na mavabyi ya fukuzana?** Was there any diagnosis of Cancer?	**Y** = Yes; **N** = No; **D** = Don't know	29	A
30	**Xana u byeriwile leswaku u na mavabyi ya rifuva ro ka ri nga tshunguleki?** Was there any diagnosis of Chronic Obstructive Pulmonary Disease (COPD)?	**Y** = Yes; **N** = No; **D** = Don't know	30	A
31	**Xana u byeriwile leswaku u na mavabyi yo rivala hi ku hatlisa?** Was there any diagnosis of Dementia?	**Y** = Yes; **N** = No; **D** = Don't know	31	A
32	**Xana u byeriwile leswaku u na mavabyi ya tshikelelo?** Was there any diagnosis of Depression?	**Y** = Yes; **N** = No; **D** = Don't know	32	A
33	**Xana a nga va a byeriwile leswaku u na mavabyi ya miehleketo?** Was there a diagnosis of other mental illness (schizophrenia, psychoses, bipolar disorder)?	**Y** = Yes; **N** = No; **D** = Don't know	33	A
34	**Xana u byeriwile leswaku u na mavabyi ya xitiroku?** Was there any diagnosis of Stroke?	**Y** = Yes; **N** = No; **D** = Don't know	34	A
35	**Xana u byeriwile leswaku u na mavabyi ya tinso?** Was there any diagnosis of Kidney disease?	**Y** = Yes; **N** = No; **D** = Don't know	35	A
36	**Xana u byeriwile leswaku u na mavabyi ya xivindzi?** Was there any diagnosis of Liver disease?	**Y** = Yes; **N** = No; **D** = Don't know	36	A
37	**Xana wanuna kumbe wansati u lovile hi nkarhi wa ti pfula?** Did s/he die during the wet season (summer)?	**Y** = Yes; **N** = No; **D** = Don't know	37	A
38	**Xana wanuna kumbe wansati u lovile hi nkarhi wa vuxika?** Did s/he die during the dry season (winter)?	**Y** = Yes; **N** = No; **D** = Don't know	38	A
39	**Xana I nkarhi wo leha ku fika kwihi wanuna kumbe wansati a karhi a vabyi a nga si lova?** For how long was s/he ill before s/he died?	**D** = Days; **W** = Weeks; **M** = Months; **Y** = Years **Number:**	39a 39b	A [ ][ ]
40	**Xana wanuna kumbe wansati u lovile hi xihatla?** Did s/he die suddenly?	**Y** = Yes; **N** = No; **D** = Don't know	40	A

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Section 6a: History of Injuries/Accidents

I would like to ask you some questions concerning the injuries and accidents that the deceased suffered.

41	**Xana wanuna kumbe wansati u karhatekile ka timbanga kumbe ngozi leyi yinga nwi yisa ku feni?** Did s/he suffer from any injury or accident that led to her/his death?	**Y** = Yes → Q42a **N** = No → End of Section 6 **D** = Don't know → Q42a	**41**	A
42 a	**Xana wanuna kumbe wansati u vaviseke e ka ngozi ya le patwini?** Did s/he suffer from a road traffic accident?	**Y** = Yes → Q42b **N** = No → Q44	**42a**	A
42 b	**Xana wanuna kumbe wansati u vaviseke a ri mufambi hi milenge?** Was s/he injured as a pedestrian/walking?	**Y** = Yes; **N** = No; **D** = Don't know	**42b**	A
42 c	**Xana wanuna kumbe wansati u vaviseke a ri unwana wava khandziyi e ka movha?** Was s/he injured as an occupant of a car vehicle?	**Y** = Yes; **N** = No; **D** = Don't know	**42c**	A
42 d	**Xana wanuna kumbe wansati u vaviseke a ri unwana wava khandziyi e ka bazi kumbe movha lowukulu (truck)?** Was s/he injured as an occupant of a bus/heavy transport vehicle?	**Y** = Yes; **N** = No; **D** = Don't know	**42d**	A
42 e	**Xana wanuna kumbe wansati u vaviseke a ri dirayivha kumbe mukhandziyi wa xithuthuthu?** Was s/he injured as a driver or passenger of a motorcycle?	**Y** = Yes; **N** = No; **D** = Don't know	**42e**	A
42 f	**Xana wanuna kumbe wansati u vaviseke a ri mufambisi wa bayisikiri?** Was s/he injured as a pedal cyclist?	**Y** = Yes; **N** = No; **D** = Don't know	**42f**	A
43 a	**Xana wa swi tiva ku i yini lexi va nga chayisa xona hi nkarhi wa nghozi?** Do you know anything about the counter-part that was hit during the road traffic accident?	**Y** = Yes → Q43b **N** = No → Q44	**43a**	A
43 b	**Xana a ri mufambi hi milenge?** Was it a pedestrian?	**Y** = Yes; **N** = No; **D** = Don't know	**43b**	A
43 c	**Xana a ku ri xilo lexi a xi lo tiyimela?** Was it a stationary object?	**Y** = Yes; **N** = No; **D** = Don't know	**43c**	A
43 d	**Xana a ku ri movha lowuntsongo?** Was it a car vehicle?	**Y** = Yes; **N** = No; **D** = Don't know	**43d**	A
43 e	**Xana a ku ri bazi kumbe movha lowukulu (truck)?** Was it a bus or heavy transport vehicle?	**Y** = Yes; **N** = No; **D** = Don't know	**43e**	A
43 f	**Xana a ku ri xithuthuthu?** Was it a motorcycle?	**Y** = Yes; **N** = No; **D** = Don't know	**43f**	A
43 g	**Xana a ku ri bayisikiri?** Was it a pedal cycle?	**Y** = Yes; **N** = No; **D** = Don't know	**43g**	A
43 h	**Xana a ku ri swinwana?** Was it something else?	**Y** = Yes; **N** = No; **D** = Don't know	**43h**	A
43 i	If OTHER, please specify.	**43i**		
44	**Xana wanuna kumbe wansati u vaviseke e ka ngozi yo ka yi ngari ya le patwini?** Was s/he injured in a non-road traffic accident?	**Y** = Yes; **N** = No; **D** = Don't know	**44**	A
45	**Xana wanuna kumbe wansati u lovile hi kuwa suka ehenhla?** Did s/he die as a result of a fall?	**Y** = Yes; **N** = No; **D** = Don't know	**45**	A
46	**Xana wanuna kumbe wansati u lovile hi ku n`wela?** Did s/he die of drowning?	**Y** = Yes; **N** = No; **D** = Don't know	**46**	A

47		**Xana wanuna kumbe wansati u vile na ku tswa?** Did s/he suffer from burns?	**Y** = Yes; **N** = No; **D** = Don't know	**47**	A
48	a	**Xana wanuna kumbe wansati a karha teka hi vuvabyi bya swiharhi kumbe a lumiwile, leswi nga endla leswaku a lova?** Did s/he suffer from any plant/animal/insect bite or sting that led to her/his death?	**Y** = Yes → Q48b **N** = No → Q49 **D** = Don't know → Q48b	**48a**	A
	b	**Xana a ku ri mbyana?** Was it a dog?	**Y** = Yes; **N** = No; **D** = Don't know	**48b**	A
	c	**Xana a ku ri nyoka?** Was it a snake?	**Y** = Yes; **N** = No; **D** = Don't know	**48c**	A
	d	**Xana a ku ri switsotswana?** Was it an insect?	**Y** = Yes; **N** = No; **D** = Don't know	**48d**	A
49		**Xana wanuna kumbe wansati u vaviseke hi swilo swa ntumbuluko?** Was s/he injured by a force of nature?	**Y** = Yes → End of Section 6 **N** = No **D** = Don't know	**49**	A
50		**Xana aku rina ku cheleriwa?** Was there any poisoning?	**Y** = Yes; **N** = No; **D** = Don't know	**50**	A
51		**Xana wanuna kumbe wansati a ri un`wana wa valwisani kumbe vavavisiwa?** Was s/he subject to violence or assault?	**Y** = Yes; **N** = No; **D** = Don't know	**51**	A
52		**Xana ku vaviseka a ku endliwe hi un`wana hi xikongomelo?** Was the injury intentionally inflicted by someone else?	**Y** = Yes; **N** = No; **D** = Don't know	**52**	A
53	a	**Xana wanuna kumbe wansati u vavisiwe hi xibamu?** Was s/he injured with a firearm?	**Y** = Yes; **N** = No; **D** = Don't know	**53a**	A
	b	**Xana wanuna kumbe wansati u vaviseke hi ku thlaviwa,tsemiwa kumbe tsemeleriwa?** Was s/he injured from a stab, cut, or pierce?	**Y** = Yes; **N** = No; **D** = Don't know	**53b**	A
	c	**Xana wanuna kumbe wansati u vavisiwe hi muchini?** Was s/he injured by machinery?	**Y** = Yes; **N** = No; **D** = Don't know	**53c**	A
54		**Xana wanuna kumbe wansati a biwe hi xiharhi kumbe hi xilo?** Was s/he struck by an animal or object?	**Y** = Yes; **N** = No; **D** = Don't know	**54**	A
55		**Xana u ehleketa leswaku wanuna kumbe wansati u lotindlaya?** Do you think s/he committed suicide?	**Y** = Yes → Section 6c **N** = No	**55**	A

If Q42a ≠ Y AND Q51 ≠ Y AND Q55 ≠ Y and Q10 >15, skip to Section 8a if female (Q6=F) OR skip to Section 9 if male (Q6=M)

<u>IF Q41 = N</u>
AND deceased is less than 1 year old skip to Section 7a
AND deceased is between 1-14 years skip to Section 7b
AND deceased is older than 14 years AND male (Q6= M) skip to Section 9
AND deceased is older than 11 years AND female (Q6= F) skip to Section 8a

Section 6b: Additional Road Traffic Accident Questions (A)

Instructions: *Ask this section to all individuals who responded 'Y' to Question 42a.*

56 a	**Xana ngozi ya le patwini yi humelele kwihi?** Where did the road traffic accident occur?	**R** = Rual → Q57 **N** = Urban → Q57 **O** = Other → Q56b	**56a**	A
b	If OTHER, please specify **56b**			
57	**Xana a ku ri nkarhi muni loko ngozi yi humelele?** What was the time of the accident?	**D** = Daytime **N** = Nightime	**57**	A
58	**Xana I muxaka muni wa patu laha ngozi yi humeleleke kona?** What type of road surface did the accident occur on?	**D** = Dirt **T** = Tar	**58**	A
59	**Xana mufi a ri kun w`eni ka byalwa loko ngozi yi humelela?** Had the deceased been drinking alcohol at the time of the accident?	**Y** = Yes; **N** = No; **D** = Don't know	**59**	A
60	**Loko mufi a nga ri yena muchayeri,xana muchayeri ari ku n`weni ka byalwa loko ngozi yi humelela?** If the deceased was <u>not</u> the driver, was the driver drinking alcohol at the time of the accident?	**Y** = Yes; **N** = No; **D** = Don't know	**60**	A
61	**Xana mufi a bohile bandhi ra vuhlayiseki?** Was the deceased wearing a seatbelt?	**Y** = Yes; **N** = No; **D** = Don't know; **A** = Not applicable-pederstrian	**61**	A
62	**Xana vakhandziyi lavanw`ana a va bohile mabandhi ya vuhlayiseki?** Were other passengers of the vehicle wearing seatbelts?	**Y** = Yes; **N** = No; **D** = Don't know	**62**	A
63	**Xana hi ntolovelo bandhi ra vuhlayiseki ri bohiwa njhani?** What is the normal pattern of seatbelt usage?	**A** = Always **S** = Sometimes **N** = Never	**63**	A
64	**Xana movha lowu a va ri ka wona a wu ri na malembe mangana?** What was the age of the vehicle involved?	**N** = <5 years old **B** = 5-10 years old **O** = >10 years old **D** = Don't Know	**64**	A
65	**Xana I nkarhi wo fika kwihi muchayeri a ri na papilla ra vuchayeri?** What was the length of time the driver of the vehicle had been licensed?	**N** = <1 year **B** = 1-4 years **O** = ≥5 years **D** = Don't Know	**65**	A
66	**Xana u love laha ngozi yi humeleleke kona?** Did the person die at the site of the accident?	**Y** = Yes; **N** = No; **D** = Don't know	**66**	A
67	**Loko ku ri ee, xana u hete tiawara kumbe masiku mangani endzhaku ka ngozi?** If NO, how many hours/days after the accident?	**H** = Hours **D** = Days	**67a**	A
		Number:	**67b**	1 1

IF deceased is less than 1 year old skip to Section 7a OR
IF decease is between 1-14 years skip to Section 7b OR
IF deceased is older than 11 years AND female (Q6 = F) skip to Section 8a OR
IF deceased is older than 14 years AND male (Q6 = M) skip to Section 9

Section 6c: Additional Assault Questions (A)

Instructions: *Ask this section to all individuals who responded 'Y' to Question 51.*

68	**Xana mufi ari ku n`weni ka byalwa hi nkarhi wo vavisiwa?** Had the deceased been drinking alcohol at the time of the assault?	**Y** = Yes; **N** = No; **D** = Don't know	**68**	A
69	**Xana lava n`wi vaviseke a va ri kun we`ni ka byalwa?** Had the attackers been drinking alcohol at the time of the assault?	**Y** = Yes; **N** = No; **D** = Don't know	**69**	A
70 a	**Xana ku vaviseka ku vangiwe hi:** Were the injuries caused by:	**S** = Stabbing **G** = Gunshot **F** = Fighting (blunt trauma) **O** = Other → Q70b	**70a**	A
b	**If OTHER, please specify: 70b**			
71	**Xana ku lwa a ku ri ka:** Was the violence?	**D** = Domestic **P** = Political **S** = Street **L** = Police **O** = Other	**71**	A

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72	**Hi byihi vuxaka bya muhlaseri na mufi?** What was the relation of the attacker to the deceased?	**P** = Partner (husband/wife) **F** = Family member **N** = Neighbour **R** = Friend **S** = Stranger; relation unknown	72	A
73	**Xana u lovele e ka ndhawu leyi a nga vavisiwa e ka yona?** Did the person die at the site of the assault?	**Y** = Yes → End of Section 6c **N** = No **D** = Don't know	73	A
74	**Loko ku ri ee, xana u hetile tiawara kumbe masiku mangani endzhaku ko vaviseka?** If NO, how many hours/days after the assault?	**H** = Hours **D** = Days	74a	A
		Number:	74b	1 1

IF deceased is older than 1 year old skip to Section 7a OR
IF decease is between 1-14 years skip to Section 7b OR
IF deceased is older than 11 years AND female (Q6 = F) skip to Section 8a OR
IF deceased is older than 14 years AND male (Q6 = M) skip to Section 9

Section 6d: Suicide Module (A)

Instructions: *Ask this section to all individuals who responded 'Y' to Question 55.*

75	**Xana mufi u tshame a tshunguriwa mavabyi ya miehleketo?** Had the deceased previously been treated for a mental health condition?	**Y** = Yes **N** = No **D** = Don't know	75	A
76	**Xana mufi a ri le ku tshunguriweni ka mavabyi ya miehleketo?** Was the deceased currently being treated for a mental health condition?	**Y** = Yes **N** = No **D** = Don't know	76	A
77 a	**Xana ku vile na xiyimo xo kala xi nga ri kahle lexi endleke ati dlaya?** Was there a traumatic event precipitating the suicide?	**Y** = Yes → Q77b **N** = No → Q78 **D** = Don't know → Q78	77a	A
b	**Loko ku ri ina, xana hi swihi:** 77b If YES, what was this:			
78	**Xana masiku ndzhaku, u ringetile ku tidlaya?** Was there a previous, unsuccessful suicide attempt?	**Y** = Yes; **N** = No; **D** = Don't know	78	A
79	**Xana ku nga va ku ri na matimu endyangwini hi mavabyi ya miehleketo?** Is there a family history of mental illness?	**Y** = Yes; **N** = No; **D** = Don't know	79	A
80	**Xana u lovele e ka ndhawu leyi a nga tidlayela e ka yona?** Did the person die at the site of the suicide?	**Y** = Yes; **N** = No; **D** = Don't know	80	A
81	**Loko ku ri ee, xana u hete tiawara tingani kumbe masikumangani endzhaku ko tidlaya?** If NO, how many hours/days after the suicide?	**H** = Hours **D** = Days	81a	A
		Number:	81b	1 1

<u>End of Section 6</u>

IF deceased is less than 1 year old continue to Section 7a OR
IF decease is between 1-14 years skip to Section 7b OR

IF deceased is female (Q6 = F) AND 14 years and older skip to Section 8a OR
IF deceased is male (Q6 = M) AND 14 years and older skip to Section 9

Section 7a: Symptoms and Signs noted during the final illness of Infants

Instructions: *Only ask the following questions IF decease is less than 1 year old.*

82	**Xana nwana a tika mpimo wa le hansi ka 2.5 kg?** Was the child born smaller than normal, weighing under 2.5 kg?	**Y** = Yes; **N** = No; **D** = Don't know	82	A
83 a	**Xana a tike mavhiki kumbe tinhweti tingani loko n'wana a beburiwa?**	**W** = Weeks → Q83b **M** = Months → Q83b **D** = Don't know →Q84	83a	A
b	How many weeks or months was the pregnancy when the baby was born?	**Number:**	83b	1 1
84	**Xana nwana a kukumukile rhavarhava?** Did the child have bulging of the fontanelle?	**Y** = Yes; **N** = No; **D** = Don't know	84	A
85	**Xana rhavarhava ya nwana a yi nghene endzeni?** Did the child have a sunken fontanelle?	**Y** = Yes; **N** = No; **D** = Don't know	85	A

Continue to Section 9

Section 7b: Symptoms and Signs noted during the final illness of child

Instructions: *Ask the following questions for ALL deceased aged 1 and 14 years.*

86	**Xana wanuna kumbe wansati arina mukhuhwlana wa xi mbyembye?** Did s/he make a whopping sound when coughing?	**Y** = Yes; **N** = No; **D** = Don't know	86	A
87	**Xana ku vonakile marhambu ya le xifuveni na marhambu ya le timbambeni loko nwana hefemula?** Did you see the lower chest wall/ribs being pulled in as the child breathed?	**Y** = Yes; **N** = No; **D** = Don't know	87	A
88	**Xana nwana a kula kahle?** Was the child growing normally?	**Y** = Yes; **N** = No; **D** = Don't know	88	A
89	**Xana u kona un'wana a tshamaka laya kaya na n'wana loyi, a vabyaka hi TB?** Had anyone living in the same house as the child recently had TB?	**Y** = Yes; **N** = No; **D** = Don't know	89	A
90	**Xana n'wana loyi a khomiwa hi mavabyi ku tlula vana van'wana endyangwini kumbe emugangeni ke?** Did the child get more illnesses compared to other children in the family or the community?	**Y** = Yes; **N** = No; **D** = Don't know	90	A
91 a	**Xana manana wa n'wana loyi a nga lova wa ha hanya?** Is the mother of the deceased newborn alive?	**Y** = Yes → Q91b **N** = No → Q92a **D** = Don't know → Q92a	91a	A
b	**Xana manana wa n'wana langa lova u hanya kahle ke?** Is the mother (of the dead child) healthy?	**Y** = Yes → Q92a **N** = No → Q91c **D** = Don't know → Q92a	91b	A
c	**Loko kuri ee, u karhatiwa (vabya) hi yini ke?** If NO, what is her sickness?	91c		
92 a	**Xana tatana wa n'wana loyi a nga lova wa ha hanya?** Is the father of the deceased newborn alive?	**Y** = Yes → Q92b **N** = No → Q93 **D** = Don't know → Q93	92a	A
b	**Xana tata wa mufi u hanye kahle ke?** Is the father (of the dead child) healthy?	**Y** = Yes; **N** = No; **D** = Don't know	92b	A
c	**Loko kuri ee, u karhatiwa (vabya) hi yini ke?** If NO, what is his sickness?	92c		

Instructions: *Only ask the following questions for deceased younger than 2 years.*

93	**Xana mufi a tsandzeka ku endla swilo swa ntolovelo, xikombiso kufamba, kutlanga, ku vulavula?** Did the child stop doing things s/he could do before (eg sit, walk, talk, play)?	**Y** = Yes; **N** = No; **D** = Don't know	93	A
94	**Xana n'wana a ha mama bodlhela?** Was the child still bottle-feeding?	**Y** = Yes; **N** = No; **D** = Don't know	94	A
95	**Xana n'wana a ha mama vele?** Was the child still breast-feeding?	**Y** = Yes; **N** = No; **D** = Don't know	95	A

IF deceased is female (Q6= F) AND 12 years and older continue to Section 8a OR

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IF deceased is male (Q6= M) OR female (Q6 = F) AND younger than 12 years skip to Section 9

Section 8a: Symptoms and Signs Associated with Illness of Women

Instructions: *Only ask the following questions IF deceased is a FEMALE 12 years and older.*

96	**Xana wanuna kumbe wansati a rina ti ULCERS kumbe ku pfimba eka mavele ya yena?** Did she have an ulcer or swelling in the breast?	**Y** = Yes; **N** = No; **D** = Don't know	**96**	A
97	**Xana wansati a huma ngati ko tala loko a ri masikwini ku tlula kan'we?** Did she have excessive vaginal bleeding in between menstrual periods?	**Y** = Yes; **N** = No; **D** = Don't know	**97**	A
98	**Xana ku huma ka ngati ku yimile hi ntumbuluko hinkarhi lowu a kurile a fanele ku yima ku ya enkarhini?** Did her vaginal bleeding stop naturally during menopause?	**Y** = Yes; **N** = No; **D** = Don't know	**98**	A
99	**Xana u humile ngati endzhaku ka loko a yimile ku ya enkarhini hi ntumbuluko?** Did she have vaginal bleeding after menopause?	**Y** = Yes; **N** = No; **D** = Don't know	**99**	A

Continue to Section 8b

Section 8b: Symptoms and Signs Associated with Pregnancy

Instructions: *Only ask the following questions IF deceased is a FEMALE 12 years AND 49 years old.*

100	**Xana a nga va a tikile, kumbe a ha ku heta ku bebula exikarhi ka mavhiki ya tsevu yak u lova ka yena?** Was she pregnant or had she delivered within 6 weeks of her death?	**Y** = Yes → Q101 **N** = No → Section 9 **D** = Don't know → Section 9	**100**	A
101	**Xana a tikile hi nkarhi lowu a nga lova hi wona?** Was she pregnant at the time of death?	**Y** = Yes; **N** = No; **D** = Don't know	**101**	A
102	**Xana ulovile exikarhi ka 6 yamavhiki loko a bebukile?** Did she die within 6 weeks of giving birth?	**Y** = Yes; **N** = No; **D** = Don't know	**102**	A
103	**Xana u lovile edzhaku ka mavhiki ya tsevu a tikile kwirhi leri ri nga teka tsevu wa tin`weti ku ya e hansi?** Did she die within 6 weeks of a pregnancy that lasted less than 6 months?	**Y** = Yes; **N** = No; **D** = Don't know	**103**	A
104	**Xana u lovile 24 wati awara endzhaku ka loko a beburile?** Did she die within 24 hours after delivery?	**Y** = Yes; **N** = No; **D** = Don't know	**104**	A
105	**Xana u love a lunwa, kambe anga bebulanga?** Did she die during labour, but undelivered?	**Y** = Yes; **N** = No; **D** = Don't know	**105**	A
106	**Xana a mamisa a nga se lova?** Was she breasfeeding at death?	**Y** = Yes; **N** = No; **D** = Don't know	**106**	A
107	**Xana u bebule kangani, ku katsa ni lava nga beburiwa va lovile a nga si kuma nwana loyi?** How many births, including stillbirths did she have before this baby?	**Number of births/stillbirths (D =** Don't know)	**107**	1 1
108	**Xana uve tshama a endliwa vuhandzuriwa loko a kuma nwana?** Did she have any previous C-section?	**Y** = Yes; **N** = No; **D** = Don't know	**108**	A
109	**Xana u lovile exikarhi kumbe endzhaku ko tika mahahlwa?** Did she die during or after a multiple pregnancy?	**Y** = Yes; **N** = No; **D** = Don't know	**109**	A
110	**Loko a tikile u karhatiwile hi ku tlakuka ka mabelo ya mbilu?** During pregnancy, did she suffer from high blood pressure?	**Y** = Yes; **N** = No; **D** = Don't know	**110**	A
111	**Xana a huma thyaka ro nuha eka xirho xa yena xa xisati loko ata va a tikile kumbe loko a heta ku bebula nwana?** Did she have foul smelling vaginal discharge during pregnancy or after delivery?	**Y** = Yes; **N** = No; **D** = Don't know	**111**	A
112	**Exikarhi ka tinhweti ti nharhu ka ku tika ka yena, xana a karhatiwile hi kurhurhumela ka mirhi ko ka ku nga lawuleki?** During the last 3 months of pregnancy, did she suffer from convulsions?	**Y** = Yes; **N** = No; **D** = Don't know	**112**	A

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113	**Exikarhi ka tinhweti tinharhu to hetelela ta ku tika ka yena a nga va a karhatiwe hi ku ka a nga voni kahle?** During the last 3 months of pregnancy, did she suffer blurred vision?	**Y** = Yes; **N** = No; **D** = Don't know	**113**	A
114	**Xana u bebule n`wan a hanya naswona a hanye kahle exikarhi ka tsevu wa mavhiki yak u lova ka yena?** Did she give birth to a live, healthy baby within 6 weeks of death?	**Y** = Yes; **N** = No; **D** = Don't know	**114**	A
115	**Xana ku vile na ku huma ka ngati yi nga yimi loko ata va atikile kumbe endzaku ka loko a beburile?** Was there any vaginal bleeding during pregnancy or after delivery?	**Y** = Yes; **N** = No; **D** = Don't know	**115**	A
116	**Xana u humile ngati exikarhi hi le ka xirho xa yena xa xisati exikarhi ka tsevu watinwe`ti ta tsevu to sungula ta ku tika ka yena?** Was there any vaginal bleeding during the first 6 months of pregnancy?	**Y** = Yes; **N** = No; **D** = Don't know	**116**	A
117	**Xana ku vile na ku huma ka ngati eka tinhweti tinharhu to hetelela ta ku tika ka yena kambe anga si sungula ku lunwa?** Was there vaginal bleeding during the last 3 months of pregnancy but before labour started?	**Y** = Yes; **N** = No; **D** = Don't know	**117**	A
118	**Xana ku vile na ku huma ngopfu ka ngati loko a lunwa?** Was there excessive vaginal bleeding during labour?	**Y** = Yes; **N** = No; **D** = Don't know	**118**	A
119	**Xana ku vile na ku huma ngopfu ka ngati endzhaku ka loko a kumile nwana?** Was there excessive vaginal bleeding after delivering the baby?	**Y** = Yes; **N** = No; **D** = Don't know	**119**	A
120	**Xana yindlu ya nwana ayi humangi hinkwayo?** Was the placenta not completely delivered?	**Y** = Yes; **N** = No; **D** = Don't know	**120**	A
121	**Xana u kumile nwana wo ka anga tshamanga hi ndlela ya kahle?** Did she deliver or try to deliver an abnormally positioned baby?	**Y** = Yes; **N** = No; **D** = Don't know	**121**	A
122	**Xana u lunwe nkarhi wo leha ku tlula wa ntolovelo (ku tlula 24 wa tiawara)?** Was she in labour for unusually long (more than 24 hours)?	**Y** = Yes; **N** = No; **D** = Don't know	**122**	A
123	**Xana u ringetile ku herisa khwiri?** Did she attempt to terminate the pregnancy?	**Y** = Yes; **N** = No; **D** = Don't know	**123**	A
124	**Xana a ri na kwhirhi leri ri nga ti humela?** Did she recently have a pregnancy that ended in an abortion (spontaneous or induced)?	**Y** = Yes; **N** = No; **D** = Don't know	**124**	A
125	**Xana u kumile nwana eka ndhawu ya swa rihanyo?** Did she give birth in a health facility?	**Y** = Yes → Q128 **N** = No **D** = Don't know	**125**	A
126	**Xana u kumile nwana ekaya?** Did she give birth at home?	**Y** = Yes; **N** = No; **D** = Don't know	**126**	A
127	**Xana u kumile nwana kunwana, xikombiso endleleni ya kuya ku pfunekeni (exibendlele)?** Did she give birth elsewhere, e.g. on the way to the facility?	**Y** = Yes; **N** = No; **D** = Don't know	**127**	A
128	**Xana u kumile ku pfuneka hi mutirhi wa swa rihanyo hi nkarhi wo bebula?** Did she receive professional assistance for the delivery?	**Y** = Yes; **N** = No; **D** = Don't know	**128**	A
129	**Xana ku vile na vuhandzuri byo susa xivelekelo xa yena anga se lova?** Did she have an operation to remove her uterus shortly before death?	**Y** = Yes; **N** = No; **D** = Don't know	**129**	A
130	**Xana u kumile nwana hi ndlela ya ntolovelo?** Did she have a normal vaginal delivery?	**Y** = Yes → Q133 **N** = No **D** = Don't know	**130**	A
131	**Xana u pfuniwile loko a kuma nwana, nwana a kokiwa hi muchini ku humela handle?** Did she have an assisted delivery, with forceps/vacuum?	**Y** = Yes; **N** = No; **D** = Don't know	**131**	A
132	**Xana u kumile nwana hi ndlela ya vuhandzuri?** Was it a delivery with caesarean section?	**Y** = Yes; **N** = No; **D** = Don't know	**132**	A
133	**Xana nwana u tswarile ku sale nhweti leswaku a beburiwa?** Was the baby born more than one month early?	**Y** = Yes; **N** = No; **D** = Don't know	**133**	A

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Continue to Section 8c

Section 8c: Additional Symptoms and Signs Associated with Pregnancy (A)

134	a	**A ya ka kliniki ya vanhu vo tika?** Attend ante-natal clinic?	**Y** = Yes → Q134b **N** = No → Q135b **D** = Don't know → Q135b	**134a**	A
	b	**Loko ku ri ina u ye ka ngani?** If yes, how many times?	**Number:**	**134b**	1 1
135	a	**Xana u kamberiwile mavabyi ya HIV?** Was she tested for HIV?	**Y** = Yes → Q135b **N** = No → Q136 **D** = Don't know → Q136	**135a**	A
	b	**Loko a ri HIV+, xana u nikiwile vutshunguri byo sivele n'wana ke?** If HIV+, was PMTCT initiated?	**Y** = Yes; **N** = No; **D** = Don't know	**135b**	A
136		**A n'wa byala loko a tikile?** Did she drink alcohol during her pregnancy?	**Y** = Yes; **N** = No; **D** = Don't know	**136**	A
137		**A dzaha sikireti loko a tikile?** Did she smoke cigarettes during her pregnancy?	**Y** = Yes; **N** = No; **D** = Don't know	**137**	A
138	a	**Xana u va byile a nga se tika?** Was she ill before her pregnancy?	**Y** = Yes → Q138b **N** = No → Q139a **D** = Don't know → Q139a	**138a**	A
	b	**Loko ku ri lna, hlamusela** If yes, specify the illness	**138b**		
	c	**Xana u kumile vutshunguri?** Was she receiving treatment?	**Y** = Yes → Q138d **N** = No → Q139a **D** = Don't know → Q139a	**138c**	A
	d	**Bya njhani?** If yes, what treatment?	**138d**		

Continue to Section 8d

Section 8d: Pregnancy, Labour open narrative (A)

	a	**Xana nw`na u bebuleriwe kwihi?** Where was the baby born?	**H** = Home → Q140 **C** = Clinic → Q139b **X** = Hospital → Q139b	**139a**	A
139	b	**Loko a nga bebuleriwanga ekaya, xana manana u fikise ku yini exibedlhele/kliniki?** If not born at home, how did the mother get to the hospital/clinic?	**W** = Walking **B** = Bus **T** = Taxi **I** = Own private transport **E** = Rented private transport **A**= Ambulance **O** = Other → Q139c	**139b**	A
	c	**If OTHER, please specify**	**139c**		
140		**Xana ku vile na ku khomeleleka ka mufi ku yisiwa ka vuhlayiseki bya swa rihanyu hinkarhi lowu a kombeta ku lova?** Were there any delays in getting the woman to health services in the time leading to her death?			
141		**Xana u hleketa ku yini leswi a swi ta endla swi olova ku kuma vu korhokeri bya rihanyu?** What do you think could have made it easier to access health services?			

Continue to Section 9

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Section 9: Symptoms noted during the Final Illness

Instructions: *Ask the following questions about ALL deceased.*

142	a	**Xana wanuna kumbe wansati a twa ku hisa kumbe xirhami?** Did s/he have a fever?	**Y** = Yes **N** = No → Q143 **D** = Don't know	**142a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a hisa miri?** For how long did s/he have a fever?	**S** = Days **W** = Weeks **D** = Don't know → Q143	**142b**	A
	c		**Number:**	**142c**	I I
143		**Xana wanuna kumbe wansati a dzuka nyuku na vusiku?** Did s/he have night sweats?	**Y** = Yes; **N** = No; **D** = Don't know	**143**	A
144	a	**Xana wanuna kumbe wansati a khohlola?** Did s/he have a cough?	**Y** = Yes → Q144b **N** = No → Q145 **D** = Don't know → Q145	**144a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a khohlola?** For how long did s/he have a cough?	**S** = Days **W** = Weeks **D** = Don't know → Q144d	**144b**	A
	c		**Number:**	**144c**	I I
	d	**Xana ku khohlola ka yena a ku humesa na xikhohlola?** Was the cough productive with sputum?	**Y** = Yes; **N** = No; **D** = Don't know	**144d**	A
	e	**Xana wanuna kumbe wansati a khohlola ku huma na ngati?** Did s/he cough out blood?	**Y** = Yes; **N** = No; **D** = Don't know	**144e**	A
145		**Xana wanuna kumbe wansati a ri na ku tikeriwa hi ku hefemula?** Did s/he have any breathing problem?	**Y** = Yes → Q146a **N** = No → Q149 **D** = Don't know → Q146a	**145**	A
146	a	**Xana wanuna kumbe wansati a hefumula hi ku hatlisa?** Did s/he have fast breathing?	**Y** = Yes → Q146b **N** = No → Q147a **D** = Don't know → Q147a	**146a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a hefemula hiku hatlisa?** For how long did s/he have fast breathing?	**S** = Days **W** = Weeks **D** = Don't know → Q147a	**146b**	A
	c		**Number:**	**146c**	I I
147	a	**Xana wanuna kumbe wansati a helela hi moya loko a hefemula?** Did s/he have breathlessness?	**Y** = Yes → Q147b **N** = No → Q148 **D** = Don't know → Q148	**147a**	A
	b	**Xana i nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a helela hi moya loko a hefemula?** For how long did s/he have breathlessness?	**S** = Days **W** = Weeks **D** = Don't know → Q147d	**147b**	A
	c		**Number:**	**147c**	I I
	d	**Xana wanuna kumbe wansati tsandzeka ku endla mintirho ya yena ya siku hinkwalaho ko helela hi moya loko a hefemula?** Was s/he unable to carry out daily routine activities due to breathlessness?	**Y** = Yes; **N** = No; **D** = Don't know	**147d**	A
	e	**Xana wanuna kumbe wansati a helela himoya loko a etlela a ololokile?** Was s/he breathless while lying flat?	**Y** = Yes; **N** = No; **D** = Don't know	**147e**	A
148		**Xana wanuna kumbe wansati ku hefemula ka yena aku rina huwa?** Did s/he have noisy breathing (grunting or wheezing)? *DEMONSTRATE*	**Y** = Yes; **N** = No; **D** = Don't know	**148**	A
149		**Xana wanuna kumbe wansati a twa ku vava ngopfu e xifuveni?** Did s/he have severe chest pain?	**Y** = Yes; **N** = No; **D** = Don't know	**149**	A
150	a	**Xana wanuna kumbe wansati a chuluka?** Did s/he have diarrhoea?	**Y** = Yes → Q150b **N** = No → Q151 **D** = Don't know → Q151	**150a**	A
	b	**Xana i nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a chuluka?** For how long did s/he have diarrhoea?	**S** = Days **W** = Weeks **D** = Don't know → Q151	**150b**	A
	c		**Number:**	**150c**	I I

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151		**Eka nkarhi wun`wana na wun`wana exikarhi ka mavabyi ya yena yo hetelela, xana mapapa ya yena a ma hlanganile na ngati?** At any time during the final illness was there blood in the stools?	**Y** = Yes; **N** = No; **D** = Don't know	**151**	A
152	a	**Xana wanuna kumbe wansati a hlanta?** Did s/he vomit?	**Y** = Yes → Q152b **N** = No → Q153 **D** = Don't know → Q153	**152a**	A
	b	**Xana wanuna kumbe wasati a hlanta mahlanta ya muhlovo wa ngati?** Did s/he vomit 'coffee grounds' or bright red/blood?	**Y** = Yes; **N** = No; **D** = Don't know	**152b**	A
153		**Xana wanuna kumbe wansati a ri na ku tikeriwa ekhwirhini?** Did s/he have any abdominal problem?	**Y** = Yes → Q154a **N** = No → Q156 **D** = Don't know → Q154a	**153**	A
154	a	**Xana wanuna kumbe wansati a twa kun vava ngopfu e khwirhini?** Did s/he have severe abdominal pain?	**Y** = Yes → Q154b **N** = No → Q155a **D** = Don't know → Q155a	**154a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a nga twa ku vava ngopfu e khwirhini?**	**S** = Days **W** = Weeks **D** = Don't know → Q155a	**154b**	A
	c	For how long before death did s/he have severe abdominal pain?	**Number:**	**154c**	1 1
155	a	**Xana wanuna kumbe wansati a kukumukile kwhirhi ku tlula swa ntolovelo?** Did s/he have more than usual protruding abdomen?	**Y** = Yes → Q155b **N** = No → Q156a **D** = Don't know → Q156a	**155a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a nga vana ku kukumuka ngopfu ka khwirhi ko ka ku nga tolovelekangi?**	**S** = Days **W** = Weeks **D** = Don't know → Q156a	**155b**	A
	c	For how long did s/he have a more than usual protruding abdomen?	**Number:**	**155c**	1 1
156	a	**Xana wanuna kumbe wansati u vile na ku tiya endzeni ka khwirhi?** Did s/he have any lump inside the abdomen?	**Y** = Yes → Q156b **N** = No → Q157 **D** = Don't know → Q157	**156a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a nga van a ku tiya endzeni ka khwirhi?**	**S** = Days **W** = Weeks **D** = Don't know → Q157	**156b**	A
	c	For how long did s/he have the lump inside the abdomen?	**Number:**	**156c**	1 1
157		**Xana wanuna kumbe wansati u vile na ku pandza ngopfu ka nhloko?** Did s/he have a severe headache?	**Y** = Yes; **N** = No; **D** = Don't know	**157**	A
158	a	**Xana wanuna kumbe wansati u vile na ku oma ka nhamu kumbe ku vava ka nhamu?** Did s/he have a stiff or painful neck?	**Y** = Yes → Q158b **N** = No → Q159a **D** = Don't know → Q159a	**158a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a nga van a ku oma kumbe ku vava ka nhamu?**	**S** = Days **W** = Weeks **D** = Don't know → Q159a	**158b**	A
	c	For how long did s/he have a stiff or painful neck?	**Number:**	**158c**	1 1
159	a	**Xana wanuna kumbe wansati a hlangene nhloko?** Did s/he have mental confusion?	**Y** = Yes → Q159b **N** = No → Q160a **D** = Don't know → Q160a	**159a**	A
	b	**Xani nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a ri na mavabyi ya miehleketo?**	**S** = Days **W** = Weeks **D** = Don't know → Q160a	**159b**	A
	c	For how long did s/he have mental confusion?	**Number:**	**159c**	1 1
160	a	**Xana wanuna kumbe wansati a titivarile ku tlula tiawara ta 24?** Was s/he unconscious for more than 24 hours?	**Y** = Yes → Q160b **N** = No → Q161a **D** = Don't know → Q161a	**160a**	A
	b	**Xana ku titivala ku sungule hi xihatla?** Did the unconsciousness start suddenly, quickly (at least within a single day)?	**Y** = Yes; **N** = No; **D** = Don't know	**160b**	A

161	a	**Xana wanuna kumbe wansati a rina ku rhurhumela ka miri koka ku nga lawuleki?** Did s/he have convulsions?	**Y** = Yes → Q161b **N** = No → Q162a **D** = Don't know → Q162a	**161a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a nga vana na ku rhurhumela koka ku nga lawulek ka mirii?** For how long did s/he have convulsions?	**S** = Days **W** = Weeks **D** = Don't know → Q161c	**161b**	A
	c		**Number:**	**161c**	1 1
	d	**Xana wanuna kumbe wansati u titivarile hi xihatla endzhaku ko va na miri wo ka wu nga lawuleki?** Did s/he become unconscious immediately after the convulsion?	**Y** = Yes; **N** = No; **D** = Don't know	**161d**	A
162	a	**Xana wanuna kumbe wansati arina kutikeriwa mitsakamiso ya yena?** Did s/he have any urine problems?	**Y** = Yes → Q162b **N** = No → Q163 **D** = Don't know → Q163	**162a**	A
	b	**Xana wanuna kumbe wansati a yimileku tsakamisa?** Did s/he pass no urine at all?	**Y** = Yes; **N** = No; **D** = Don't know	**162b**	A
	c	**Xana wanuna kumbe wansati a tsakamisa ko tala ku tlula swa ntolovelo?** Did s/he go to urinate more often than usual?	**Y** = Yes; **N** = No; **D** = Don't know	**162c**	A
163		**Exikarhi ka mavabyi ya yena yo hetelela xana wanuna kumbe wansati a tsakamisa na ngati?** During the final illness, did s/he ever pass blood in the urine?	**Y** = Yes; **N** = No; **D** = Don't know	**163**	A
164		**Xana wanuna kumbe wansati a ri na kutikeriwa eka hlonge ya yena?** Did s/he have any skin problems?	**Y** = Yes → Q165a **N** = No → Q166 **D** = Don't know → Q165a	**164**	A
165	a	**Xana wanuna kumbe wansati arina ti ulcer kumbe swirhumbana kumbe marhumba kunwana handle ka le milengeni?** Did s/he have any ulcers, abscess or sores anywhere except the feet?	**Y** = Yes; **N** = No; **D** = Don't know	**165a**	A
	b	**Xana wanuna kumbe wansati a rina ti ulcer kumbe swirhumbana kumbe marhumba emilengeni leswi a swi nga ri kona eka tindhawu tinw`ana emirini?** Did s/he have any ulcers, abscess or sores on the feet that were not also on other parts of the body?	**Y** = Yes; **N** = No; **D** = Don't know	**165b**	A
166	a	**Exi karhi ka mavabyi lawa ma nga muyisa ku feni, xana wanuna loyi kumbe wansati u vile na swirhumbana eka hlonge ya yena?** During the illness that led to death, did s/he have any skin rash?	**Y** = Yes → Q166b **N** = No → Q167 **D** = Don't know → Q166d	**166a**	A
	b	**Xana I nkarhi wo leha ku fika kwihi laha wanuna kumbe wansati a nga van a swirhumbana?** For how long did s/he have the skin rash?	**S** = Days **W** = Weeks **M** = Months **D** = Don't know → Q166d	**166b**	A
	c		**Number:**	**166c**	1 1
	d	**Xana wanuna kumbe wansati u vile na swimungwamungwana?** Did s/he have measles rash?	**Y** = Yes; **N** = No; **D** = Don't know	**166d**	A
	e	**Xana wanuna kumbe wansati u vile na bandhi?** Did s/he have shingles/herpes zoster?	**Y** = Yes; **N** = No; **D** = Don't know	**166e**	A
167		**Xana wanuna kumbe wansati a huma ngati hi le tinhopfini, non`wini kumbe hi le mpfileni?** Did s/he have bleeding from the nose, mouth, or anus?	**Y** = Yes; **N** = No; **D** = Don't know	**167**	A
168		**Xanawanuna kumbe wansati a ondzile?** Did s/he have weight loss?	**Y** = Yes; **N** = No; **D** = Don't know	**168**	A
169		**Xana wanuna kumbe wansati a ondze ku tlula mpimo?** Was s/he severely thin or wasted?	**Y** = Yes; **N** = No; **D** = Don't know	**169**	A
170		**Xana wanuna kumbe wansati a humile swi rhumbana e nonwini kumbe e ririmini?** Did s/he have mouth sores or white patches in the mouth or on the tongue?	**Y** = Yes; **N** = No; **D** = Don't know	**170**	A

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171	**Xana wanuna kumbe wansati a omile miri hinkwawo kumbe a tsandzeka ku pfula nomo?** Did s/he have stiffness of the whole body or was unable to open the mouth?	**Y** = Yes; **N** = No; **D** = Don't know	**171**	A
172	**Xana wanuna kumbe wansati a pfimbile xikandza?** Did s/he have swelling (puffiness) of the face?	**Y** = Yes; **N** = No; **D** = Don't know	**172**	A
173	**Xana wanuna kumbe wansati a pfimba milenge hinkwayo?** Did s/he have both feet swollen?	**Y** = Yes; **N** = No; **D** = Don't know	**173**	A
174 a	**Xana wanuna kumbe wansati arina mabundzu?** Did s/he have any lumps?	**Y** = Yes → Q174b **N** = No → Q175 **D** = Don't know → Q175	**174a**	A
b	**Xana wanuna kumbe wansati a rina mabundzu kumbe swirhumbana leswi tsongo e nonwini?** Did s/he have any lumps or lesions in the mouth?	**Y** = Yes; **N** = No; **D** = Don't know	**174b**	A
c	**Xana wanuna kumbe wansati arina mabundzu e nkolweni?** Did s/he have any lumps on the neck?	**Y** = Yes; **N** = No; **D** = Don't know	**174c**	A
d	**Xana wanuna kumbe wansati arina mabundzu e makeheleni?** Did s/he have any lumps on the armpit?	**Y** = Yes; **N** = No; **D** = Don't know	**174d**	A
e	**Xana wanuna kumbe wansati ari na mabundzu eka ti groin?** Did s/he have any lumps on the groin?	**Y** = Yes; **N** = No; **D** = Don't know	**174e**	A
175	**Xana wanuna kumbe wansati u omile thlelo rinwe ra mirhi wa yena?** Did s/he have paralysis of one side of the body?	**Y** = Yes; **N** = No; **D** = Don't know	**175**	A
176	**Xana wanuna kumbe wansati arina kutikeriwa kumbe ku twa ku vava loko a minta swilo leswi nga mati?** Did s/he have difficulty or pain while swallowing liquids?	**Y** = Yes; **N** = No; **D** = Don't know	**176**	A
177	**Xana wanuna kumbe wansati arina muhlovo wo ka wu nga tolovelekanga wa mahlo?** Did s/he have yellow discoloration of the eyes?	**Y** = Yes; **N** = No; **D** = Don't know	**177**	A
178	**Xana wanuna kumbe wansati misisi ya yena a yi chichile yiva yo tshuka kumbe xitshopana?** Did her/his hair colour change to reddish or yellowish?	**Y** = Yes; **N** = No; **D** = Don't know	**178**	A
179	**Xana wanuna kumbe wansati a languteka a nga ri na ngati (thininning/lack of blood) kumbe a nga ri na ngati e mavokweni, matihlo kumbe minwala?** Did s/he look pale (thinning/lack of blood) or have pale palms, eyes or nail beds?	**Y** = Yes; **N** = No; **D** = Don't know	**179**	A
180	**Xana wanuna kumbe wansati a rina mahlo yo nghena ndzeni?** Did s/he have sunken eyes?	**Y** = Yes; **N** = No; **D** = Don't know	**180**	A
181	**Xana wanuna kumbe wansati a nwa ngopfu mati ku tlula swa ntolovelo?** Did s/he drink a lot more water than usual?	**Y** = Yes; **N** = No; **D** = Don't know	**181**	A
Section 10: Treatment and Health Service Use for the Final Illness				
182	**Xana wanuna kumbe wansati a kumile nthlavelo?** Was s/he vaccinated?	**Y** = Yes; **N** = No; **D** = Don't know	**182**	A
183	**Xana wanuna kumbe wansati u kumile vutshunguri eka mavabyi lawa ma ngateka vutomi bya yena?** Did s/he receive any treatment for the illness that led to death?	**Y** = Yes; **N** = No; **D** = Don't know	**183**	A
184	**Xana wanuna kumbe wansati u nikiwile diripi (diripi yo endliwa ekaya)?** Did s/he receive oral rehydration salts?	**Y** = Yes; **N** = No; **D** = Don't know	**184**	A
185	**Xana wanuna kumbe wansati u nyikiwile kumbe a lava diripi (intravenous fluids)?** Did s/he receive (or need) intravenous fluids (drip) treatment?	**Y** = Yes; **N** = No; **D** = Don't know	**185**	A

186	**Xana wanuna kumbe wansati u nyikiwile kumbe a lava ku tatisiwa ngati?** Did s/he receive (or need) a blood transfusion?	**Y** = Yes; **N** = No; **D** = Don't know	**186**	A
187	**Xana wanuna kumbe wansati u nyikiwile kumbe a lava vutshunguri kumbe swakudya leswi swi fambisiwaka hi payipi ku hundza hi le tinhopfini?** Did s/he receive (or need) treatment/food through a tube passed through the nose?	**Y** = Yes; **N** = No; **D** = Don't know	**187**	A
188	**Xana wanuna kumbe wansati u kumile kumbe a lava jekixeni yo tlhaviwa eka diripi kumbe e nyameni (antibiotics)?** Did s/he receive (or need) injectable (IV or IM) antibiotics?	**Y** = Yes; **N** = No; **D** = Don't know	**188**	A
189	**Xana wanuna kumbe wansati u kumile kumbe a lava vuhandzuri eka mavabyi ya yena?** Did s/he have (or need) an operation for the illness?	**Y** = Yes; **N** = No; **D** = Don't know	**189**	A
190	**Xana wanuna kumbe wansati u endliwile vuhandzuri exikarhi ka nhweti yinwe a nga si lova?** Did s/he have the operation within 1 month before death?	**Y** = Yes; **N** = No; **D** = Don't know	**190**	A
191	**Xana wanuna kumbe wansati u tshuxiwile exibedhlele a ha vabya ngopfu?** Was s/he discharged from the hospital very ill?	**Y** = Yes; **N** = No; **D** = Don't know	**191**	A

Section 11: Risk Factors/ Lifestyle

Instructions: *Ask the following section for all deceased individuals over the age of 15 years.*

A nwa byalwa
Drinking

	a	**Xana wanuna kumbe wansati a nwa byala?** Did s/he drink alcohol?	**Y** = Yes → Q192b **N** = No → Q197a	**192a**	A
	b	**Loko kuru ina, anwa masiku mangani evhikini?** If YES, how many days a week did s/he drink?	**Number** (1-7, **D** = Don't know)	**192b**	
192	c	**A nwa byala byo fikela kwihi (hi siku)?** How much in one day?	**Number** (**D** = Don't know)	**192c**	
	d	**U n'we nkari wotani hikwihi (malembe)?** For how long (in years)?	**Number** (**D** = Don't know)	**192d**	
	e	**A nwa swipyopyisi swa muxaka wihi?** What type of alcohol?	**A** = African beer **W** = Western beer **T** = Traditional 'hot stuff'	**192e**	A
193		**Xana kuvile na nkari lowu anga lahlekeriwa hi ntirho hi kwalaho ko nwa byalwa ngopfu ke?** Did the person ever lose a job because of alcohol?	**Y** = Yes; **N** = No; **D** = Don't know	**193**	A
194		**Xana munhu loyi u tshamile a va ni nghozi hi kwalaho ko nwa byalwa ke?** Did the person ever have an accident because of alcohol?	**Y** = Yes; **N** = No; **D** = Don't know	**194**	A
195		**Xana u tshame a lwisa hikokwalaho ko nwa byalwa ke?** Did the person ever have a fight because of alcohol?	**Y** = Yes; **N** = No; **D** = Don't know	**195**	A
196	a	**Xana a pyopyiwile e ka vhiki leri anga lova hi rona?** In the week before death, did the deceased get drunk?	**Y** = Yes → Q196b **N** = No → Q197a **D** = Don't know → Q197a	**196a**	A
	b	**Loko kuri ina, xana a dedeleka?** If YES, was the deceased unable to walk due to drunkenness?	**Y** = Yes; **N** = No; **D** = Don't know	**196b**	A

A dzaha fole
Smoking

	a	**Xana wanuna kumbe wansati a dzaha fole (fole, pipe na swinwana na swinwana)?** Did s/he smoke tobacco (cigarette, cigar, pipe, etc)?	**Y** = Yes → Q197b **N** = No → Q199 **D** = Don't know→ Q199	**197a**	A
197	b	**Loko kuri ntiyiso, a dzaha mafole mangani hisiku?** If YES, how many cigarettes per day?	**Number** (**D** = Don't know)	**197b**	
	c	**U dzaha nkari wotani hikwihi (malembe)?** For how long (in years)?	**Number** (**D** = Don't know)	**197c**	

209	**Xana swi nga teka ku tlula tiawara timbirhi ku ya fika exibedhlele xa le kusuhi kumbe eka ndhawu ya swa vutshunguri?** Does it take more than 2 hours to get to the nearest hospital or health facility from the deceased's household?	**Y** = Yes; **N** = No; **D** = Don't know	**209**	A
210	**Emakumu ka masiku ya yena a ngasi lova, xana a ku ri na ku kanakana ku vutshunguri bya xilungu bya laveka?** In the final days before death, were there any doubts about whether medical care was needed?	**Y** = Yes; **N** = No; **D** = Don't know	**210**	A
211	**Emakumu ka masiku ya yena anga si lova, xana ku tirhisiwile mirhi ya xinto?** In the final days before death, was traditional medicine used?	**Y** = Yes; **N** = No; **D** = Don't know	**211**	A
212	**Emakumu ya masiku ya yena anga si lova, xana mi mtirhisile riqingo ra le ndlwini kumbe ra le nyongeni ku lava ku pfuniwa?** In the final days before death, did anyone use a telephone or cell phone to call for help?	**Y** = Yes; **N** = No; **D** = Don't know	**212**	A
213	**Eka mavabyi hikwawo, xana mali leyi tirhisiweke ku kuma vushunguri yi nga va yi endle leswaku swilaveko swa ndyangu swi nga fikeleriwi hinkwaswo?** Over the course of the illness, did the total costs of care and treatment prohibit other household payments?	**Y** = Yes; **N** = No; **D** = Don't know	**213**	A

Section 13: Treatment & Health Care Utilization During Terminal Illness (A)

Instructions: *Ask the following section for ALL deceased individuals.*

214	a	**Xana a tshunguriwile hi xilungu ke?** Did the deceased receive biomedical treatment?		**Y** = Yes → Q214b **N** = No → Q215a **D** = Don't know → Q215a	**214a** A
	b	**Loko ku ri ina, a nyikiwile mirhi yihi xana?** If YES, what medication was received?	**214b**		
215	a	**Xana a nyikiwile mirhi ya xintima ke?** Did the deceased receive traditional treatment?		**Y** = Yes → Q215b **N** = No → Q217 **D** = Don't know → Q217	**215a** A
	b	**Loko ku ri ina a ku ri muhlovo wihi wa murhi?** If YES, what medication was received?	**215b**		
216		**Loko atshunguriwile hi xilungu na xintima, xana hi wihi murhi lowu a nga sungula a kuma wona?** If both types of treatment were used (Q214a = Y & Q215a = Y), which was sought first?		**B** = Biomedical **T** = Traditional	**216** A
217	a	What was the Residential Status (RES STATUS) of the deceased individual?		**RES STATUS**	**217a** A
	b	If M, was the deceased ill in the site?		**Y** = Yes; **N** = No; **D** = Don't know	**217b** A

218	**Immunisation: child under 5 years old (only if RTH card available YELLOW/WHITE**	**Immunisation** Number of doses: 0, 1, 2, 3, 4	BCG	**218a** A	Measales	**218f** A
			OPV-Polio	**218b** A	RV	**218g** A
			DPT	**218c** A	DTaP-IPVHib	**218h** A
			Hib	**218d** A		
			Hep B	**218e** A	PCV	**218i** A

219	If not RTH card, was the child immunised?	**Y** = Yes; **N** = No; **D** = Don't know	**219**	A

220	Did the deceased have access to medical aid or employer support for health care?	**N** = No **Y** =covered medical aid for whenever person needs to go to doctor **C** = is covered by health insurance for a specific disease(s) **W** = is allowed to go to employer's clinic/hospital **H** =access to free public HOSPITAL care **D** =don't know	**220**	A

What action was taken during the deceased's terminal illness? (out-patient care only)

221

1 = None over entire illness period
2 = Took natural home remedy (eg herbs, ash, roots)
3 = Took left-over medication from doctor/clinic
4 = Drugs from a shop
5 = Private chemist
6 = Public clinic / health center
7 = Public doctor didn't have to pay for (district surgeon), not in a public hospital
8 = Private doctor (had to pay/on medical aid)
9 = Out-patient care by **private specialist** doctor (referred to by another doctor / specialises in certain illnesses) that had to pay for?
10 = Out-patient care by **public specialist** doctor (referred to by another doctor / specialises in certain illnesses) that did not have to pay for
11 = Faith healer or Traditional healer (sangoma, inyanga)
12 = Out-patient or casualty in public hospital
13 = Out-patient or casualty in private hospital
14 = Second public clinic / health centre
15 = Don't know
16 = Other → Q221f

1st Action	**221a**	1 1
2nd Action	**221b**	1 1
3rd Action	**221c**	1 1
4th Action	**221d**	1 1
>4? (Y, N, D)	**221e**	1 1

If OTHER, please specify: **221f**

If Q221= 1, 2, 3, 4, 11 AND never admitted to hospital, why was biomedical care not consulted?

222

1 = Did not seem sick enough
2 = Thought illness would get better on its own
3 = Sudden death, no time for treatment
4 = Did not know what to do
5 = No time, too busy
6 = Not enough money for consultation
7 = Transport too expensive
8 = Too far to travel
9 = Needed permission of another person eg husband/father/mother etc, and not available/refused
10 = Patient refused to go for care
11 = Nobody to go with him/her
12 = Nobody to care for children
13 = No drugs at health care facility
14 = Staff attitudes poor
15 = Not enough privacy
16 = Too little time with health worker
17 = Queue too long, wait too long
18= Western care could do nothing for illness
19 = Other → Q222d
20 = Don't know

1st Reason	**222a**	1 1
2nd Reascn	**222b**	1 1
3rd Reason	**222c**	1 1

If OTHER, please specify: **222d**

223	a	Whas the deceased admitted to hospital during terminal illness?	**Y** = Yes →Q223b **N** = No → Q225 **D** = Don't know → Q225	**223a** A
	b	If YES, number of admission in the PAST YEAR?	**Number of admissions:**	**223b** 1 1
224	a	Which hospital? (Select all that apply; bracket codes together if admitted to one & then referred to another)	**1** = Mapulaneng **2** = Matikwane **3** = Tintswalo **4** = Rob Ferreira **5** = Nelspruit Medi-clinic **6** = Pietersburg Mankweng **7** = Garankuwa **8** = Bhubezi **9** = Other → Q224b **10** =Don't know	**224a**
	b	If OTHER hospital, please list	**224b**	

Section 13: Epilepsy Module (A)

Instructions: Ask the following section for ALL deceased individuals.

225	**A rhurhumela, nhamu yi omile, ku oma ka miri, miri wu khotsekela endzhaku?** Spasm, convulsions, stiff neck, stiff body, body bent backwards?	**Y** = Yes → Q226 **N** = No → end section box	**225** A
226	**Hlamusela leswi nga humelela** Describe what happened.	**226**	
227	**Xana a swi humelela ro sungula ka mavabyi lawa?** Was the spasm for first time during this illness?	**Y** = Yes; **N** = No; **D** = Don't know	**227** A
228	**Xana swi humelele ka ngani eka mavabyi la yo hetelela?** How many times did it happen during final illness?	**Number:**	**228** 1 1
229	**Nkarhi wa xiphemu xin'wana ni xin'wana?** What was the duration of each episode?	**Number (of minutes):**	**229** 1 1

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220 Did the deceased have access to medical aid or employer support for health care?

N = No
Y =covered medical aid for whenever person needs to go to doctor
C = is covered by health insurance for a specific disease(s)
W = is allowed to go to employer's clinic/hospital
H =access to free public HOSPITAL care
D =don't know

220 [A]

221 What action was taken during the deceased's terminal illness? (out-patient care only)

1 = None over entire illness period
2 = Took natural home remedy (eg herbs, ash, roots)
3 = Took left-over medication from doctor/clinic
4 = Drugs from a shop
5 = Private chemist
6 = Public clinic / health center
7 = Public doctor didn't have to pay for (district surgeon), not in a public hospital
8 = Private doctor (had to pay/on medical aid)
9 = Out-patient care by **private specialist** doctor (referred to by another doctor / specialises in certain illnesses) that had to pay for?
10 = Out-patient care by **public specialist** doctor (referred to by another doctor / specialises in certain illnesses) that did not have to pay for
11 = Faith healer or Traditional healer (sangoma, inyanga)
12 = Out-patient or casualty in public hospital
13 = Out-patient or casualty in private hospital
14 = Second public clinic / health centre
15 = Don't know
16 = Other → Q221f

1st Action	**221a**	[1][1]
2nd Action	**221b**	[1][1]
3rd Action	**221c**	[1][1]
4th Action	**221d**	[1][1]
>4? (Y, N, D)	**221e**	[1][1]

If OTHER, please specify: **221f**

222 If Q221= 1, 2, 3, 4, 11 AND never admitted to hospital, why was biomedical care not consulted?

1 = Did not seem sick enough
2 = Thought illness would get better on its own
3 = Sudden death, no time for treatment
4 = Did not know what to do
5 = No time, too busy
6 = Not enough money for consultation
7 = Transport too expensive
8 = Too far to travel
9 = Needed permission of another person eg husband/father/mother etc, and not available/refused
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13 = No drugs at health care facility
14 = Staff attitudes poor
15 = Not enough privacy
16 = Too little time with health worker
17 = Queue too long, wait too long
18= Western care could do nothing for illness
19 = Other → Q222d
20 = Don't know

1st Reason	**222a**	[1][1]
2nd Reasen	**222b**	[1][1]
3rd Reason	**222c**	[1][1]

If OTHER, please specify: **222d**

223a Whas the deceased admitted to hospital during terminal illness?
Y = Yes →Q223b
N = No → Q225
D = Don't know → Q225
223a [A]

223b If YES, number of admission in the PAST YEAR? **Number of admissions:** [1][1]

224a Which hospital? (Select all that apply; bracket codes together if admitted to one & then referred to another)
1 = Mapulaneng
2 = Matikwane
3 = Tintswalo
4 = Rob Ferreira
5 = Nelspruit Medi-clinic
6 = Pietersburg Mankweng
7 = Garankuwa
8 = Bhubezi
9 = Other → Q224b
10 =Don't know
224a

224b If OTHER hospital, please list **224b**

Section 13: Epilepsy Module (A)

Instructions: Ask the following section for ALL deceased individuals.

225 **A rhurhumela, nhamu yi omile, ku oma ka miri, miri wu khotsekela endzhaku?**
Spasm, convulsions, stiff neck, stiff body, body bent backwards?
Y = Yes → Q226
N = No → end section box
225 [A]

226 **Hlamusela leswi nga humelela**
Describe what happened. **226**

227 **Xana a swi humelela ro sungula ka mavabyi lawa?**
Was the spasm for first time during this illness?
Y = Yes; **N** = No; **D** = Don't know **227** [A]

228 **Xana swi humelele ka ngani eka mavabyi la yo hetelela?**
How many times did it happen during final illness?
Number: **228** [1][1]

229 **Nkarhi wa xiphemu xin'wana ni xin'wana?**
What was the duration of each episode?
Number (of minutes): **229** [1][1]

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230	**Xana swi endleke rini hi nkarhi wa vuvabyi?** When during illness?	**B** = Beginning **M** = Middle **E** = End	230	A
231	**Xana u huwelerile?** Did s/he cry out?	**Y** = Yes; **N** = No; **D** = Don't know	231	A
232	**Xana rhurhumela ka miri a ku nga lawuleki ?** Uncontrolled sudden movements?	**Y** = Yes; **N** = No; **D** = Don't know	232	A
233	**Xana nhloko na miri a swi omile swi tlhela swi govekela endzhaku?** Head and body stiff and bent backward?	**Y** = Yes; **N** = No; **D** = Don't know	233	A
234	**Xana milenge na mavoko a swi omile na swi govekile kumbe swi ololokile?** Legs and arms stiff and straight/bent?	**Y** = Yes; **N** = No; **D** = Don't know	234	A
235	**Mavoko ma endle swi bakele?** Clenched hands?	**Y** = Yes; **N** = No; **D** = Don't know	235	A
236	**Xana tinhlaya ati omile (anga swi koti ku dya)?** Clenched jaws?	**Y** = Yes; **N** = No; **D** = Don't know	236	A
237	**Xana mufi a tsakamisa?** Urinating during episode?	**Y** = Yes; **N** = No; **D** = Don't know	237	A
238	**Xana mufi a ti onhela hinkarhi wolowo?** Defecating during episode?	**Y** = Yes; **N** = No; **D** = Don't know	238	A
239	**Xana mufi a luma ririmi hi karhi wa vuvabyi?** Biting tongue?	**Y** = Yes; **N** = No; **D** = Don't know	239	A
240	**Xana a huma khuvi hi nomo?** Frothing at the mouth?	**Y** = Yes; **N** = No; **D** = Don't know	240	A
241	**Xana mufi a ri na mavabyi ya switshetshela?** Was this epilepsy?	**Y** = Yes → Q242 **N** = No → Q244 **D** = Don't know → Q244	241	A
242 a	**Loko kuri ina, xana mufi u ve na swi tshetshela nkarhi wo tani hi kwihi?** If YES, for how long did the person have epilepsy?	**M** = Months **Y** = Years **D** = Don't know → Q243	242a	A
b		**Number:**	242b	[ ][ ]
243	**Xana a swiri swa muxaka muni?** What were the types of seizures?	**G** = Generalized (whole body) **S** = Starts in one part of body **I** = Starts in one part of body then involves whole body	243	A
244	**Xana swi humelerile eka lembe leri nga hundza a nga se lova?** Had they occurred in the one year before death?	**Y** = Yes; **N** = No; **D** = Don't know	244	A
245	**U tshunguriwile?** Was the person treated for epilepsy?	**Y** = Yes; **N** = No; **D** = Don't know	245	A
246	**Loko a tshungriwile kwihi? (xibedlhele, kliniki, n'angeni)** Where?	**H** = Hospital **E** = Health Centre **C** = Clinic **T** = Traditional Healer	246	A
247	**Xana mufi ari ku tirhiseni ka vutshunguri?** Was the deceased currently on treatment?	**Y** = Yes; **N** = No; **D** = Don't know	247	A
248	**Xana mufi u vile na mahanyelo yo kala ya nga tolovelekangi?** Did s/he have any abnormal behaviour?	**Y** = Yes; **N** = No; **D** = Don't know	248	A
249	**Xana uvile na ku tikeri wa hi ku dyondza?** Did s/he have learning difficulties?	**Y** = Yes; **N** = No; **D** = Don't know	249	A
250	**Ku vile na vumbhoni eka rifu leri?** Was the death witnessed?	**Y** = Yes; **N** = No; **D** = Don't know	250	A
251	**Xana u love hinkarhi wa switshetshela?** Did s/he die during a seizure?	**Y** = Yes; **N** = No; **D** = Don't know	251	A
252	**Xana u lovile na vusiku ku ri hava u nwana?** Did s/he die during the night?	**Y** = Yes; **N** = No; **D** = Don't know	252	A
253	**Xana u lovile hi swi tshetshela a ri matini?** Did s/he die while having a seizure in water?	**Y** = Yes; **N** = No; **D** = Don't know	253	A
254	**Xana u lovile hi ku tshwa hinkwalaho ka switshetshela?**	**Y** = Yes; **N** = No; **D** = Don't know	254	A

Arbitrator's assessment

Probable Main Cause	ICD 10
Probably Immediate Cause	ICD 10
Probably Contributing Cause(s)	ICD 10

Name of Medical Doctor:

Consensus Diagnosis	
Probable Main Cause	ICD 10
Probably Immediate Cause	ICD 10
Probable Contributing Cause(s)	ICD 10

Assessment One

Cause of Death Diagnosis	
Probable Main Cause	**ICD 10**
Probably Immediate Cause	**ICD 10**
Probably Contributing Cause(s)	**ICD 10**

Name of Medical Doctor:

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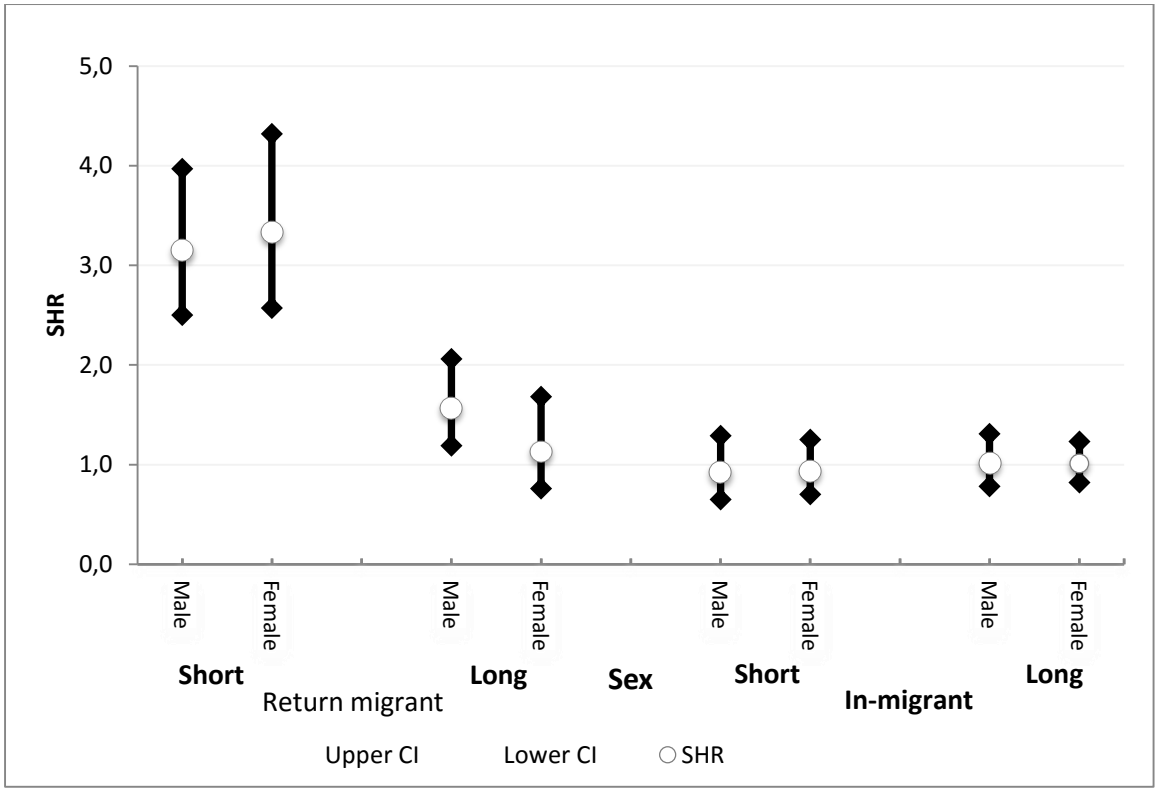
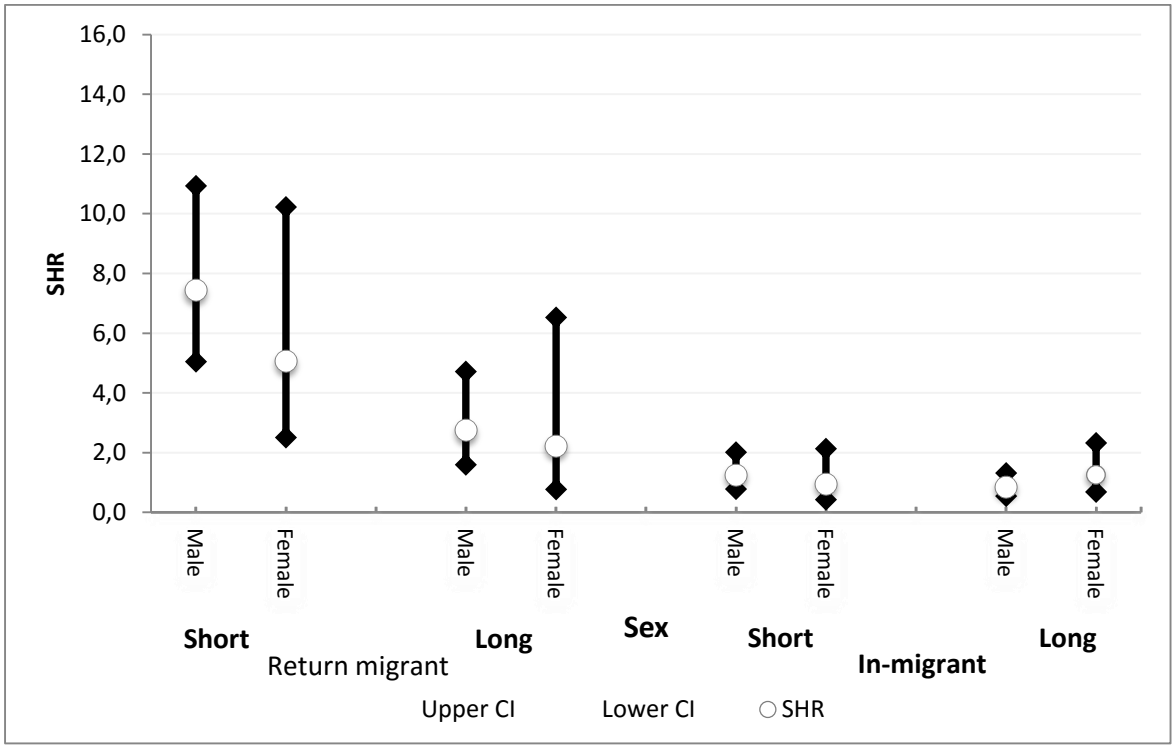
Appendix 8: **Dissemination of findings: conferences and publications**

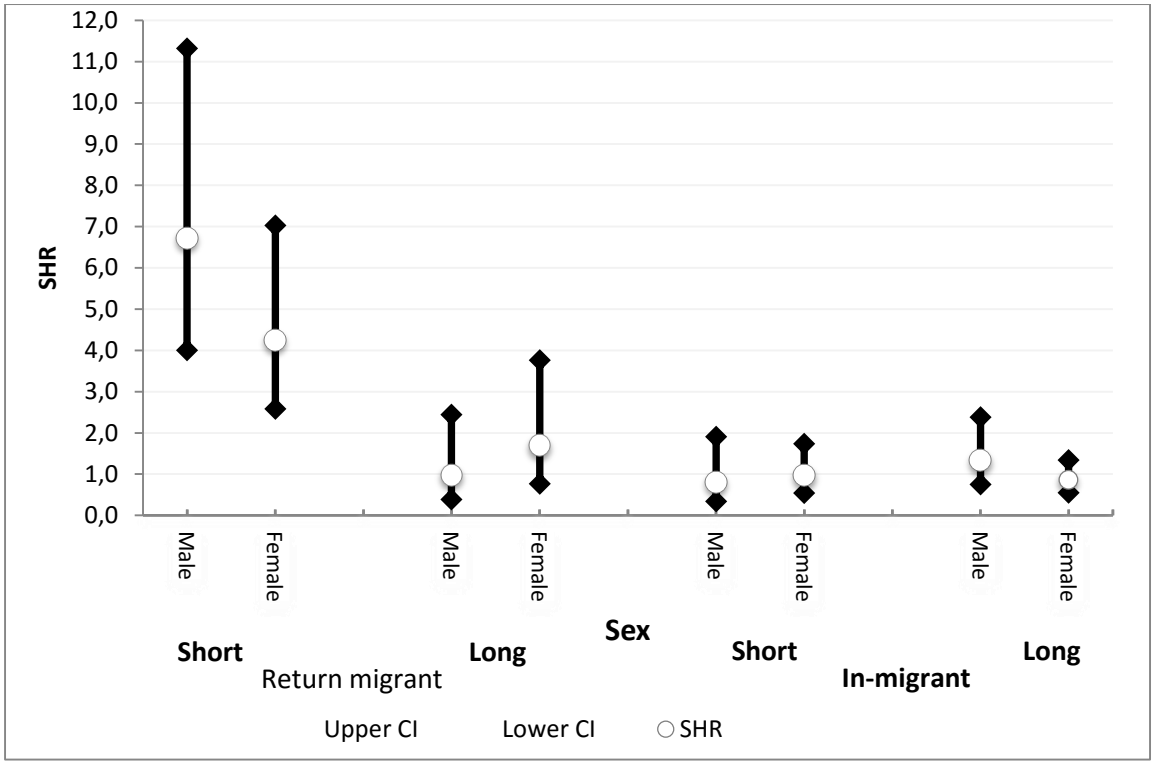
S/N	Conferences/ Workshop	Date	Title	Outcome
1	Population Association of America, San Francisco, USA.	3rd-5th May, 2012	Competing Risk Approach to Studying AIDS/TB mortality Consequence of Migration	The paper was presented at the conference and valuable inputs were received.
2	Population and Development: New Approaches to Enduring Global Problems, Brown International Advanced Research Institutes (BIARI), Brown University, Providence , USA	9th-23rd, June 2012	License to Move: Longitudinal Study of Migration and its relation to AIDS/TB Mortality in Rural South Africa	The paper was presented at this workshop and valuable inputs were received.
3	27th Population conference of International Union for the Scientific Study of Population (IUSSP), South Korea.	26th-31st August, 2013	The Relationship between AIDS/TB Mortality and Migration in the Context of Other Causes of Death in Rural South Africa	The paper was presented at the conference and valuable inputs were received.
4	Wits Demography Popstudies Mini Conference 2015, University of the Witwatersrand, Johannesburg, South Africa	25th-26th November, 2015	Longitudinal Study of Migration and its relation to AIDS/TB Mortality in Rural South Africa	The paper was presented at the conference and valuable inputs were received



Appendix 9**:** Relative risk of a migrant dying of NCDs in the presence of other causes (Unadjusted)



Appendix 10**:** Relative risk of a migrant dying of external causes in the presence of other causes (unadjusted)



Appendix 11: Risk of a migrant dying of other infection in the presence of other causes (Unadjusted)

Death Due to External Cause	Freq.	Percent
traffic accident	113	35.65
Accid drowning and submersion	1	0.32
Accid expos to smoke fire & flame	11	3.47
Accid poisoning & noxious subs	1	0.32
Intentional self-harm	41	12.93
Assault	144	45.43
Other and unspecified external Co	6	1.89

Appendix 12: Death due to external cause of death

Death Due to Other Infections	Freq.	Percent
Sepsis (non-obstetric)	6	1.47
Acute resp infect incl pneumonia	275	67.57
Diarrhoeal diseases	37	9.09
Malaria	52	12.78
Meningitis and encephalitis	14	3.44
Haemorrhagic fever	2	0.49
Other and unspecified infect dis	19	4.67
Pregnancy-related sepsis	2	0.49

Appendix 13: Death due to other infectious diseases

Appendix 14: Abridge of version of the stata syntax

stset EventDate if resi==1, id(Id) failure(CoD==1) origin(timeDoB) time0(datebeg) scale(31557600000) – – – – – – – – –— – – – – – – – – Stata (s1)

stset: A syntax that alerts the program that it is about to process a time-to-event dataset

EventDate: A variable that refers to the date that an event occurred

residence: A variable that captures the residence criteria with 1 indicating resident and 0 indicating the non-resident.

id: A syntax acting as a container for the Id i.e. identifier of the respondents.

failure: A syntax, which holds the occurrence of the specified event of interest

CoD: Cause of death variable with value 1 indicates AIDS/TB death

origin: This syntax holds the start date of exposure of the respondent.

DoB: Date of birth variable

time0: A syntax holding the start of an event

datebeg: Variable that indicates start of a residence e.g. in-migration

scale: stata command making the records to be in date unit of interest e.g. year

31557600000 : This is a year in milliseconds specified to scale the results back to years.

xi: stcrreg i.xMigStat i.PPeriod1 … if Sex==1, compete(CoD==2 3 4 5) iter(3) – – – – – - Stata (s2)

xi: syntax telling stata that categorical variables are involved

stcrreg: syntax signifying the Fine and Gray model

i.xMigStat i.PPeriod1: The independent variables with "i." indicating the categorical variables

if Sex==1: A conditional statement syntax when sex==1

compete: A syntax holding the competing causes of death variables only

CoD==2 3 4 5: competing causes of death categories excluding "1" i.e. AIDS/TB

iter(3): A syntax for the number of times iteration should be done

Implication of Circular Migration on AIDS/TB Mortality and Other Causes of Death in Rural South Africa

Policy Brief

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:: Introduction

There is a body of evidence indicating that labour migration can have implications for the spread of HIV infection with TB being one of its major opportunistic infections infections (Decosas, Kane et al. 1995; Bouare 2007; Coffee, Lurie et al. 2007). This raises concerns for communities with high levels of migration. Few studies have taken a step further to examine the AIDS/TB mortality consequence of migration but without making provision for other causes. It is recognised that migrants could die of other causes that can preclude their death from AIDS/TB.

Summary of Policy Implications

- **Unabated labour migration will keep on fuelling mortality originating from all causes;**
- **High mortality risk implies the absence of community level social control in the migrants' place of destination;**
- **Disease induced migration create burdens on the health facilities in the rural area;**
- **Intervention programmes for curbing infectious disease and resultant mortality need to recognise labour migration.**

:: Approach

This research project is a part of a longitudinal study of all the inhabitants of the Agincourt sub-district situated in the rural north-eastern part of South Africa. The study utilised the Agincourt data spanning 12 years, starting from 1st January, 2000 to 31st December, 2011. The main target group for the study were individuals aged 20 to 69 years as at the date of analysis. The selected individuals were divided into the following categories: (i) the return migrants who returned after spending certain period of time outside the study area; (ii) the never-resident group of people [in-migrants] who moved into the study location and (iii) the permanent residents [non-migrants]. A six months residence threshold period was used to distinguish participants from ordinary visitors. The migration category variable was further expanded from three to five with in-migrant and return-migrant being split to accommodate short and long-term duration exposure. In the year 2000, the baseline year, a total of 25,621 individuals who met the aforementioned criteria were recruited into the study. AIDS/TB, NCDS, external cause and other infectious diseases are the cause of death categories.

References:
Bouare, O. (2007). "Internal Migration and the Spread of HIV/AIDS in South Africa." The Social Sciences 2(4): 405-411.
Coffee, M., M. N. Lurie, et al. (2007). "Modelling the impact of migration on the HIV epidemic in South Africa." AIDS 21(3): 343-350.
Decosas, J., F. Kane, et al. (1995). "Migration and AIDS." The Lancet 346(8978): 826-828.
Wolffers, I., I. Fernandez, et al. (2002). "Sexual behaviour and vulnerability of migrant workers for HIV infection." Culture, Health & Sexuality 4(4): 459-473.

:: Findings

- in the context of other causes of death, return-migrants have greater risk of dying of AIDS/TB death when compared to non-migrants regardless of their sex.
- The mortality risks originating from external causes (e.g. assault and accident) and other infectious diseases (e.g. acute respiratory infection including pneumonia) for male and female return-migrants respectively are greater than the risk of death due to AIDS/TB mortality.

:: Policy Implications

Unabated Labour Migration Will Keep on Fuelling Mortality

With circular labour migration in South Africa showing no evidence of declining and with the attendant mortality risks due to AIDS/TB and other causes, there is no gainsay that migration is a force to reckon with when it comes to controlling mortality in South Africa. Migration in the country mostly takes place internally from rural to urban and semi-urban areas. The government can capitalise on the availability of infrastructural facilities like road in the rural area by identifying goods and services that are in great demand by the dwellers and introduce incentives for industries to be setup in the areas in order to discourage the movement of people enmasse to far distant places to work.

High Mortality Risk Implies the Absence of Community Level Social Control in the Migrants Place of Destination

The exposure of in-migrants to AIDS/TB as well as death originating from other causes is minimal because they move to rural area where there is certain level of community social control. On the other hand, the inadequacy or absence of community level social control connotes high risk of mortality among return migrants. Wolffers, Fernandez et al. (2002), expresses that "community level social control is dependent on how well people know each other, how close the community is and the repercussions of deviant behaviour". These three characteristics are missing in the case of labour migrants, who also have a high probability of not migrating with their sexual partners.

Disease Induced Migration Create Burdens on the Health Facilities in the Rural Area

Illness due to HIV is a determinant of people moving back permanently to the rural area to receive familial and medical support (Clark, Collinson et al. 2007 and Welaga, Hosegood et al. 2009). This morbidity induced migration creates burdens on the health care facilities in the rural area as ill migrants return home to utilize the health resources meant for the permanent rural dwellers. Therefore, the rural health authorities should make provision for these people coming home sick.

Intervention Programmes for Curbing Infectious Disease and Resultant Mortality Need to Recognise Labour Migration

The success of any intervention programme towards addressing the problem of HIV infection and the resultant mortality can only be guaranteed by recognising the circular labour migrants. There is the possibility of these people not knowing their HIV status until it is too late. This can be responsible for them dying on a short term basis when they retrun back to their place of origin as shown in this study. Hence, in rolling out treatment as prevention programme on a large scale by the South African department of health or other non governmental institutions scale, migrants should be the main target group. Also, a nationwide electronic linkage system should be set up to monitor their initiation and adherence to medication. This is to ensure the health centres at their place of destination can be able to access their records and ensure continuity of care.

This Policy Brief is based on a doctoral thesis titled, "Longitudinal Study of Migration and its Relation to AIDS/TB Mortality in Rural South africa" submitted to the Faculty of Humanities, University of the Witwatersrand, Johannesburg, South Africa.

Acknowledgement

Appendix 15: Policy brief