LEVELS, CAUSES AND DETERMINANTS OF ADOLESCENT MORTALITY IN SOUTH AFRICA, 2001 TO 2007

BY

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DECLARATION

I, Nicole De Wet, 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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List of Abbreviations and Acronyms

ARVs – Anti Retrovirals

ASMR – Age Specific Mortality Rate

COD – Cause of Death

CS- Community Survey

CSDH - Commission on Social Determinants of Health

CSMR – Cause- Specific Mortality Rate

DALYs – Disability Adjusted Life Years

DHA - Department of Home Affairs

DNF – Death Notification Forms

DoSD- Department of Social Development

EAs - Enumeration Areas

HIV/ AIDS – Human Immunodeficiency Virus Infection / Acquired Immunodeficiency Syndrome

MDG- Millennium Development Goals

NPR - National Population Register

PCA- Principle Component Analysis

PCV - Percentage Change in Variance

PES – Postenumeration Survey

PMR- Proportional Mortality Ratio

SE - Standard Error

SSA- Sub-Saharan Africa

Statistics SA - Statistics South Africa

STI – Sexually Transmitted Disease

TB – Tuberculosis

VPC - Variance Partition Coefficient

WHO – World Health Organisation

YPLL - Years of Potential Life Lost

ABSTRACT

The burden of disease and mortality in South Africa is a challenge. In the area of HIV/AIDS, an estimated 316,900 new infections to persons aged 15 and older were reported in 2011. For persons below the age of 15 years, 63,600 new infections were detected in this year (Stats SA, 2011). South Africa is also doing poorly with regard to other development indicators. The infant mortality rate for this year was estimated at 37.9 deaths per 100,000 live births and under- five mortality is 54.3 deaths per 100,000. With adolescents in South Africa constituting approximately 20% of the total population, a substantial percentage of adolescents could then be orphans.

Adolescents in contemporary South Africa are affected by HIV/AIDS, teen pregnancy, domestic violence and other reproductive health issues (Pettifor et al., 2005; Kaufman et al., 2001; King et al., 2004). They are also faced with poverty and unemployment (Ngoma, 2005). Given the overall optimistic forecast for South Africa's economic and political growth, based on the end of Apartheid, these grave challenges that youth face persist, making South Africa a very interesting study area to examine the determinants of other-health related and mortality risks for adolescents. The main objective of this study is to identify the levels, causes and determinants of adolescent mortality in South Africa. More specifically the study examines a host of natural, unnatural and broad-underlying causes of death. In addition, individual, household and community, demographic and socioeconomic characteristics are tested as determinants of adolescent mortality.

This study is a cross - sectional study using nationally representative data from the South African Census 2001; the Community Survey 2007 and Death Notification Forms as collated by

Statistics SA. The Community Survey is nationally representative and collects the same information as the Census. Thus demographic, socioeconomic and mortality questions are similar in both sources and are suitable for a nationally representative study on mortality trends. Death Notification Forms articulate immediate and broad- underlying causes of death, this is useful in identifying specific risks.

Adolescents aged 10 to 19 years old are covered in this study. Both adolescent males and females are studied. A total of 41,261 adolescent deaths were recorded in 2001 and 54,046 adolescent deaths were noted for 2007. Demographic and socioeconomic indicators are included for all adolescents represented in the surveys. This study is a quantitative study of adolescent mortality in South Africa. STATA 11(SE) was for the management and analysis of data in this study. The methods of analysis for this study follow the order of the study objectives. To determine levels of adolescent mortality, frequency distributions, age and sex specific mortality rates and proportional mortality ratios were used. In identifying and evaluating prevalent causes of death age- standardized death rates by cause and cause- specific mortality rates are initially used. Then multiple and associated decrement life tables (in particular, probability of dying, survival function, life expectancy and cause- deleted life expectancy) and Years of Potential Life Lost (YPLL) are calculated. To identify determinants of adolescent mortality logistic regression and multilevel logistic regression is applied.

Among other results, the main findings of this study are first the levels of adolescent mortality in South Africa increased from 2001 to 2007 by approximately 1.3%. Second among adolescents, the levels of male mortality (21,686) exceed that of their female (19,575) counterparts in 2001, however the reverse is true of 2007, where female adolescent mortality

(28,517) exceeds that of males (25,529). This particular finding is unusual since male mortality during youth (15- 24 years) is generally higher among males. This is due to the increased burden of disease on females in the country, which is now affecting adolescent females too. This is shown in results that the see plight of Tuberculosis- related deaths is more concentrated among females than males. In addition, the probability of adolescent females dying from Tuberculosis increased for 1.45 in 2001 to 1.75 in 2007 in South Africa. In addition, this study shows that for specific causes of adolescent mortality the elimination of causes of death such as Tuberculosis and pneumonia could produce substantial gains in life expectancy. Females have consistently lower odds of adolescent mortality from unnatural causes of death compared to males. Finally, having a few household assets, 6 or more people living in a residence, and high ethnic diversity within the community is associated with increased odds of adolescent mortality in South Africa in 2001.

A main conclusion of this study is that with adolescent mortality in the country increasing future economic growth is compromised. Adolescents will soon enter the labour force and contribute to the country's growth. With fewer adolescent's surviving to adulthood this means the country's economic growth with be slow. In addition, increasing adolescent mortality compromises the economic support available to dependent populations. With fewer economically active adults, the country's dependency ratio will be high, thus increasing the burden placed on government to provide for the elderly and children.

Chapter 1

Introduction

1.1 Problem Statement:

Mortality in Africa is high; this is particularly true of Sub- Saharan Africa. Life expectancy in this region was approximately 57.7 in 2009 (WHO, 2011). This is far lower than the second lowest region in the world, which is Asia with a life expectancy of 67 years. It has been reported that annually approximately 11 million children under the age of five die globally and that more than 10 million deaths occur in developing countries (Hill and Amouzou, 2006). In Sub- Saharan Africa in particular, it has been shown that one- third of under- five child deaths occur in this region. Adult mortality in the region is also high. It was found that of the 40 countries in the world with the highest adult mortality rates, 37 were countries in Sub- Saharan Africa(Bradshaw and Timaeus, 2006).

In Sub- Saharan Africa, mortality is occurring in the context of HIV/AIDS, war and famine, other communicable diseases and more recently an increase in non-communicable diseases. Studies in the region have focused on the impact of HIV/AIDS on both child and adult mortality. The impact of HIV/AIDS in the region has been devastating. Of the 40 million HIV infected individuals at the end of 2003, 26 million (65%) were living in this region (Lau and Muula, 2004). Studies have extensively covered the levels and determinants of HIV related deaths. These include the impact of parental illness on households, the economic impact and health and nutrition (Foster and Williamson, 2000, Demmer, 2009). The impact of other communicable diseases, such as malaria and diarrhoea, on child deaths in Sub- Saharan Africa has also been noted in research. A study in Kenya found that 34% of under-five child deaths were due to malaria (Korenromp et al., 2003). In Malawi, it was found that dehydration caused by diarrhoea is a major cause of mortality and morbidity in young children (Phoya and Kang'oma, 2005).

Recently, studies have begun to focus on the impact of non-communicable diseases on adult mortality in the region. In 2002, the national cause of death statistics in South Africa showed that 18% of deaths of all ages and 20% of the 35-64 year olds were a result of chronic diseases of lifestyle (Stats SA, 2005). In a 2005 study it was found that cardiovascular disease accounted for almost 25% of all mortality to adults in South Africa (Bradshaw et al., 2005). Mortality due to injury in Sub- Saharan Africa also contributes to the mortality rates of both children and adults. In Tanzania it was found that injury contributed to approximately 5% of all deaths in the capital city, Dar es Salam for all age groups (Moshiro et al., 2001). It is due to the context in which mortality occurs in Africa that countries will most likely miss the MDG deadlines.

The Millennium Development Goals (MDGs) have focused attention on achieving clear targets with regard to mortality reduction worldwide. These goals are meant to be achieved by 2015. Yet many African countries run the risk of not meeting their targets. One of the MDGs aims to reduce, specifically under- five mortality globally. Other MDGs which focus on the reduction of HIV/AIDS, poverty and hunger and the improvement of maternal health, all have indirect implications which will improve mortality rates. These goals, although clearly defined and regionally set, remain unattainable in many African countries. Despite policy and programme interventions many states fear the 2015 deadline will not be met. Perhaps a new approach to the research and understanding of health outcomes is what is needed in meeting these goals. More age- specific, comprehensive and contextual analysis of the dynamics surrounding health outcomes is required for policy to be directed at the respective populations at risk. This study aims to achieve this, through analysing the multilevel determinants of mortality outcomes of the adolescent population in South Africa.

In South Africa, the issue of health and mortality has been studied in many different contexts. Key determinants shaping child health and mortality in South Africa have been identified as poverty, poor maternal education, racial and gender inequalities, undernutrition and HIV infection (Sanders et al., 2010). More recent studies have noted that determinants of adult health and mortality in the country include unemployment, cultural practices, living and working conditions and HIV/AIDS (Hosegood et al., 2004b, Kahn et al., 2007, Bradshaw, 2008). These studies acknowledge that individual outcomes are influenced by social and economic structures within which people exist. Hosegood and others (2004) found that 48% of adult deaths were due to AIDS from data collected using the verbal autopsy method. Kahn and others (2007) found that in rural South Africa, rates of adult female mortality have increased since 1990. In addition, Bradshaw (2008) found that poverty and under- development has contributed to South Africa's growing burden of disease. These broader social structures need to be examined with regard to health outcomes in the country.

Mortality in South Africa is not as high as other African countries, but remains higher than developed countries. Between the early 1990s and 1997, men's probability of dying between exact ages 15 and 60 increased from 30-35 per cent to about 45 per cent. During the same period, women's probability of dying in this age range increased from 15-20 per cent to about 30 per cent (Bradshaw et al., 2000b). More recently, in 2009 it was reported that life expectancy was 53 years for males and 57 years for females in the country (Stats SA, 2010c). This is indicative of a persistent high mortality rate in the country. The implications of this on the population are a high dependency ratio and a strain on social services and resources.

For children in South Africa, mortality rates are worrisome, with infant mortality being 45 deaths per 1,000 live births and under-five mortality being 61 deaths per 1,000 live births in 2002 (Redelinghuys and Van Rensburg, 2004). According to the Medical Research Council (2010) the number of under- five children dying annually in South Africa is about 60,000. For adolescents in the country, road accident injury and drowning were among the leading causes of injury- related deaths which constituted approximately 50% of all deaths to those aged 10-19 between 1985 and 1995 (Redelinghuys and Van Rensburg, 2004). More recently, it was found that adolescents between the ages of 10 and 14 years constituted 0.64% (n= 3,3339) and those aged 15- 19 years constituted 1.63% (n= 8,977) of deaths in all age groups in 2003 (Stats SA, 2005). This demographic of adolescents is of particular interest to this study. The World Health Organization (WHO) defines an adolescent as being between the age of 10 and 19 years old, thus making them no longer children nor yet adults (WHO, 2010). Individuals in this age group are the future working population, making them an asset to the economic growth of any developing country.

Studies on children and adults often incorporate factions of the 10- 19 year old age group in their analysis. Some studies look at adults as anyone over the age of 15 and children as being under the age of 10 so there is a gap concerning those between the ages of 11 and 14 years old. Alternatively studies would focus on children under the age of five and consider youth to be anyone between 10 and 24 years old, which incorporates the age- group of interest as well as young adults who are over the age of 19 years old, representing a very, large age- group. Studies have not really focused on the determinants of mortality of the 10- 19 year old age group specifically. The needs of adolescents are specific and related to the issues which they specifically face. There are existing social, economic and political pressures which impact on adolescent health and mortality. These have been identified as violence and unsafe environments, poverty, lack of resources, mental health problems and migration (Viner et al., 2011, Emmer, 2003, Goosby, 2007). Furthermore, variation of risk within this age- group is unknown. Whether the risks of 10-13 year olds is the same as mortality and health risks for 16-19 year olds requires investigation.

Research has addressed these issues of adolescents and others related to reproductive health, poverty and HIV/ AIDS only (Bearinger et al., 2007, Varga, 2003, Reading, 1997, Ford and Hosegood, 2005). For reproductive health studies, it was found that in most countries of sub-Saharan Africa about a third of unmarried adolescent girls have had sexual intercourse. This increases the chances of adolescents falling pregnant and contracting HIV and other STIs (Bearinger et al., 2007). In South Africa, focus- group discussions discovered that gender differentials reinforce poor sexual negotiation dynamics and this places adolescents at risk for early pregnancy and other sexual and reproductive health complications (Varga, 2003). Ford and Hosegood (2005) observed that as AIDS mortality in South Africa increases, more adolescents move to new households. Reading (1997) found that poverty and economic factors are central to the causes of social differences in the health of children and adolescents. Additional health related research for adolescents, specifically in South Africa, have looked at the increasing occurrences of key sexual and reproductive health issues such as HIV/AIDS, maternal health, teenage pregnancies and drug and alcohol use (Lobel et al., 2004, Abdoulaye, 2006, Cunningham and Boult, 1996). Redelinghuys and others (2004) found that HIV/AIDS is a leading cause of death for children under the age of 14 years old and that risky sexual behaviour is a risk factor in the illness and mortality of adolescents in South Africa. This study, however, has not examined the sociodemographic factors associated with mortality among adolescents. Adolescent mortality has been studied in South Africa mainly with regard to predominant causes of death. These causes include mental health disorders (Madu and Matla, 2004), interpersonal violence (Swart et al., 2002), HIV/AIDS (Seedat et al., 2009)and maternal mortality (Khan et al., 2001).

Since studies have focused primarily on the individual level determinants of adolescent health and mortality in South Africa. For example, Flisher and others (1992) found that racial differences with regard to adolescent mortality exist in South Africa. The study reported that White adolescents had the lowest mortality and acknowledged that at the time there was insufficient data to measure the mortality of Black adolescents. This study, in addition to omitting Black adolescent mortality rates, did not consider the determinants of mortality for adolescent South Africans. The study did not account for socioeconomic factors that are associated with mortality individually or at a higher social level such as the household. There is need to place mortality outcomes in the context of the households and communities in which they are situated.

The households and communities that adolescents live in are key indicators of the resources and services that 10- 19 year olds have available to them. It is this environment then that adolescents are exposed to that could adjust the individual characteristics that contribute to mortality. Studies on adolescents in South Africa have largely ignored this fundamental contextual aspect. This contextual aspect refers to the household and community environment of adolescents. It includes the demographic and socioeconomic characteristics of household heads, parents and families. Studies done on adolescents have found positive associations between socioeconomic status characteristics and health behaviours of adolescents. Such as, Hanson and Chen (2007) who found a positive association between parents education, occupation and family income and alcohol use among 16- 19 year olds (Hanson and Chen, 2007).

Similarly, Gordon-Larsen and others (2000) found that family income was a determinant of cigarette smoking among 12- 22 year olds in a study of American adolescents (Gordon-Larsen et al., 2000). Family income was found, in a different study by Blum and others (2000), to be positively associated with alcohol use among 11- 18 year olds (Blum et al., 2000).

Therefore while mortality studies tend to focus on child and mortality, none have focused exclusively on the mortality of adolescents. Research on adolescent health and mortality is vital for development in the country. Adolescents are the future working population and in a few short years will become the chief contributors to the South African economy as both labourers and consumers. Ensuring the survival of adolescents then ensures the future economic development of the country. Addressing adolescent health is also vital to development since adolescent health sets the foundation for adult health status. Adolescent is noted as a time in which life-long patterns of behaviour are established (Fine and Large, 2005). Health behaviours including the prevention of disease and risky behaviours should begin at adolescence to ensure the safe and healthy survival of these young people into adulthood. Certain diseases such as adolescent obesity and sexually transmitted infections affect adolescents later in their adult lives.

Adolescents are also current and future parents in the country. A study done in Durban, South Africa found that maternal mortality among adolescent women is compounded by TB and HIV-1 (which refers to the most common subtype of the HI virus) infected young mothers (Khan et al., 2001). There is no indication of this at a national level though. However there is a need to ensure that young mothers survive into adulthood to care and provide for their offspring. A consequence of the mortality of adolescent parents is that the number of South African orphans will increase and this will create a social and economic burden on the state.

As previously noted, mortality in South Africa is high among adults and children (Burgard and Treiman, 2006, Dorrington et al., 2004). This has resulted in reduced life expectancy for both males and females in the country. Many of these deaths, for children and adults are preventable. The same could be true of adolescent deaths however little is known of the levels and causes of adolescent mortality in contemporary South Africa. There is need then for an investigation into the causes of adolescent death so that inferences can be made about what adolescent life- expectancy in South Africa would be if these causes were eliminated, such as HIV/ AIDS. Through addressing this gap of adolescence in research, a more comprehensive understanding of the mortality of adolescents in South Africa will be presented and can be used to inform national health policies, such as the National Youth Policy 2009- 2014.

Therefore this study will pick-up on two identified gaps in research. Firstly, levels and causes of adolescent mortality will be explored. Secondly the contextual effect of households and community level factors on adolescent mortality will be examined.

1.2 Main Research Question:

What were the levels, causes and determinants of adolescent mortality in South Africa in 2001 and 2007?

1.3 Research Objectives:

1. To estimate mortality levels of the adolescent population in South Africa;
2. To identify causes of death among adolescents in the country;
3. To determine the sociodemographic factors that contribute to adolescent mortality at different levels of analysis;
4. To assess the extent to which contextual factors account for variations in regional patterns of adolescent mortality.

1.4 Justification:

Adolescents constitute a significant proportion of the population at 20% in 2009. Adolescents are the future labour force of the country. These persons will become the prime working and productive age in a few short years' time. Social development, economic growth and national leadership will all soon become the responsibility of South African adolescents. Thus the well-being and education of adolescents is especially important to the overall future development of South Africa. For this reason the health and mortality of adolescents is of particular concern to policy- makers and parents. However little is known about the health status and mortality of adolescent South Africans. Efforts made to enhance adolescent health are stifled by limited analysis of data pertaining to this age group in the country. The levels and determinants of adolescent mortality in the country remain under-researched. This has resulted in policies and programmes being based on a limited understanding of the complexities that determine adolescent health and mortality.

In addition, the MDGs for the country need to be met. The specific goals relating to poverty and hunger, maternal health, universal education and gender equality all relate to adolescents. In attempting to achieve these targets, policies must address the needs of adolescents, not just children and adults. Moreover these goals need to be met by 2015. Failure to meet the MDG deadlines has social and developmental consequences for the South African population. The country will continue to struggle with issues of poverty and hunger, HIV/ AIDS and high rates of maternal mortality. Given the dearth of information about the mortality of adolescents in the country, it is not clear at this point how 10- 19 year olds are addressed in achieving the MDG targets. This research is needed to inform policy that will address the needs of adolescents in South Africa. Often policy is directed at children, under- 15 years old and the youth, 15- 30 years old. These overlapping policies are problematic as they undermine the specific needs of 10- 19 year olds, whose needs are decidedly different from those under-10 years old and those over 20 years old. It is thus fundamental that research now focus efforts on understanding the mortality dynamics of adolescents to be included in policy and programmes in order to meet the deadline.

Dynamics that need to be studied with regard to adolescent mortality include, causes of death and sociodemographic determinants using recent data. Cause of death statistics have previously been produced for the entire population (Stats SA, 2005). These show that overall the main natural cause of death in 2001 for adults was tuberculosis. For children and adolescents, 0- 18 years old, the main natural cause of death in 1997 and 2001 was respiratory and cardiovascular disease. How many of these deaths were to adolescents between the ages of 10- 19 is unknown from these figures. Non- natural cause of death statistics show that transport accidents accounted for the most deaths to those aged 15- 49 years and in 1999 and in 2001, assault (3,279) accounted for more deaths than transport accidents (3,025) for the same age group. The attribution of adolescents to these statistics is unknown. Thus there is need for specific and recent investigation into the cause of death of adolescents in South Africa. In examining this, a more holistic understanding of the issues that adolescents face in South Africa will become apparent.

Little research has been done on adolescent mortality of South Africans. Research on individual-level factors such as race and provincial distributions of adolescent death in the 1980s are noted (Flisher et al., 1992). However, individuals exist within households and households exist within communities and neighbourhoods. Thus, individual characteristics alone are no longer sufficient in research attempting to establish associations and determinants of mortality. There is need for a different approach to understanding the mortality outcomes of adolescents. Since individuals are colloquially referred to as 'products of their environments' it is these environments that need to be studied in establishing determinants of mortality.

Research has recognised the need to bear in mind community and environment characteristics in health studies. Luke (2004) argues "if we do not do this, we can run into serious problems like the Ecological Fallacy. Where relationships observed in groups are assumed to hold for individuals" (Luke, 2004). Alternatively relying on individual- level analysis for the study of adolescent mortality would result in a misunderstanding of the effect of household and community influences on mortality outcomes. Individual- level analysis will ignore the exogenous influences of society on mortality outcomes.

For this reason multilevel models have also appealed to many different disciplines of study, including social sciences, because of this practice of examining hierarchical social structures (Guo and Zhao, 2000). Since in social sciences, social structures are hierarchical in nature, multilevel models are used. This study will produce findings which may direct policy toward addressing household and community issues in their relation to adolescent mortality, as opposed to policy which focuses merely on the individual. In this way policy will be able to address the needs of individuals as grouped by their type of community and household and hopefully target a larger number of adolescents.

1.5 Hypotheses:

$H_0$1: The levels and rates of adolescent mortality in South Africa are decreasing over time.

$H_0$2: All causes of adolescent mortality contribute equally to the overall adolescent mortality rates in South Africa.

$H_0$3: Contextual factors account for significant differences in regional patterns of adolescent mortality in the country

1.6 Definition of key terms:

1.6.1 Adolescent: This is any individual between the ages of 10 and 19 years old.

1.6.2 Younger adolescents: These are persons aged between 10 and 14 years old.

1.6.3 Older adolescents: These are persons aged between 15 and 19 years old.

1.6.4 Adolescent Mortality: This refers to the death of persons aged 10 to 19 years old

1.6.5 Household: This is defined as "a group of persons (or one person) who make common provision for food, shelter and other essentials for living, but practices vary significantly among countries" (Bongaarts, 2001: 4).

1.6.6 Community: This is defined as a group of households who share a common geographical location.

1.6.7 Cause of death: all those diseases, morbid conditions or injuries which either resulted in or contributed to death and the circumstances of the accident or violence which produced any such injuries.

1.6.8 Natural Causes of Death: These are deaths from disease and infection, such as HIV/ AIDS and tuberculosis.

1.6.9 Unnatural Causes of Death: These are deaths from causes that are not related to disease or infection, such as violence and injury, poisoning, suicide, drowning and motor vehicle accidents.

1.6.10 Recorded death: is a death registered at the Department of Home Affairs and processed at Statistics South Africa.

1.6.11 A transport accident: is any accident involving a device designed primarily for, or being used at the time primarily for, conveying persons or goods from one place to another.

1.6.12 A traffic accident: is any vehicle accident occurring on the public highway/street (i.e. originating on, or involving a vehicle partially on the highway/street).

1.6.13 A road traffic accident death: a death resulting from injuries sustained in a road traffic accident including those of a pedestrian, pedal cyclist, motorcycle rider, occupants of three-wheeled motor vehicle, occupant of pick-up truck or van, occupant of heavy transport vehicles, bus occupant and individuals injured in other land traffic accidents (animal riders, occupants of a railway train etc.).

1.6.14 Underlying cause of death: the underlying cause of death is defined by the WHO as the disease or injury that initiated the train of morbid events leading directly to death

1.6.15 Immediate cause of death: the disease, injury, or complication that directly precedes death, which is the ultimate consequence of the underlying cause of death.

Chapter 2

Literature Review and Theoretical Framework

2.1 Mortality in South Africa

2.1.1 Introduction:

This chapter will review the relevant literature on adolescent mortality and more specifically mortality in South Africa. Beginning with a background of adolescent mortality studies done in other African countries, a necessary to review research done on mortality in South Africa will follow. Literature on child and adult mortality will be discussed. Finally, given the fact that adolescent mortality is not as extensively researched as child and adult mortality in the country, as overview of studies that have been done on adolescents will be offered. Not all of the studies address the mortality of 10- 19 year olds specifically, but do include this age group in their target populations. Through highlighting the work that has already been done, especially in South Africa, it will become evident that there is need for this study within the South African context.

2.1.2 Adolescent mortality in Africa:

In developing countries nearly two thirds of premature deaths and one third of the total disease burden in adults are associated with conditions or behaviours that began in youth, including tobacco use, a lack of physical activity, unprotected sex or exposure to violence (WHO, 2010). The total number of incident DALYs in those aged 10–24 years was about 236 million, representing 15.5% of total DALYs for all age groups. DALYs are the sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability. Africa had the highest rate of DALYs for this age group, which was 2.5 times greater than in high-income countries (208 *vs* 82 DALYs per 1000 population) (Gore et al., 2011).

Studies contend that a dominant cause of mortality of adolescents in the region is HIV/AIDS. In developing countries, HIV/AIDS has been noted as the second largest contributor to mortality of young people (Blum and Mmari, 2004). The measurement of AIDS deaths has remained a problem in African countries, but prevalence of the disease is high. It is argued that today, nearly 5 million young people (15- 24 years old) are living with HIV/AIDS (UNAIDS, 2011). In Sub- Saharan Africa there is an HIV prevalence of 3.4% among young females and 1.4% among young males (UNAIDS, 2011). In the region an estimated 30% of women aged 20- 24 years in Botswana were infected and in Rwanda over 25% of pregnant adolescents aged 17 and below tested positively for the virus (Verkuyl, 1995).

Literature has shown that gender differentials in patterns of infections vary around the world (Lobel et al., 2004). Of notable importance in Africa, is that young women have higher rates than their male counterparts. The reasons for this have been well documented and include young women being unable to negotiate safe sex, transactional sex and the biological development of young girls (Verkyl, 1995; UNAIDS, 2000; UNAIDS, 1999). In relation to gendered mortality is adolescent maternal mortality maternal mortality is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, from any cause related to or aggravated by the pregnancy or its management (irrespective of the duration and site of the pregnancy) but not from accidental or incidental causes (Khan et al., 2006) . In developing countries, pregnancy is the leading cause of death of adolescent girls aged 15 to 19 years old (Graczyk, 2007). An estimated 80% of maternal deaths are due to sepsis, unsafe abortion, haemorrhage, obstruction and eclampsia (Mmari and Blum, 2009).

It is reported that annually about 2 million young women undergo unsafe abortions (Graczyk, 2007). In Nigeria complications arising from unsafe abortions account for 72% of all deaths in women under the age of 19 years (Graczyk, 2007). Unsafe abortions are carried out in developing countries because abortion itself is illegal in most developing countries. This restricts a young woman's ability to safely and wisely regulate her reproductive behaviour. Furthermore information about abortion and its consequences is not known to many adolescents in developing countries which only heighten their risk.

Lifetime risk of maternal mortality is higher in developing countries than it is in developed countries. It was reported that the risk of maternal mortality in developing countries is 1 in 61 women, compared to developed countries where it is 1 in 2,800 (Graczyk, 2007). In Mozambique, a study has shown that hospital staff tend to underestimate the impact of disease on young and first pregnancies and this tends to delay treatment and management during pregnancy (Granja et al., 2001).

2.1.3 Mortality in South Africa:

In South Africa, mortality declined from 1986 – 1992 and thereafter increased (Dorrington et al., 2004). It has been argued that the country is off -track for the health-related Millennium Development Goals (MDGs) (Patterson, 2008; Bradshaw et al, 2010). Mortality in children younger than 5 years has increased, whereas maternal and neonatal mortality remain constant

(Patterson, 2008). This was substantiated by Sanders and Bradshaw (2010) who argued that there has been a downward trend in child mortality from the 1980s but was reversed in the 1990s. This reversal in mortality trends in the country presents a challenge for South Africa in meeting the 2015 MDG deadline. However research in the country has made numerous attempts at addressing the issues of child and adult mortality.

For infant mortality, a study examining the trends in overall infant mortality, from the mid-1980s to the late-1990s revealed that mortality among African infants was higher than all other age- groups (Burgard and Treiman, 2006). This paper was done using South Africa Demographic and Health Survey (SADHS) data, however, the specific years of the survey that had been reviewed is unknown. However, a main conclusion of this paper was that persistent inequalities in the personal and household resources of South Africa's four main racial groups substantially account for racial differences in infant survival rates in both periods (Burgard and Treiman, 2006). This study did not use recent data nor did it consider children under the age of five. Hence, there is no indication of whether or not these racial differences in South African child mortality persist.

Other infant and child mortality studies in South Africa have been done and have concentrated on the socioeconomic determinants and levels and trends of mortality. In a study that examined the relationship between child mortality and socioeconomic status among migrants and non-migrants in South Africa, it was found that among migrants, child mortality decreased faster as socioeconomic status increased than among non-migrants (Thomas, 2007). This study did not include internal migrants in its sample and only focused on the plight of international migrants. The extent to which internal migrants are affected by child mortality in the country remains unclear.

Similarly for determining factors of mortality, it was revealed that the proximal underlying factors for common childhood infections which if untreated contribute to mortality include: inadequate sanitation; poor hygiene practices and poorly ventilated and crowded living spaces. Distal risk factors include lack of resources such as financial, physical, educational or organisational were also identified in this paper (Sanders et al., 2008). The impact of HIV/AIDS on infants and children has not been ignored in South Africa. Violari and others (2008) revealed that early HIV diagnosis and early antiretroviral therapy reduced early infant mortality by 76% and HIV progression by 75% (Violari et al., 2008). Others ways in which HIV/AIDS has affected children were studied by Ford and Hosegood (2005). In this study it was observed that child mobility following maternal deaths from AIDS was lower than child mobility following maternal deaths from other causes. Younger children, boys and children whose mothers or fathers were resident members of the children's households were also less likely to move (Ford and Hosegood, 2005). Based on data from the Africa Centre Demographic Information System, this study's implication for policy is fundamental in addressing the needs of new caregivers and where there is need for better schools and health provision for children.

For adult mortality, between the early 1990s and 1997, men's probability of dying between exact ages 15 and 60 increased from 30-35 per cent to about 45 per cent. During the same period, women's probability of dying in this age range increased from 15- 20 percent to about 30 percent; the rise in mortality in the country is due to HIV/AIDS (Bradshaw et al., 2000b).

From 1997 – 2003, it was reported in the country that the number of reported deaths had steadily increased, which is partly associated with population growth and with improved notification. It was also observed that while an increasing number of deaths are associated with lifestyle diseases as the underlying cause, the dominant contributors to the growth in mortality are deaths associated with tuberculosis and influenza and pneumonia (Stats SA, 2005). These two studies have reported on the levels and rates of adult mortality in South Africa over the years. These studies have not however, examined the determinants of different causes of death.

Bradshaw (2008) opined that South Africa can be considered to have a quadruple burden of disease including, diseases and conditions related to poverty and under-development, chronic diseases, injuries and HIV and AIDS. For chronic disease, a study which set out to investigate the shift of diseases associated with under-development, such as infectious diseases and poor maternal and child health, to chronic degenerative diseases affecting adults, found that South Africa is in the process of transition (Bradshaw et al., 2005). More specifically the study revealed that compared with the whites, the African population is earlier in the transition, while the coloured group may be in the additional stage of the transition. The poorer provinces appear to be in the earlier stages of the transition with high mortality from stroke (Bradshaw et al., 2005). These findings show that the country is not free from the burden of HIV/AIDS on adult mortality. In 2005, a study observed that as a large proportion of AIDS deaths appear to be classified to AIDS related conditions, without reference to HIV, interpretation of death statistics in South Africa cannot be made on face value as a large proportion of deaths caused by HIV infection are misclassified (Groenewald et al., 2005).

Despite this revelation, literature has focused on quantifying deaths attributed to HIV/AIDS in the country through using data from Demographic and Health Surveillance Sites (DHSS). These studies have found that AIDS, with or without tuberculosis, is the leading cause of death in adulthood (48%) (Hosegood et al., 2004b) and in rural South Africa high mortality is attributable to the epidemic (Kanjala et al., 2010). Using the verbal autopsy method, these methods were able to evaluate cause of death in the predefined study areas. DHSS has also been used to note adult mortality differentials in the country. Kahn and others (2007) found that since the mid-1990s female mortality has increased in the country more than that of males. This study found that life expectancy of females had declined by 12 years since the 1990s (Kahn et al., 2007). This finding is similar to that of another study which found that female's probability of dying from 1990- 1997 had increased from 15- 20 percent to around 30 percent (Bradshaw et al., 2000b).

Female mortality attributed to maternal mortality has also been researched in South Africa. In one study, based on hospital records from the KwaZulu Natal province, it was found that 54% of maternal deaths were caused by tuberculosis and the HIV-1 infection (Khan et al., 2001). This finding is consistent with a regional study that found that 48% of all maternal mortality occurs in Africa, with the highest rates occurring in Sub- Saharan Africa (Abdoulaye, 2006).

2.1.4 Adolescent Mortality in South Africa:

A study on causes of mortality for adolescents in South Africa highlighted racial and gender differences in mortality rates between 1984 and 1986 (Flisher, et al, 1992). The study found that the mortality of Coloured adolescents was 1.7 that of their White counterparts. The study noted that the mortality of Black adolescents was not included in the analysis because of inaccurate data at the time. A main result of the paper was that adolescent mortality was high and that many deaths were a result of risky behaviour. Risky behaviour tends to happen in different contexts and environments suggesting that there are exogenous factors that determine the behaviours of individuals. In this way, it is the networks and communities that adolescents are part of that influence their risky behaviour. The authors also suggest that due to the increasing urbanisation at the time of the Black population, the impact of external causes was likely to further increase in the future.

This paper presented two fundamental aspects of research that has yet to be fully recognised. Firstly, it admits to the under-count and inaccuracy of data pertaining to the Black population due to Apartheid. For this reason the mortality of Black adolescents was not analysed in the paper. Since the Black population are currently the majority in South Africa, there is need for recent and inclusive analysis of adolescent mortality including Blacks. The second important aspect raised from this paper is that the authors anticipated that external causes would have an increased bearing on adolescent mortality in the future. External causes then need to be studied with regard to its relationship to adolescent mortality. External causes are factors exogenous to individual –level characteristics thus presenting an opportunity for research to examine the broader contextual characteristics of adolescents.

Few other studies in South Africa have focused on the mortality of 10- 19 year olds. One study focused on the suicidal behaviours of adolescents in the Limpopo province of South Africa (Madu and Matla, 2004). Having noted from previous literature that adolescent suicide was of growing concern in the country, a significant finding of this work was that conflict within a family is highly correlated with suicidal behaviour among 15- 19 year olds in the province. This study's significance then lies in its departure from only considering the individual emotional and psychological state and incorporates household characteristics. That is, this study has placed the individual within the context of their residential environment.

Another study done in the country was concerned with the mortality of 15- 24 years with regard to interpersonal violence (Swart et al., 2002). This study was based on deaths within the city of Johannesburg and was based on previous findings that suggested that 52% of non-natural deaths among youth were due to violence. A main finding of this study was that the homicide rate for youth in Johannesburg was exceedingly high compared to that of other cities in the world. The study also found that males were victims more than females and that most homicides were carried out with the use of firearms. This study has done well to assess the extent of homicide in Johannesburg, arguably South Africa's most economically active city. Yet the contribution of homicide to the overall, national mortality rate is unknown. In this study, one city was selected and analysed, however, not much analytical statistics was applied. So the study does not make any inferences about any characteristics other than age and sex of the population at risk. Other than age and sex, not much is known about the population, such as educational status and employment status. Finally the study has not included the extent of youth homicide in South Africa's other major cities nor has it addressed other causes of death rates in comparison to that of homicide.

However, Seedat and others (2009) attempted to address this latter issue of non-generalisability, but similar to the previous studies has not focused on adolescents aged 10- 19 specifically but has rather grouped this age group with younger and older ages. Nonetheless they (Seedat et al., 2009) identified that in addition to homicide, intimate partner violence and traffic related injuries as major contributors to the mortality of young people in the country. This study found that unintentional injuries was the leading cause of death for those aged between 0 and 14 years old and that intimate partner violence mostly affects females between the ages of 14 and 44 years old. This presents a well- rounded look at injury and violence related deaths in the country, but does not specifically focus on the plight of 10- 19 year olds. The paper makes no indication of how many of the females affected by intimate partner violence are 14- 19 years or how many of the unintentional injury deaths are to 10-14 year olds.

In South Africa, adolescent maternal mortality remains a challenge, especially since teenage pregnancy rates are increasing in the country (Grant and Hallman, 2008). In an effort to decipher the determinants of adolescent maternal mortality, a study conducted in the city of Durban, South Africa, assessed the impact of maternal mortality associated with HIV-1 status of the mother (Khan, Pillay et al. 2001). The study was of women of reproductive age starting at age 15 (Khan et al., 2001). A main finding of this paper was that the overall mortality rate was 200/ 100 000 for HIV-1-infected women the mortality rate was 323.3/100 000. The study concluded that TB and HIV-1 were emerging as important contributors to maternal mortality in the KwaZulu Natal province of the country.

This study demonstrates two important points. Firstly, that research is focused on individual-level determinants of health outcomes. This study's main predictor variable is the HIV status of pregnant females. Secondly, the study does little to disaggregate findings by age within the broad reproductive age- group. This categorization of findings is fundamental from a contextual or background perspective. The circumstances of pregnant teenagers are different to that of older women, especially with regard to being able to access ARVs and sufficient food and nutrients during their pregnancy. HIV infected teenage mothers who are not economically active are reliant on others to provide food and healthcare for them, which adds to their risk of poor health and mortality. This facet of dependence cannot be ignored and adolescents, who are arguably more dependent than adults, cannot be grouped with adults when considering causes and determinants of mortality.

With regard to disease studies, research has focused on the prevalence, risk factors and association between adolescents, again at different definitions of this age group, and a host of illness outcomes including HIV. Pettifor and others found that young women were significantly more likely to be infected with HIV in comparison with young men (15.5 versus 4.8%) (Pettifor et al., 2005). In addition, young women with older partners were also at increased risk of HIV infection. Among both men and women, increasing partner numbers and inconsistent condom use were significantly associated with HIV infection (Pettifor et al., 2005). Similarly, another study that examined 15- 24 year olds, found , young adults who were married or had been involved in a relationship for 6 months or more were significantly less likely to have used a condom during their most recent sexual intercourse (Hendriksen et al., 2007).

It was further noted that HIV/AIDS remains a leading cause of death of 0-14 year olds in South Africa (Redelinghuys and Van Rensburg, 2004). These studies are in line with the findings from adult and child HIV/AIDS- mortality studies that noted the burden of the disease in South Africa.

For adolescents risky sexual behaviour is a risk factor of morbidity and mortality – with about 70% of South Africans having their first sexual encounter before the age of 20 years (Redelinghuys and Van Rensburg, 2004). Despite offering quantitative information regarding HIV- mortality in the country, the paper does not offer a comprehensive examination of risk factors and determinants of adolescent mortality in South Africa. There is need for inferential analysis of a broad scope of determinants.

As evident from this review of the literature, *aspects* of adolescent mortality have been studied globally and in South Africa. However the *levels and determinants* of adolescent mortality in South Africa, remains largely under- researched. A possible reason for this is because adolescents are spilt among either being considered children, 10 years old or younger or being youth, between the ages of 15 and 24 years old. These age groups tend to ignore 10- 14 year olds or split these ages between child and youth categories. This research will contribute to the literature presented in this review through examining the extent and determinants of adolescent mortality in South Africa. Specifically, this research will present determinants of adolescent mortality at household and community levels, not only the individual – level determinants. This will broaden the scope for future research to look at other health related issues in the context of a multilevel approach. It is thus an aim of this study then, that future research firstly recognize the unique plight of 10- 19 year olds and secondly include in analysis the contextual dynamics within which South African adolescents exist.

2.2 Theoretical Framework:

Models that focus on the linkages and relationships among numerous determinants affecting health are currently being used in public health research (Grzywacz and Fuqua, 2000, McIntyre et al., 2006, Dooris, 2006). Models of this nature are referred to as 'ecological models'. An ecological approach to health studies involves multiple strategies being developed to impact determinants of health related to the health outcome being examined (Gebbie et al., 2003). This has been found useful in health studies since determinants of health have been found to be related and linked in many ways (Denton and Walters, 1999, Stokols, 1996). It is within this concept of linkages and relationships that ecological models do well in explaining multiple determinants of mortality in populations.

With regard to ecological models, there is no single model which is the most correct to use in studying health outcomes. A number of models have been developed and adapted in a number of disciplines relating to health. The common thread however for all these models, is that, in addition to individual characteristics, the models include broad social, economic, cultural, health and environmental conditions as well as the more narrow living and working conditions, community networks and social and family structures. This is beneficial as it provides background and context to individual health outcomes thus broadening the scope of research to extend to the social and economic environments in which individuals exist. It is these environments that influence individual behaviours and practices, which determine mortality outcomes.

This research will build upon two established models in developing a conceptual framework for this study. The first is the analytical framework for the study of social determinants of health commissioned by the WHO in 2007. Secondly, is a public health model by Gebbie and others (2003) which acknowledges the need to look beyond biological risk factors and include environmental, social and behavioural aspects in studying health. Based on these models, this study's conceptual framework will then be presented and explained.

2.2.1 WHO Commission on Social Determinants of Health (2007)

In 2007 WHO Director- General Lee Jong- Wook created the Commission on Social Determinants of Health (CSDH). The aim of the commission was to promote equity in global health in an effort to reduce health differences among social groups within and between countries. The CSDH has adopted a broad definition of the social determinants of health. The concept encompasses the full set of social conditions in which people live and work. There were three problems the CSDH aimed to address:

1. The roots of health differences between social groups
2. The pathways through which causes lead to differences in health status at population level
3. Finally, where and how should the CSDH intervene to reduce health inequities? (CSDH, 2007)

In addressing these issues the CSDH developed a framework (Figure 2.1) which includes the following key components of health determinants:

1. The socioeconomic and political context;
2. The structural determinants of health inequities

3. The intermediary determinants of health (CSDH, 2007).

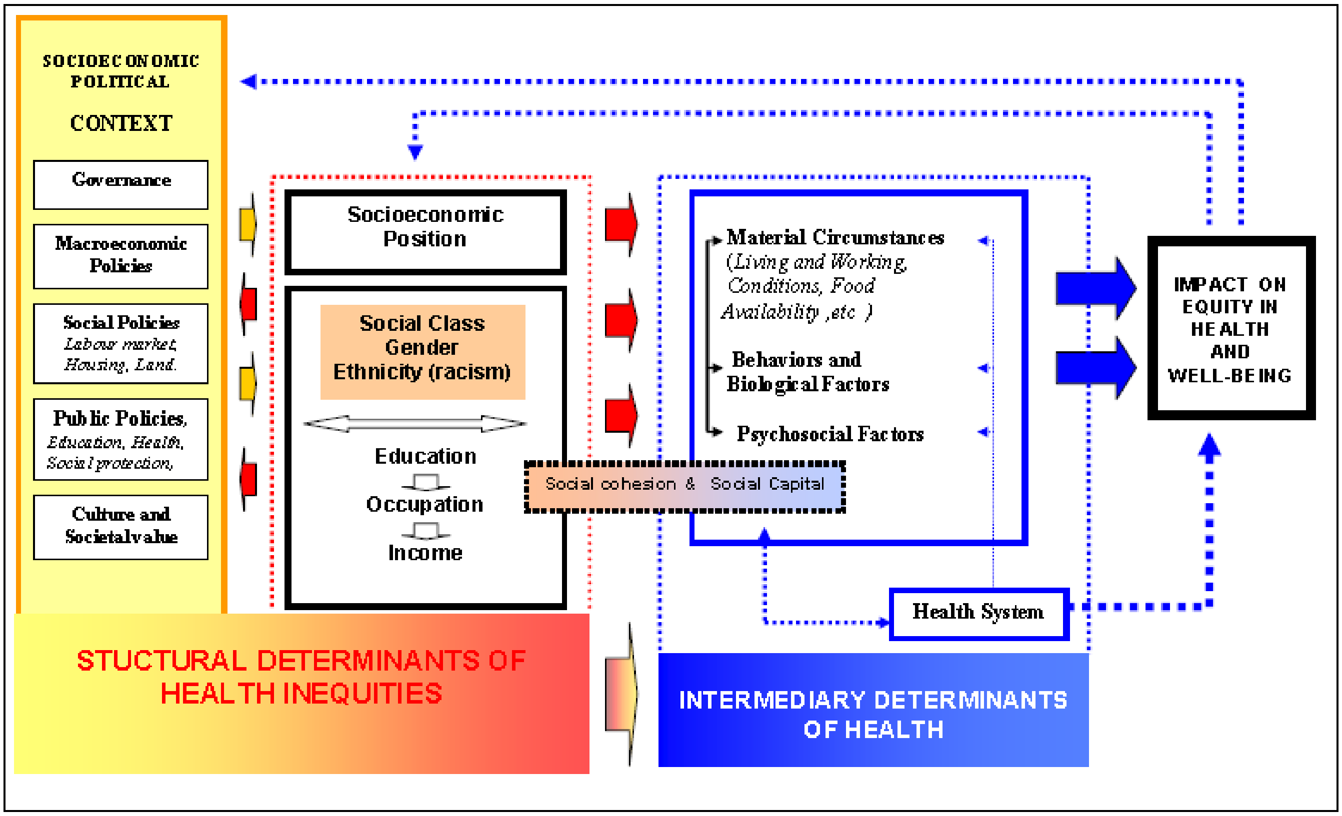

Figure 2.1 Structural Determinants of Health Framework by the CSDH (Source: CSDH, 2007)

For the CSDH the socioeconomic and political context in which individuals live consists of governance, macroeconomic policies, social policies (labour and housing) and public policies related to education and health. This context then impacts the socioeconomic position of individuals (individual education, occupation and income). These broader level policies also affect class, gender and race norms. Thus the socioeconomic political context and the socioeconomic position encompass the structural determinants of health inequities. These structural determinants then work through intermediary determinants of health which encompass the following:

1. Material circumstances (living and working conditions, food availability, etc)

2. Behaviours and biological factors (healthseeking behaviours)
3. Psychosocial factors

These intermediary determinants then relate to the outcome of health and well-being equity.

Source: (CSDH, 2007)

This framework although developed for the purpose of determining health equity between countries, can be adapted to examine determinants of health outcomes, such as mortality, within countries too. The framework details levels through which health is determined starting at the broadest level of policy which determines socioeconomic status (education, occupation, etc). Socioeconomic status affects resources (material circumstances) and behaviours in determining the final outcome of health. For this study on adolescent mortality, the broad notions of socioeconomic structural determinants and intermediary factors will be adapted to show a potential pathway leading to mortality. The structural determinants of the CSDH which will be used in this study, include among others, gender, race, education and employment. The intermediary determinants through which the structural determinants influence mortality, from the CSDH framework that will be adopted include, among others, material circumstances. Material circumstances in this study will be represented by an asset index which will be created from variables pertaining to available resources.

2.2.2 An ecological model for Public Health:

The challenges that public health researchers currently face are related to contemporary occurrences of globalisation, technological advances and demographic changes. This is happening worldwide and at varying paces. These contemporary occurrences have brought about changes in the nature and spread of disease and mortality globally. Researchers now argue that a one-sided approach to addressing disease and mortality is no longer useful (Gebbie et al., 2003). In order to prevent, delay or mitigate the effects of recent diseases there is need for a more ecological understanding of the determinants of disease. This approach then, extends beyond individual and biological risk factors and takes into account the effect of social structures and environments.

With this in mind, Gebbie et al (2003) have suggested the model seen in Figure 2.2 below. This model shows concentric circles, which represent different stages and levels of determinants of health outcomes. Each circle represents a facet of an individual's life that has bearing on their health choices and care seeking behaviour. At the heart of the diagram are the individual's innate characteristics and traits. The authors propose that this innermost circle is no longer sufficient for the basis of research, policy and programmes. They propose that starting with the individual and then working outward toward the broader social, economic and cultural environments that impact health is needed to inform policy and programmes in the 21st century. It is essentially, these structures that determine individual behaviours and choices.

The model represented in Figure 2.2 has two main features that are relevant for this study. Firstly the model accounts for the interaction effects between and among the various levels of health determinants. The dotted lines that separate each circle are representations of these interactions. Secondly, the model demonstrates that over the life-span the number of levels of interaction increase from purely innate individual traits, until interactions at the broad social, economic, cultural, health and environmental levels take place. The reason that this is important to this study is because of the intermediary phase of adolescence. Adolescence is a time whereby individuals are transitioning and their interactions with their broader environments are increasing. As children, individuals begin with individual characteristics and as time progresses, they start to interact with family and social networks, living and working conditions and in their transition to adulthood will also interrelate with the broad structures.

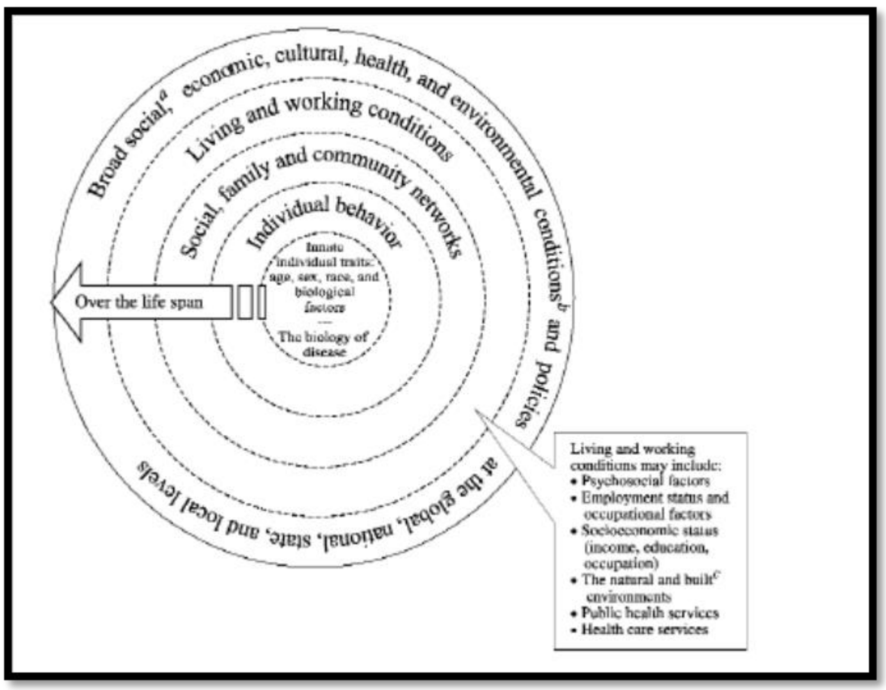

Figure 2.2 The future of public health

Source: Gebbie and others, 2003

Thus from the graphical portrayal in Figure 2.2, adolescents will start to move from the inner-most circle to the outer-most. This is significant as it means that the sphere of influence for 10-19 year olds is in effect increasing and the extent of this influence needs to be measured. It needs to be measured because adolescents are not completely independent and self- reliant, nor are they completely dependent on parents and guardians. They are for the first-time interacting with work and living environments while still being part of their existing family and social networks. The impact of this context needs to be analysed.

In summary, there are a few key concepts from the fore mentioned frameworks that have bearing on this study. Firstly, the intermediary determinants presented by the CSDH serve as the foundational model upon which this study will be built. The acknowledgement that background socioeconomic factors work through proximate determinants to determine mortality outcomes is essential to both social science and medical research. Secondly are the notions of inter-dependence and interaction across different spheres or stages. Adolescents do not exist in isolation and through different stages of their lives will interact with different social structures. Third, is the notion that as the individual starts to interact, move away from the innermost circle, the social structures that they come into contact with are broader, encompass more characteristics, and tend to include a larger number of people, such as a community. In addition, the idea that greater social structures will influence the smaller ones is key to conceptualizing this study. The suggestion that environments affect individual mortality outcomes will be explored in this work. With these key concepts in mind, the following conceptual framework has been developed for the purpose of this study.

2.2.3 Conceptual Framework:

In developing this conceptual framework, the objectives of the study, the models by the CSDH and Gebbie et al have been adapted to suit this overall study objective.

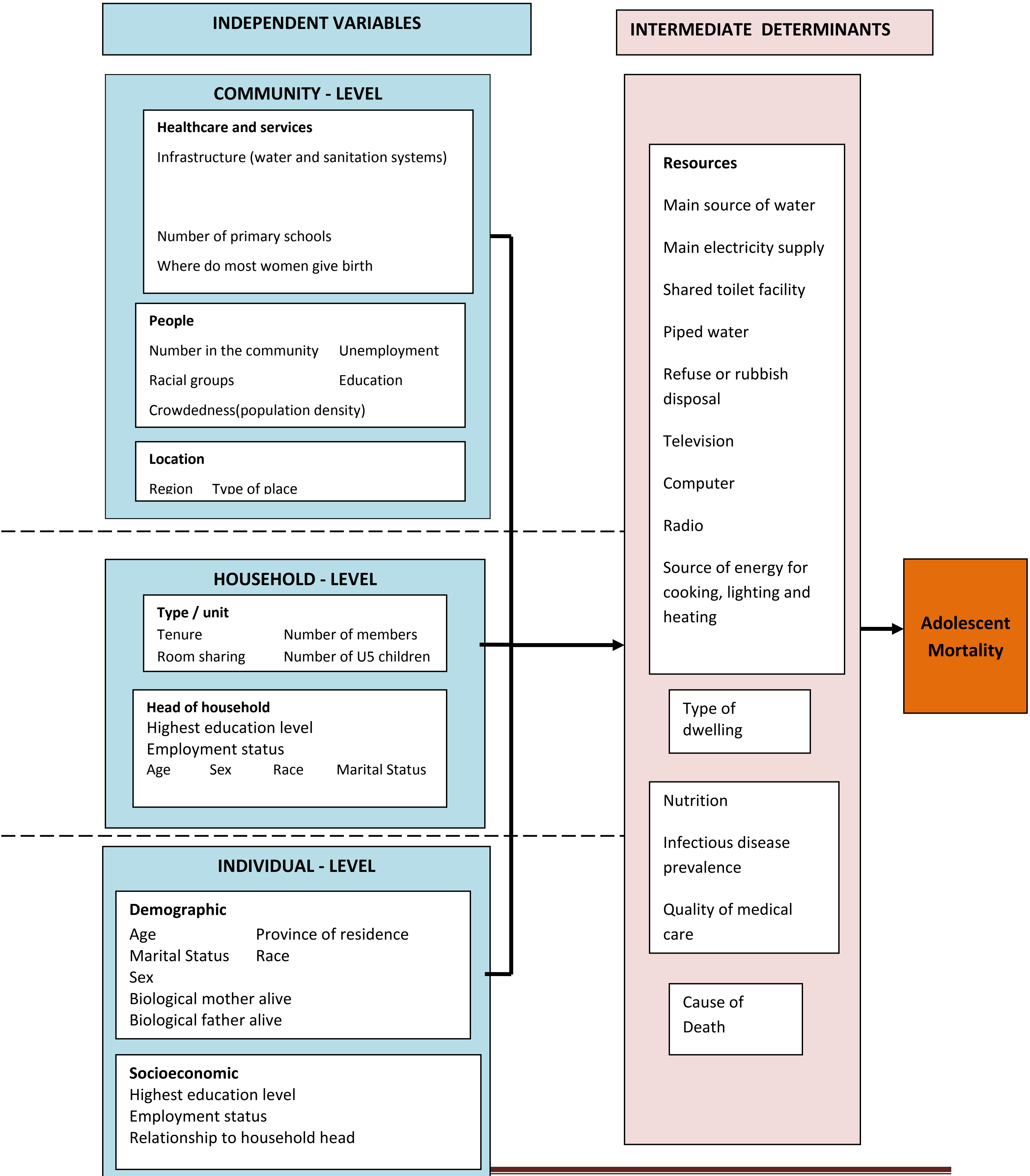
INDEPENDENT VARIABLES
INTERMEDIATE DETERMINANTS
COMMUNITY - LEVEL
Healthcare and services
Infrastructure (water and sanitation systems)
Number of primary schools
Where do most women give birth
People
Number in the community
Unemployment
Racial groups
Education
Crowdedness(population density)
Location
Region
Type of place
HOUSEHOLD - LEVEL
Type / unit
Tenure
Number of members
Room sharing
Number of U5 children
Head of household
Highest education level
Employment status
Age
Sex
Race
Marital Status
INDIVIDUAL - LEVEL
Demographic
Age
Province of residence
Marital Status
Race
Sex
Biological mother alive
Biological father alive
Socioeconomic
Highest education level
Employment status
Relationship to household head
Resources
Main source of water
Main electricity supply
Shared toilet facility
Piped water
Refuse or rubbish disposal
Television
Computer
Radio
Source of energy for cooking, lighting and heating
Type of dwelling
Nutrition
Infectious disease prevalence
Quality of medical care
Cause of Death
Adolescent Mortality

Figure 2.3 Conceptual Framework for the study the relationship between multilevel factors and adolescent mortality (adapted CSDH, 2007 and Gebbie et al, 2003)

In Figure 2.3, it is shown how each classification of variables will be regarded in this study. It shows the variables that will be used to measure individual, household, community factors and mortality in this study. A more detailed list of the variable definitions is offered in the Methodology chapter.

The diagram places mortality as an outcome at the far right of the concept. This was done because mortality is the resulting condition under review. Bearing this in mind, the conceptual diagram shows that the levels work through the intermediate determinants to influence the mortality outcomes. This is based on the CSDH's framework (2007). The framework shows on the far left, the independent variables grouped according to individual, household and community level determinants also as per the structural determinants in the CSDH framework. In the figure, the arrow, which extends from the independent variables to the proximate determinants indicates the path of influence. That is, it shows that individual, household and community variables do not lead directly to adolescent mortality but work though factors such as maternal occupation, type of place of residence and the resources available. Adolescent mortality from disease also work through factors such as nutrition, prevalence of infectious diseases in the population and quality of healthcare. However, these latter variables will not be analysed in this study. A suitable study design for analysis the effect of nutrition, other infectious disease and healthcare on mortality outcomes is a longitudinal study, which this study is not. The interaction effect is represented by the dotted lines which separate the different levels of determinants. From Gebbie et al (2003) these dotted lines show the interface of levels and argue that these characteristics should not be examined as autonomous entities.

For the purpose of this study, health-seeking practices and other health outcomes will not be examined, but are noted as important intermediary factors that influence health. Factors of prevention and treatment of disease are noted as key to mortality outcomes, however since this study is looking at determinants of mortality, the prevention and treatment actions of adolescents will not be examined at this time.

Chapter 3

Methodology:

This chapter presents an overview of the study area, data sources, study design, study population, ethics and variables used in the analysis. In addition, a detailed description of the analysis conducted in order to meet the study objectives is presented. At the very end of this chapter, a list for the dissemination of findings are offered as proof of the feasibility of the methodology.

3.1 Study Area:

South Africa has been selected as the study region for this study. The country is situated in the bottom most area of Africa. Its neighbouring countries include Botswana, Mozambique, Zimbabwe, Namibia, Lesotho and Swaziland. There are nine provinces in the country and the mid- year population estimate for 2011, was 50,59 million people (Stats SA, 2011). The national 2011 Census estimated the South African population to be 51,770, 560 (Stats SA, 2012).

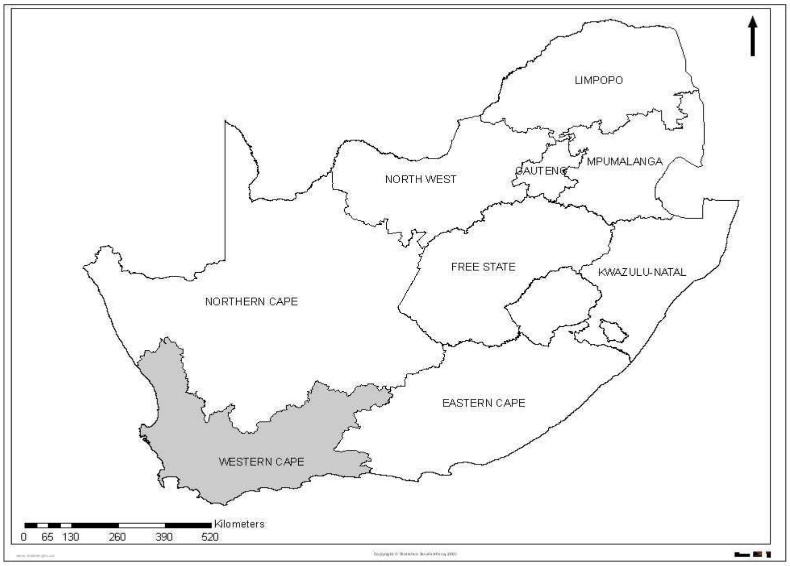

Figure 3.1 Map of South Africa, showing all nine provinces

Source: Statistics South Africa (2011)

South Africa has an interesting and politically turbulent past. Racial discrimination plagued the country for decades and in 1994 was declared a democracy. Since the end of Apartheid, South Africa has enjoyed a peaceful and prosperous economic and political era. The transition to democracy itself was a peaceful time and since abolishing racial discrimination in the country, equal economic opportunity for all residents has been made available. Disadvantaged racial groups now have access to good- quality education, employment and healthcare in a country where this was previously only available to White residents. South Africa's prosperity in this regard has elevated the status of the country and is often likened to a developed country. The nation has far exceeded expectations with regard to its post- Apartheid economic growth and political stability (Carmody, 2002, Williams and Taylor, 2000).

However, despite the progress made and stability achieved, South Africa remains, much like the rest of Africa, plagued by inequality. Within the country, there is still inequality with regard to education, and employment. Sibanda and Lehloenya (2005) found in their study that the racial gaps in educational attainment exist in South Africa. The authors found that the school completion rate of White students is 173 % higher than that of African / Black students (Sibanda and Lehloenya, 2005). Another study found that while as many as 69.4 % of White South Africans are employed in the formal sector, only 36.9 % of Coloureds and African/ Blacks are employed in the same sector (Michael, 2003).

Further, the burden of disease and mortality remains a challenge. In the area of HIV/AIDS, an estimated 316,900 new infections to persons aged 15 and older were reported in 2011. For persons below the age of 15 years, 63,600 new infections were detected in this year (Stats SA, 2011). South Africa is also doing poorly with regard to other development indicators. The infant mortality rate for this year was estimated at 37.9 deaths per 100,000 live births and under- five mortality is 54.3 deaths per 100,000. Of interest, the number of AIDS orphans in South Africa is also high at 2,01 million in 2011 (Stats SA, 2011). Some studies have included children up to the age of 18 in their definition of orphans. Either way, this includes a faction of the population of interest in this study, which is 10- 19 year olds (Bicego et al., 2003, Hunter, 1991). With adolescents in South Africa constituting approximately 20% of the total population, a substantial percentage of adolescents could then be AIDS orphans. Further, since these adolescents were born in post- Apartheid South Africa, the challenges they face with regard to services and access to healthcare are presumably different to the previously disadvantaged. However, the correctness of this statement is yet to be determined.

Adolescents in contemporary South Africa are affected by HIV/AIDS, teen pregnancy, domestic violence and other reproductive health issues. In a study by Pettifor and others, it was found that while infection the HIV infection rate among males, aged 15 – 24 years old was 4.8%, the HIV infection rate among their female counterparts was as much as 15.5% in the country (Pettifor et al., 2005). Elsewhere it was found that as many as 30% of 19 year old South African girls had given birth at least once in their lifetime (Kaufman et al., 2001). Added to this plight, it was found that adolescent girls were almost 4 times more likely to experience sexual violence than adolescent boys in the country (King et al., 2004).

They are also faced with poverty and unemployment. A study found that the unemployment rate for those aged 15- 35 years old in South Africa was 36.7% in 2001 and increased to only 39.1% in 2004 (Ngoma, 2005). Given the overall optimistic forecast for South Africa's economic and political growth (based on the end of Apartheid) these grave challenges that youth face persist, making South Africa a very interesting study area to examine the determinants of mortality risks for adolescents.

3.2 Data sources:

This study analyzes data from the South African Census 2001; the Statistics SA Community Survey 2007 and Death Notification Forms as collated by Statistics SA. The reason for the selection of the first two data sources is to show trends in adolescent mortality in the country from 2001 to 2007. The Community Survey is nationally representative and collects the same information as the Census. Thus demographic, socioeconomic and mortality questions are similar in both sources and are suitable for a nationally representative study on mortality trends. Death Notification Forms articulate immediate and broad- underlying causes of death, which is useful in identifying specific risks (Stats SA, 2008c).

3.3 Survey and questionnaire designs:

3.3.1 Census 2001:

During October 2001 the Census in South Africa took place. People living in households across the country, as well as those in hostels, hotels, hospitals and all other types of communal living quarters, and even the homeless, were all visited. In preparation for the count, the entire country had been divided into approximately 80,000 enumeration areas (EAs), each containing an average of 150 households (Stats SA, 2003a).

Three different census questionnaires were developed – one for households (the A questionnaire), one for individuals in institutions (the B questionnaire), and one for the institutions themselves (the C questionnaire). The household questionnaire had space to collect information on ten people, whereas the B questionnaire had space for only one respondent. The personal questions were identical in the two questionnaires, with the exception of relationship questions, which were not relevant for individuals. The A questionnaire also contained questions on housing, services and household goods. These questions were not in the B questionnaire, but were asked in the C questionnaire in relation to the institution as a whole. (Stats SA, 2003a)

3.3.2 Community Survey 2007:

All nine provinces of South Africa were part of the sample included in the design of the Community Survey 2007. Of the provinces a total of 17,098 enumeration areas (EAs) were sampled and used in the data collection. The Community Survey is a nationally representative survey which was carried out from February 2007 to March 2007. (Stats SA, 2008)

The Community Survey was designed to provide information on the trends and levels of demographic and socio-economic data, such as population size and distribution; the extent of poor households; access to facilities and services, and the levels of employment/unemployment at national, provincial and municipality level. The principal data collection tool was the Community Survey questionnaire which was administered to households within the sample area. Thus community level variables will be derived by aggregating household variables in the dataset. (Stats SA, 2008)

3.3.3 Death Notification Forms

According the Statistics SA (Stats SA, 2008), Death Notification Forms are collected as follows:

"Death registration takes place at the Department of Home Affairs (DHA). After a death is registered, the DHA issues a death certificate to an informant who registered the death and where applicable, updates the national population register (NPR). The NPR is updated only for South African citizens and permanent residents whose births were already registered on the

NPR at the time of death. The details of the deceased who were non-South African citizens but who had remained temporarily in the country and all South African citizens and permanent residents who died before notice of their births had been registered are not captured in the NPR.

All death notification forms, including forms for deaths captured on the NPR as well as those not eligible for inclusion in the NPR, are then collected by Statistics South Africa (Statistics SA) for data processing, analysis and dissemination of information on mortality and causes of death. While the NPR includes only South African citizens and permanent residents whose births were registered, Statistics SA processes all death notification forms regardless of civil status. Consequently, the number of deaths processed by Statistics SA will always be higher than the number of deaths recorded on the NPR for the same period".

The data used for this study is the Death Notification Forms as collated by Statistics SA for 2001 and 2007. The data received from the organisation are based on Form BI-1663 (Notification / Register of Deaths / Stillbirth) which was introduced in South Africa in 1998 (see Appendix). Statistics SA acknowledges that in the event of a death not being certified by a medical practitioner, "Form BI-1680 (Death Report) is completed by a chief/headman/induna to certify the death and to provide a description of circumstances that led to and caused the death" (Stats SA, 2008).

3.3.4 Data assessment

Ill- defined causes of death pose a problem when needing accurate information to guide decision-making processes in public health. Upon examining the recorded broad- underlying causes of death from the Death Notification Forms, there is a high prevalence of 'ill- defined and unknown causes of death' (R90-R95) and 'events of undetermined intent' (Y10- Y34). Such vague classification of causes of death are problematic in two ways. First, risk factors or determinants of ill- defined causes are difficult to determine. Second, at risk populations cannot be identified. For the analysis of 2001 Death Notification Forms, it was found that 4,485 (38.44%) of adolescent deaths were classified by these causes. In 2007, the number of adolescent deaths classified by ill-defined causes was 3,185 (24.19%). The change could be attributed to better classification of causes of death. Statistics SA (2013) report a vigorous quality check which is done on the data using the 'analysis of mortality levels and causes-of-death' (ANACoD) tool. With this software, diseases that are unlikely to cause death both generally and among specific age groups are highlighted. Following this manual investigation of the forms is completed and corrected where necessary. Further using the tool to calculate rates of death, assessment of the completeness of reporting and plausibility of death patterns by sex and age are done. Finally this software enables easier analysis of the ill-defined causes of death. For the general population, it was found that in 2001, 12.6% of deaths (to all ages) and in 2007 13.9% of deaths were ill-defined. Thus suggesting that for all ages there remains a problem with causes of death, however, among adolescents there seems to be some improvement.

The data for adolescents from death notification forms have fault. Table 3.1 shows the distribution of demographic and socioeconomic characteristics of adolescents by the forementioned ill-defined causes (events of undetermined intent and ill-defined causes of death) of death in the DNF. The table shows that less than 1 % of adolescents sex was ill-defined. Of all ages, not only adolescents 0.47% in 2001 and 0.29% of deaths were ill-defined. For province, ill-defined classifications were higher in 2001 at 20.20% and declined to 13.34% in 2007. For highest level of education, the reverse is seen with 44.06% of education status among adolescents being ill-defined and this increased to 448.04% in 2007. Finally, by marital status, the table shows that percentage ill-defined doubled from 2001 (5.37%) to 2007 (10.33%).

Table 3.1 Number and percentage of ill-defined causes of death among adolescents by demographic and socioeconomic characteristics

Characteristics	**Number and Percentage ill-defined**	
	2001	**2007**
Sex	38 (0.85%)	8 (0.25%)
Age (all)	401 (0.47%)	287 (0.29%)
Province of Residence	906 (20.20%)	425 (13.34%)
Education	1,976 (44.06%)	1,530 (48.04%)
Marital Status	241 (5.37%)	329 (10.33%)

Mahapatra et. al (2007) proposed a framework for the assessment of death registration data. This framework has been adopted by Statistics SA to assess Death Notification data in South

Africa (Stats SA, 2013). According to Mahaptra et al. and Statistics SA, South Africa falls into the 'low quality' category with regard to classification of causes of death, having more than 20% of deaths ill-defined (Mahapatra et al., 2007). Here the framework will be used to assess the quality of adolescent death registration in South Africa for 2001 and 2007. The framework by Mahapatra et al (2007) assesses coverage of civil registration systems, completeness as measured by the percentage of vital events recorded and comparability. This framework has been adapted in Table 3.2 to show an assessment of adolescent mortality data in 2001 and 2007. The adapted framework shows that completeness of death registration in the country was 93% from 2001 to 2007 (Stats SA, 2013). For missing data, the table shows the number and percentage of missing data for particular adolescent characteristics that are used in this study. To begin the number of missing data on province of residence declined from 20.54% in 2001 to 9.93% in 2007. For sex and age, less than 1% of data were missing for both time periods. By education between 47% and 48% of deceased adolescents had incomplete education data in 2001 and 2007. Finally 8.13% of deceased adolescents in 2001 had incomplete marital status data and this increased to 10.22% in 2007.

Table 3.2 Assessment of Death Notification Form data using the Mahapatra et al (2007) framework

Criteria and Indicators	Measure	
	2001	**2007**
Accuracy (%)		
Completeness of death registration	93%*	
Missing Data		
Province of Residence	2,396 (20.54%)	1, 308 (9.93%)
Sex	84 (0.71%)	17 (0.13%)
Age (all ages)	1,926 (0.41%)	1,215 (0.20%)
Education	5,555 (47.61%)	6,157 (46.76)
Marital Status	949 (8.13%)	1,345 (10.22%)
Comparability		
Stability of key definitions	100%*	
Uniformity of definitions across time	100%*	

*Source:(Stats SA, 2013)

Related to data quality is the issue of underreporting. It has been argued that South Africa has a well-established system for vital registration and collection of mortality statistics, but is challenged by under-reporting of death statistics. This is particularly true in rural areas and of young children. Further, “the quality of medical certification and misclassification of causes of death are also of concern” (Nojilana et al., 2009b). It has been added that errors could be the result of difficulties in diagnosis, statistical coding and data processing (Sulaiman, 2003).

Related to the misclassification of suicide and self- related causes of death is the issue of the misclassification of HIV/AIDS deaths in south Africa. In their paper “Cause of death statistics for South Africa: Challenges and possibilities for improvement”, the Medical Research Council (2010) argue that the extent of the problem of misclassification of causes of death in the country is high. The authors identified two studies conducted in the Cape Town area which found relatively high levels of errors made on the Death Notification Forms (Burger et al., 2007, Nojilana et al., 2009a). In these studies about a third of the Death Notification Forms had inaccuracies with regard to the classification of underlying causes of death and this indicates a clear need for the improvement of death certification in the country (Bradshaw et al., 2010). In conclusion, the authors argue, that “good quality of death certification without good quality coding of the underlying cause of death, or good quality coding without good quality death certification, will not translate into a good quality vital (death) registration system” (Bradshaw et al., 2010).

3.4 Ethics:

The data being used is from a secondary source. This study is purely quantitative and has no qualitative components. The survey and DNF data are completely anonymous so as to protect the identity of the respondents and minimize any risk of harm that this may cause. Statistics SA have allowed for open- access to these data sets from their organization and have been meticulous in removing any personal, confidential and identifying information of the respondents.

3.5 Study Design:

This study is a cross - sectional study using nationally representative data sample of South African adolescents as collected by the South African Census 2001 and the Community Survey 2007.

The second democratic Census was held in October 2001. More than 83,000 enumerators and over 17,000 supervisors and fieldworkers collected information on persons and households throughout the country, using a standard methodology. In preparation, South Africa was divided into approximately 80,000 enumeration areas (EAs). An enumerator was assigned to each EA to visit all the people who were living in that area. (Stats SA, 2003a)

The study design for the 2001 Census took into account the possibility of under and over counting people. In the month following the Census, a postenumeration survey (PES) was administered to determine the extent of undercount or over-count. The count was adjusted and fractions were produced. The fractions were then rounded to whole numbers. (Stats SA, 2003a)

To address the issues of unavailable, unknown, incorrect or inconsistent responses, imputation was used. The category of 'undetermined' was kept and used for a few observations in a few variables such as 'industry; and 'occupation'. The imputation employed made use of logical and dynamic techniques. For the logical imputation, a consistent value is deduced from other information offered by the household and was preferred over the dynamic imputation technique. The logical imputation technique resolves inconsistencies by examining other household characteristics. For instance a married person with the wrong sex filled in would be become the opposite of their spouse. For the dynamic imputation technique “a consistent value is imputed from a hot deck, which bases the imputation on nearby persons or households that share similar characteristics” (Stats SA, 2003a).

The Community Survey 2007 aimed to cover 274,348 dwelling units across all the nine South African provinces. The sampled dwellings were visited by fieldworkers in their homes. Fieldworkers were divided into teams of five fieldworkers to one supervisor and four field enumerators. Training was conducted by Statistics SA personnel on two important areas, firstly how to administer the questionnaire and secondly on the quality assurance procedures that were to be used. Of the initial sample, a total of 238, 067 dwellings had completely participated in the fieldwork. The questionnaires produced were scanned into a computer for capturing (Stats SA, 2008).

Further the survey response rate was approximately 94%. “This rate takes into account the non-response rates at the EA, dwelling unit and household levels. Two EAs were not covered due to problems encountered with the communities who refused to participate in the survey. Only 238 067 dwelling units out of 274 348 sampled dwelling units had completed a questionnaire. At the household level, the non-response always occurs inside the dwelling unit” (Stats SA, 2008). This issue of non- response was not easy for the Community Survey to deal with because the Community Survey did not have a post-enumeration survey like the Census (Stats SA, 2008).

In dealing with the matter of non- response, classifications were made based on the based on the household's status of enumeration. That is, if they were partially, completely or refused to be enumerated. Other classifications included having no usable information, a listing error, an unoccupied, vacant or demolished dwelling or no contact with the household. For this category of non- response 15, 393 cases were classified (Stats SA, 2008).

Similar to the Census, the Community Survey employed imputation for dealing with cases of unavailable, unknown, incorrect or inconsistent responses in most categories. Also similar to the Census, this survey used a combination of logical and dynamic imputation techniques. Again, the logical imputation technique was preferred over the dynamic technique. Dynamic imputation was used in cases whereby logical imputation was unsuccessful (Stats SA, 2008).

3.6 Study population:

Adolescents aged 10 to 19 years old are covered in this study. Both adolescent males and females are studied. Demographic and socioeconomic indicators are included for all adolescents represented in the surveys. Additional information concerning the head of household's demographic and socioeconomic status and community information such as services and utilities are also included in the analysis.

3.7 Definition of outcome variable:

The main outcome being analysed in this study is adolescent mortality. For adolescent mortality, in the Census data households were asked if anybody had died. Further information regarding the age, sex and cause of death of the deceased was also collected. For adolescent mortality in the Community Survey the responses are 'yes' if the household had an adolescent death and 'no' if the household had not experienced a household death. Similarly in the Community Survey if a household death is recorded as 'yes', the demographics and cause of death information of the deceased were collected. In both surveys adolescent deaths (yes) are compared to non- adolescent deaths (no).

For this study, if a death had occurred in either period, it was coded as 'yes' and if not a code of 'no' was appointed. Information from both surveys on the age of the deceased at time of death was used to identify adolescent mortality. Other information such as the sex and cause of the death of the adolescents is included in the analysis.

In addition to the demographic and socioeconomic information (see Table 3.1) provided on adolescent household members, whether dead or alive, household and community level responses (see Table 3.2 and Table 3.3) are obtained from the same questionnaires in which the adolescents were or are residing. Using the unique identifying number assigned to each questionnaire, individual, household and community information was merged for this analysis.

3.8 Definitions of individual, household and community variables

The following three tables highlight the explanatory variables used in this study. The name and definition of each variable is offered here. In addition the table shows the data source which collects this information.

Table 3.3 Individual level variables, definitions response categories and data source

	Name of variable	Response Categories	Data Source
	Demographic		
1	Age	Refers to the age in years of the adolescents	Census, Community Survey and DNF
2	Sex	Refers to the respondent being male or female	Census, Community Survey and DNF
3	Marital status	Response options - married, consensual union, widow, divorced, never married	DNF
4	Province of residence	All 9 official provinces of South Africa	Census, Community Survey and DNF
	Socioeconomic		
8	Highest education level	Refers to having no education, Primary, Secondary	DNF
11	Type of place of residence	Refers to whether residence was in a 'rural' or 'urban' setting	Census

Individual- level characteristics were chosen based on relevance to this study and others concerning mortality outcomes. Age and sex are particularly important in health outcome studies, since it is known that at different ages and for each sex, health-seeking perceptions and behaviours differ. Also it is known that are prominent sex differentials with regard to health in Africa and it is to be tested if this is true of South Africa too.

Socioeconomic variables for adolescents are also included in this study. The reason for this is because adolescents are not children and many are in some way economically active. In the age group of interest, adolescents would have varying educational attainments, some with none and some having completed primary and / or secondary education.

Table 3.4 Household level variables, response categories definitions and data source

	Name of variable	Response Categories	Data Source
1	Tenure of the household	Respondent asked if the house is owned, rented, occupied, paid- off or not yet paid off	Census and Community Survey
2	Household Income	Respondent asked for the approximate salary per annum – the value of which is between R0-R2,457,601 or more	Census and Community Survey
3	Number of household members	Refers to actual number of people who reside in the household for a minimum 4 nights a week	Census and Community Survey

Household level variables were reported by household heads in the surveys. The household characteristics for this study were selected for their importance to adolescent survival. As such, tenure of the household was selected as this is a proxy for the socioeconomic status of the household. If they home is owned it implies a higher socioeconomic standing than households which are occupied, rent- free which could be government free- housing, offered to predominantly poor people. Household income is selected as a direct measure of a household's socioeconomic status. In this study, income is segregated into low income households (<R38, 400 per annum), average income households (R38, 401 – R153, 600 per annum) and high income households (> R153, 601 per annum). Number of household members was selected as this variable is a proxy for the distribution of household resources. If households have a large number of residents, it is assumed that resources (food, wealth, etc) are spread thinly among all. For the purpose of this study, it was identified that the average number of household members in South Africa, for both 2001 and 2007, was 5 people. Therefore this study has categorized the number of household members into less than or 5 residents or more than 6 residents.

Table 3.5 Community level variables, response categories definitions and data source

	Name of variable	Response Categories	Data Source
1	Type of Place of Residence	Proportion of urban and rural settlements	Census
2	Ethnic diversity	Proportion of Black, White, Coloured, Indian/Asian or Other households in the community	Census
3	Poverty	Proportion of household heads in the community who are poor	Census

Table 3.5 demonstrates the different variables to be used to measure community- level characteristics in this study. The community variables represent individual responses which will be aggregated by District. Responses from the household surveys pertaining to ethnicity / race and income, are aggregated and proportions for specific geographical locations are attained for the purpose of multilevel analysis.

Community ethnic diversity is the proportion of Black, White, Coloured and Indian/Asian households in the community. This variable measures racial or population group diversity within communities. This measure was divided into three quintiles and categorised as low, medium and high. If the households in the community are predominantly a single race or population group, then the ethnic diversity is considered low. If the community households are made up various combinations of the four racial groups, the ethnic diversity is considered high.

Community poverty is measured as the proportion of households with the lowest reported annual income (<R38, 400 per annum). This measure is also divided into three quantiles and

categorised as low, medium and high. If there are many households in the community with an annual income of less than R38, 400 per annum, then it is considered a high poverty area. Conversely, if the community has a majority of households that earn an annual income of more than R38, 400 per annum, then community poverty is considered low.

Table 3.6 Intermediate variables, response categories definitions and data source

	Name of variable	Response Categories	Data Source
1	Main source of or access to water	Respondents were asked to indicate their main source of water for drinking– options given include piped water in dwelling, piped water outside dwelling, borehole, public tap, stream or river, pool or dam.	Census and Community Survey
2	Shared toilet facility	Respondents was asked if the toilet facility was shared with other dwellings – response options were 'yes' or 'no'	Census and Community Survey
3	Connection to main electricity supply	Respondents were asked if they have a connection to a main electricity supply – response options were 'yes' or 'no'	Census and Community Survey
4	Radio	Respondent was asked to reply 'yes' or 'no'	Census and Community Survey
5	Television	Respondent was asked to reply 'yes' or 'no'	Census and Community Survey
6	Generator / Refrigerator	Respondent was asked to reply 'yes' or 'no'	Census and Community Survey
7	Telephone	Respondent was asked to reply 'yes' or 'no'	Census and Community Survey
8	Computer	Respondent was asked to reply 'yes' or 'no'	Census and Community Survey
9	Access to telephone	Respondent was asked to reply 'yes' or 'no'	Census and Community Survey
10	Energy source for cooking	Respondent was asked which of the following is a main source: electricity, gas, paraffin, wood, coal or candles	Census and Community Survey
11	Energy source for heating	Respondent was asked which of the following is a main source: electricity, gas, paraffin, wood, coal or candles	Census and Community Survey
12	Energy source for lighting	Respondent was asked which of the following is a main source: electricity, gas, paraffin, wood, coal or candles	Census and Community Survey
13	Piped water	Respondent was asked to reply 'yes' or 'no'	Census and Community Survey
14	Refuse or rubbish disposal	Respondent was asked to reply 'yes' or 'no'	Census and Community Survey
15	Cause of death	Respondents were asked if the household member had died in an accident – 'yes' or 'no' reply. If 'yes' then it is an unnatural cause of death. If the response was 'no' then the cause of death was natural. And the ICD-10 code for classification of death on the DNF using both the immediate and underlying causes of death respectively throughout the paper	Census and Community Survey DNF

The household resources and assets variables are used to create a *wealth index*. First, Principle Component Analysis (PCA) is performed on the data to create linear combinations from the set of variables and order the variables according to their contribution to the overall variability of the variables analysed. Based on the creation of this asset index, wealth quintiles are created which reflect the rankings of population by socioeconomic status. A total of three categories were created within the wealth index. Based on the number of assets possessed, low, middle and high categories were created. A status of low within the wealth index means less than 4 assets. A status of middle means 5-7 assets, since 6 was the mean number of assets per household and high means having up to all 14 assets.

3.8 Addressing the objectives of the study:

This study is a quantitative study of adolescent mortality in South Africa. STATA 11 was for the management and analysis of data in this study. The analytic plan for this study follows the order of the objectives. To begin extensive data management and cleaning of the datasets was done. All variables that are required for the community-level was derived from the responses in the Census. In this way the proportions needed for individual- responses to constitute community-level responses was created.

Thereafter the first type of analysis that was done concerns describing the data and showing the distribution of the adolescent population across the country in 2001 and 2007. This detailed description of the study population is essential as it places the later inferential findings within a context. This shows the characteristics of the environment surrounding adolescents. In this way, the exact numbers of the population of interest and all characteristics are displayed. Frequency tables of the all variables were calculated to describe the population and characteristics. Cross- tabulations of the main outcome variables and each predictor variable were also generated to calculate the proportion of the population affected by adolescent mortality by specific characteristics for both years.

Objective 1: To estimate mortality levels of the adolescent population in South Africa

In order to meet objective 1, firstly the distribution of adolescent deaths by age, sex and broad-underlying cause of death is displayed using tables and graphs.

Then the age- specific mortality rates and mortality estimates of the adolescent population for both years under review, are derived. To achieve the age- specific mortality rate, the following calculation is used:

$$nMx = \frac{nDx}{nPx}$$

Where nDx = deaths to persons of age group *x* to *x +n;* nPx = midyear population of age- group *x* to *x+n* *(Hinde, 1998)*

For adolescents aged 10 – 19 years old in the study, two age- specific mortality rates are calculated. First for those aged 10 – 14 and second for those aged 15- 19 years old for both years under review. Thus, the formulas for the two age-groups is noted as follows:

$${}_5M_{10} = \frac{{}_5D_{10}}{{}_5P_{10}}$$

$${}_5M_{15} = \frac{{}_5D_{15}}{{}_5P_{15}}$$

A direct estimation of mortality technique is used to derive the probability of dying from age 10 and before age 20. This life table approach is computed as follows:

$$ {}_nq_x = (n * {}_nM_x)/(1+(n-{}_na_x) * {}_nM_x) $$

Where ${}_nM_x$ refers to the age-specific mortality rate (in this case for the age group 10- 19 years old); n refers to the year interval and ${}_na_x$ refers to the average number of years lived by those who die in the interval (Preston et al., 2000). This is computed for both years under review.

Proportional Mortality Ratios (PMR) specifies the contribution of either natural or unnatural causes deaths to overall mortality. In this study, the contribution of natural and unnatural causes of death to all- cause mortality is shown by age- group and sex of the adolescents for both years under review. The ratios are expressed as percentages (%) and the formula used is as follows:

$$ PMR = \frac{{}_nD^i_x}{{}_nD_x} $$

Where ${}_nD^i_x$ is the number of deaths from a cause (either unnatural, natural or broad underlying cause of death) and ${}_nD_x$ is the total number of deaths from all causes (Mallin et al., 1986). Thus formula by age group is:

$$ PMR(10\text{- }14) = \frac{{}_5D^i_{F10}}{{}_5D_{F10}} $$

$$ PMR(15\text{- }19) = \frac{{}_5D^i_{M15}}{{}_5D_{M15}} $$

In addition, the formula by sex is:

$$PMR(females) = \frac{{}_9D^i_{F10}}{{}_9D_{F10}}$$

$$PMR(males) = \frac{{}_9D^i_{M10}}{{}_9D_{M10}}$$

For this objective data from the Census (2001), Community Survey (2007) and Death Notification forms for 2001 and 2007 were used.

Objective 2: To identify the prevalent causes of adolescent death in the country

For this objective, prevalent causes of death were identified and quantified. In both the Census 2001 and the Community Survey 2007, limited cause of death information is collected from surviving household members who are the survey's respondents. The availability of specific causes of death from both sources is not available. Two broad categories of natural and unnatural causes of death are captured in the survey, but there are no specific causes of death. For this reason, data from the Death Notification Forms are added here to examine immediate and broad underlying causes of death. South Africa's Death Notification Forms use the International Classification of Diseases Tenth Revision (ICD-10). The ICD – 10 is the latest version of codes for the classification of causes of death. This system contains more than 141,000 codes and is set to completely replace the 17,000 codes of the ICD – 9 by 2013 (AAPC, 2011). Using this system for the classification of causes of death, the measurement of causes of death is done.

To begin the exploration of causes of adolescent deaths, age-standardised death rates by certain prevalent causes of death are determined. To generate the age- standardised death rates, the following steps, as developed by the WHO (Ahmad et al., 2001), were followed:

(1) A standard population was selected. For this study, the WHO World Standard Population is used (see Table 3.5). This standard population reflects the average age structure of the world's population expected over the next generation, from 2000 to 2025. This ensures a standard approach with the option of long-term use and facilitates global comparisons.

(2) For all- cause mortality, the number of male and female deaths were determined for the age groups: 0-4, 5-9, 10-14, 15-19, 20-24, 25-19, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69. The data used for this was the Census and Community Survey.

(3) Population estimates, for males and females, were taken from the Census and Community Survey for the above age- groups.

(4) Age-specific death rates for each age group by sex were calculated, as follows:

$$\textit{Age-specific death rate} = \frac{\textit{Number of deaths, age x to x+n}}{\textit{Population, age x to x+n}} \; X\ 100,000$$

Where *x to x+n* is the individual 5- year age-groupings, as highlighted in step 2.

(5) Calculate the age-standardized death rate (ASDR) for each age group by sex, were calculated by multiplying each age-specific rates by the appropriate weight in the standard population, as follows:

AgeStndDR = age-specific death rate per 100,000 population x weight

Where *weight* is calculated as WHO standard population distribution – percentage of population <70 years old / 100 (see Table 3.5 below)

Table 3.7 WHO World Standard Population Distribution including Weight

Age group	Percentage All Age Groups	Percentage < 70 years	Weight
0-4	8.86	9.35	0.0935
5-9	8.69	9.17	0.0917
10-14	8.60	9.08	0.0908
15-19	8.47	8.94	0.0894
20-24	8.22	8.67	0.0867
25-29	7.93	8.37	0.0837
30-34	7.61	8.03	0.0803
35-39	7.15	7.55	0.0755
40-44	6.59	6.95	0.0695
45-49	6.04	6.37	0.0637
50-54	5.37	5.67	0.0567
55-59	4.55	4.80	0.0480
60-64	3.72	3.93	0.0393
65-69	2.96	3.12	0.0312
Total	**94.76**	**100.00**	**1.00**

Source: Ahmed, et al, 2001

(6) For each sex the sum of the products across all age-groupings were obtained to estimate the overall age-standardized rate. This study used the age- standardized rates for adolescents in the age- groups 10- 14 and 15- 19.

Second, frequency distributions and cause- specific mortality rates are generated. The initial frequency distributions show overall the number of deaths due to causes in 2001 and 2007. In doing this, the most prevalent overall causes of adolescent mortality are apparent. A table is used to show this information for 2001 and 2007. Next, cause- specific mortality rates are calculated using the following formula:

$$CSMR = \frac{{}_nD^i{}_x}{{}_nP_x}$$

Where ${}_nD^i{}_x$ is the number of deaths from a cause (either unnatural or natural) and ${}_nP_x$ is the total number of adolescents in the population.

Male and female cause- specific mortality rates are calculated separately. Since causes of death generally differ by sex, it is fundamental that sex differentials for the adolescent population is calculated. Male and female cause- specific mortality rates are computed using the following equations:

$$CSMR\ (females) = \frac{{}_9D^i{}_{F10}}{{}_9P_{F10}}$$

Where ${}_9D^i{}_{F10}$ is the number of female deaths, aged 10- 19 years old, from a cause (either unnatural or natural) and ${}_9P_{F10}$ is the total number of female adolescents, aged 10- 19 years old, in the population.

$$CSMR\ (males) = \frac{{}_9D^i{}_{M10}}{{}_9P_{M10}}$$

Where ${}_{9}D^{i}_{M10}$ is the number of male deaths, aged 10- 19 years old, from a cause (either unnatural or natural) and ${}_{9}P_{F10}$ is the total number of male adolescents, aged 10- 19 years old, in the population.

In addition, sex-specific mortality rates by cause of death and male to female ratio of deaths per broad- underlying cause of death are also generated. Using the number of deaths from particular causes and the total number of deaths per sex, the sex-specific mortality rates are generated. Using the sex- specific number of deaths per cause, the male to female death ratio is calculated.

This simple male to female ratio is expressed as follows:

$$M:F = \frac{\textit{Number of male deaths from cause}^{i}}{\textit{Number of female deaths from cause}^{i}}$$

Where $cause^{i}$ is each broad- underlying cause of death under review for both years.

Then, age cause-specific mortality rates are also generated. For the broad age- group of adolescents (10- 19 years old), these cause- specific rates are split between younger adolescents, 10- 14 years old and older adolescents, 15- 19 years old. The reason for the split within the age- group is due to differences in exposure to risk for younger compared to older adolescents. Older persons are generally at higher risk of mortality than younger people, therefore in order to provide a comprehensive analysis of adolescent mortality in South Africa, these inherent age risks need to be analysed. The formulae used for this is:

$$CSMR = \frac{{}_5D^i_{10}}{{}_5P_{10}}$$

Where ${}_5D^i_{10}$ is the number of deaths, aged 10- 14 years old, from a cause (either unnatural or natural) and ${}_9P_{10}$ is the total number of adolescents, aged 10- 14 years old, in the population.

$$CSMR = \frac{{}_5D^i_{15}}{{}_5P_{15}}$$

Where ${}_5D^i_{15}$ is the number of deaths, aged 15- 19 years old, from a cause (either unnatural or natural) and ${}_9P_{15}$ is the total number of adolescents, aged 15- 19 years old, in the population.

Cause- specific mortality rates are also generated by sex and age together and are here graphed. Graphs are also used to show any trends in cause of death mortality rates over the years.

Thereafter, multiple and associated single decrement life tables are generated for the population of South Africa as a whole in 2001 and 2007. The purpose of these life tables is to illustrate the survival function (l_x) and life expectancy (e_x) for the adolescent population should unnatural and certain natural causes of death be eliminated from the population respectively. These tables are thus fundamental to policy- makers in generating specific policy and programmes to address the United Nations Millennium Development Goals.

In constructing the life tables, the conventional approaches to derive ${}_nq_x$, ${}_nd_x$, l_x, ${}_nL_x$, ${}_nT_x$ and e_x have been used (see Table 3.6). However, the ${}_na_x$ function, which is the mean number of person- years lived in the interval has been based on Chiang's approach for ages older than 5 years old (Chiang, 1984). For ages under 5 years old, the Coale and Demney approach has been used (Coale and Demeny, 1983). For the decrement process, probability of dying from a cause ($_nq^i_x$) has been derived as follows:

$$_nq^i_x = {_nq_x} \, ({_nD^i_x} / {_nD_x})$$

Where $_nq_x$ is the probability of dying from age x to x+n; $_nD_x$ is the observed total number of deaths from all causes; and $_nD_x$ is the observed total number of deaths from all causes.

For the associated single decrement life table, a constant of proportionality for decrements other than those under- review in the age intervals needed to be computed. This was done using the following formula:

$$R^{-i} = \frac{_nD_x - {_nD^i_x}}{_nD_x}$$

Where $_nD^i_x$ is the number of deaths from a cause and $_nD_x$ is the observed total number of deaths from all causes.

Further for the associated single decrement life table, the probability of surviving from age x to x+n in the absence of a specific cause of death, has been used as follows:

$$_nP^{-i}_x = [{_nP_x}]^{R-i}$$

Where $_nP_x$ is the probability of surviving from age x to x+n

Finally for the average number of person years lived in the age intervals (x to x+n) in the absence of causes of death ($_na^{-i}_x$) two formulae were used. First for ages under 10 years old:

$$_n a_x^{-i} = n + R^{-1} \frac{_nq_x}{n_q^{-i}{}_x} ({_na_x} - n)$$

Second for ages over 10 years old:

$$_5 a_x^{-i} = \frac{-\frac{5}{24} \; {_5 d_{x-5}^{-i}} + 2.5 \; {_5 d_x^{-i}} + \frac{5}{24} \; {_5 d_{x+5}^{-i}}}{_5 d_x^{-i}}$$

Source: Preston, et al. 2001

Table 3.8 Life table notations, definitions and formulae

Notation	Definition	Formula
n	Interval	Number of interval years
${}_nm_x$	Mortality rate for people in the age group x to x+n	Deaths / Population
${}_nq_x$	Probability of dying between ages x and x+n	$(n*{}_nm_x)/(1+(n-{}_na_x)*{}_nm_x)$
${}_np_x$	Probability of surviving between ages x and x+n	$1-{}_nq_x$
l_x	Number surviving at each age	${}_np_x*l_x$
${}_nd_x$	Number of deaths between ages x and x+n	l_x-l_{x+n}
L_x	Person years lived between ages x and x+n	$({}_n*l_x)+({}_na_x*{}_nd_x)$
T_x	Person years lived beyond age x	Sum of L_x
e_x	Life expectancy at age x	T_x/l_x
R^{-i}	Constant of proportionality for decrement other than unnatural causes in the interval x to x+n	(Deaths-Unnatural Deaths)/ Deaths
${}_n*p^{-i}{}_x$	Probability of surviving from age x to x+n in the absence of unnatural causes	${}_np_x$^R^{-i}
${}_n*q^{-i}{}_x$	Probability of dying from age x to x+n in the absence of unnatural causes	$1-n*p^{-i}{}_x$
$*l^{-i}{}_x$	Number of people left alive at age x in the absence of unnatural causes of death	$*l^{-i}{}_x * {}_n*p^{-i}{}_x$
${}_n*d^{-i}{}_x$	Number of people dying between ages x and x+n in the absence of unnatural causes of death	$*l^{-i}{}_x * {}_n*q^{-i}{}_x$
${}_n*L^{-i}{}_x$	Person years lived between ages x to x+n in the absence of unnatural causes of death	$({}_n*l_x^{-i})+({}_na^{-i}{}_x*{}_n*d^{-i}{}_x)$
${}_n*T^{-i}{}_x$	Person years lived above age x in the absence of unnatural causes of death	Sum of ${}_n*L^{-i}{}_x$
$*e^{-i}{}_x$	Life Expectancy at age x in the absence of unnatural causes of death	${}_n*T^{-i}{}_x / *l_x^{-i}$

Finally, an index of Years of Potential Life Lost (YPLL) is generated. The index measures the incidence of 'premature' mortality at ages where death may be considered untimely (Jain, 1992). The formula used for this is:

$$YPLL = \sum({}_nd^i_x) *(60-(n*2.5)$$

Where ${}_nd^i_x$ is the lifetable number of deaths, from a cause, n is the age-interval (in this study this is 5- years) (Jain, 1992).

For this objective data from the Census (2001), Community Survey (2007) and Death Notification forms for 2001 and 2007 were used.

Objective 3: To determine the sociodemographic factors that contributes to adolescent mortality at different levels of analysis

In order to achieve this objective, inferential statistics was used. To begin, a bivariate logistic regression was fit to establish an association between the dependent (different causes of death outcomes) and each predictor variable (see Table 3.7) provided for on Death Notification Forms.

Secondly, multivariate logistic regression was done to establish a relationship between each independent variable and each different causes of mortality outcomes. Since there are different cause of mortality outcomes (all- causes, natural causes, unnatural causes, main immediate and broad- underlying causes of death), the regression technique is repeated on all outcomes. In order to examine such an association using the logistic regression technique, adjusted odds ratios are displayed to explain the likelihood of mortality occurring.

The formula for logistic regression is as follows:

$L_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki}$

Where: L_i = dependent variables, α = constant, β_k = regression coefficients, X = independent variables.

Table 3.9 List of predictor variables used in logistic regression analysis

Predictor Variable	**Categories**
Sex	Male (1); Female (2)
Marital Status	Single (1); Married (2); Widowed (3); Divorced (4)
Highest level of Educational Attainment	None (1); Primary (2); Secondary (3); Tertiary (3)
Province of Residence	Western Cape (1); Eastern Cape(2); Northern Cape (3); Free State (4); KwaZulu-Natal (5); North West (6); Gauteng (7); Mpumalanga (8); Limpopo (9)

For this objective data from the Death Notification forms for 2001 and 2007 were used.

Objective 4: To assess the extent to which contextual factors account for variations in regional patterns of adolescent mortality

In order to meet the final objective of this study, to determine the relationship between individual/household and community characteristics and adolescent health outcomes at different levels, multilevel analysis was done. The outcome variables (the different causes of mortality – all causes, unnatural or natural causes) in this study are binary, for each dependent variable there are 'yes' or 'no' responses. For this reason a two- level model for dichotomous or binary outcomes is used.

These two levels, the first being a standard logistic regression model and the second accounting for additional, related characteristics, are combined to create the two- level model. The equation for a two- level model for a dichotomous outcome is as follows:

$log[p_{ij}/(1-p_{ij})] = \beta_0 + \beta_1 x_{ij} + u_j$ *(Combined model)*

Where u_j is the random effect at level two, without u_j, would be a standard logistic regression model. Conditional on u_j, y_{ij}s are assumed to be independent (Guo and Zhao, 2000). Odds ratios are produced and expressed at a 95% confidence interval.

The random effects (u_j) are the measures of variation in adolescent mortality across communities. The fixed effects (measures of association) were expressed as odds ratios (ORs) and 95% confidence intervals (95% CIs). The random effects (measures of variation) were expressed as variance partition coefficient (VPC) and percentage change in variance (PCV). The VPC, which in this study is equal to intra-class correlation (ICC), is a measure of the extent to which households resemble each other more than they resemble other communities in the sample (Antai, 2011). A large VPC would indicate that household and community factors are important in understanding the adolescent mortality, while a VPC close to 0 would indicate that individual and community-level factors exert only a small influence on adolescent mortality. Precision was evaluated by using the standard error (SE) of the explanatory variables (Antai, 2011).

The community differences in adolescent mortality may be due to contextual influences or differences in individual composition of communities (including unobserved individual characteristics) (Merlo et al., 2005). Thus it is suggested by Merlo and others (2004) that "while adjusting for the individual characteristics in the multilevel models, some part of the compositional differences were taken into consideration to explain some of the community differences observed in the empty model. The equation for the proportional change in community variance is:

$PCV_1 = (V_{N-1} - V_{N-2}) / V_{N-1}$

Where

V_{N-1} is the community variance in the empty model and V_{N-2} is the community variance in the models including individual characteristics or community characteristics" (Merlo et al., 2005)

Further, Boco (2010) proposes that "while the likelihood ratio (LR) statistics was used to test the null hypothesis that the community level variance is equal to zero. Regression diagnostics AIC (Akaike information criterion) and the BIC (Bayesian information criterion) were used to determine the goodness of fit of the model. The AIC is appropriate for comparing non-nested models such as those estimates used in the analysis and is calculated as -2 (log-likelihood of fitted model) +2p, where p is number of parameters in the model" (Boco, 2010). In comparing the AIC and BIC values for each model, it is the model with the lowest of these values that is deemed to be the better explanatory model (Uthman and Kongnyuy, 2008).

Using the Census geography, the District Municipality codes were adopted to represent clusters of households (or communities) needed for multilevel modelling. . The Census geography is "a hierarchical system of nested areas that vary according to the level of information that is required. The lowest level of the hierarchy is *enumeration areas* (EAs)" (Stats SA, 2004). Figure 4 below shows the hierarchical system of the Census geography for 2001. This study falls under level two which is the District level of data collection. This level was selected since it is the second largest of the geographical demarcations, with the largest being provincial level. Further, due to the scarce occurrence of reported adolescent mortality (this age group has lower mortality than children and adults) a large sampling area is needed to avoid the effect of random variation in the findings. Since adolescent mortality does not occur in every household, it is thus necessary to group the households together by larger groupings than town or township area.

The sample consists of approximately 30 households within each cluster. All private households, within which an adolescent had died were selected and used from each cluster.

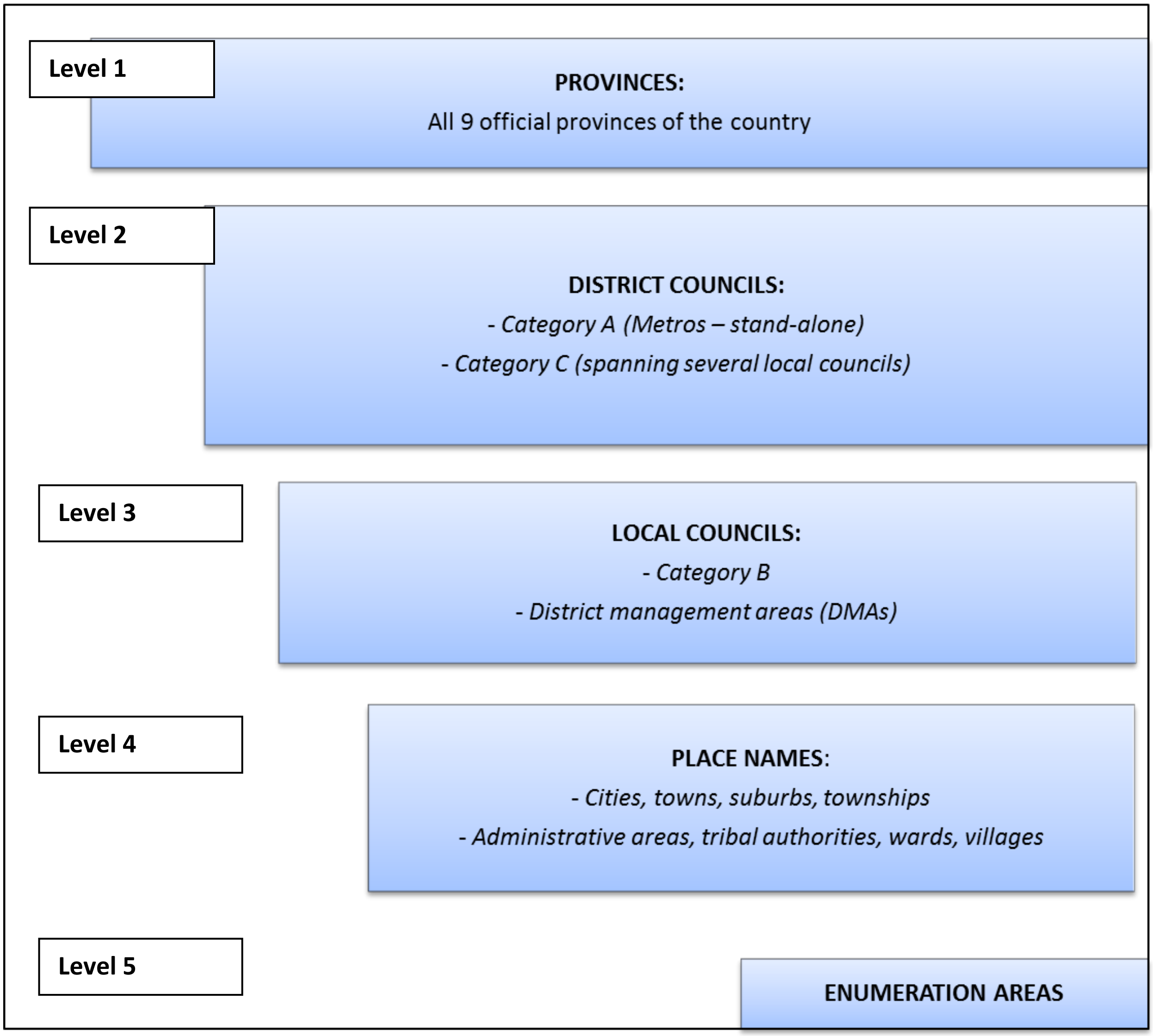

Figure 3.2 Hierarchical System of Census 2001 Geography

(Adapted from: Statistics SA (2004) *Concepts and Definitions*)

Logistic regression has been used in mortality studies which focus on multilevel determinants. One study used multilevel logistic regression to establish risk ratios for residence in poverty areas when adjusting for age, sex and race among others (Haan et al., 1987). In a review of 10 studies done on multilevel determinants of mortality, Picket and Pearl (2001) argued that: "Neighbourhood effects are fairly consistent across studies, with modest (RR less than 2.0) but statistically significant increased risk of mortality in poorer or more deprived neighbourhoods. In contrast, Davey Smith and colleagues (1997) found effects of neighbourhood deprivation within categories of lifetime socioeconomic status, but the overall effect of neighbourhood deprivation was not significant" (Pickett and Pearl, 2001).

This multilevel modelling technique is required for this study to remove the effect of clustering, to study the effect of variables acting at different levels and to examine the variation of the effect across the levels. Due to the hierarchical nature of the data that is used, the effect of clustering needs to be removed in order to obtain valid point estimates for the study parameters and standard errors for the point estimates (Vu, 2005). In addition, it is a focus of this study to examine determinants of mortality outcomes. For this reason, there is need to examine the effect of each explanatory variable and inspect the extent of the variation across the different levels. (Vu, 2005).

To show the variation clearly, four models were be produced with different combinations of the individual/ household and community variables as follows:

Model 1 - will be the empty or null model

Model 2 - will consider each of the explanatory variables at the household – level (also in the conceptual framework) and the outcome of the risk of adolescent mortality

Model 3 – will consider each of the explanatory variables at the community – level (also in the conceptual framework) and the outcome of the risk of adolescent mortality

Model 4 – will consider the household and community – level variables and the outcome of the risk of adolescent mortality

The reason for the first three models is to trace the risk of mortality at each level separately and at different combinations before merging all levels into a single model. To trace the risk at individual/ household and then community levels autonomously and at different groupings gives a better indication of the extent to which these determinants affect mortality on their own and when combined with other characteristics. These first three models then present a comprehensive analysis of which individual/ household and community characteristics determine adolescent mortality and when. That is, which combinations of characteristics are more or less likely to determine adolescent mortality. Then in the final model (model 4) it becomes clear which characteristics (individual/ household or community) when grouped with other hierarchical characteristics have a greater or lesser influence on adolescent mortality outcomes.

For this objective data from the Census (2001) were used.

3.9 Strategy for the dissemination of findings:

The results of this study are expected to be published in peer- reviewed journals and presented at national and international conferences. The table below shows a preliminary list of conferences that papers from this study will be submitted to for oral presentation.

Table 3.10 Dissemination of study results

Title	Conference Title Presentation Type (oral/poster) Conference date Conference Venue	Journal Title Submission Date Submission status
Levels and Causes of Adolescent Mortality in South Africa, 2001- 2007	(1) International Conference on Interdisciplinary Social Sciences – **oral**, 2012; Barcelona, Spain (2) Wits Symposium- **poster**, 2012; Johannesburg, South Africa (3) Population Association of America, **poster**, 2013; New Orleans, USA	*The International Journal of Interdisciplinary Social and Community Studies* Submitted: May 2012; **accepted** for publication (awaiting typesetting)
Adolescent mortality in South Africa: An analysis of unnatural causes of deaths by sex, 2006- 2009	(1) Population Association of America, **poster**, 2013; New Orleans, USA (2) IUSSP, **oral**, 2013; Busan, RSK	**African Population Studies** Submitted: January 2013; Draft due 30 June 2013
Youth Mortality due to HIV/AIDS in South Africa: an application of life table techniques	(1) Population Association of America, **poster**, 2013; New Orleans, USA (2) IUSSP, **oral**, 2013; Busan, RSK	**African Journal of AIDS Research** Submitted: Dec 2012 Awaiting Editor's decision
Determinants of Adolescent Mortality in South Africa, 2001- 2007	(1) IUSSP, **oral**, 2013; Busan, RSK	**Journal of Health and Social Behaviour** To submit June 2013
The Impact of Infectious Diseases on South African Adolescents Expectation of Life	(1) Wits Symposium 2013	**African Journal of Health Sciences** Submitted: May 2013 Awaiting Editor's decision
Contextual Determinants of Causes of Death among Adolescents in South Africa	(1) Wits Symposium 2013	**Social Science and Medicine** To submit June 2013

Chapter 4

LEVELS OF ADOLESCENT MORTALITY, 2001 and 2007

4.1 Introduction

Adolescents in Sub- Saharan Africa, including South Africa, face a number of challenges. These include reproductive health challenges, HIV/ AIDS and poverty (Bearinger et al., Varga, 2003, Reading, 1997, Ford and Hosegood, 2005). In reproductive health studies, it was found that in most countries of sub-Saharan Africa about a third of unmarried adolescent girls have had sexual intercourse. This increases the chances of adolescents falling pregnant and contracting HIV and other STIs (Bearinger et al., 2007). In South Africa, focus- group discussions discovered that gender differentials reinforce poor sexual negotiation dynamics and this places adolescents at risk for early pregnancy and other sexual and reproductive health complications (Varga, 2003). Ford and Hosegood (2005) observed that as AIDS mortality in South Africa increases more adolescents move to new households. Reading (1997) found that poverty and economic factors are central to the causes of social differences in the health of children and adolescents.

Additional health related research on adolescents, specifically in South Africa, have looked at the increasing occurrences of other key sexual and reproductive health issues such as maternal health, teenage pregnancies and drug and alcohol use (Lobel et al., 2004, Abdoulaye, 2006, Cunningham and Boult, 1996). Redelinghuys and others (2004) found that HIV/AIDS is a leading cause of death for children under the age of 14 years old and that risky sexual behaviour is a risk factor in the illness and mortality of adolescents in South Africa. Under such conditions it is understandable that adolescent mortality in the country would be increasing. However, little is known of the distribution and levels of adolescent mortality in South Africa.

Information regarding the distribution and level of adolescent mortality is important for policy and programmes. The recommendations made for adolescents in the National Youth Policy and provincial health and wellness campaigns can benefit from knowing this information. The adolescent population will in turn benefit as policy and programmes will be based on empirical evidence, such as age and sex- specific death rates, proportional mortality ratios and probabilities of dying. With these figures in mind, realistic and holistic recommendations can be made to avert the increasing rates of adolescent mortality in the country.

This chapter provides background statistics of the distribution of adolescent mortality in South Africa, in 2001 and 2007. Secondly, tables showing the distribution of adolescent deaths in South Africa by individual characteristics of the deceased (from Death Notification Forms) are provided. Third, this chapter provides analysis of the levels of adolescent mortality in South Africa from 2001 to 2007. Within the analysis of levels, age-specific mortality rates, probability of dying and proportional mortality ratios are calculated and presented.

4.2 Background characteristics of deceased adolescents

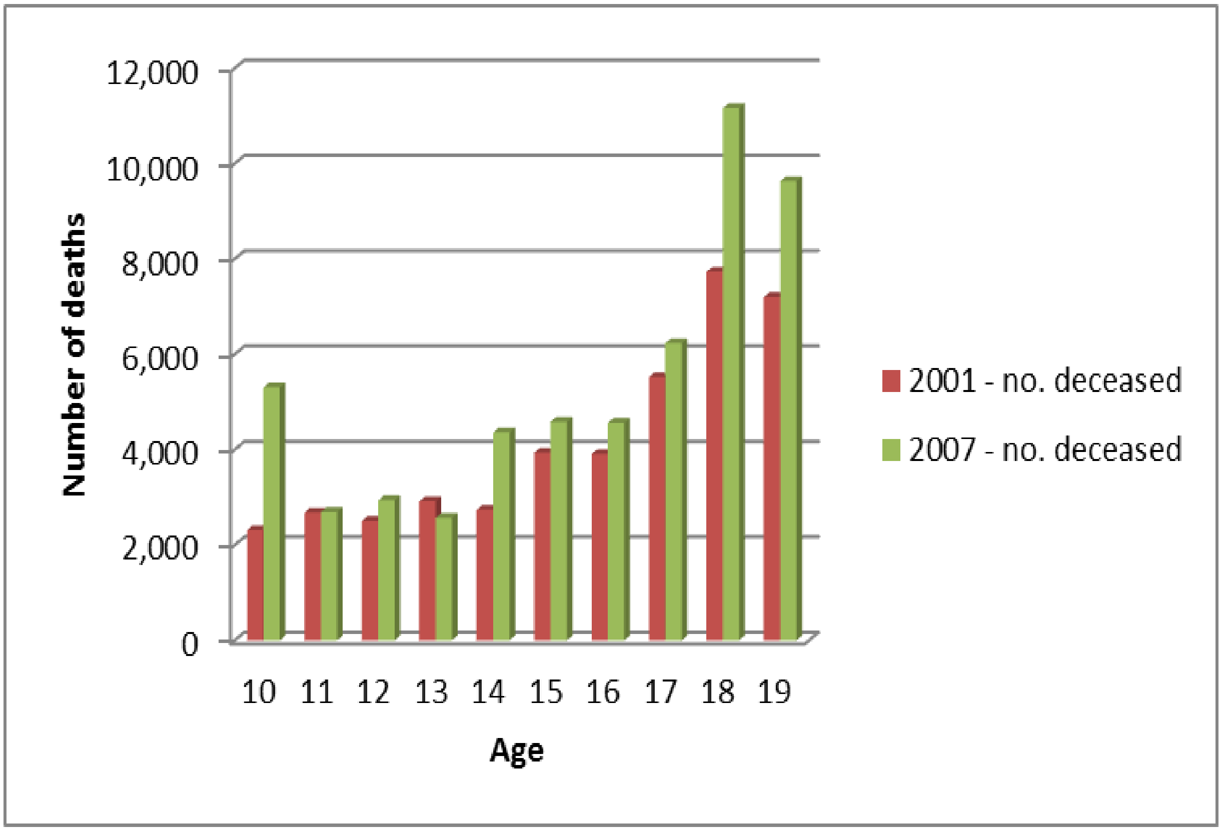

Figure 4.1 Age distribution of adolescent deaths in South Africa, Census 2001 and CS 2007

Figure 4.1 shows the distribution of adolescent deaths, 2001 (p-value =0.0043) and 2007 (p-value =0.0032), by actual age at death, from 10 to 19 years old. The figure shows that in 2007, deaths were higher at each specific age with the exception of 11 year olds, where the number of deaths were almost the same and age 13 where there were fewer deaths in 2007. Of notable importance, 10, 14, 18 and 19 year olds had much higher mortality in 2007 than in 2001, compared to all other ages.

The figure also shows that mortality is much higher in older adolescents, 15- 19 years old than younger adolescents, 10- 14 years old. This is seen for both 2001 and 2007. This increase in mortality with age is expected.

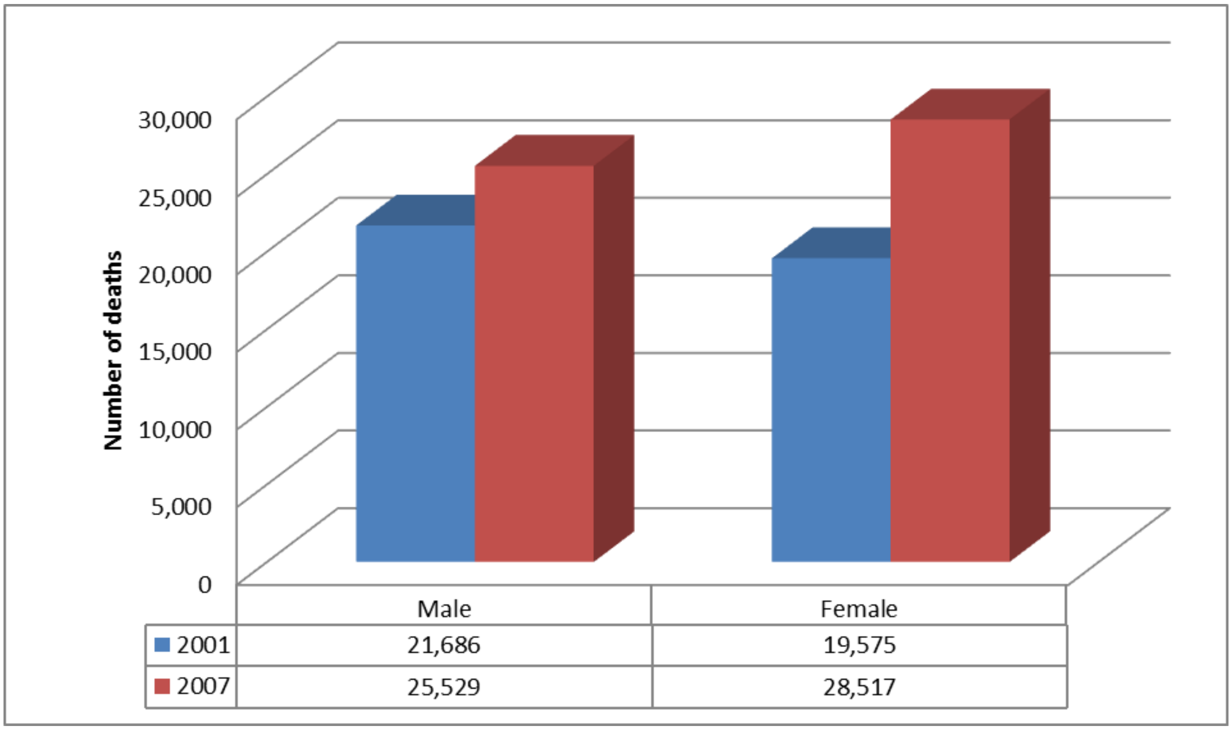

Figure 4.2 Sex distribution of adolescent deaths in South Africa, Census 2001 and CS 2007

Figure 4.2 offers a broad overview of the number of adolescent deaths by sex for 2001 (p-value =0.0043) and 2007 (p-value =0.0032). The figure shows that in 2001, male mortality (21,686) was higher than female adolescent mortality (19,575). In 2007, the reverse can be seen with higher female mortality (28,517) than male adolescent mortality (25,529) in South Africa.

In addition, the figure shows that over time both male and female adolescent mortality increased. The increase is more substantial for females. There was approximately an 18%

increase in the number of female deaths from 2001 to 2007. For males in this period, there was approximately an 8% increase in the number of adolescent deaths.

4.3 Distribution of adolescent deaths

4.3.1 Leading causes of adolescent deaths, 2001 and 2007.

Tables 4.1 (a) and (b) show the leading causes of death among adolescents in South Africa from 2001 and 2007. The data used to generate these are taken from Death Notification Forms. The tables are generated for the male and female adolescent populations combined.

Table 4.1 (a) Distribution of adolescent deaths by broad underlying cause and sex, 2001

ICD- 10 Code	Broad Underlying Cause of Death	Males		Females		Total	
		Freq.	Percent	Freq.	Percent	Freq.	Percent
A00-A09	Intestinal infectious diseases	150	2.41	271	5.05	421	3.63
A15-A19	Tuberculosis	288	4.63	735	13.70	1023	8.85
B20-B24	Human immunodeficiency virus diseases	25	0.40	134	2.50	159	1.37
D80-D89	Certain disorders involving the immune mechanism	29	0.47	171	3.19	200	1.71
G00-G09	Inflammatory diseases of the central nervous system	137	2.20	138	2.57	275	2.37
G40-G47	Episodic and paroxysmal disorders	145	2.33	99	1.84	244	2.11
I30-I52	Other forms of heart disease	120	1.93	161	3.00	281	2.43
J10-J18	Influenza and pneumonia	231	3.72	436	8.13	667	5.76
R95-R99	Ill-defined and unknown causes of mortality	395	6.35	602	11.22	997	8.59
V01-V99	Transport accidents	323	5.20	169	3.15	492	4.23
W00-X59	Other external causes of accidental injury	306	4.92	123	2.29	429	3.7
X85-Y09	Assault	419	6.74	54	1.01	473	4.06
Y10-Y34	Events of undetermined intent	2,542	40.89	908	16.92	3450	29.85

In 2001, 'events of undetermined intent' (29.85%) was the most reported broad underlying cause of death among adolescents in South Africa. For both adolescent males and females, 'Tuberculosis' was the second highest underlying cause of death at almost 9%. 'Transport accidents' and 'assaults' each contributed about 4% of all deaths to South African adolescents. The distribution by sex shows some differences between adolescent males and females in 2001. Almost 41% of adolescent male deaths were recorded as 'events of undetermined intent', an unnatural or non-disease related grouping of deaths. While only approximately 17% of female deaths were recorded as the same cause. For adolescent females, the second most cited broad underlying cause of death noted was from 'Tuberculosis' at 13.7%, compared to the 4.64% of adolescent males with the same cause.

Table 4.1 (b) Distribution of adolescent deaths by broad underlying cause and sex, 2007

ICD- 10 Code	Broad Underlying Cause of Death	Males		Females		Total	
		Freq.	Percent	Freq.	Percent	Freq.	Percent
A00-A09	Intestinal infectious diseases	197	2.78	354	5.85	551	8.63
A15-A19	Tuberculosis	466	6.57	875	14.45	1341	21.02
B20-B24	Human immunodeficiency virus diseases	50	0.71	157	2.59	207	3.30
D80-D89	Certain disorders involving the immune mechanism	66	0.93	157	2.59	223	3.52
G00-G09	Inflammatory diseases of the central nervous system	211	2.98	183	3.02	394	6.00
I30-I52	Other forms of heart disease	122	1.72	140	2.31	262	4.03
J10-J18	Influenza and pneumonia	321	4.53	500	8.26	821	12.79
R95-R99	Ill-defined and unknown causes of mortality	610	8.6	739	12.2	1349	20.8
V01-V99	Transport accidents	390	5.5	196	3.24	586	8.74
W00-X59	Other external causes of accidental injury	1,374	19.37	525	8.67	1899	28.04
X85-Y09	Assault	656	9.25	61	1.01	717	10.26
Y10-Y34	Events of undetermined intent	1,343	18.94	485	8.01	1828	26.95

In 2007, 'other external causes of accidental injury' was the prominent cause of death among male and female adolescents in South Africa at 14% of all deaths. The number deaths due to 'Events of undetermined intent' decreased from 2001 to about 14% in 2007. In addition, the number of deaths due to 'Ill- defined and unknown causes of mortality' and 'Tuberculosis' were approximately 10% of all deaths to adolescents in 2007 in the country.

4.3.2 Distribution of adolescent deaths by characteristics, 2001- 2007

Table 4.2 Number and percentage distribution of adolescent deaths 10- 14 and 15- 19 years old and age- specific mortality rates, Census 2001 and CS 2007, South Africa

		Total Population		Total Deaths		Age- Specific Mortality Rates*	
Age Groups		**2001**	**2007**	**2001**	**2007**	**2001**	**2007**
	N	5,052,183	4,947,002	13,146	17,863	2.6**	3.61**
10- 14	%	50.34	49.27	31.72	33.05		
	N	4,982,231	5,093,139	28,298	36,183	5.68**	7.10**
15- 19	%	49.66	50.73	68.28	66.95		
	N	**10,034,414**	**10,040,141**	**41,443**	**54,046**	**4.13****	**5.38****
Total	**%**	**100**	**100**	**100**	**100**		

***per 1,000 population; **denotes p-values <0.05**

As previously noted, adolescent mortality has increased in South Africa over time. This is reflected in the ASMRs generated from Census and CS data, which has also increased. In 2001, there were approximately 2.6 deaths to those aged 10- 14 years old per 1,000 population. The rate for adolescents aged 15- 19 years old was higher in this period with 5.68 deaths per 1,000 population. A similar differentiation between the two age- groups is seen in 2007 too. For those aged 10- 14 years old the ASMR was 3.61 deaths per 1,000 population. For the older age- group (15- 19 years old) this was higher at 7.1 deaths per 1,000 population in South Africa. Thus for both years under review, ASMRs were consistently higher in the age- group 15- 19 years old. Finally for the overall age- group of 10- 19 years old, the ASMRs show that in 2001, 4.13 deaths occurred per 1,000 population and again, the increase is reflected in 2007, whereby 5.38 deaths are recorded per 1,000 population.

Table 4.3 Direct estimation of adolescent mortality showing probability of dying, Census 2001 and CS 2007, South Africa

Age	Age Specific Mortality Rates ($_nm_x$)		Interval (n)		Average number of years lived ($_na_x$)		Probability of dying ($_nq_x$)	
Groups	**2001**	**2007**	**2001**	**2007**	**2001**	**2007**	**2001**	**2007**
10- 14'	0.0026	0.0036	5	5	2.843	2.843	0.0129	0.0179
15- 19	0.0057	0.0071	5	5	2.657	2.657	0.0280	0.0349
Total	**0.0041**	**0.0054**	**5**	**5**	**2.7**	**2.7**	**0.0205**	**0.0266**

Table 4.3 shows that had adolescents reached the age- group 10- 14 years old in 2001; they had a 1.29% chance of dying before their 15th birthday. In 2007, their chances of dying before their 15th birthday increased marginally to 1.79%. In 2001, adolescents who had reached the 15- 19 years age- group had a 2.8% chance of dying before their 20th birthday and again the chances of dying increased slightly for this age- group in 2007 (3.5%). By age- group Table 4.3 shows that the probability of dying before their 20th birthday is higher among 15- 19 year olds and this has been consistent over the period. Overall, for 10- 19 year olds, the probability of dying before their 20th birthday increased from a 2.05% chance in 2001 to a 2.66% chance in 2007.

4.4 Characteristic-specific mortality rates

Tables 4.4 (a) and (b) show the number of adolescents alive in the population, as well as the number who had died in 2001 and 2007. The tables show individual characteristics of adolescents. The data used to generate characteristics of the deceased are taken from Death Notification Forms.

Table 4.4 (a) Levels of characteristic- specific adolescent mortality death rate and probability of dying in South Africa, 2001

Characteristic	Number in population*	Number of deaths*	Death rate**
Total	**10,034,594**	**11,667**	**1.16**
Sex			
Male	4,964,807	6,217	1.25
Female	5,069,788	5,366	1.06
Marital Status			
Married	86,981	83	0.95
Living Together	67,926	70	1.03
Never Married	9,860,089	10,549	1.07
Widowed	10,115	14	1.38
Separated/divorced	9,483	29	3.06
Education			
Primary	5,876,893	2,621	0.45
Secondary	3,470,976	2,849	0.82
Incomplete Secondary	416,971	0	0.00
Province of residence			
Western Cape	868,122	768	0.96
Eastern Cape	1,699,928	1,688	1.06
Northern Cape	171,122	237	1.30
Free State	608,362	671	1.47
KwaZulu Natal	2,267,843	2,271	1.40
North West	793,165	621	1.16
Gauteng	1,435, 155	1,541	1.42
Mpumalanga	750,119	661	1.65
Limpopo	1,449,813	803	0.73

*Unknown and unspecified characteristics have been omitted under certain characteristics

** per 1,000 population

While the living population characteristics are from the Census and Community Survey. In addition the tables show the rate of mortality per individual characteristics in the same year. The reason deaths have been selected from Death Notification Forms while population numbers have been selected from Census and Community Survey is because Census and Community Survey data do not have the marital status and education of deceased adolescents. Due to incomplete data, the number of deaths from Death Notification Forms are lower than that of Census and Community Survey records.

Table 4.4 (a) shows that the overall mortality rate for adolescents in 2001 (p-value=0.0023) was 1.16 deaths per 1,000 adolescent population in South Africa. The mortality rate was also higher among males (1.25 deaths) than females aged 10- 19 years old. By marital status, the rate is highest among adolescents who were separated/ divorced (3.06) and widowed (1.38). Table 4.4 (a) shows that adolescents with secondary education have a mortality rate of 0.82. By province of residence, the Eastern Cape had the highest mortality rate at 273 adolescent deaths. This is followed by KwaZulu Natal at 255 adolescent deaths per 1,000 population.

Table 4.4 (b): Levels of characteristic- specific adolescent mortality and probability of dyingdeath rate in South Africa, 2007

Characteristic	Number in population*	Number of deaths*	Death rate**
Total	**10,040,317**	**13,165**	**1.31**
Sex			
Male	5,016,679	7,092	1.41
Female	5,023,638	6,056	1.21
Marital Status			
Married	46,147	117	2.54
Living Together	42,108	0	0.00
Never Married	9,793,138	11,692	1.19
Widowed	5,736	9	1.57
Separated/divorced	3,372	2	0.59
Education			
None	70,286	70	1.00
Primary	4,466,170	2,086	0.47
Secondary	5,091,660	3,630	0.71
Incomplete Secondary	195,613	0	0.00
Background			
Province of residence			
Western Cape	762,384	731	0.96
Eastern Cape	1,803,011	1,917	1.06
Northern Cape	193,707	251	1.30
Free State	566,200	834	1.47
KwaZulu Natal	2,295,782	3,219	1.40
North West	695,025	807	1.16
Gauteng	1,269,291	1,803	1.42
Mpumalanga	691,854	1,141	1.65
Limpopo	1,518,961	1,106	0.73

*Unknown and unspecified characteristics have been omitted under certain characteristics

** per 1,000 population

Table 4.4 (b) shows that the overall mortality rate for adolescents in 2007 (p-value=0.0025) increased to 1.31 deaths per 1,000 adolescent population in South Africa. The mortality rate again was higher among males (1.41 deaths) than females aged 10- 19 years old. By marital status, the rate is highest among adolescents who were married at 2.54 deaths and widows

(1.57). The table also shows that adolescents with no education have a higher mortality rate (1.00) than those with primary (0.47) or secondary (0.71). By province of residence, Mpumalanga had the highest mortality rate at almost 2 adolescent deaths. This is followed by the Free State at 1.47 adolescent deaths per 1,000 population.

4.5 Proportional Mortality Ratios

Proportional Mortality Ratios are here displayed by natural and unnatural causes for 2001 and 2007 in South Africa. The graphs are further sub- divided by sex (male and female) and age-group (10-14 and 15- 19 years old). The full tables from which these figures were generated can be found in the appendix.

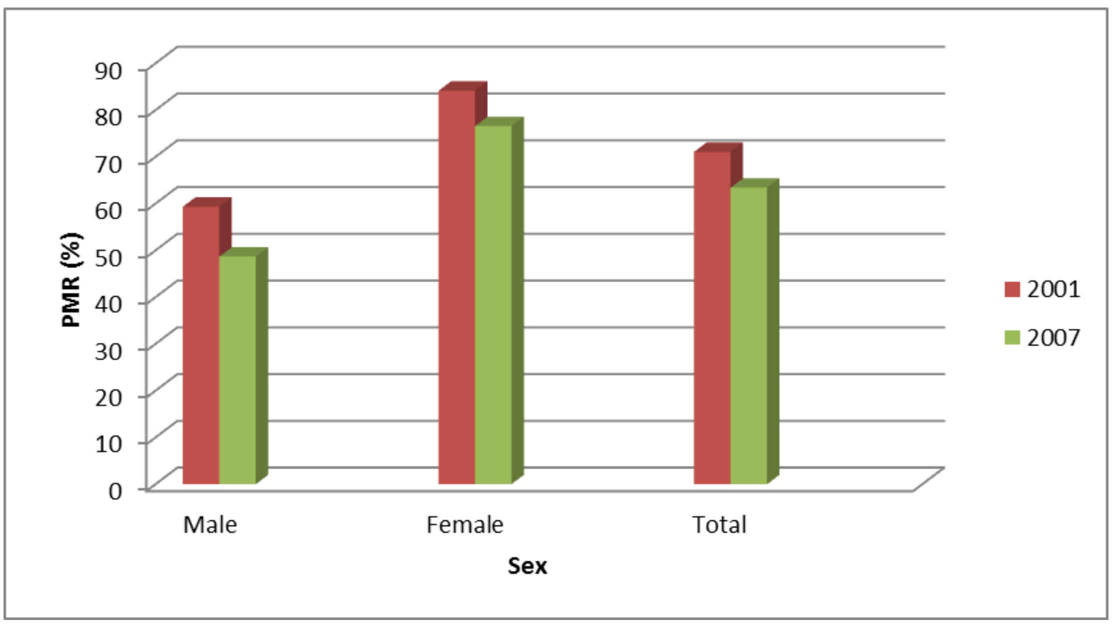

Figure 4.3 (a): Proportional Mortality Ratio by sex, for natural causes of death, Census 2001 and CS 2007, South Africa

For natural causes of death in 2001, male deaths contributed approximately 59% (p-value = 0.003) of all deaths and female natural cause deaths contributed about 84% (p-value = 0.021) according to the Proportional Mortality Ratio. This ratio also shows than in 2007, the contribution of natural cause male deaths declined to about 49% (p-value = 0.013) of all deaths to adolescents at that time. Female natural causes of death contribution to overall mortality, declined in 2007 to 77% (p-value = 0.042). Overall, the contribution of natural causes of death declined from 2001 to 2007 among adolescents in South Africa.

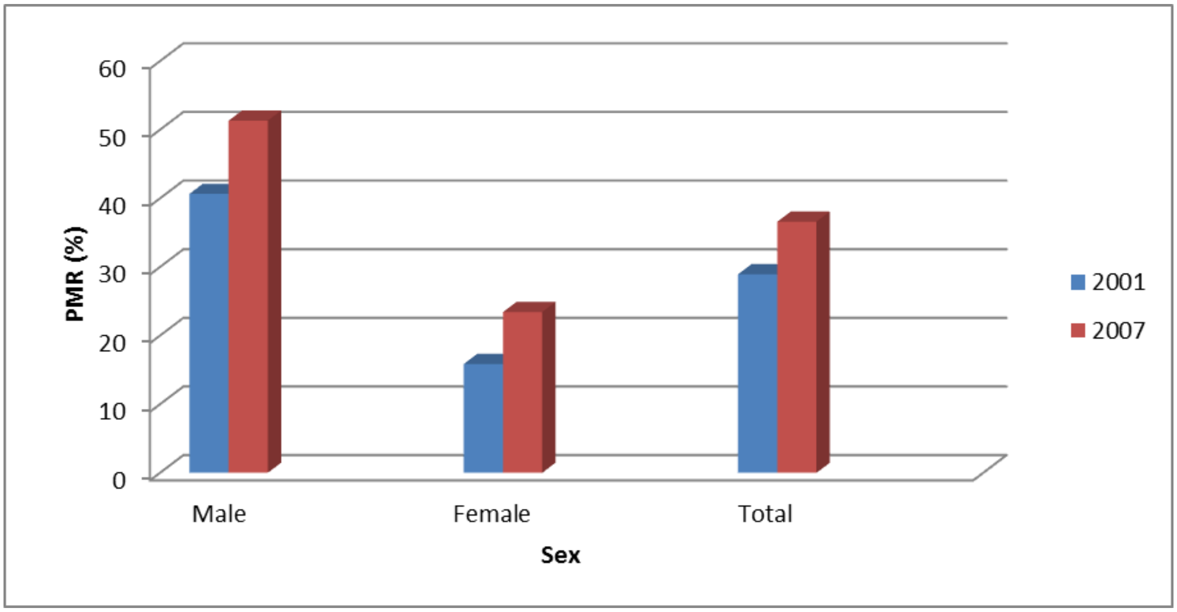

Figure 4.3 (b): Proportional Mortality Ratio by sex, for unnatural causes of death, Census 2001 and CS 2007, South Africa

For unnatural causes of death, the contribution of males to total all- cause adolescent deaths in 2001 was about 41% (p-value = 0.043)and this increased to 51% (p-value = 0.041)in 2007. The Proportional Mortality Ratio also shows that the percentage contribution of unnatural deaths among adolescent females increased from approximately 16% (p-value = 0.002) in 2001 to about 23% (p-value = 0.013) in 2007. Overall Figure 7(b) shows that the contribution of unnatural deaths to total all- cause mortality increased from 2001 to 2007, at 29% (p-value = 0.045) overall to 37% (p-value = 0.026) overall.

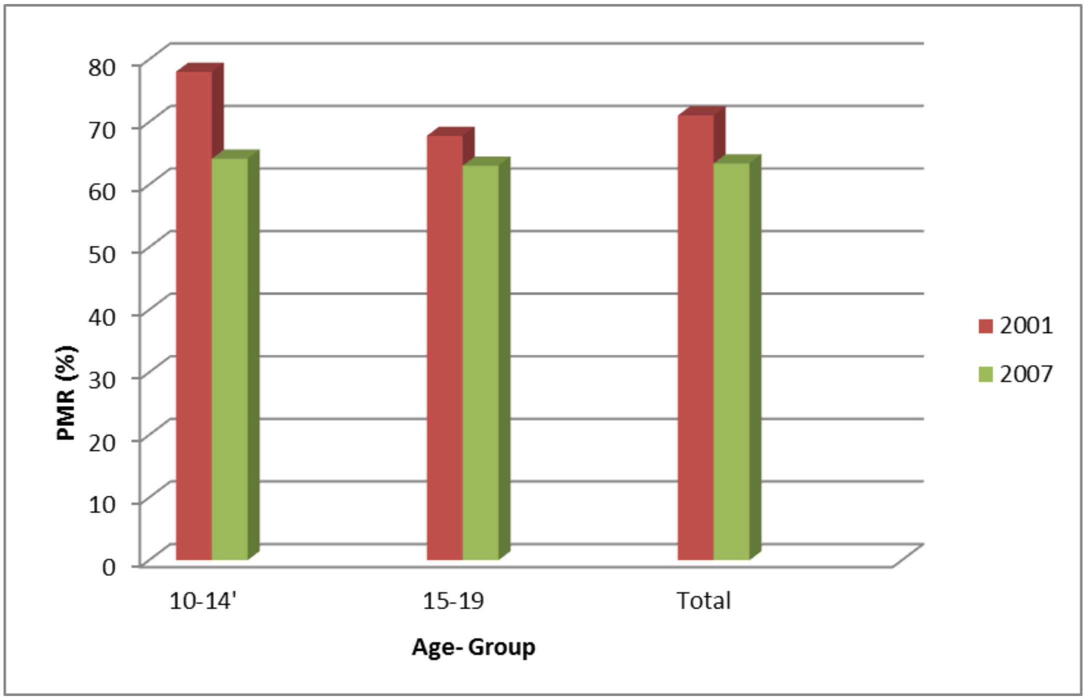

Figure 4.4 (a): Proportional Mortality Ratio by age- group, for natural causes of death, Census 2001 and CS 2007, South Africa

Figure 4.4 (a) shows the Proportional Mortality ratios, by age- group for adolescents who died from natural causes of death, 2001- 2007. For younger adolescents (10-14 years old), the percentage of deaths from natural causes decreased from 2001 (78%; p-value = 0.002) to 2007 (64%; p-value = 0.003). For older adolescents, aged 15- 19 years old, the proportional mortality ratio for deaths from natural causes also decreased, although more marginally, from 68% (p-value = 0.009) in 2001 to 64% (p-value = 0.019) in 2007. Overall, for the broader 10- 19 years old age- group, the proportional mortality rate for natural causes of death was 71% (p-value = 0.007) in 2001 and 63% (p-value = 0.006) in 2007.

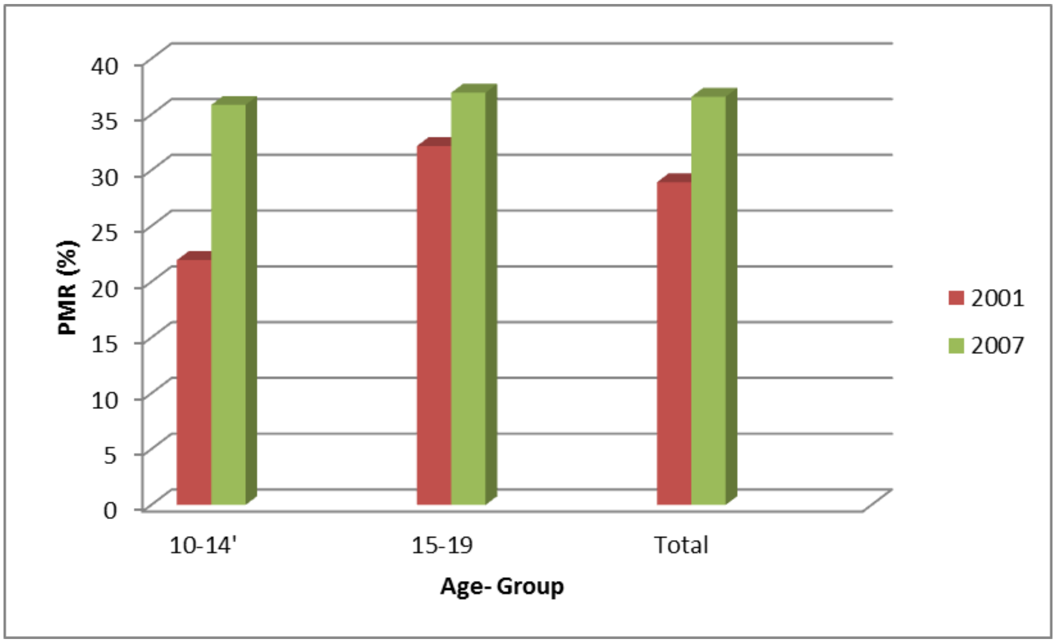

Figure 4.4 (b): Proportional Mortality Ratio by age- group, for unnatural causes of death, Census 2001 and CS 2007, South Africa

Figure 4.4 (b) shows the Proportional Mortality ratios, by age- group for adolescents who died from unnatural causes of death, 2001- 2007. For younger adolescents, aged 10-14 years old, the proportion of deaths from unnatural causes increased from 2001 (22%; p-value = 0.007) to 2007 (36%; p-value = 0.013). For older adolescents, the proportional mortality of deaths from unnatural causes also increased, from 32% (p-value = 0.029) in 2001 to 37% (p-value = 0.030) in 2007. Overall, for the broader 10- 19 years old age- group, the proportional mortality rate for unnatural causes of death was 29% (p-value = 0.007) in 2001 and 37% (p-value = 0.015)in 2007.

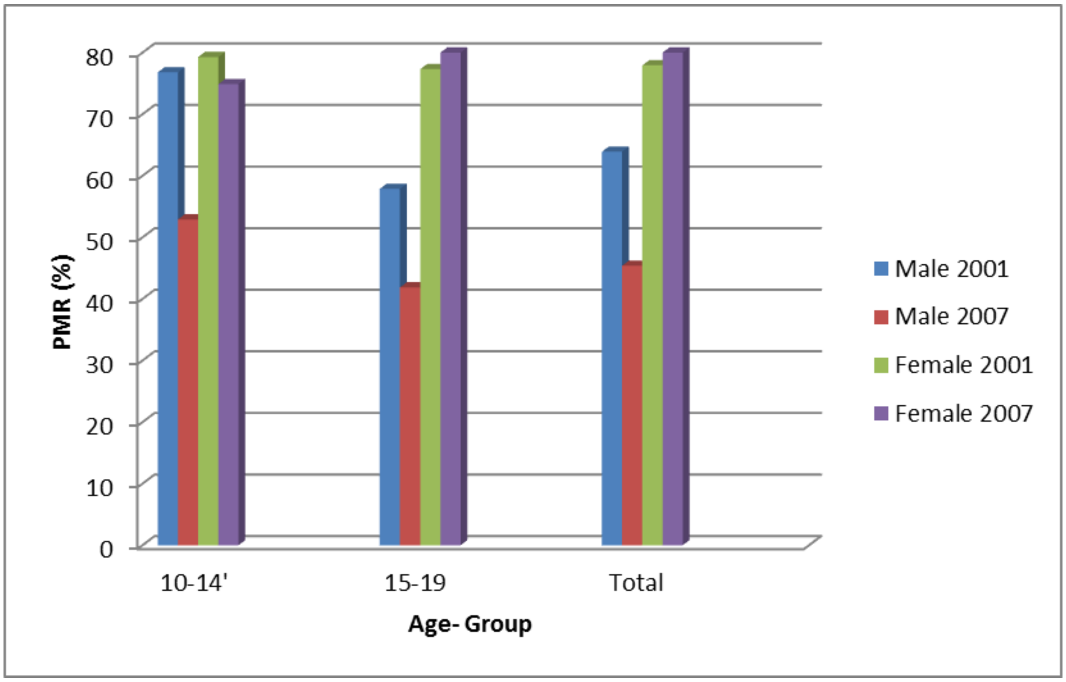

Figure 4.5 (a): Proportional Mortality Ratios by sex and age- group for natural causes of death, South Africa, Census 2001 and CS 2007

Figure 4.5 (a) shows the proportional mortality ratios for adolescents by sex and age- group for deaths by natural causes in 2001 and 2007. The figures shows that the proportion of adolescent male deaths from natural causes in 2007 is lower than in 2001 and lower than female mortality from natural causes, at both age- groups.

For 10- 14 year olds, male mortality declined in 2007 (53%) from 2001 (77%). The proportion of females aged 10 -14 years old, also declined from 79% to 74% over the period. For older adolescents, the figure shows that the proportion of male natural deaths was 58% in 2001 and this went down to 42% in 2007. For females of this same age- group (15- 19), the proportion of natural deaths increased from 77% in 2001 to 86% in 2007.

Overall for the broad age- group of 10- 19 years old, the proportion of male deaths due to natural causes decreased over time (64% to 45%) whereas female deaths, from the same causes, increased from 78% to 81%.

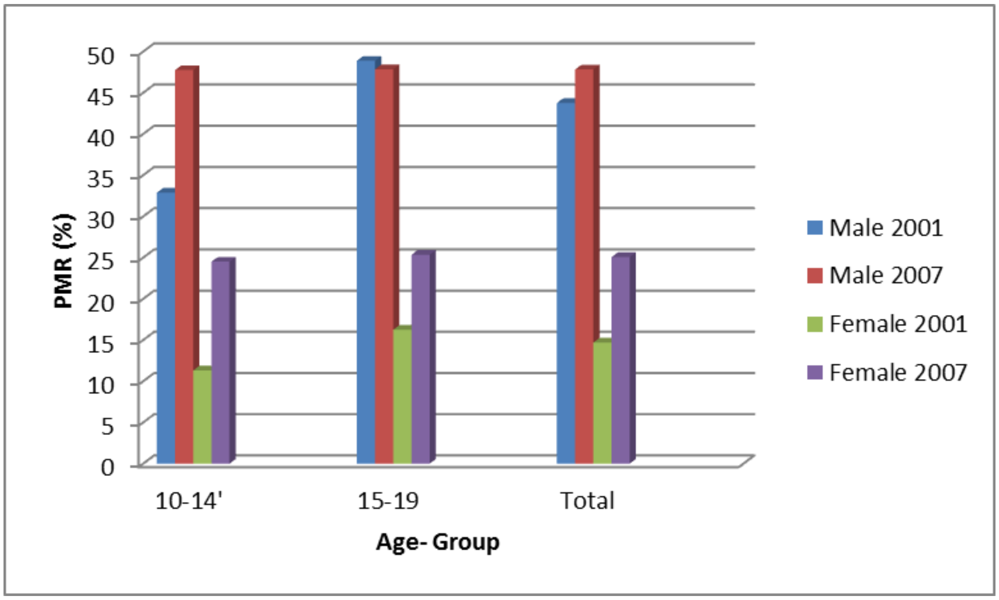

Figure 4.5 (b): Proportional Mortality Ratios by sex and age- group for unnatural causes of death, South Africa, Census 2001 and CS 2007

Figure 4.5 (b) shows the proportional mortality ratios for adolescents by sex and age- group for deaths by unnatural causes in 2001 and 2007. Overall, the figure shows that the proportion of adolescent male deaths from unnatural causes increased from 2001 to 2007, and is higher than female mortality from unnatural causes.

For 10- 14 year olds, male mortality increased in 2007, 33%, from 2001 (48%). The proportion of females aged 10 -14 years old, also increased from 11% to 24% over the years. For older adolescents, the figure shows that the proportion of male unnatural deaths was 49% in 2001 and this went down, marginally, to 48% in 2007. For females of this same age- group (15- 19), the proportion of unnatural deaths increased from 16% in 2001 to 25% in 2007.

Overall, for the broad age- group of 10- 19 years old, the proportion of male deaths due to unnatural causes increased over time (44% to 48%). Similarly, female deaths, from the same causes, increased from 15% to 25%.

Table 4.5 Proportional mortality ratios for main most reported causes of death among adolescent males and females, 2001 and 2007, South Africa

Broad underlying cause of death		Number of deaths				PMR			
		Males		Females		Males		Females	
Description of diseases	**Code**	**2001**	**2007**	**2001**	**2007**	**2001**	**2007**	**2001**	**2007**
All Causes		6217	7092	5366	6056				
Intestinal infectious diseases	A00-A09	150	354	271	336	2.41	4.99	5.05	5.55
Tuberculosis	A15-A19	288	884	735	860	4.63	12.46	13.70	14.20
Human immunodeficiency virus diseases	B20-B24	25	187	134	160	0.40	2.64	2.50	2.64
Certain disorders involving the immune mechanism	D80-D89	29	178	171	179	0.46	2.51	3.19	2.96
Inflammatory diseases of the central nervous system	G00-G09	137	225	138	204	2.20	3.17	2.57	3.37
Episodic and paroxysmal disorders	G40-G47	145	111	99	87	2.33	1.56	1.85	1.43
Other forms of heart disease	I30-I52	120	176	161	11	1.93	2.48	3.00	0.18
Influenza and pneumonia	J10-J18	231	535	436	434	3.72	7.54	8.13	7.17
Ill-defined and unknown causes of mortality	R95-R99	395	772	602	755	6.35	10.89	11.22	12.47
Transport accidents	V01-V99	323	200	169	208	5.20	2.82	3.15	3.43
Other external causes of accidental injury	W00-X59	306	1374	123	750	4.92	2.48	2.29	12.38
Assault	X85-Y09	419	656	54	525	6.74	9.24	1.01	8.66
Events of undetermined intent	Y10-Y34	2542	956	908	186	40.89	13.48	16.92	3.07
All other causes		1281	2625	1641	1984	20.60	37.01	30.58	32.76

Table 4.5 shows the number of adolescent deaths and the proportional mortality ratio, by sex and year, for specific causes of death. To begin, the table shows that for all causes with the exception of 'episodic and paroxysmal disorders', 'transport accidents' and 'events of

undetermined intent', male adolescent mortality increased from 2001 to 2007. With regard to the number of female deaths in the period, deaths increased for all broad underlying causes of death, with the exceptions of 'episodic and paroxysmal disorders', 'other forms of heart disease', 'influenza and pneumonia' and 'events of undetermined intent'.

The table shows that the proportion of adolescent deaths due to 'events of undetermined intent' was prominent among adolescent males in 2007, at 14% of all adolescent male deaths. For adolescent females in 2007, the proportion of female adolescent deaths due to 'Tuberculosis' was highest at 14%.

Chapter 5

CAUSES OF ADOLESCENT MORTALITY, 2001and 2007

5.1 Introduction

Causes of mortality are pivotal in identifying populations at risk. It provides important information regarding the burden of diseases and offers a starting point for the direction of policies and programmes.

Generally, for unnatural causes of death, the issue of unintentional injuries has been documented as a major problem for youth, aged 15- 29 years in developed countries (Blum and Mmari, 2004). In Africa, it was reported that road traffic mortality among adolescents increased more than 200% since 1980 (Blum and Mmari, 2004). In addition, suicide is noted as the fifth leading cause of mortality globally and the second highest leading cause of death for adolescents in developing countries (Wasserman et al., 2005). Further suicide rates for adolescents vary by region and sex. The lowest rates of suicide are found in Latin America and Sub- Saharan Africa (Wasserman et al., 2005). In addition, studies have found that suicide is more common among males than females (Patel et al., 2007).

For natural causes of death, HIV/AIDS is a large contributor to adolescent and youth mortality in developing countries (Blum and Mmari, 2004). The measurement of AIDS deaths has remained a problem in African countries, but prevalence of the disease is high. It is argued that today, nearly 12 million young people are living with HIV/AIDS (Kiragu, 2001). Of this, 8.6 million of the infected young people live in the Sub- Saharan African region (Kiragu, 2001). Literature has contended that gender differentials in patterns of infections vary around the world (Lobel et al., 2004). In Sub- Saharan Africa an estimated 30% of women aged 20- 24 years in Botswana were infected and in Rwanda over 25% of pregnant adolescents aged 17 and below tested positively for the virus (Verkuyl, 1995). Of notable importance in Africa, is that young women have higher rates than their male counterparts. The reasons for this have been well documented and include young women being unable to negotiate safe sex, prevalence of transactional sex and the biological development of young girls (Verkyl, 1995; UNAIDS, 2000; UNAIDS, 1999).

This research has covered the causes of death literature for South Africa in Chapter 2 (Literature Review). This chapter shows that issues of interpersonal violence, suicide and HIV/ AIDS are applicable to South African adolescents too. These studies identified, through the use of smaller samples, prominent causes of adolescent death in the past. However, these studies are neither recent nor on a national- scale. Problems with producing analysis on specific causes on a national- scale are related to data availability on causes of death. Inadequate registration of deaths and the dearth of information provided in surveys makes this task challenging. For this research, the availability of specific causes of death from the 2001 Census and 2007 CS is not available for analysis. Two broad categories of natural and unnatural causes of death are captured in the survey and used here. Unnatural causes of death in the population include violence and injury, poisoning, suicide, drowning and motor vehicle accidents, whereas natural causes of death include deaths from disease and infection, such as HIV/ AIDS and Tuberculosis. To supplement the dearth of data in population surveys, Death Notification Forms from 2001 and 2007 are used to identify broad- underlying causes of death.

This chapter begins with showing the distribution of adolescent deaths by individual characteristics and natural and unnatural cause of death. Thereafter, cause- specific mortality rates are generated by sex, age- group and cause of death (natural, unnatural and broad- underlying cause of death). This technique is a more refined and informative rate, that offers precise measurement of the populations at risk. The life table approach is finally used in this chapter and figures of essential functions have been produced. Life tables are widely used in demography and its applications are vast. The purpose of a life table to appropriately summarize variations of mortality with age (Hinde, 1998). In theory, a life table is “derived by following a birth cohort of persons through life and tabulating the proportion still alive at various ages” (Hinde, 1998: pp30). This technique of inference is particularly useful in health- provision planning, policy formation and programme development. The life table can be used to identify age- groups at risk of certain causes of death, life expectancy at each age- group and probability of a cohort not surviving to their next birthday. This study uses an abridged life table technique, which means that instead of reporting on age in single years, age is grouped into 5 year intervals.

5.2 Cause of mortality by sex

5.2.1 Cause- specific mortality by sex of adolescents

Mortality differentials between the sexes are documented in literature (Lopez, 1984, Pampel, 2002, Waldron, 1993). Male mortality from causes such as violence and accidents (unnatural causes of death) are often higher than that of females (Waldron, 1993). To examine the differences between adolescent male and female mortality by unnatural and natural causes of death, cause- specific mortality rates are generated.

To begin, age-standardized mortality rates are used since it enables the comparison of mortality rates of countries without being affected by the difference in age distributions between countries. The standard used here is adopted from the WHO World Standard Population Distribution recommendation (see Methodology chapter). Without using this standardization, it would be unclear if differing mortality rates were due to age or as a result of other factors (Ahmad et al., 2001).

5.2.2 Standardized death rates by sex

Table 5.1 (a): Standardized death rates by Broad Underlying Cause of Death and sex in South Africa, 2001

Broad underlying COD			Standardized Death Rate*	
Description of the Code	**Code**	**Age- Group**	**Males**	**Females**
All- Causes		10-14	6.07	5.03
		15-19	15.67	13.28
Intestinal infectious diseases	A00-A09	10-14	0.24	0.31
		15-19	0.28	0.61
Tuberculosis	A15-A19	10-14	1.65	0.38
		15-19	0.64	2.12
Influenza and pneumonia	J10-J18	10-14	0.29	0.32
		15-19	0.52	1.16
Ill-defined and unknown causes of mortality	R95-R99	10-14	0.56	0.57
		15-19	0.82	1.48
Transport accidents	V01-V99	10-14	0.38	0.24
		15-19	0.75	0.33
Other external causes of accidental injury	W00-X59	10-14	0.28	0.18
		15-19	0.79	0.24
Assault	X85-Y09	10-14	0.10	0.03
		15-19	1.37	0.15
Events of undetermined intent	Y10-Y34	10-14	1.96	1.94
		15-19	6.83	6.63

***per 100,000 population**

Tables 5.1 (a) and (b) show the age- standardized death rates for younger (10- 14 years) and older (15- 19 years) adolescents by sex and the most reported broad- underlying cause of death in 2001. For the group of 'all causes' of mortality, which includes other causes of that were not analysed due to low reporting, , the death rates are higher for males than females of both age sub-groups. The table shows that the age-standardized death rates in 2001, were higher for females dying from 'intestinal infectious diseases', 'influenza and pneumonia' and 'ill-defined and unknown causes of mortality'. Conversely, male adolescents (both older and younger) have higher death rates for 'transport accidents', 'other external causes of accidental injury' and 'assault'.

For 'Tuberculosis' younger males (10- 14 years) have a higher age- standardized death rate than females of the same age at 1.65 deaths per 100,000 population and 0.38 deaths per 100,000 respectively. However, for older adolescents (15- 19 years old) females have a higher mortality rate at 2.12 deaths per 100,000 population compared to males of the same age (0.64 deaths per 100,000 population).

'Events of undetermined intent' produced high age- standardized death rates which are fairly equal for males and females. For this cause, older adolescents of both sexes have higher rates than younger ones (6.83 for males and 6.63 for females).

Table 5.1 (b): Standardized death rates by Broad Underlying Cause of Death and sex in South Africa, 2007

Broad underlying COD			Standardized Death Rate*	
Description of the Code	**Code**	**Age- Group**	**Males**	**Females**
All- Causes		10-14'	7.62	6.52
		15-19'	16.74	14.44
Intestinal infectious diseases	A00-A09	10-14'	0.43	0.49
		15-19'	0.25	0.74
Tuberculosis	A15-A19	10-14'	0.71	0.82
		15-19'	0.89	2.21
Influenza and pneumonia	J10-J18	10-14'	0.54	0.56
		15-19'	0.56	1.17
Ill-defined and unknown causes of mortality	R95-R99	10-14'	0.89	0.81
		15-19'	1.21	1.75
Transport accidents	V01-V99	10-14'	0.43	0.27
		15-19'	0.91	0.41
Other external causes of accidental injury	W00-X59	10-14'	1.04	0.68
		15-19'	3.68	1.14
Assault	X85-Y09	10-14'	0.13	0.02
		15-19'	2.13	0.19
Events of undetermined intent	Y10-Y34	10-14'	0.54	0.46
		15-19'	0.56	1.22

***per 100,000 population**

It is also shown that the age-standardized death rates, were higher for females dying from 'intestinal infectious diseases', 'influenza and pneumonia' and 'tuberculosis'. Conversely, male adolescents (both older and younger) have higher death rates for 'transport accidents', 'other external causes of accidental injury' and 'assault'. Compared to 2001, here it is seen that females of both age sub- groups have higher rates of death from 'Tuberculosis'. For 'ill-defined and unknown causes of mortality' and 'events of undetermined intent' the table shows that in 2007, younger (10-14 years) males had higher death rates and older (15- 19 years) females.

Table 5.2 Unstandardised Sex-specific death rates by sex and ratio of male to female deaths by broad underlying cause of death, 2001- 2007

Broad underlying cause of death		Male Rates*		Female Rates*		Ratio of male to females	
Description of diseases	**Code**	**2001**	**2007**	**2001**	**2007**	**2001**	**2007**
Intestinal infectious diseases	A00-A09	24.13	27.78	50.50	58.45	0.48	0.48
Tuberculosis	A15-A19	46.32	65.71	136.97	144.48	0.34	0.46
Human immunodeficiency virus diseases	B20-B24	4.02	7.05	24.97	25.92	0.16	0.27
Inflammatory diseases of the central nervous system	G00-G09	22.04	29.75	25.72	30.22	0.86	0.99
Episodic and paroxysmal disorders	G40-G47	23.32					
Influenza and pneumonia	J10-J18	37.16	45.26	81.25	82.56	0.46	0.55
Ill-defined and unknown causes of mortality	R95-R99	63.54	86.01	112.19	122.03	0.57	0.71
Transport accidents	V01-V99	51.95	54.99	31.49	32.36	1.65	1.70
Other external causes of accidental injury	W00-X59	49.22	193.74	22.92	86.69	2.15	2.24
Assault	X85-Y09	67.40	92.5	10.06	10.07	6.7	9.18
Events of undetermined intent	Y10-Y34	408.88	189.37	169.21	80.09	2.42	2.37
All other causes		206.05	182.32	305.81	447.99	0.67	0.41

***per 1,000 population**

Table 5.2 shows the ratio of adolescent male to female deaths per cause for the same period, 2001 (p-value=0.0003) and 2007 (0.0012). It shows that for adolescent males, deaths from 'events of undetermined intent' were as high as 409 deaths per 1,000 adolescent female deaths in 2001. However this declined to about 190 adolescent male deaths in 2007. In the same year, the rate of adolescent male deaths from 'other external causes of accidental injury' was highest at 194 deaths per 1,000 male population.

For adolescent females, death rates from 'events of undetermined intent' was highest in 2001 at 169 deaths per 1,000 female population in South Africa. This declined to a death rate of 80 deaths per 1,000 female population in 2007. In addition, the table shows that female death rates from 'Tuberculosis' was high in both years, with an increase from 137 deaths in 2001 to 145 deaths per 1,000 female population in 2007.

The ratio of male to female deaths by broad underlying causes shows that in both 2001 and 2007, the ratio of deaths from 'assault' was highest. In 2001, there were 6 male deaths from 'assault' to every 1 female death from the same cause. This increased in 2007, to 9 male deaths from 'assault' to every 1 female death from the same cause. This trend of increased ratio of male compared to female deaths is true for other unnatural causes of death seen in the table too, such as 'transport accidents', 'other external causes of accidental injury' and 'events of undetermined intent'.

Table 5.3 (a): Cause- specific mortality rates, by sex, for natural deaths among adolescents, Census 2001 and CS 2007

Sex		Total Adolescent Population		Adolescent Deaths from Natural Causes		Cause- Specific Mortality Rates	
		2001	2007	2001	2007	2001	2007
Male	N	4,964,763	5,016,503	12,979	12,429	26.14	24.78
	%	49.48	49.96	44.07	36.27		
Female	N	5,069,651	5,023,716	16,470	21,838	32.49	43.47
	%	50.52	50.04	55.93	63.73		
Total	**N**	**10,034,414**	**10,040,219**	**29,449**	**34,267**	**29.35**	**34.13**
	%	**100**	**100**	**100**	**100**		

The cause- specific mortality rates show that there were about 26 natural cause deaths to adolescent males per 10,000 adolescent male population in 2001. This rate decreased in 2007, showing approximately 25 natural cause deaths to adolescent males per 10,000 population aged 10- 19 years old (p-value=0.002). For females, the cause- specific mortality rates for natural deaths were higher. In 2001, approximately 33 adolescent female deaths per 10,000 adolescent females were due to natural causes of death (p-value=0.001). This increased in 2007, whereby approximately 43 natural cause deaths to female adolescents were recorded per 10,000 female adolescent population. (p-value=0.001) Overall Table 5.3 (a) shows that cause- specific mortality rates for natural causes of death increased from 2001 to 2007 among adolescents in South Africa.

Table 5.3 (b): Cause- specific mortality rates by sex, for unnatural deaths among adolescents, Census 2001 and CS 2007

Sex		Total Adolescent Population		Adolescent Deaths from Unnatural Causes		Cause- Specific Mortality Rates	
		2001	2007	2001	2007	2001	2007
Male	N	4,964,763	5,016,503	8,889	13,100	17.90	26.11
	%	49.48	49.96	74.11	66.23		
Female	N	5,069,651	5,023,716	3,105	6,680	6.12	13.30
	%	50.52	50.04	25.89	33.77		
Total	**N**	**10,034,414**	**10,040,219**	**11,994**	**19,780**	**11.95**	**19.70**
	%	**100**	**100**	**100**	**100**		

The cause- specific mortality rates for unnatural causes show that in 2001, 18 adolescent males per 10,000 adolescent males in the country died from unnatural causes (p-value=0.001). In 2007, this increased to about 26 male deaths per 10,000 (p-value=0.001). A stark increase in cause- specific mortality rates for adolescent female deaths from unnatural causes is also seen from 2001 to 2007. In 2001, approximately 6 adolescent females died from unnatural causes per 10,000 population (p-value=0.003) and this increased to about 13 per 10,000 in 2007 (p-value=0.001), indicating that the number of deaths had doubled.

Overall Table 5.3 (b) shows that cause- specific mortality rates for unnatural causes of death increased from 2001 to 2007 at 12 and 20 per 10,000, respectively, among adolescents in South Africa.

5.3 Cause of mortality by younger and older adolescents

Table 5.4 (a): Cause- specific mortality rates, by age-group, for natural deaths among adolescents, 2001 and 2007

Age-Group		Total Adolescent Population		Adolescent Deaths from Natural Causes		Cause- Specific Mortality Rates	
		2001	2007	2001	2007	2001	2007
10-14	N	5,052,183	4,947,002	10,259	11,457	20.31	23.16
	%	50.34	49.27	34.84	33.44		
15-19	N	4,982,231	5,093,139	19,190	22,810	38.52	44.79
	%	49.66	50.73	65.16	66.56		
Total	**N**	**10,034,414**	**10,040,141**	**29,449**	**34,267**	**29.35**	**34.13**
	%	**100**	**100**	**100**	**100**		

Table 5.4 (a) shows the cause- specific mortality rates by younger and older adolescents for natural causes of death. In 2001, about 20 young adolescents (10- 14 years) per 10,000 in this age- group had died from natural causes of death (p-value=0.001). In 2007, this number increased to about 23 young adolescents per 10,000 population (p-value=0.001). For older

adolescents (15-19 years) there was about 38 deaths from natural causes per 10,000 population (p-value=0.001) and, again, this increased in 2007 (45 deaths per 10,000 population; p-value=0.001). For the overall age- group of 10- 19 year olds, the number of deaths from natural causes per 10,000 population in 2001 was 29 and this increased to 34 deaths in 2007.

Table 5.4 (b): Cause- specific mortality rates by age-group, for unnatural deaths among adolescents, 2001 and 2007

Age-Group		Total Adolescent Population		Adolescent Deaths from Unnatural Causes		Cause- Specific Mortality Rates	
		2001	2007	2001	2007	2001	2007
10-14	N	5,052,183	4,947,002	8,889	13,100	17.59	26.48
	%	50.34	49.27	74.11	66.23		
15-19	N	4,982,231	5,093,139	3,105	6,680	6.23	13.12
	%	49.66	50.73	25.89	33.77		
Total	**N**	**10,034,414**	**10,040,141**	**11,994**	**19,780**	**11.95**	**19.70**
	%	**100**	**100**	**100**	**100**		

Table 5.4 (b) shows the cause- specific mortality rates of young and older adolescents by unnatural cause of death in 2001 and 2007. To begin, younger adolescents (10- 14 years) had about 18 deaths from unnatural causes per 10,000 population (p-value=0.001)and this rose to 26 deaths in 2007 (p-value=0.001). The 2001 rate for younger adolescents dying from unnatural causes is lower than the rate for natural causes. However in 2007, there is a higher rate for natural causes of death compared to unnatural causes (see Table 5.3 (a)).

For older adolescents (15- 19 years) there were approximately 6 deaths from unnatural causes per 10,000 population in 2001 (p-value=0.001). This increased to 13 deaths from unnatural causes of death per 10,000 population in 2007 (p-value=0.001). The rates of death from unnatural causes of death are much lower than the rates from natural causes of death

(Table 4.4 (a)). This is similarly true for the overall cause- specific mortality rates for the broad age- group of 10- 19 years old. For unnatural causes of death about 12 adolescents died from unnatural causes of death in 2001 (p-value=0.002) compared to the 29 per 10,000 who died from natural causes of death in the same year. In 2007, 19 adolescents aged 10-19 years old, per 10,000 population died from unnatural causes of death (p-value=0.001)compared to the 34 who died of natural causes in the same period (p-value=0.001).

Tables 5.3 (a) and (b) and Tables 5.4 (a) and (b) show that in 2001 and 2007, the cause-specific mortality rates for natural causes of death were higher than unnatural causes of death.

5.4 Cause- Specific Mortality Rates by select broad- underlying causes of death, sex and age- group, 2001 and 2007, South Africa.

The following figures show cause- specific mortality rates by broad-underlying causes of death from Death Notification Forms. The broad- underlying causes are classified according to the ICD-10 codes (see Appendix 2).

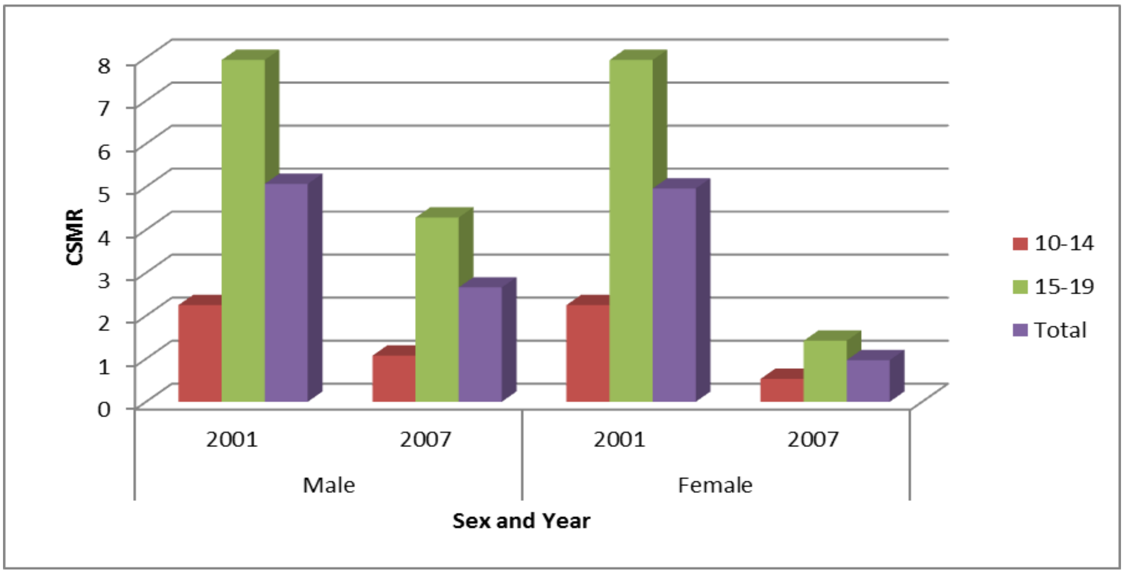

Figure 5.1 CSMRs for deaths for 'undetermined intent' (Y10-Y34) by sex and age-group, 2001 & 2007

The cause- specific mortality rates (CSMRs) in the figure above show that older adolescents (15- 19 years old) have higher rates of mortality from 'events of undetermined intent' (Y10-Y34) for both sexes. The figure shows that older males and females in 2001, had higher rates of mortality from this cause, compared to males and females of the same age in 2007.

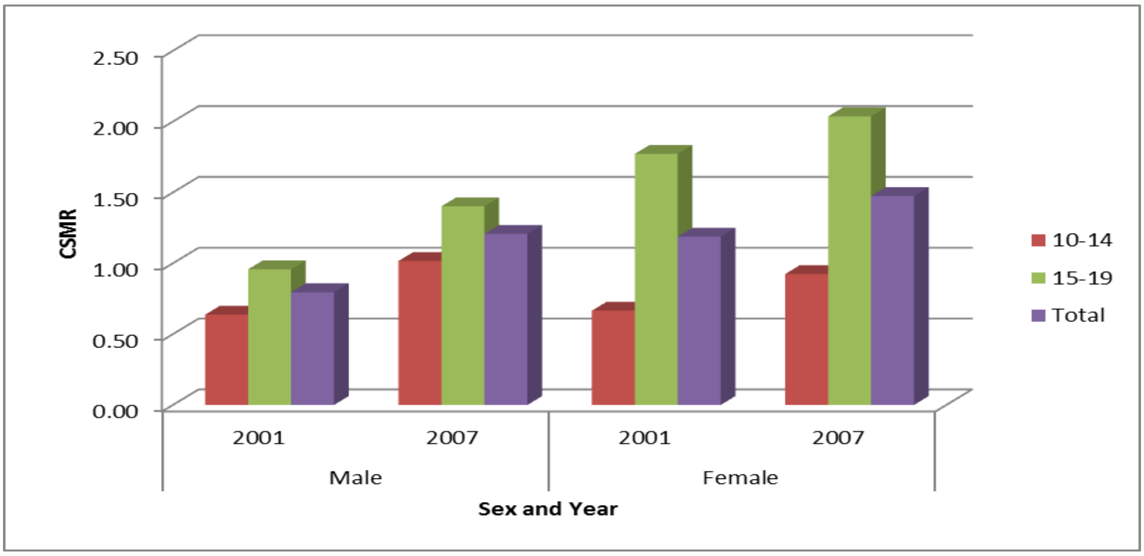

Figure 5.2 CSMRs for deaths for 'ill-defined and unknown causes' (R95- R99) by sex and age-group, 2001 & 2007

Figure 5.2 above shows that adolescent male deaths from 'ill- defined and unknown causes' (R95-R99) increased from 2001 to 2007. For younger males (10-14 years old) the rate of male mortality was approximately 0.50 deaths per 1,000 population and this increased to about male death in 2007. The same is seen for older adolescent males, whereby the rate increased from almost 1 death in 2001 to to about 1.5 deaths in 2007.

For females, a similar trend in the rate of deaths from 'ill- defined and unknown causes' (R95- R99) is seen. The CSMRs for both younger and older adolescent females increased from 2001 to 2007. Older females in 2007 reported the highest rates of mortality from this cause with approximately 2 deaths per 1,000 adolescent population of the same age.

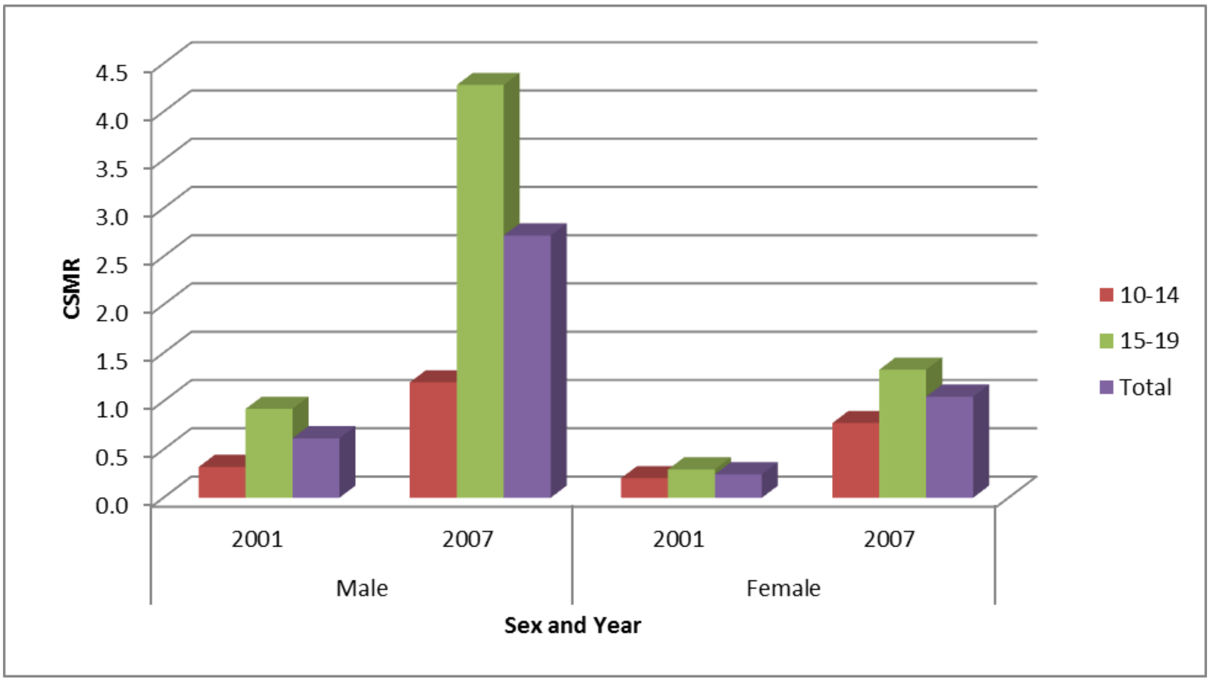

Figure 5.3 CSMRs for deaths for 'other external causes of accidental injury' (W00-X59) by sex and age-group, 2001 & 2007

The figure above (Figure 5.3) shows a dramatic increase in the CSMRs of older adolescent males from 2001 to 2007 due to 'other external causes of accidental injury' (W00- X59). The rate for younger adolescent males was less than 1 death per 1,000 population in 2001. This increased to over 4 male deaths per 1,000 male population aged 15- 19 years old. A relatively vast increase in the rates of adolescent female (both age groups) deaths is also seen with regard to this cause. In 2007, female rates for younger and older adolescents increased from less than 0.5 deaths to over 0.5 deaths in younger females and over 1 death in older adolescents.

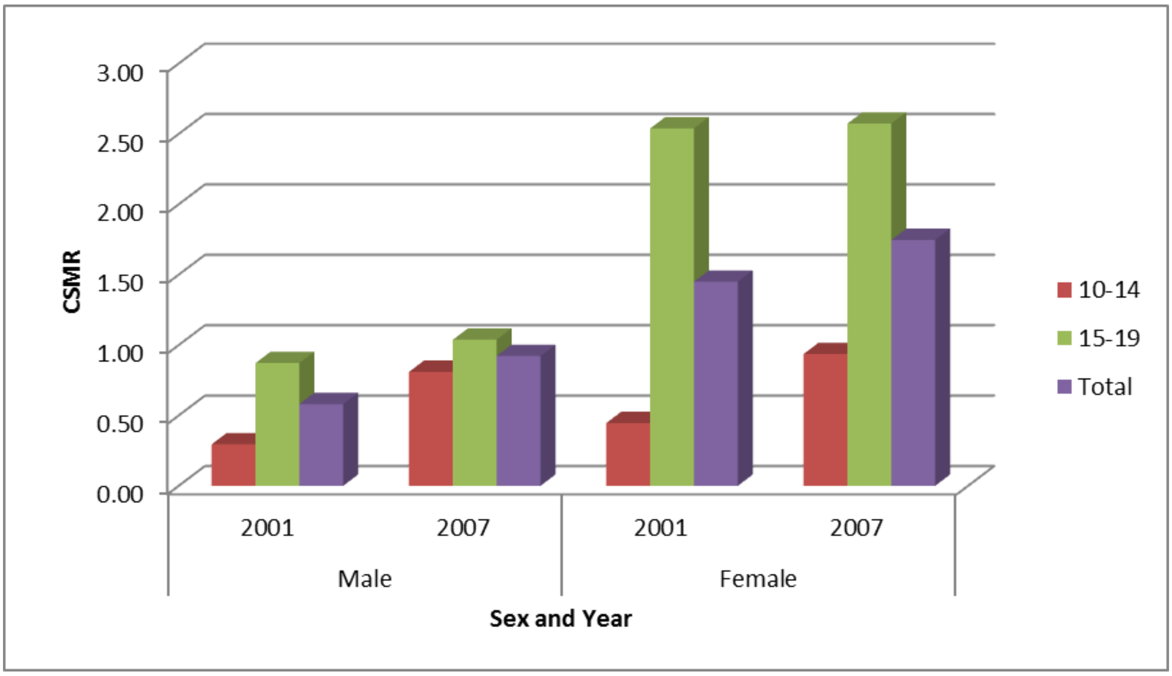

Figure 5.4 CSMRs for deaths for 'Tuberculosis' (A15-A19) by sex and age-group, 2001 & 2007

The most stark difference seen in Figure 5.4, is that the CSMRs for females dying from 'Tuberculosis' (A15- A19) than male adolescents, especially in the older age- group (15- 19 years old). In both 2001 and 2007, the rate of deaths to females aged 15- 19 years old is double (and over) that of the rates of younger adolescents. Further in 2007, there was a slight increase in the rates to older females, being about 2.5 deaths per 1,000 older female adolescent population.

For males, the figure shows that the rates of death to younger adolescents is twice as high in 2007 (0.75) than it was in 2001 (0.25). Among older adolescents males, there was an increase from 0.87 deaths in 2001 to about 1 death per 1,000 population in 2007.

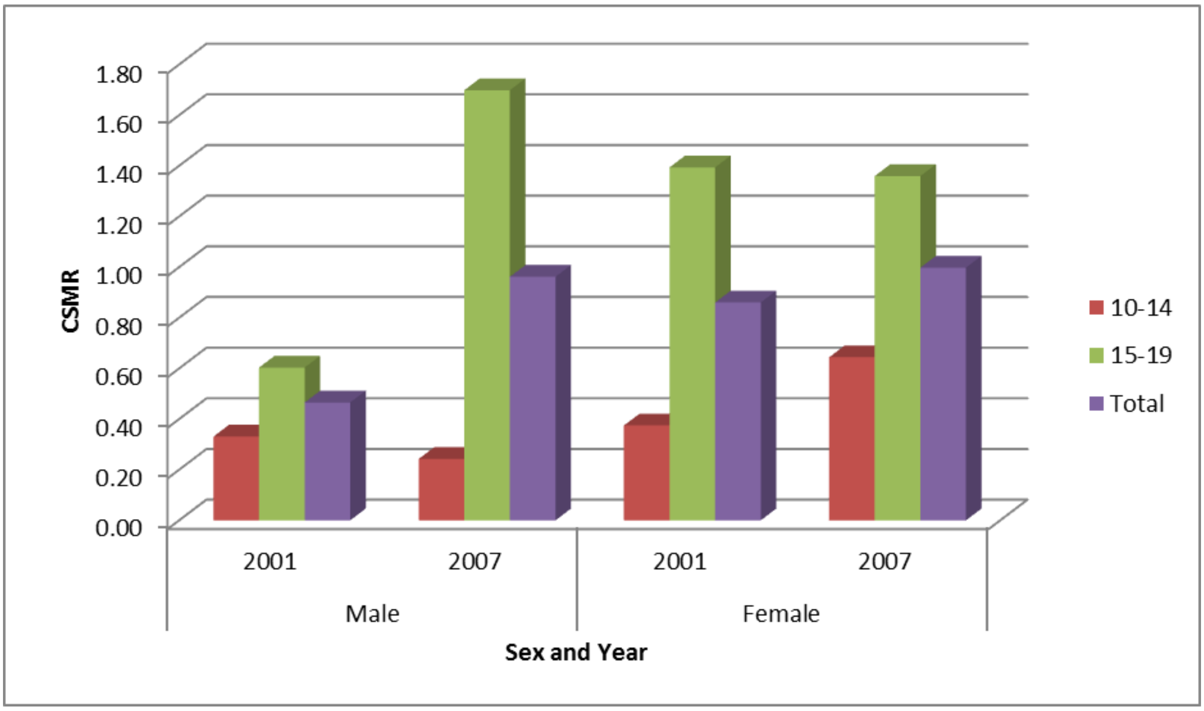

Figure 5.5 CSMRs for deaths for 'influenza and pneumonia' (J10-J18) by sex and age-group, 2001 & 2007

Figure 5.5 shows the cause- specific mortality rates (CSMRs) for deaths from 'influenza and pneumonia' (J10-J34) by sex and sub-age groups in South Africa. The figure shows that older adolescent males in 2007 had the highest rates of death from this broad underlying cause at about 1.7 deaths per 1,000 population. Despite the increased number of rates among older adolescent males, the figure also shows that the CSMRs from 'influenza and pneumonia' among younger adolescent males, declined over the period. In contrast however, the rates among younger females in 2001 (0.37) increased in 2007 (0.64).

5.5 Multiple decrement life tables

For the multiple decrement life tables and associated single decrement life tables, graphic depictions of the relevant functions are provided. Completed life tables are provided in the Appendix.

5.5.1 Number of survivors by age and sex, South Africa, 2001- 2007

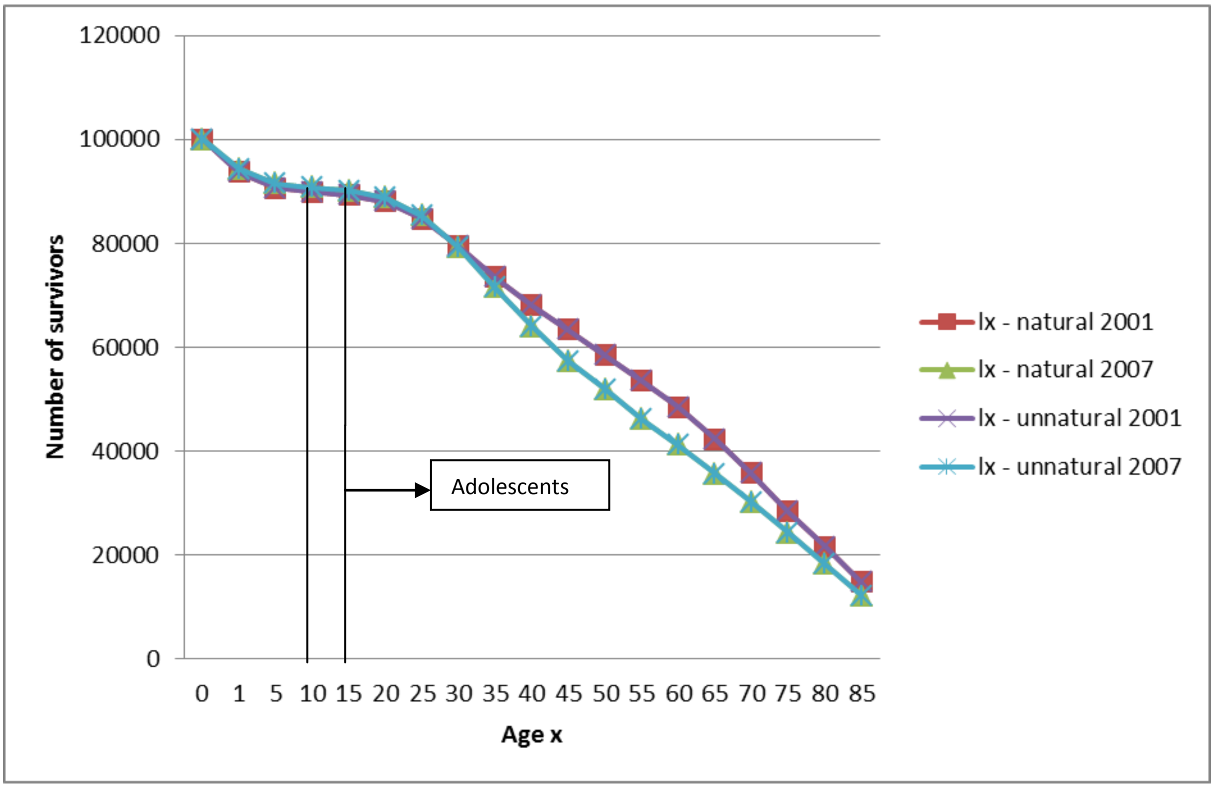

Figure 5.6 Number of survivors at age x (lx) from natural and unnatural causes of death, Census 2001 and CS 2007

Figure 5.6 shows the number of survivors at each age in 2001 and 2007 who have survived natural and unnatural causes of death. For the population of interest in this study, 10- 19 years old, the figure shows that there has not been much difference in the number of survivors from 2001 to 2007. In 2001 the number of survivors for 10- 19 year old was some 450,000, in 2007 this decreased to about 430,000, for younger adolescents. However, the number of survivors within the older adolescent age- group increased to some 470,000 in

2007. The figure shows that from age 20 onwards the number of survivors starts to decline rapidly and in 2007 there were fewer survivors at older ages than in 2001.

The figure shows that for adolescents, aged 10- 19 years old, the number of survivors from natural causes of deaths does not vary as greatly as in the older age – groups (40+ years). The number of survivors in 2001 and 2007 was some 980,000 adolescents.

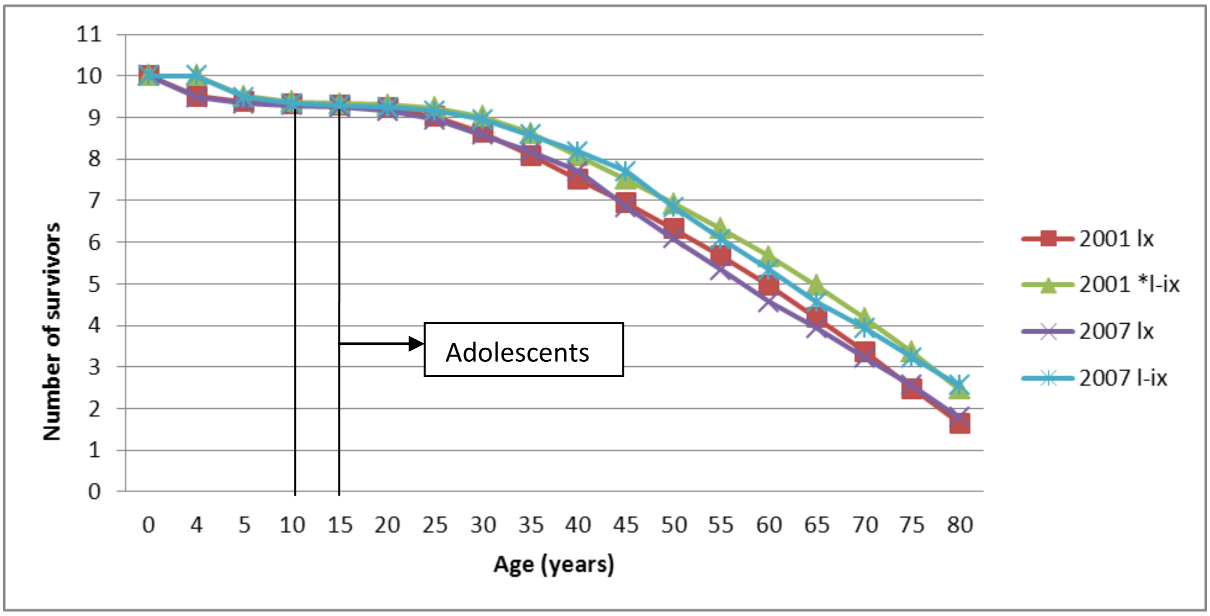

Figure 5.7 Number of male survivors (in 10,000s) at age x from all causes of death (lx) and number of male survivors if 'events of undetermined intent' (2001) and 'other external causes of accidental injury' (2007) were eliminated, South Africa

Figure 5.7 shows the number of male survivors at each age in 2001 who survived all causes of death and the expected number of survivors should '<u>events of undetermined intent</u>' (the most cited cause of death on DNFs) be eliminated from the population. For the population of interest here, males aged 10- 19 years old, the figure shows that there has not been much difference in the number of survivors from all causes and that of the main cause. The exact difference in the number of survivors gained is 93,825 for 10- 14 year olds and for 15-

19 year olds, 93,415. The figure shows that from age 20 onwards the number of survivors of all causes starts to decline rapidly with a visible trend of the number of survivors.

In 2007, the main cause of death for adolescent males was ‘other external causes of accidental injury’. This graph shows the number of survivors at each group from all causes of death and the number of survivors at each group that can be expected should ‘other external causes of accidental injury’ be eliminated from the population. The number of male adolescent survivors that could be expected in the younger age group (10-14 years) is 92,850 . Also the number of older adolescent males that can be expected should there no longer be any deaths due this cause is 92,466.

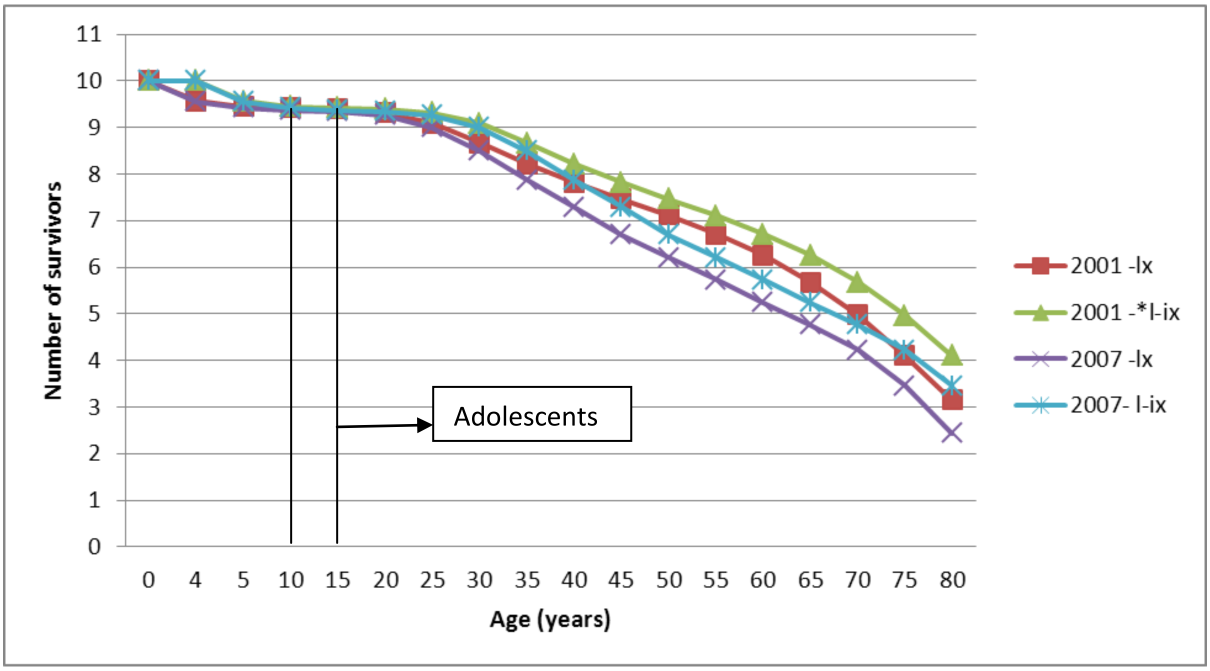

Figure 5.8 Number of female survivors (in 10,000s) at age x from all causes of death (lx) and number of male survivors if ‘events of undetermined intent’ (2001) and ‘other external causes of accidental injury’ (2007) were eliminated, South Africa

Figure 5.8 shows the number of female survivors at each age in 2001 who survived all causes of death and the expected number of survivors should '<u>events of undetermined intent</u>' (the most prominent cause of death for both sexes) be eliminated from the population. For the population of interest here, females aged 10- 19 years old, it is shown that there has not been much difference in the number of survivors from all causes and that of the main cause. The exact difference in the number of survivors gained is 94,545 for 10-14 year olds and for 15- 19 year olds, 94,213.

In 2007, the main cause of death for adolescent females was '<u>other external causes of accidental injury</u>'. The number of female adolescent survivors that could be expected in the younger age group (10-14 years), should this cause be eliminated from the population is 93,757. Also the number of older adolescent females that can be expected should there no longer be any deaths due this cause is 94,228.

5.5.2 Probability of dying by specific causes of death, 2001 and 2007

Table 5.5(a): Probability of dying before next age-interval for younger (10-14) and older (15-19) adolescents, South Africa 2001

Broad underlying COD		10-14 years old		15- 19 years old		Total	
Description of the Code	**Code**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Intestinal infectious diseases	A00-A09	0.14	0.18	0.16	0.35	0.30	0.53
Tuberculosis	A15-A19	0.15	0.22	0.43	1.23	0.58	1.45
Inflammatory diseases of the central nervous system	G00-G09	0.12	0.03	0.15	0.23	0.28	0.26
Other forms of heart disease	I30- I52	0.07	0.09	0.17	0.22	0.24	0.32
Influenza and pneumonia	J10-J18	0.17	0.18	0.30	0.67	0.47	0.86
Ill-defined and unknown causes of mortality	R95-R99	0.32	0.33	0.48	0.86	0.79	1.19
Transport Accidents	V01-V99	0.21	0.14	0.44	0.19	0.65	0.33
Other external causes of accidental injury	W00-X59	0.16	0.10	0.46	0.14	0.62	0.24
Assault	X85-Y09	0.06	0.02	0.79	0.09	0.85	0.11
Events of undetermined intent	Y10-Y34	1.12	1.11	3.96	3.84	5.08	4.95

Table 5.5 (a) above shows the probability of dying before the next age-group for 10-14 and 15- 19 year olds in South Africa, 2001. The table shows that for males and females, both younger and older, the probability of dying before the next age- interval is highest for deaths from 'events of undetermined intent'. To be specific, the probability of dying from this cause is higher among older adolescents (15- 19 years old) especially males at 3.96 deaths per 1,000 population. For older adolescent males, aged 15- 19 years old, the probability of dying from 'events of undetermined intent' was highest at about 1.11 deaths per 1,000.

For females, the table shows that the probability of dying before the next age interval is highest for both younger (10- 14 years old) and older (15- 19 years old) adolescents from 'events of undetermined intent'. For younger adolescent females, the probability of dying is is very high at almost 3.96 deaths per 1,000 but slightly declines to 3.84 deaths per 1,000 population among older adolescent females. Overall, for adolescent males, aged 10- 19 years old, the probability of dying is highest for 'events of undetermined intent' at 5.08 deaths per 1,000 population. For females, overall, the probability of dying is highest for 'events of undetermined intent' at 4.95 deaths per 1,000 population.

Table 5.5 (b): Probability of dying before next age-interval for younger (10-14) and older (15-19) adolescents, South Africa 2007

Broad underlying COD		10-14 years old		15- 19 years old		Total	
Description of the Code	**Code**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Intestinal infectious diseases	A00-A09	0.24	0.28	0.14	0.43	0.39	0.71
Tuberculosis	A15-A19	0.40	0.47	0.52	1.28	0.92	1.75
Inflammatory diseases of the central nervous system	G00-G09	0.20	0.12	0.21	0.24	0.42	0.37
Other forms of heart disease	I30- I52	0.10	0.10	0.16	0.21	0.26	0.31
Influenza and pneumonia	J10-J18	0.31	0.32	0.32	0.68	0.63	1.00
Ill-defined and unknown causes of mortality	R95-R99	0.51	0.46	0.70	1.01	1.20	1.48
Transport accidents	V01-V99	0.25	0.15	0.52	0.24	0.77	0.39
Other external causes of accidental injury	W00-X59	0.60	0.39	2.13	0.66	2.73	1.05
Assault	X85-Y09	0.10	0.01	1.23	0.11	1.33	0.12
Events of undetermined intent	Y10-Y34	0.53	0.26	2.13	0.71	2.67	0.97

The table above shows the probability of male and female adolescents dying before the entering the next age- interval by specific causes of death in2007. To begin, in 2007, the probability of dying was greatest for ‘other external forms of accidental injury’ (0.60 per 1,000) than any other cause of death for young adolescent males. For older adolescent males, aged 15- 19 years old, the probability of dying from ‘events of undetermined intent’ was highest at about 2.13 per 1,000. In addition, the probability of dying from ‘events of undetermined intent’ was equally high at 2.13 male deaths per 1,000 adolescents.

For females, the table shows that the probability of dying before the next age interval is highest for both younger (10- 14 years old) and older (15- 19 years old) adolescents from ‘Tuberculosis’. For younger adolescent females, the probability of dying is not as high at 0.47 deaths per 1,000 but increases to 1.28 deaths per 1,000 population among older adolescent females. Overall, for adolescent males, aged 10- 19 years old, the probability of dying is highest for ‘other external causes of accidental injury’ at 2.73 deaths per 1,000 population. For females, overall, the probability of dying is highest for ‘tuberculosis’ at 1.75 deaths per 1,000 population.

5.5.3 Associated decrement life tables – life expectancy

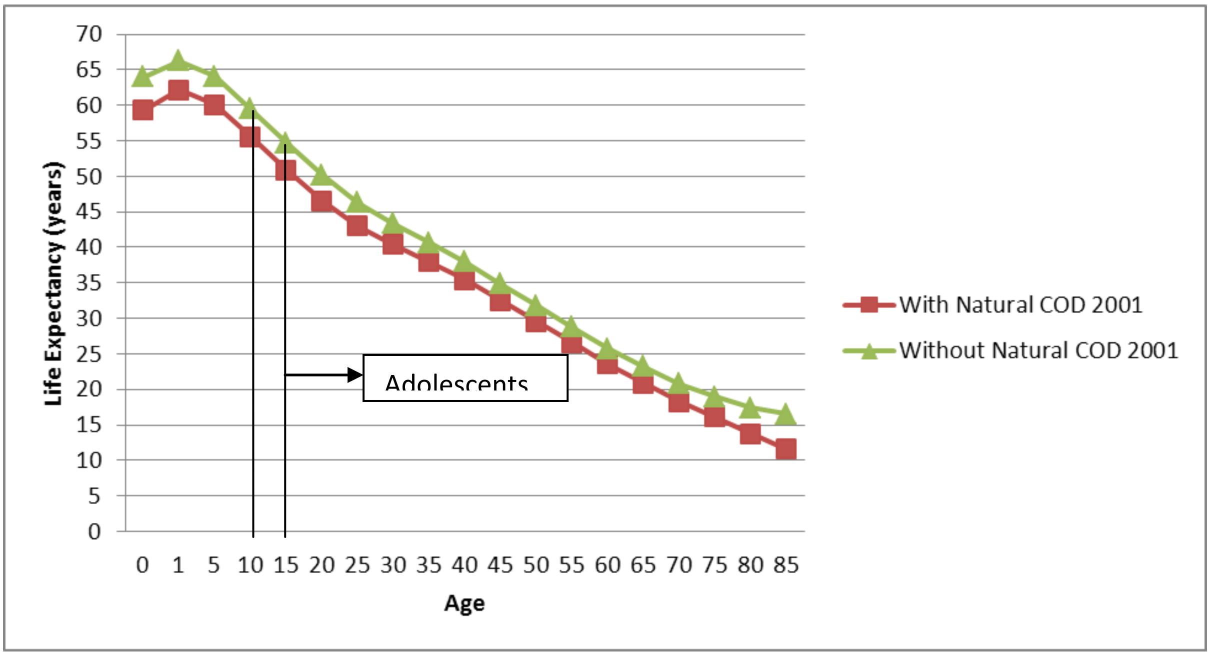

Figure 5.9 (a): Life expectancy with and without natural causes of death, 2001 (South Africa)

Figures 5.9 (a) and (b) shows the gains in life expectancy the South African population can expect to make if natural causes of death were eliminated from the population, using life expectancy in 2001 and 2007 respectively. The figures shows that for the younger age-groups (less than 30 years old) the gains in additional years of life are substantial and this falls off in the older age groups, as expected. For the population of interest, adolescents, the figure shows that hypothetically, life expectancy can drastically increase with the eradication of natural causes of death.

In 2001 life expectancy with natural causes of death was 55.56 years for adolescents aged 10 -14 years old and 50.87 for adolescents aged 15- 19 years old. Without natural causes of death in the population, life expectancy for both younger and older adolescents almost doubles.

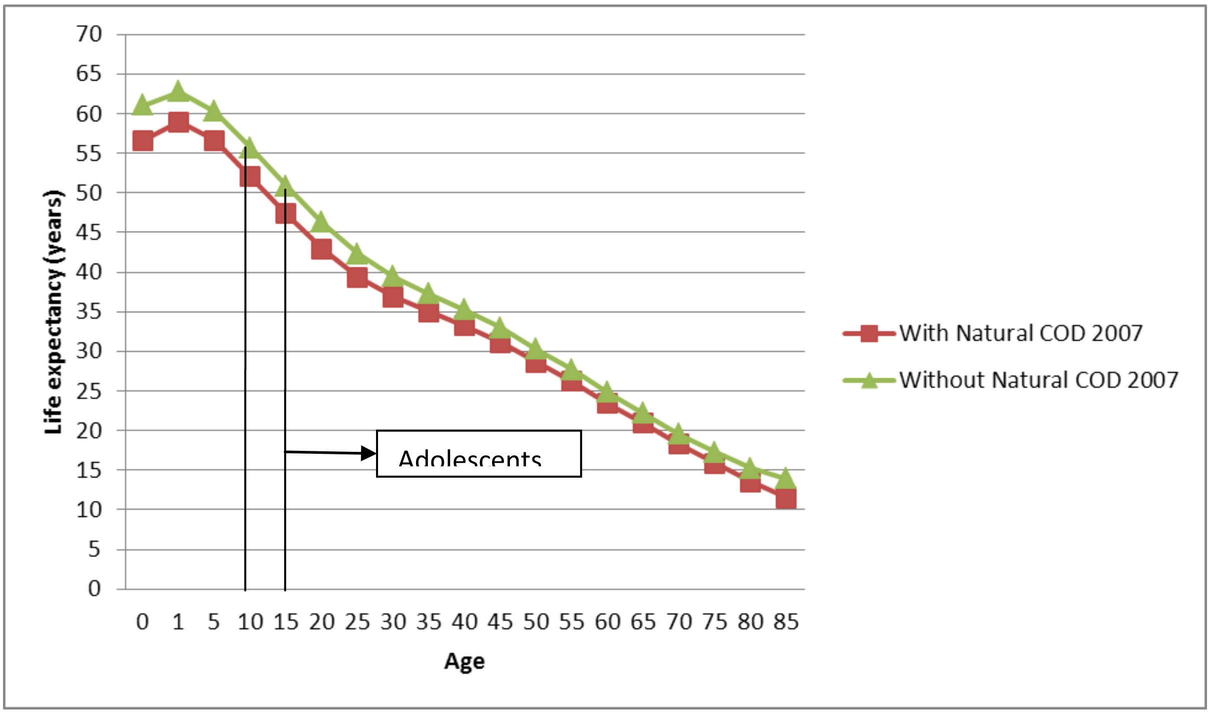

Figure 5.910 (b): Life expectancy with and without natural causes of death, 2007 (South Africa)

From Figure 5.9 (b) it is seen again, that substantial gains in life expectancy can be made with the elimination of natural causes of death in the South African population. For the adolescent population, it is seen that among younger adolescents (10- 14 years old) life expectancy could increase from about 51 years to 86 years. For older adolescents (15- 19 years old) life expectancy would increase from 47 years to approximately 81 years.

Of notable importance, it is seen that the gains in life expectancy were much higher in 2001, than in 2007. Where the maximum life expectancy for adolescents in 2007 was 86 years, in 2001 this was closer to 100. Life expectancy with natural causes of death is the basis of this variation in cause- deleted life expectancy. In 2001, life expectancy with the existence of natural causes of death was higher, especially at younger ages than in 2007. This higher life expectancy with the existence of natural causes of death, is because there were fewer deaths from natural causes in 2001 than 2007 (see Table 4.3 and Table 4.4 (a)). Thus as the number of adolescent deaths from natural causes increased over time, life expectancy worsened and the potential gains if these causes were eradicated also declined.

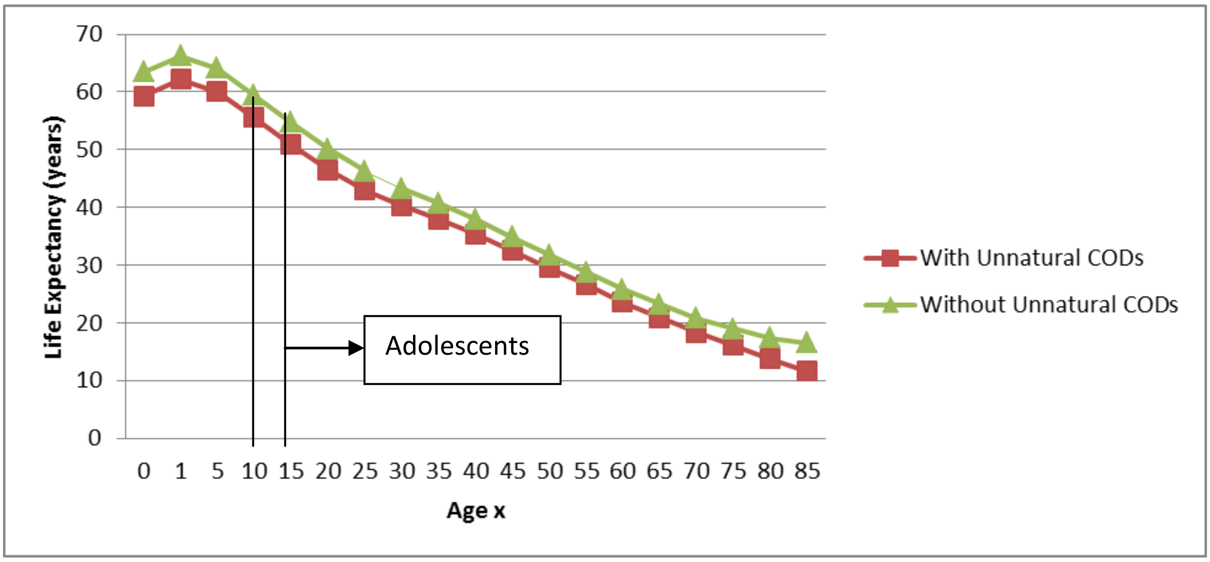

Figure 5.11 (a): Life expectancy with and without unnatural causes of death, 2001 (South Africa)

Figure 5.10 (a) shows the life expectancy of the South African population with unnatural causes of death and without unnatural causes of death in 2001. The figure shows that with unnatural causes of death, the life expectancy at all ages is lower than if unnatural causes of death were eliminated from the population. For the adolescent population if shows that at least 3 years of additional life can be gained in the absence of unnatural causes of death. This would put the expectancy of adolescents closer to 60 years, compared to the approximate 55 years with unnatural causes.

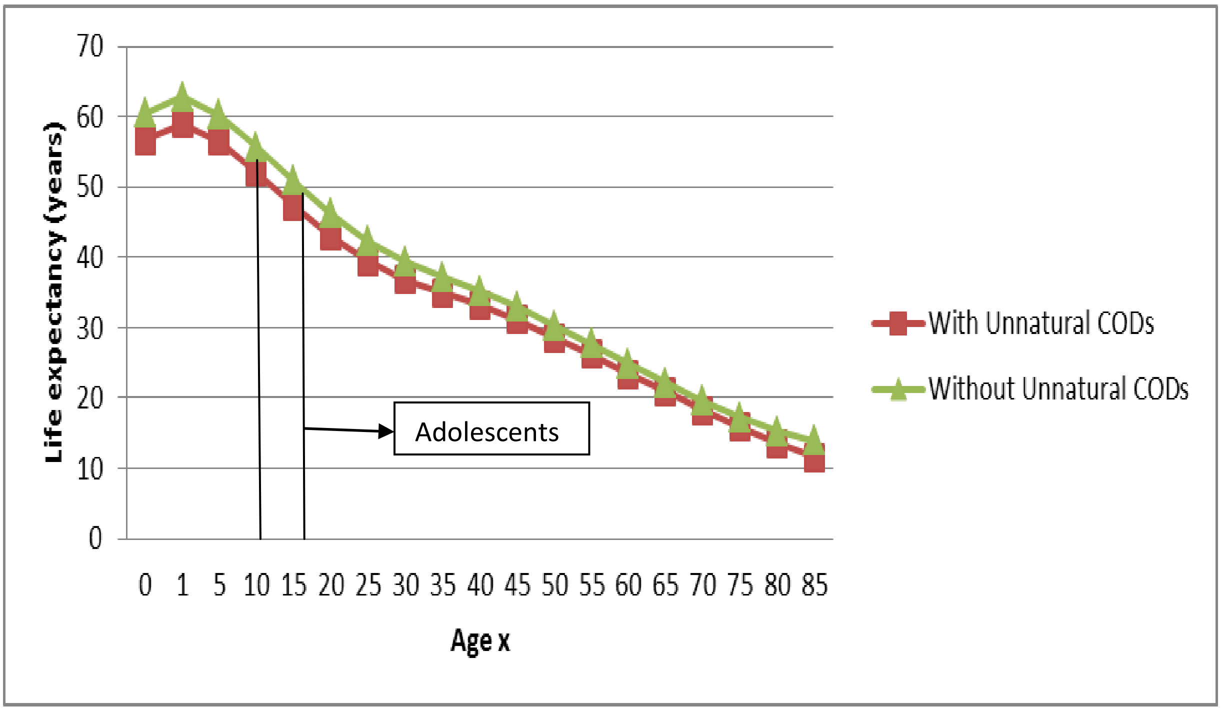

Figure 5.12 (b): Life expectancy with and without unnatural causes of death, 2007 (South Africa)

Figure 5.12 (b) shows life expectancy with and without unnatural causes of death in South Africa in 2007. The figure again shows that life expectancy is higher at all ages in the absence of unnatural causes of death, especially in the younger age groups. For adolescents, the figure shows that with unnatural causes of death, the life expectancy in 2007 was lower than that of the same age- group in 2001, about 50 additional years. If unnatural causes of death were to be eradicated, the life expectancy increases to almost 60 extra years of life.

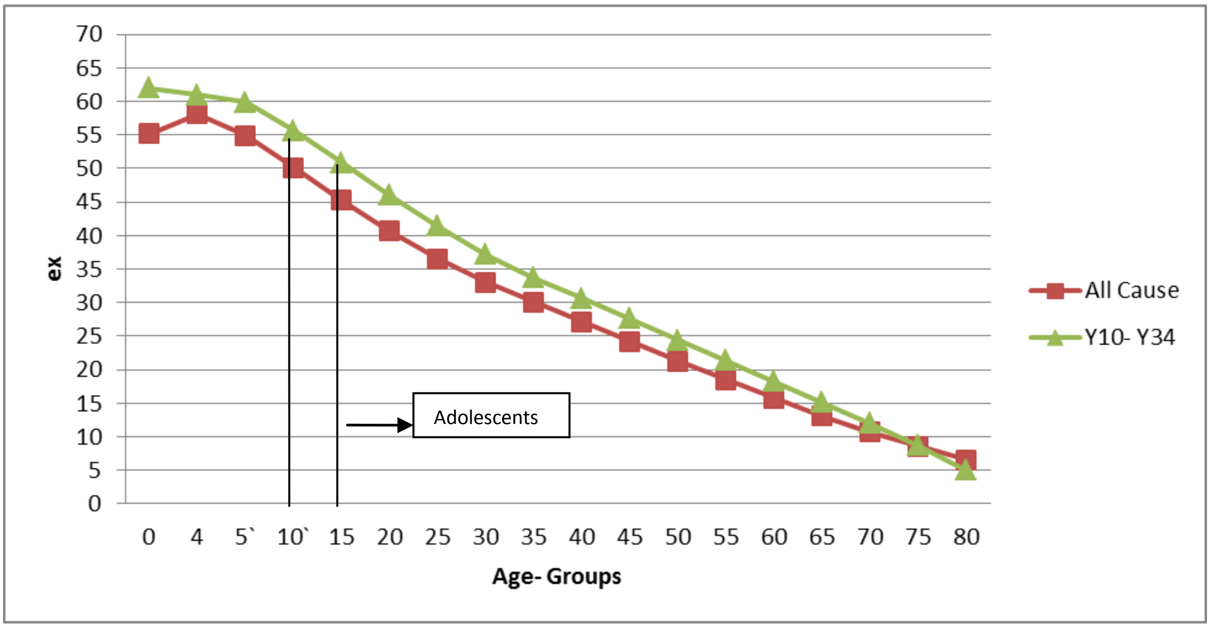

Figure 5.13 Male life expectancy from all causes of death (All Cause) and if 'events of undetermined intent' (Y10- Y34) were deleted, South Africa, 2001

Figure 5.11 shows male life expectancy by all causes of mortality and if the main cause of adolescent mortality in 2001 ('events of undetermined intent') were eliminated from the population. For adolescent males, 10- 14 years old, life expectancy from all causes was 50.1 years. For the same age-group, life expectancy in the absence of 'events of undetermined intent' was 55.6 years. This means that in the absence of this particular cause of death, young adolescent males could gain approximately 5.5 additional years of life. For older adolescent males (15- 19 years), life expectancy for all causes was 45.3 years and in the absence of this cause was 50.9 years. Here older adolescent males would gain an additional 5 years of life in the absence of 'events of undetermined intent'.

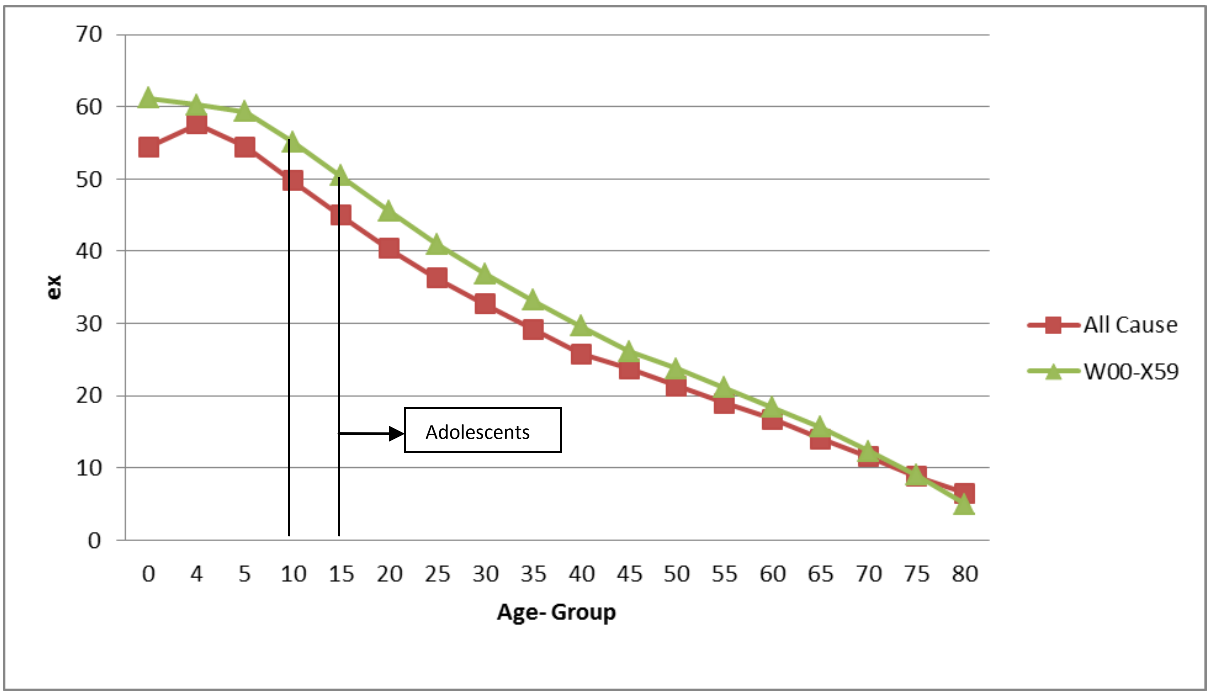

Figure 5.14 Male life expectancy from all causes of death (All Cause) and if 'other external causes of accidental injury' (W00-X59) were deleted, South Africa, 2007

The above graph shows the life expectancy from all causes and if 'other external causes of accidental injury' were eliminated from the population for the male population in 2007. For younger adolescent males, life expectancy from all causes of death was 49.8 years. The expected life expectancy should this cause be eliminated from the population for this age-group is 55.13 years. The potential gain in additional years of life is thus 5.35 years for males aged 10-14 years. For older adolescent males, life expectancy was 45 years from all causes and with the elimination of 'other external causes of accidental injury' life expectancy was 50.41 years. Thus the gain in life expectancy for these males is 5.43 additional years of life.

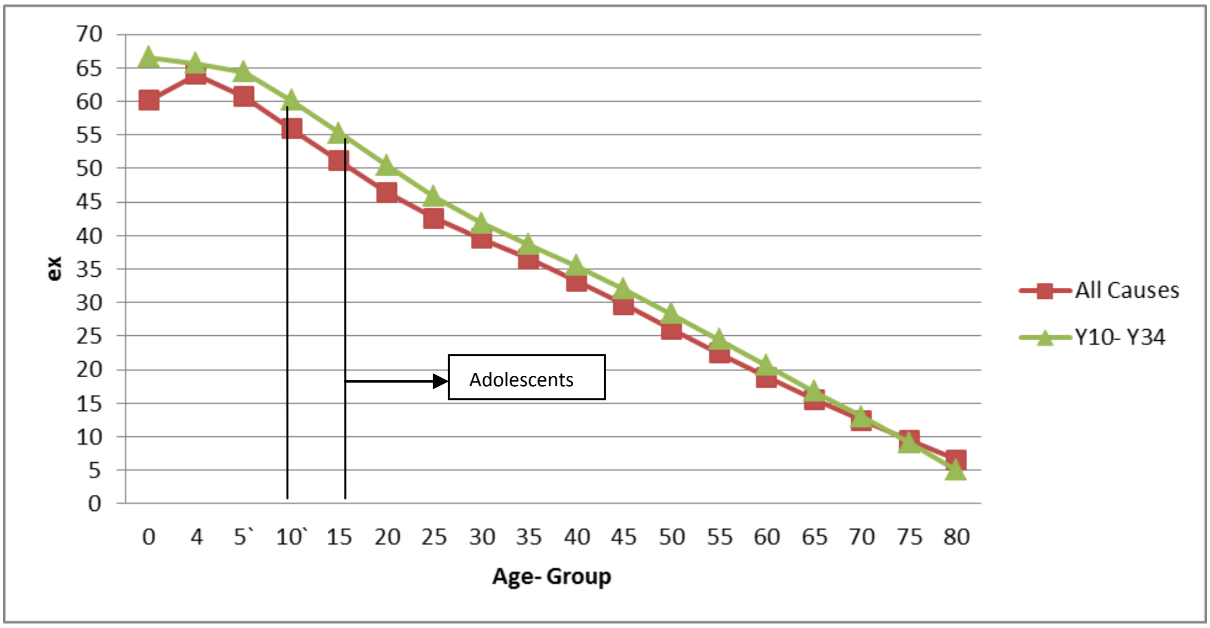

Figure 5.15 Female life expectancy from all causes of death (All Cause) and if 'events of undetermined intent' (Y10- Y34) were deleted, South Africa, 2001

Figure 5.13 shows the life expectancy of the female South African population with all causes of mortality and 'events of undetermined intent' deleted in 2001. For the female adolescent population if shows that at least 4 years of additional life can be gained in the absence of this cause of death among younger females (10-14 years old). This would put the expectancy of these female adolescents closer to 60 additional years of years, compared to the approximate 55 years with 'events of undetermined intent'. For older adolescent females, aged 15- 19 years old, life expectancy in the absence of this cause is increased to 50.45 years compared to the life expectancy of 46.5 years with all causes.

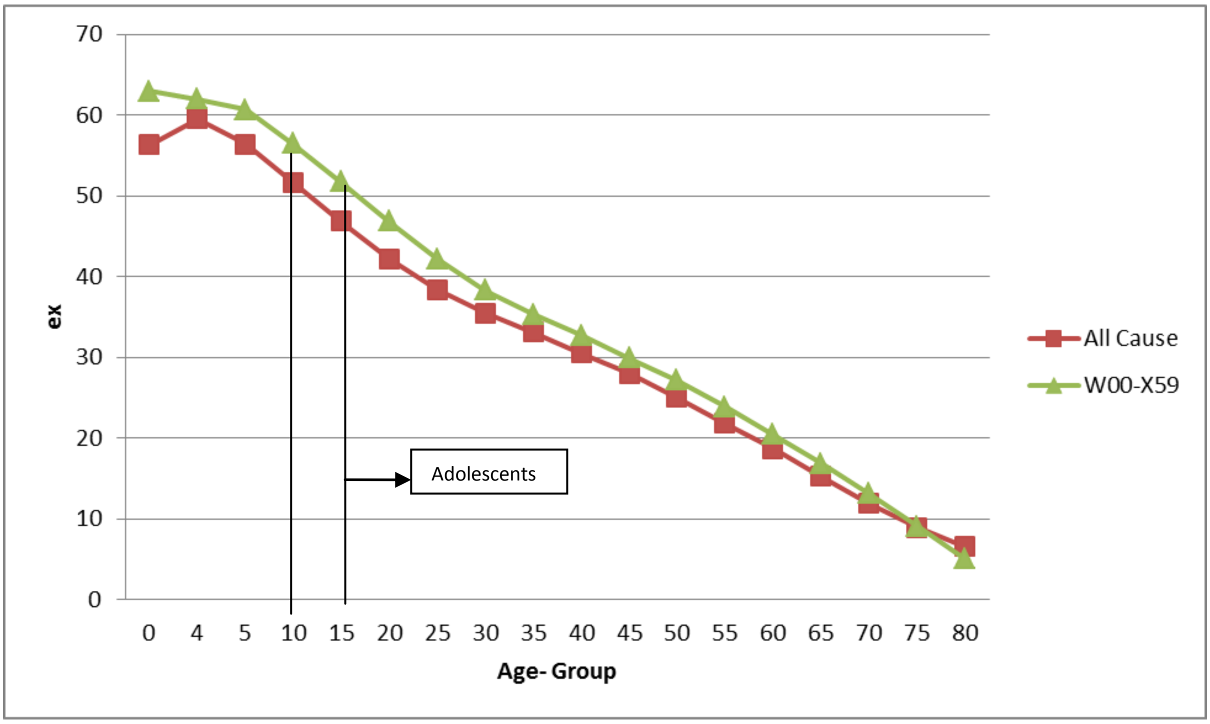

Figure 5.16 Female life expectancy from all causes of death (All Cause) and if 'other external causes of accidental injury' (W00-X59) were deleted, South Africa, 2007

Figure 5.14 shows the life expectancy from all causes and if 'other external causes of accidental injury' were eliminated from the population for the female population in 2007. For younger adolescent females, life expectancy from all causes of death was 51.7 years. The expected life expectancy should this cause be eliminated from the population for this age- group is 56.44 years. The potential gain in additional years of life is thus 5.3 years for females aged 10-14 years. For older (15-19 years old) adolescent females, life expectancy was 46.8 years from all causes and with the elimination of 'other external causes of accidental injury' life expectancy was 51.7 years. Thus the gain in life expectancy for these females is 5.1 additional years of life.

5.6 Median age at death for adolescents and Years of Potential Life Lost due to select causes of death

Table 5.6 Median age at death by broad underlying cause of death and sex, 2001 and 2007

Broad Underlying Cause of Death		Males		Females	
Description of diseases	**Code**	**2001**	**2007**	**2001**	**2007**
All causes		16	16	16	16
Intestinal infectious diseases	A00-A09	15	13	16	16
Tuberculosis	A15-A19	16	15	17	17
Inflammatory diseases of the central nervous system	G00-G09	15	15	15	16
Other forms of heart disease	I30- I52	16	16	16	17
Influenza and pneumonia	J10-J18	15	15	17	17
Ill-defined and unknown causes of mortality	R95-R99	15	15	16	16
Transport accidents	V01-V99	16	16	15	16
Other external causes of accidental injury	W00-X59	16	17	15	16
Assault	X85-Y09	17	18	16	18
Events of undetermined intent	Y10-Y34	16	17	16	16

The median age at death offers a summary measure of the age- distribution of deaths from specific underlying causes. Table 5.6 above shows the median age at death for adolescents by all causes of mortality, 10 specific leading underlying causes of death and all other causes of mortality, for males and females separately, 2001 and 2007. The table shows that for all-cause male and female mortality, the median age at death was 16 years old in 2001 and 2007. For deaths from 'ill- defined and unknown causes of mortality' the median age at death for adolescent males was 15 years old, for both years under review and an equally steady 16 years old for their female counterparts. For deaths from 'Tuberculosis' the table shows that the median age at death for adolescent males was 16 years old in 2001 and declined to 15 years old in 2007. This shows that victims of the disease are getting younger. For females dying from 'Tuberculosis', the median age at death was 17 years old in both years.

The table also shows that the median age for male adolescent deaths from 'assault' was 17 years in 2001 and increased to 18 years old in 2007. This shows that male victims of 'assault' as a cause of death are getting older. Similarly, adolescent female victims of 'assault' are also getting older, with 16 years old being the median age in 2001 and 18 years old, being the median age in 2007.

In addition the table shows that male adolescents at younger ages are more affected by 'intestinal infectious diseases' with median age in 2007 being 13 years old.

Table 5.7 Years of Potential Life Lost (YPLL) between the age- group 10-19 and 60 years old by broad underlying cause and sex, 2001 - 2007

Broad Underlying Cause of Death		YPLL 10- 19							
		(years)				(percentage)			
		Males		Females		Males		Females	
Description of diseases	**Code**	**2001**	**2007**	**2001**	**2007**	**2001**	**2007**	**2001**	**2007**
All causes		55,606	142,312	47,283	164,404	100	100	100	100
Intestinal infectious diseases	A00-A09	1,335	5,737	2,383	543	2.40	4.03	5.04	0.33
Tuberculosis	A15-A19	2,573	5,301	6,464	6,555	4.63	3.72	13.67	3.99
Inflammatory diseases of the central nervous system	G00-G09	1,220	1,706	1,214	3,136	2.19	1.20	2.57	1.91
Other forms of heart disease	I30- I52	1,071	1,062	1,416	1,243	1.93	0.75	2.99	0.76
Influenza and pneumonia	J10-J18	2,060	4,048	3,834	7,767	3.70	2.84	8.11	4.72
Ill-defined and unknown causes of mortality	R95-R99	3,520	11,716	5,294	4,305	6.33	8.23	11.20	2.62
Transport accidents	V01-V99	2,882	3,395	1,486	1,737	5.18	2.39	3.14	1.06
Other external causes of accidental injury	W00-X59	2,733	1,831	1,082	1,623	4.92	1.29	2.29	0.99
Assault	X85-Y09	3,754	2,786	475	4,435	6.75	1.96	1.00	2.70
Events of undetermined intent	Y10-Y34	22,468	11,982	22,108	4,653	40.41	8.42	46.76	2.83
All other causes		11,991	92,748	1,528	128,407	21.56	65.17	3.23	78.10

The index of Years of Potential Life Lost (YPLL) measures the incidence of 'premature' deaths that occurs in a population at ages at which a death may be regarded as untimely (Jain, 1992). It is here considered that deaths from age 10- 19 (adolescence) and before age 60 are considered untimely or 'premature'. The proportion of YPLL was highest for deaths due to 'events of undetermined intent' among males in 2001 at 40.41% and 8.42% in 2007. Similarly, for females the proportion of YPLL was highest for 'events of undetermined intent' at 46.76% in 2001. In 2007, deaths from 'influenza and pneumonia' presented the highest proportion of potential years of life lost at 4.72%.

For adolescent males, the percentage of YPLL for 'intestinal infectious diseases' and 'ill-defined and unknown causes' of death have increased from 2001 to 2007. However, for females, the percentage of YPLL for all of the above listed causes has declined in the period. This shows that there is an increase in the incidence of premature deaths, from selected causes, among males and a decline in premature deaths among adolescent females.

Table 5.8 (a): Percentage gain in expectation of life at birth 2001 and 2007, contributed by mortality changes in specific age and cause groups, South Africa, 2001

Broad underlying cause of death			Males			Females		
Description of the Code	Code	Age-Group	e^{-i}_x	No. of years gained	% gain in e_x	e^{-i}_x	No. of years gained	% gain in e_x
Tuberculosis	A15-A19	10-14	55.62	5.51	10.99	60.12	4.17	7.45
		15-19	50.85	5.56	12.29	55.31	4.21	8.24
Influenza and pneumonia	J10-J18	10-14	55.64	5.53	11.03	60.12	4.17	7.46
		15-19	50.87	5.58	12.33	55.31	4.21	8.24
Ill-defined and unknown causes of mortality	R95-R99	10-14	55.07	5.29	10.63	60.10	4.15	7.42
		15-19	50.53	5.37	11.94	55.29	4.19	8.21
Other external causes of accidental injury	W00-X59	10-14	55.68	5.56	11.09	60.13	4.19	7.49
		15-19	50.90	5.62	12.40	55.33	4.23	8.28
Events of undetermined intent	Y10-Y34	10-14	55.65	5.53	11.04	60.11	4.17	7.45
		15-19	50.87	5.59	12.34	55.31	4.21	8.24

Life Expectancy: Males: ***10- 14=*** ***50.12***; ***15- 19=*** ***45.28;*** **Females:** ***10- 14=*** ***55.94***; ***15- 19=*** ***51.10.***

Tables 5.12 (a) and (b) show the cause- deleted life expectancy (e^{-i}_x), number of years gained without selected broad- underlying causes of death and the percentage gain in life expectancy (e_x) for males and females in 2001 and 2007. To begin, in 2001, life expectancy for younger males was 50.12 years and older males, 45.28 years. For females, younger adolescents could expect an additional 55.94 years of life, while older female adolescents could expect an extra 51.10 years. The table shows that younger males in 2001, could benefit most from the eradication of 'other external causes of accidental injury' with 10- 14 year olds gaining as much as 5.56 additional years of life in the absence of this cause. For older adolescent males in 2001, the table shows that with the eradication of 'events of undetermined intent' 15- 19 year olds could gain as much 5.59 additional years of life, making their life expectancy at this age about 51 additional years of life.

For females, younger adolescents could gain 4.19 additional years of life with the eradication of 'other external causes of accidental injury'. Similarly, older adolescent females can gain the most years, 4.23 extra years, from the eradication of this cause. For all other causes, younger females can expect about a 7% gain in life expectancy, while older females can expect about an 8% increase.

Table 5.8 (b): Percentage gain in expectation of life at birth 2001 and 2007, contributed by mortality changes in specific age and cause groups, South Africa, 2007

Broad underlying cause of death			**Males**			**Females**		
Description of the Code	**Code**	**Age- Group**	e^{-i}_{x}	**No. of years gained**	**% gain in e_x**	e^{-i}_{x}	**No. of years gained**	**% gain in e_x**
Tuberculosis	A15- A19	10-14	55.08	5.3	10.64	56.41	4.76	9.2
		15-19	50.36	5.38	11.96	51.67	4.83	10.32
Influenza and pneumonia	J10- J18	10-14	55.11	5.33	10.7	56.42	4.76	9.22
		15-19	50.39	5.41	12.02	51.67	4.84	10.34
Ill-defined and unknown causes of mortality	R95- R99	10-14	55.07	5.29	10.63	56.39	4.74	9.16
		15-19	50.35	5.37	11.94	51.64	4.81	10.28
Other external causes of accidental injury	W00- X59	10-14	55.12	5.35	10.74	56.44	4.79	9.26
		15-19	50.41	5.43	12.07	51.7	4.86	10.39
Events of undetermined intent	Y10- Y34	10-14	55.13	5.35	10.74	56.44	4.79	9.26
		15-19	50.40	5.43	12.07	51.7	4.86	10.39

Life Expectancy: Males: *10- 14=49.8*; *15- 19=45* ; Females: *10- 14=51.7*; *15- 19= 46.*

In 2007, life expectancy for younger males was 49.8 years and older males, 45 years. For females, younger adolescents could expect an additional 51.7 years of life, while older female adolescents could expect an extra 46.8 years. For males, 5.35 additional years of life for younger adolescents could be gained with the eradication of ‘other external causes of accidental injury’ and ‘events of undetermined intent’ as broad- underlying causes of death. For older adolescent males, 15- 19 years old, the same is true, with these males gaining 5.43 additional years of life from the eradication of these two causes of death. A similar trend is seen with regards to adolescent females, both younger and older females could gain almost 5 additional years of life with the elimination of ‘other external causes of accidental injury’ and ‘events of undetermined intent’.

For other selected causes of the death, the table shows that younger females could gain an additional 9% on their life expectancy, while younger males could gain about 10% more. For older adolescents, it is seen that females could gain an additional 10% on their life expectancy while males could gain almost 12% extra.

Chapter 6

DETERMINANTS OF ADOLESCENT MORTALITY, 2001 – 2007

6.1 Introduction

Determinants of mortality offer appropriate insight into the explanation of mortality rates and differentials in any population. These generally differ by age, sex and a host of socioeconomic characteristics. Studies in South Africa have shown that determinants of child mortality include mother's education, sex, birth interval, type of dwelling and place of delivery (Buwembo, 2010). Key determinants shaping child health and mortality in South Africa have been identified as poverty, poor maternal education, racial and gender inequalities, undernutrition and HIV infection(Sanders et al., 2010). Studies have also noted that determinants of adult health and mortality in the country include unemployment, cultural practices, living and working conditions and HIV/AIDS (Hosegood et al., 2004b, Kahn et al., 2007, Bradshaw, 2008).

This chapter focuses on the individual determinants of adolescent mortality in South Africa in 2001 and 2007. Logistic regression analysis is used to produce odds ratios. The outcome remains adolescent mortality (dying during adolescent ages compared to dying at other ages) and the odds of adolescent mortality occurring at bivariate (Model I) and multivariate (Model II) levels are displayed along with p-values. In addition to all-causes of mortality, this chapter has also analysed the determinants of broadly grouped natural and unnatural causes of death as well as the most prevalent main immediate cause of death for both years under review. The variables used differ from those in the proposed theoretical framework (see Chapter 2) because of the data available on Death Notification Forms. Only characteristics of deceased that is collected on the forms are used in this chapter. In addition, given that little is known of the different determinants between the sexes, this chapter analyses both sexes and then the determinants of males and females separately for natural, unnatural and main immediate causes of death. This allows for in-depth and robust examination of the possible demographic and socioeconomic determinants associated with adolescent mortality in the country. Significant results are here discussed. Results are interpreted in relation to the Reference Categories.

6.2 Individual determinants of adolescent mortality

6.2.1 Determinants of all- causes of mortality

Table 6.1 : Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and all-cause adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

	2001				2007			
	Model I		Model II		Model I		Model II	
Characteristic	Odds Ratio	*p-value*	Odds Ratio	*p-value*	Odds Ratio	*p-value*	Odds Ratio	*p-value*
Sex								
Male*	1.00		1.00		1.00		1.00	
Female	0.95	*0.003*	0.86	*0.000*	0.89	*0.000*	0.75	*0.000*
Marital Status								
Single*	1.00				1.00		1.00	
Married	0.00	*0.024*	0.02	*0.000*	0.02	*0.000*	0.02	*0.000*
Widowed	0.01	*0.003*	0.00	*0.000*	0.012	*0.000*	0.013	*0.000*
Divorced	0.00	*0.001*		*(omitted)*	0.013	*0.000*	(omitted)	
Education								
None*	1.00		1.00		1.00		1.00	
Primary	0.32	*0.000*	2.37	*0.320*	0.35	*0.000*	0.62	*0.000*
Secondary	0.34	*0.000*	2.43	*0.054*	0.81	*0.000*	0.13	*0.000*
Tertiary	0.10	*0.730*	1.09	*0.531*	0.30	*0.000*	0.11	*0.000*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	1.23	*0.000*	0.95	*0.488*	1.37	*0.000*	0.68	*0.000*
Northern Cape	0.93	*0.359*	0.67	*0.000*	0.93	*0.303*	0.69	*0.002*
Free State	0.82	*0.000*	0.59	*0.000*	0.85	*0.001*	0.5	*0.000*
KwaZulu-Natal	1.15	*0.001*	0.72	*0.000*	1.34	*0.000*	0.51	*0.000*
North West	0.91	*0.080*	0.55	*0.000*	0.94	*0.200*	0.5	*0.000*
Gauteng	0.87	*0.001*	0.66	*0.000*	0.94	*0.172*	0.57	*0.000*
Mpumalanga	1.17	*0.004*	0.75	*0.000*	1.24	*0.000*	0.58	*0.000*
Limpopo	1.21	*0.000*	1.01	*0.868*	1.15	*0.004*	0.61	*0.000*
Outside South Africa	0.61	*0.193*	0.30	*0.232*	1.34	*0.123*	0.73	*0.241*

***denotes the Reference Category**

Table 6.1 shows the bivariate (Model I) and multivariate (Model II) logistic regression results displaying select individual characteristics and all- causes of death during adolescent ages in

2001 and 2007. Model I for 2001 shows that, with the exception of a few provinces of residence (Northern Cape, North West and Outside of South Africa) and tertiary education (p-value= 0.730), the predictor variables are each statistically significant (p-value<0.05). This model also shows that those who are married (0.00), divorced (0.00) or widowed (0.01) and those with an education, all have lower odds of mortality, than the reference categories. While females have almost even odds of dying with an odds ratio of 0.95.

Model II for 2001, did not exclude the statistically insignificant categories. When combining the predictor variables in this multivariate model, it is seen that females (0.86), who are married (0.02) and residing in provinces other than Limpopo, all have a lesser likelihood of dying. Level of education in this model produced increased odds of all- cause mortality, however, the findings are not statistically significant.

Model I for 2007 showed, similarly, the statistical significance of the predictor variables, again with the exception of a few South African provinces. This bivariate model shows that the odds of female mortality were lower than the almost even odds of 2001 at 0.89. Similar to the 2001 model results, this model also shows that not being single and some education (primary, secondary or tertiary) are all associated with decreased odds of adolescent mortality. Also similar to the 2001 model, it is seen that adolescents living in the Eastern Cape (1.37), KwaZulu Natal (1.34), Mpumalanga (1.24) and Limpopo (1.15) are all at higher odds of mortality than the Western Cape which was selected as the reference category.

For Model II, when combining the predictor variables in the multivariate model, it is seen that females (0.75), who are married (0.02) or widowed (0.013) and residing any of the nine provinces, all have a lesser likelihood of dying. In this model compared to its 2001 equivalent, level of education in this model produced decreased odds of all- cause mortality, and the findings are statistically significant, proving that education has a protective effect against all-causes of adolescent mortality, compared to adolescents who have no education.

6.2.1 Determinants of natural causes of mortality

Table 6.2 (a): Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and natural causes of adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

	2001				2007			
	Model I		Model II		Model I		Model II	
Characteristic	Odds Ratio	*p-value*	Odds Ratio	*p-value*	Odds Ratio	*p-value*	Odds Ratio	*p-value*
Sex								
Male*	1.00		1.00		1.00		1.00	
Female	4.53	*0.000*	4.85	*0.000*	1.50	*0.000*	1.61	*0.000*
Marital Status								
Single*	1.00		1.00		1.00		1.00	
Married	1.52	*0.013*	1.32	*0.328*	0.014	*0.000*	0.017	*0.000*
Widowed	0.11	*0.022*	0.65	*0.784*	0.006	*0.000*	0.005	*0.000*
Divorced	(omitted)		(omitted)		0.007	*0.000*	(omitted)	
Education								
None*	1.00		1.00		1.00		1.00	
Primary	0.30	*0.000*	0.28	*0.000*	0.01	*0.000*	0.097	*0.000*
Secondary	0.21	*0.000*	0.19	*0.000*	0.02	*0.000*	0.013	*0.000*
Tertiary	0.08	*0.000*	0.08	*0.000*	0.07	*0.000*	0.065	*0.000*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	2.76	*0.000*	2.46	*0.000*	1.82	*0.000*	0.98	*0.846*
Northern Cape	2.72	*0.000*	2.43	*0.000*	1.27	*0.027*	0.74	*0.070*
Free State	4.42	*0.000*	2.72	*0.000*	1.61	*0.000*	0.88	*0.336*
KwaZulu-Natal	4.09	*0.000*	2.81	*0.000*	2.45	*0.000*	0.92	*0.498*
North West	5.06	*0.000*	6.09	*0.000*	1.79	*0.000*	0.92	*0.518*
Gauteng	2.72	*0.000*	1.99	*0.000*	1.58	*0.000*	0.75	*0.026*

Mpumalanga	4.51	*0.000*	4.09	*0.000*	2.51	*0.000*	1.14	*0.290*
Limpopo	4.19	*0.000*	3.72	*0.000*	2.30	*0.000*	1.15	*0.270*

***denotes the Reference Category**

Table 6.2 (a) shows the bivariate (Model I) and multivariate (Model II) logistic regression results of select individual characteristics and natural causes of death during adolescent ages in 2001 and 2007. For 2001 Model I shows that, the predictor variables are each statistically significant (p-value<0.05). This model shows that females (4.53) and those who are married (1.52), have increased odds of mortality, compared to the reference categories. While adolescents with education, primary (0.30), secondary (0.21) or tertiary (0.08) have lesser odds of dying.

Model II for 2001, combines all the predictor variables into a single model. It is seen that females (4.85) who reside in any of the 9 provinces have a higher likelihood of dying from natural causes. Marital status (married and widowed) in this model produced increased odds of natural cause mortality, however, the findings are not statistically significant.

Model I for 2007 also showed the statistical significance of all the predictor variables. This bivariate model shows that the odds of female mortality are 1.50 times more than that of adolescent males. Contrary to the 2001 model results, this model also shows that having a marital status (that is, not being single) is all associated with decreased odds of adolescent mortality from natural causes of death. Similar to the 2001 model, it is seen that adolescents living in any of the 9 South African provinces all have higher odds of mortality from natural causes than the Western Cape which was selected as the reference category (odds ratio=1).

For Model II, when combining the predictor variables in the multivariate model, it is seen that females (1.61), who reside in Mpumalanga (1.14) or Limpopo (1.15) have higher odds of dying from natural causes of death. In this model again similar to 2001, level of education in produced decreased odds of natural cause mortality, and the findings are statistically significant, proving again that education has a protective effect against natural causes of adolescent mortality, compared to adolescents who have no education. Finally Model II showed that when incorporating other individual characteristics (predictors), being married (0.017) or widowed (0.05) and having any level of education is associated with lesser odds of mortality compared to single adolescents with no education with p-values of <0.05.

Table 6.2 (b): Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and natural causes of male adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

	2001				2007			
	Model I		Model II		Model I		Model II	
Characteristic	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***
Marital Status								
Single*	1.00		1.00		1.00		1.00	
Married	1.80	*0.015*	1.88	*0.108*	0.007	*0.000*	0.009	*0.000*
Widowed	4.81	*0.174*	(omitted)		0.003	*0.000*	*(omitted)*	
Divorced	(omitted)		(omitted)		0.008	*0.000*	*(omitted)*	
Education								
None*	1.00		1.00		1.00		1.00	
Primary	0.25	*0.000*	0.25	*0.000*	0.19	*0.000*	0.95	*0.000*
Secondary	0.14	*0.000*	0.15	*0.000*	0.17	*0.000*	0.12	*0.000*
Tertiary	0.08	*0.000*	0.09	*0.000*	0.04	*0.000*	0.05	*0.000*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	2.52	*0.000*	2.22	*0.000*	1.85	*0.000*	1.15	*0.444*
Northern Cape	2.44	*0.000*	2.46	*0.003*	1.29	*0.122*	0.84	*0.471*
Free State	3.33	*0.000*	2.15	*0.001*	1.39	*0.005*	0.88	*0.501*
KwaZulu-Natal	3.59	*0.000*	2.69	*0.000*	2.47	*0.000*	1.01	*0.942*
North West	5.12	*0.000*	6.28	*0.000*	1.32	*0.019*	0.70	*0.091*
Gauteng	2.64	*0.000*	2.24	*0.000*	1.55	*0.000*	0.70	*0.068*
Mpumalanga	4.12	*0.000*	4.02	*0.000*	2.25	*0.000*	1.24	*0.242*
Limpopo	4.05	*0.000*	4.18	*0.000*	2.60	*0.000*	1.66	*0.006*

***denotes the Reference Category**

Table 6.2 (b) shows the bivariate (Model I) and multivariate (Model II) logistic regression results showing select individual characteristics for male adolescents and natural causes of death during adolescent ages in 2001 and 2007. Model I (2001) shows that, the predictor variables are each statistically significant (p-value<0.05), with the exception of widowed males (p-value= 0.174).

This model shows that those who are married (1.80), have increased odds of mortality, compared to the reference category of single males. In addition, adolescent males with education, primary (0.25), secondary (0.14) or tertiary (0.08) have lesser odds of dying from natural causes. While there are increased odds in each of the 9 provinces of residence. In Model II for 2001, the combined model, it is seen that adolescent males with any of the education categories, again, have a lesser likelihood of dying from natural causes of death. Also, there are increased odds of dying in all 9 South African provinces, especially the North West province where the odds are 6.28 times higher than the reference group. Marital status in Model II is not statistically significant.

Model I for 2007 also shows the statistical significance of all the predictor variables, with the exception of the Northern Cape province (p-value= 0.122). This shows that the odds of male mortality, contrary to the 2001 model results, if they are not single is associated with decreased odds of adolescent mortality from natural causes of death. Similar to the 2001 model, it is seen that adolescents with any level of education (except having no education) or living in any of the 9 South African provinces all have lesser odds of dying from natural causes of death.

For Model II, when combining the predictor variables in the multivariate model, it is seen that province of residence is not statistically significant (p-value>0.05). In this model again similar to 2001, it shows that when incorporating other individual characteristics (predictors), being married (0.009) with any level of education (secondary or tertiary) is associated with lesser odds of mortality compared to single adolescents with p-values of less than 0.05. However, males with only a primary education (0.95) have almost even odds of dying from natural causes in 2007.

Table 6.2 (c): Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and natural causes of female adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

	2001				2007			
	Model I		Model II		Model I		Model II	
Characteristic	Odds Ratio	*p-value*	Odds Ratio	*p-value*	Odds Ratio	*p-value*	Odds Ratio	*p-value*
Marital Status								
Single*	1.00		1.00		1.00		1.00	
Married	1.07	*0.805*	0.92	*0.823*	0.022	*0.000*	0.025	*0.000*
Widowed	(omitted)		(omitted)		0.006	*0.000*	0.006	*0.000*
Education								
None*	1.00		1.00		1.00		1.00	
Primary	0.41	*0.000*	0.39	*0.000*	0.14	*0.000*	0.97	*0.000*
Secondary	0.31	*0.000*	0.30	*0.000*	0.26	*0.000*	0.14	*0.000*
Tertiary	0.07	*0.000*	0.10	*0.000*	0.11	*0.000*	0.82	*0.000*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	3.00	*0.000*	2.99	*0.000*	1.73	*0.000*	0.85	*0.339*
Northern Cape	2.66	*0.000*	2.52	*0.010*	1.23	*0.152*	0.66	*0.072*
Free State	4.79	*0.000*	3.61	*0.000*	1.71	*0.000*	0.86	*0.375*
KwaZulu-Natal	3.95	*0.000*	2.99	*0.000*	2.34	*0.000*	0.84	*0.282*
North West	3.79	*0.000*	5.97	*0.000*	2.07	*0.000*	1.02	*0.923*
Gauteng	2.27	*0.000*	1.75	*0.018*	1.58	*0.000*	0.78	*0.167*
Mpumalanga	3.86	*0.000*	4.25	*0.000*	2.60	*0.000*	1.05	*0.792*
Limpopo	3.38	*0.000*	3.20	*0.000*	2.00	*0.000*	0.86	*0.384*

***denotes the Reference Category**

Table 6.2 (c) shows the bivariate (Model I) and multivariate (Model II) logistic regression results showing select individual characteristics for female adolescents and natural causes of adolescent mortality in 2001 and 2007. Model I (2001) shows that, with the exception of marital status, the predictor variables are each statistically significant (p-value<0.05). This model also shows that females with an education, all have lower odds of mortality, than the reference categories. In addition, the table shows that province of residence is associated with increased odds of dying from natural causes in all 9 provinces.

For Model II (2001), which combines all the predictor variables into one multivariate model, it is seen that education level decreases the odds of adolescent females dying from natural causes. Females with primary education have 0.39 odds, secondary education produced odds of 0.31 and tertiary education, produced the least odds of 0.10 chance of dying. While province of residence shows increased odds for adolescent females living in any of the 9 provinces, with the highest being the North West province at 5.97 times higher odds than the Western Cape.

Model I for 2007 shows the statistical significance of the predictor variables, with the exception of the Northern Cape province. The first model shows that the odds of females dying from natural causes of death decline by marital status (not being single). Also education levels (primary, secondary or tertiary) are all associated with lesser odds of female adolescent mortality. Finally Model I shows, it is seen that adolescents living in the North West (2.07), KwaZulu Natal (2.34) and Mpumalanga (2.60) are all at higher odds of mortality than the Western Cape which was selected as the reference category.

For Model II, when combining the predictor variables in the multivariate model, it is seen that married (0.025) or widowed (0.006) females, with any level of education and who do not reside in Mpumalanga or the North West, have lesser odds of dying from natural causes of death. However, in comparison to the 2001 multivariate model, province of residence was not found to be statistically significant, the p-values are greater than 0.05.

6.2.2 Determinants of unnatural causes of mortality

Table 6.3 (a): Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and unnatural causes adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

	2001				2007			
	Model I		Model II		Model I		Model II	
Characteristic	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***
Sex								
Male*	1.00		1.00		1.00		1.00	
Female	0.22	*0.000*	0.21	*0.000*	0.35	*0.000*	0.37	*0.000*
Marital Status								
Single*	1.00		1.00		1.00		1.00	
Married	0.64	*0.008*	0.76	*0.329*	0.02	*0.000*	0.01	*0.000*
Widowed	0.09	*0.022*	1.54	*0.781*	(omitted)		(omitted)	
Education								
None*	1.00		1.00		1.00		1.00	
Primary	3.35	*0.000*	3.52	*0.000*	1.64	*0.000*	1.41	*0.000*
Secondary	4.68	*0.000*	5.26	*0.000*	1.28	*0.000*	1.51	*0.000*
Tertiary	1.27	*0.000*	1.20	*0.000*	1.95	*0.000*	1.28	*0.000*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	0.36	*0.000*	0.41	*0.000*	1.07	*0.218*	1.11	*0.389*
Northern Cape	0.37	*0.000*	0.41	*0.000*	0.79	*0.016*	1.02	*0.878*
Free State	0.23	*0.000*	0.37	*0.000*	0.50	*0.000*	0.62	*0.000*
KwaZulu-Natal	0.24	*0.000*	0.36	*0.000*	0.77	*0.000*	0.71	*0.002*
North West	0.20	*0.000*	0.16	*0.000*	0.58	*0.000*	0.56	*0.000*
Gauteng	0.37	*0.000*	0.50	*0.000*	0.67	*0.000*	0.90	*0.388*
Mpumalanga	0.22	*0.000*	0.24	*0.000*	0.60	*0.000*	0.53	*0.000*
Limpopo	0.24	*0.000*	0.27	*0.000*	0.58	*0.000*	0.72	*0.009*

***denotes the Reference Category**

Table 6.3 (a) shows the bivariate (Model I) and multivariate (Model II) logistic regression results showing select individual characteristics and unnatural causes of adolescent mortality for both sexes, in 2001 and 2007. Model I (2001) shows that, the predictor variables are each statistically significant (p-value<0.05). This model shows that females (0.22) and those who are married (0.64), have decreased odds of mortality, compared to the reference categories. While adolescents with education, primary (3.35), secondary (4.68) or tertiary (1.27) have increased odds of dying from unnatural causes of death.

Model II for 2001, combines all the predictor variables into a single model. It is seen that females (0.76) who reside in any of the 9 provinces have a lower likelihood of dying from unnatural causes. Being married shows lesser odds of experiencing unnatural causes of death, but, being widowed (1.54), according to this model, increases odds of unnatural cause mortality, however, the findings are not statistically significant.

Model I for 2007 also shows the statistical significance of all the predictor variables, with the exception of a few of the provinces. This bivariate model shows that the odds of female mortality from unnatural causes is lower than that of adolescent males. Similar to the 2001 model results, this model also shows that having a marital status (that is, not being single) is all associated with decreased odds of adolescent mortality from unnatural causes of death. In addition, it is seen that adolescents living in the Eastern Cape (1.07) province have almost even odds of mortality from unnatural causes similar to that of the Western Cape which was selected as the reference category (odds ratio=1). All other provinces are seen to be associated with lesser likelihood of dying from unnatural causes.

For Model II, when combining the predictor variables in the multivariate model, it is seen that females (0.37), who are married (0.01) and who reside in provinces other than the Eastern and Northern Cape, have lesser odds of dying from unnatural causes of death. In this model again similar to 2001, level of education produced increased odds of unnatural cause mortality, and the findings are statistically significant, proving that education does not have protective effect against unnatural causes of adolescent mortality.

Table 6.3 (b): Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and unnatural causes of male adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

	2001				2007			
	Model I		Model II		Model I		Model II	
Characteristic	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***
Marital Status								
Single*	1.00		1.00		1.00		1.00	
Married	0.56	*0.015*	0.53	*0.108*	0.012	*0.000*	0.010	*0.000*
Widowed	0.21	*0.174*	(omitted)					
Education								
None*	1.00		1.00		1.00		1.00	
Primary	3.98	*0.000*	3.97	*0.000*	1.37	*0.000*	1.35	*0.000*
Secondary	7.21	*0.000*	6.70	*0.000*	1.48	*0.000*	1.35	*0.000*
Tertiary	11.82	*0.000*	10.63	*0.000*	1.78	*0.000*	1.25	*0.000*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	0.40	*0.000*	0.45	*0.000*	1.15	*0.034*	1.29	*0.063*
Northern Cape	0.41	*0.000*	0.41	*0.003*	0.74	*0.010*	1.02	*0.909*
Free State	0.30	*0.000*	0.46	*0.001*	0.47	*0.000*	0.63	*0.002*
KwaZulu-Natal	0.28	*0.000*	0.37	*0.000*	0.77	*0.000*	0.72	*0.012*
North West	0.20	*0.000*	0.16	*0.000*	0.56	*0.000*	0.59	*0.001*
Gauteng	0.38	*0.000*	0.45	*0.000*	0.62	*0.000*	0.82	*0.162*
Mpumalanga	0.24	*0.000*	0.25	*0.000*	0.57	*0.000*	0.54	*0.000*
Limpopo	0.25	*0.000*	0.24	*0.000*	0.57	*0.000*	0.73	*0.030*

***denotes the Reference Category**

Table 6.3 (b) shows the bivariate (Model I) and multivariate (Model II) logistic regression results showing select individual characteristics for male adolescents and unnatural causes of mortality in 2001 and 2007. Model I (2001) shows that, the predictor variables are each statistically significant (p-value<0.05), with the exception of widowed males (p-value= 0.174).

This model shows that those who are married (0.56), have decreased odds of mortality, compared to the reference category of single males. In addition, adolescent males with education, primary (3.98), secondary (7.21) or tertiary (11.82) have higher odds of dying from unnatural causes. While there are decreased odds in each of the 9 provinces of residence.

In Model II for 2001, the combined model, it is seen that adolescent males with any of the education categories, again, have an increased likelihood of dying from unnatural causes of death. Also, there are decreased odds of dying in all 9 South African provinces, especially the North West province where the odds are 0.16.

Model I for 2007 also showed the statistical significance of all the predictor variables. This bivariate model shows that the odds of male mortality, similar to the 2001 model results, if they are married (0.012) is associated with decreased odds of adolescent mortality from unnatural causes of death. Also similar to the 2001 model, it is seen that adolescents with any level of education (except having no education) are more likely to die from unnatural causes of death. Whereas, adolescent males living in any of the 9 South African provinces, with the exception of the Eastern Cape (1.15) all have lesser odds of dying from unnatural causes of death.

For Model II, when combining the predictor variables in the multivariate model, it is seen that province of residence is not statistically significant (p-value>0.05) for the Eastern Cape (p-value=0.063), Northern Cape (p-value=0.909) and Gauteng (p-value=0.162) provinces. In this model again similar to 2001, it shows that when incorporating other individual characteristics (predictors), being married (0.010) is associated with lesser odds of mortality compared to single adolescents with p-values of <0.05. Also, males with any education, primary (1.35), secondary (1.35) or tertiary (1.25) have increased odds of dying from unnatural causes in 2007.

Table 6.3 (c): Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and unnatural causes of female adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

Characteristic	2001				2007			
	Model I		Model II		Model I		Model II	
	Odds Ratio	*p-value*	Odds Ratio	*p-value*	Odds Ratio	*p-value*	Odds Ratio	*p-value*
Marital Status								
Single*	1.00		1.00		1.00		1.00	
Married	0.88	*0.621*	1.09	*0.82*	0.030	*0.000*	0.025	*0.000*
Education								
None*	1.00		1.00		1.00		1.00	
Primary	2.43	*0.000*	2.59	*0.000*	1.99	*0.000*	1.57	*0.000*
Secondary	3.25	*0.000*	3.35	*0.000*	1.55	*00.00*	1.35	*0.000*
Tertiary	1.38	*0.000*	1.04	*0.000*	1.65	*0.000*	1.24	*0.000*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	0.33	*0.000*	0.33	*0.000*	1.13	*0.322*	0.76	*0.254*
Northern Cape	0.38	*0.000*	0.40	*0.010*	1.07	*0.72*	0.97	*0.926*
Free State	0.21	*0.000*	0.28	*0.000*	0.73	*0.033*	0.57	*0.028*
KwaZulu-Natal	0.25	*0.000*	0.33	*0.000*	0.99	*0.953*	0.66	*0.077*
North West	0.26	*0.000*	0.17	*0.000*	0.74	*0.057*	0.46	*0.006*
Gauteng	0.44	*0.000*	0.57	*0.019*	0.93	*0.567*	1.13	*0.612*
Mpumalanga	0.25	*0.000*	0.23	*0.000*	0.84	*0.248*	0.48	*0.004*
Limpopo	0.30	*0.000*	0.31	*0.000*	0.79	*0.107*	0.68	*0.125*

***denotes the Reference Category**

Table 6.3 (c) shows the bivariate (Model I) and multivariate (Model II) logistic regression results showing select individual characteristics for female adolescents and unnatural causes of adolescent mortality in 2001 and 2007. Model I (2001) shows that, with the exception of marital status, the predictor variables are each statistically significant (p-value<0.05). This model also shows that those females with an education, have higher odds of mortality, than the reference category.

For Model II (2001), which combines all the predictor variables into one multivariate model, marital status remains an insignificant predictor of unnatural causes of death among adolescent females. Further it is seen again, that education level increases the odds of dying from unnatural causes. Females with primary education are 2.59 times more likely to die from these causes, secondary education produced odds of 3.35 and tertiary education, produced almost even odds of 1.04. While province of residence shows almost even odds for adolescent females living in the Northern Cape (1.07), with the highest being the Eastern Cape province at 1.13 times higher odds than the Western Cape.

Model I for 2007 shows the statistical significance of the predictor variables. Province of residence shows that the Free State (p-value=0.033) is the only statistically significant province. This bivariate model shows that the odds of females dying from unnatural causes of death decline by marital status (that is, not being single). In addition, education levels (primary, secondary or tertiary) are all associated with increased odds of female adolescent mortality.

For Model II, when combining the predictor variables in the multivariate model, it is seen that the Free State (p-value=0.028), North West (p-value= 0.006) and Mpumalanga (p-value= 0.004) are the only statistically significant provinces. Adolescent females who are married (0.025) and who reside in the Free State (0.57), the North West (0.46) or Limpopo (0.68), have lesser odds of dying from unnatural causes of death.

6.2.3 Determinants of immediate causes of death

Table 6.4 (a): Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and main immediate cause of death of male adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

	2001 - Y34				2007 - Y34			
	Model I		Model II		Model I		Model II	
Characteristic	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***
Marital Status								
Single*	1.00		1.00		1.00		1.00	
Married	0.58	*0.153*	0.72	*0.546*	0.89	*0.826*	1.03	*0.963*
Widowed	1.51	*0.723*	(omitted)		(omitted)		(omitted)	
Divorced	(omitted)		(omitted)		(omitted)		(omitted)	
Education								
None*	1.00		1.00		1.00		1.00	
Primary	0.23	*0.000*	0.23	*0.000*	1.55	*0.985*	5.42	*0.979*
Secondary	0.36	*0.000*	0.03	*0.000*	2.23	*0.985*	3.89	*0.979*
Tertiary	0.05	*0.000*	0.005	*0.000*	2.72	*0.984*	1.41	*0.978*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	0.48	*0.000*	0.62	*0.021*	0.17	*0.000*	0.36	*0.012*
Northern Cape	0.45	*0.006*	0.42	*0.020*	0.16	*0.000*	0.30	*0.073*
Free State	0.82	*0.255*	1.12	*0.624*	0.35	*0.000*	0.89	*0.770*
KwaZulu-Natal	0.57	*0.000*	0.73	*0.091*	0.31	*0.000*	0.91	*0.796*
North West	0.59	*0.005*	0.62	*0.121*	0.08	*0.000*	0.18	*0.010*
Gauteng	1.46	*0.003*	1.73	*0.005*	0.65	*0.004*	2.27	*0.020*
Mpumalanga	0.93	*0.657*	1.15	*0.549*	1.09	*0.596*	3.07	*0.002*
Limpopo	0.29	*0.000*	0.35	*0.000*	0.16	*0.000*	0.42	*0.041*

***denotes the Reference Category**

Table 6.4 (a) shows the bivariate (Model I) and multivariate (Model II) logistic regression results showing select individual characteristics for male adolescents and the main immediate causes of death during adolescent ages in 2001 and 2007. In 2001 and 2007, frequency distributions show that the most prevalent main immediate cause of death was 'events of undetermined intent' (Y34).

Model I (2001) shows that the predictor variables are each statistically significant (p-value<0.05), with the exception of marital status.

This model shows that those who are married (0.56), have decreased odds of mortality, compared to the reference category of single males. In addition, adolescent males with education, primary (0.23), secondary (0.36) or tertiary (0.05) have decreased odds of dying from 'events of undetermined intent'. Further this model shows that there are decreased odds of dying from this cause for adolescent males in each of the 9 provinces of residence, with the exception of Gauteng (1.46) where the odds are higher than the reference category (Western Cape).

In Model II for 2001, the combined model, it is seen that adolescent males with any of the education categories, again, have a decreased likelihood of dying from 'events of undetermined intent', and these odds decline even further as level of education increases. Finally, there are decreased odds of dying in all South African provinces, with the exception of the Free State (1.12), Gauteng (1.73) and Mpumalanga (1.15).

Model I for 2007 also showed the statistical significance of all the predictor variables. In this model it is seen that only province of residence is statistically significant, with the notable exception of Mpumalanga (p-value=0.569). This bivariate model shows that adolescent males living in any of the 9 South African provinces, with the exception of Mpumalanga (1.09) all have lower odds of dying from 'events of undetermined intent'.

For Model II, when combining the predictor variables in the multivariate model, it is seen that province of residence is statistically significant (p-value<0.05) for the Eastern Cape (p-value=0.012), North West (p-value=0.010), Gauteng (p-value=0.020), Mpumalanga (p-value= 0.002) and Limpopo (p-value=0.041) provinces. Within these provinces the odds of male adolescents dying from 'events of undetermined intent' are lower in the Eastern Cape (0.36), North West (0.18) and Limpopo (0.42). However the odds of dying from this cause are higher in Gauteng (2.27) and Mpumalanga (3.07).

Table 6.4 (b): Bivariate (Model I) and multivariate (Model II) logistic regression showing individual predictor variables and main immediate cause of death of female adolescent mortality, producing odds ratios, 2001 and 2007, South Africa

	2001 – Y34				2007 - R99			
	Model I		Model II		Model I		Model II	
Characteristic	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***	**Odds Ratio**	***p-value***
Marital Status								
Single*	1.00		1.00		1.00		1.00	
Married	1.53	*0.168*	1.59	*0.229*	1.57	*0.191*	2.00	*0.161*
Widowed	0.89	*0.909*	(omitted)		(omitted)		(omitted)	
Education								
None*	1.00		1.00		1.00		1.00	
Primary	0.62	*0.005*	0.53	*0.001*	0.30	*0.28*	0.29	*0.303*
Secondary	0.56	*0.001*	0.48	*0.000*	0.27	*0.328*	0.25	*0.367*
Tertiary	0.37	*0.018*	0.42	*0.259*	0.26	*0.307*	0.30	*0.286*
Province of residence								
Western Cape*	1.00		1.00		1.00		1.00	
Eastern Cape	2.12	*0.025*	1.78	*0.252*	1.32	*0.319*	0.73	*0.476*
Northern Cape	2.25	*0.074*	2.04	*0.260*	1.06	*0.9*	0.53	*0.336*
Free State	5.47	*0.000*	4.27	*0.003*	1.08	*0.793*	0.54	*0.178*
KwaZulu-Natal	2.47	*0.005*	2.31	*0.080*	1.31	*0.317*	0.63	*0.282*
North West	4.52	*0.000*	4.10	*0.005*	1.38	*0.281*	1.00	*0.995*
Gauteng	2.40	*0.009*	2.47	*0.065*	1.86	*0.023*	0.81	*0.635*
Mpumalanga	4.03	*0.000*	3.59	*0.010*	0.67	*0.196*	0.35	*0.026*
Limpopo	2.49	*0.009*	2.74	*0.044*	2.01	*0.013*	0.76	*0.541*

***denotes the Reference Category**

Table 6.4 (b) shows the bivariate (Model I) and multivariate (Model II) logistic regression results showing select individual characteristics for female adolescents and the main immediate causes of death during adolescent ages in 2001 and 2007. In 2001, frequency distributions show that the most prevalent main immediate cause of death was ‘events of undetermined intent’ (Y34).

In 2007, the most cited main immediate cause of death for adolescent females was 'ill- defined and unknown causes of mortality' (R99).

Model I (2001) shows that the education level and most provinces are statistically significant (p-value<0.05). This model shows that adolescent females with education, primary (0.62), secondary (0.56) or tertiary (0.37) have decreased odds of dying from 'events of undetermined intent'. Further this model shows that there are increased odds of dying from this cause for adolescent females in each of the 9 provinces of residence, compared to the reference category (Western Cape).

In Model II for 2001, the combined model, it is seen that adolescent females with any of the education categories, again, have a decreased likelihood of dying from 'events of undetermined intent', and these odds decline even further as level of education increases. Finally, there are increased odds of dying in all South African provinces, especially the Free State (4.27), North West (4.10) and Mpumalanga (3.59).

Model I and Model II for 2007 shows that none of the predictor variables are statistically significant and cannot predict a relationship between female adolescent characteristics and the odds that they will die from 'ill-defined or unknown causes of death'.

Chapter 7

CONTEXTUAL DETERMINANTS OF ADOLESCENT MORTALITY IN SOUTH AFRICA, 2001

7.1 Introduction:

Census data are inherently multilevel data. Individuals are nested within households and households are grouped into various districts. This is the basic study design of a Census. For this reason, Census data are suited for multilevel analysis. For this study, two levels of predictor variables are used. A two- level multilevel logistic regression model is applied. At level 1 household responses are adopted since individuals are enumerated within these households. Both individual and household characteristics are considered as level 1 individual (single unit) variables. The reason for this is because deceased adolescents could be located within the households they lived. Certain details, as per the report of the household head, could be used to obtain general household variables such as assets, income and province of residence. The second level used is that of communities (cluster units). As outlined in the methodology, community variables are at the level of District Councils which are not as large as provinces and not as small as local councils. This level was selected since there would be both urban and rural areas within District Councils. At the lower, smaller levels of local councils and enumeration areas, this variation does not exist. That is, local councils and enumeration areas are sub-divided as either rural or urban areas.

The Community Survey of 2007 did not collect data on rural and urban areas. Nor did the survey allow for the sampling of households by district level. For these reasons, the Community Survey was not been selected for multilevel modeling of adolescent mortality outcomes. Using the Census data from 2001 alone, this chapter models *all- cause* mortality, *unnatural causes* of mortality and *natural causes* of adolescent mortality. Household respondents who reported that a member had died from an accident (a response of 'yes') were classified as unnatural causes of death. While those who reported their household member had not died from an accident (a response of 'no') were classified as a natural cause of death.

For Model I, the empty model there are no variables however the variance is partitioned into two components. In Model II only the predictor variables are tested with the binary outcome of adolescent mortality (yes/no). Model III only tests the level- 2 determinants of place of residence – urban or rural, proportion of poverty and proportion of ethnic diversity. The final model (Model IV) incorporates both the household predictor variables and the 'community' variables in a single test.

Table 7.1 Percentage distribution of adolescent deaths by household and community characteristics, South Africa, 2001

Household/Individual	P-value	All-cause (%)	Natural (%)	Unnatural (%)
Assets				
Low		55.51	36.14	26.49
Middle	0.001	32.23	31.17	34.33
High		12.26	32.70	39.18
Income				
Low		64.17	71.89	78.19
Average	0.001	32.38	25.62	19.76
High		3.45	2.49	2.04
Number of people living in residence				
Less than or 5	0.001	61.06	58.13	55.79
More than 6		38.94	41.87	44.21
Tenure				
Own		70.43	64.44	61.84
Rent	0.001	14.17	13.19	10.48
Occupy, rent-free		15.40	22.37	27.68
Province of Residence				
Eastern Cape		15.22	22.75	18.31
Free State		12.52	5.54	5.88
Gauteng		8.88	16.06	12.52
KwaZulu Natal		13.94	23.52	31.26
Mpumalanga	0.001	14.24	5.74	10.31
North West		12.03	5.74	7.92
Northern Cape		8.66	1.34	1.70
Limpopo		5.66	7.27	8.43
Western Cape		8.85	12.05	3.66
Community Variables				
Type of place of residence				
Urban		75.45	48.76	42.67
Rural	0.001	24.55	51.24	57.33
Poverty				
Low		64.71	15.49	12.18
Medium		32.38	31.36	37.65
High	0.001	3.45	53.15	50.17
Ethnic Diversity				
Low		79.25	11.28	11.67
Medium	0.001	7.5	25.62	31.43
High		13.25	63.10	56.90

Table 7.1 shows the percentage distribution of adolescent deaths (all- causes, natural and unnatural causes) by household and community characteristics. For all-cause mortality, 55.51% of adolescent deaths occurred in households with low assets. Further, 64.17% of adolescent deaths occurred in low income income and 61.06% adolescent deaths were in households that have less than 5 residents. By province of residence, 15.22% of adolescent deaths occurred in the Eastern Cape and 13.94% deaths were in the KwaZulu Natal province. By community, 75.45% of adolescent deaths happened in urban dwellings, 64.17% of adolescent deaths were in communities with a low level of poverty and finally 79.25% of deaths were in low ethnic diversity communities.

For natural causes, adolescent mortality occurred mostly in households with low or few assets (36.14%), low income (71.89%), less than or 5 household residents (58.13%) and are home-owners (64.44%). In addition, a higher percentage of adolescent deaths are recorded in the KwaZulu Natal (23.52%) and Eastern Cape (22.75%) provinces. For community characteristics, 51.24% of adolescent deaths happened rural areas, communities with high poverty (53.15%) and high ethnic diversity (63.10%).

For unnatural causes, most adolescent deaths occurred in households with a high number of household assets (39.18%), low income (78.19%), less than or 5 household residents (55.79%) and own their own houses (61.84%). By province, most adolescent deaths were in households in the KwaZulu Natal province (31.26%). By community, 57.33% of adolescent mortality were in households are in rural areas and 50.17% deaths occurred in communities with a high proportion of community poverty. Finally, 56.09% of adolescent deaths were in communities of high ethnic diversity.

7.2 Contextual determinants of all-causes of adolescent mortality

Table 7.2 Multilevel logistic regression odds ratio of the effects of individual and community factors on Adolescent all-cause mortality, South Africa, 2001

Characteristics	*Model I Empty model*	*Model II Individual*	*Model III Community*	*Model IV Individual & community*
		OR	**OR**	**OR**
Fixed effects				
Household characteristics				
Assets				
Low		1.00		1.00
Middle		1.31*		1.17
High		1.13*	-	1.27
Income				
Low		1.00		1.00
Average		1.09*	-	0.91*
High		0.87*		0.61*
Number of people living in residence				
Less than or 5		1.00	-	1.00
More than 6		1.17*		1.17*
Tenure				
Owned		1.00		1.00
Rent		0.98		1.13*
Occupy, rent- free		1.06		1.007*
Province of Residence				
Eastern Cape		1.00	-	1.00
Free State		0.94		1.01*
Gauteng		0.77		0.78
KwaZulu-Natal		0.72		0.75*
Mpumalanga		0.98		1.04*
North West		0.73		0.76
Northern Cape		0.95		0.97
Limpopo		1.11		1.17
Western Cape		0.83		0.87

Type of place of residence Urban Rural			1.00 1.18*	1.00 1.11*
Poverty Low Medium High			1.00 0.96* 0.93*	1.00 0.97* 0.63*
Ethnic Diversity Low Medium High			1.00 1.07* 1.15*	1.00 1.05* 1.11*
Random effects parameters	***Empty***	***Individual***	***Community***	***Individual/ Community***
Community level Variance (SE) VPC=ICC (%) PCV (%)	 10.921* (2.905) 70 Reference	 1.697* (1.042) 50.1 63.2	 2.541* (0.766) 43.9 52.9	 2.048* (0.992) 38.7 81.6
Log-likelihood	**-7265.0026**	**-5406.1027**	**-6983.7326**	**-5545.3864**
Model fit statistics ***AIC*** ***BIC***	 15,215.5 15,339.0	 16,316.0 16,339.2	 13,336.6 13,581.4	 13,650.2 13,795.6

Note: SE refers to the *Standard Error*, VPC refers to the *Variance Partition Coefficient*, PCV refers to the *Proportional Change in Variance*, AIC refers to the *Akaike Information Criterion*, BIC refers to the *Bayesian Information Criterion;* * denotes *p<0.05*

Results in Table 7.2 (Model I) showed significant variation in the likelihood of occurrences of adolescent mortality across communities (τ = 10.921, *p* = 0.001). As shown by the variance partition coefficient, the intra-community correlation coefficient was estimated at 70%.

Model II shows the results of the effects of the individual level variables. Household assets is significantly associated with adolescent mortality. The table shows that adolescent mortality is more likely to occur in households with an average or middle number of assets compared to households with low or no assets. Households where income is high have lesser odds of experiencing adolescent mortality than poor households. In addition, if there are more than or 6 people living in a single residence the odds of adolescent mortality increase to 1.17 times more than residences with fewer than or 5 people. Province of residence was not statistically significant.

In comparison to the empty model, the variation in occurrences of adolescent mortality was significant across communities ($\tau = 1.697$; $p<0.05$). The intra-community correlation was 50.1% indicating that the clustering of the outcome variable across communities was as a result of the composition of the communities by household level characteristics.

Model III shows the results of the effects of community variables. All the community variables are positively and significantly associated with all- cause adolescent mortality. The likelihood of experiences of all- cause adolescent mortality increases in rural areas (1.18) compared to urban areas. Community poverty is significantly associated with all- cause adolescent mortality. Living in communities with high proportion of poor households is associated with higher odds of adolescent mortality. Results further showed communities with a high proportion of ethnic diversity are 1.15 times more likely to experience adolescent mortality than areas of low ethnic diversity. Compared to model II the variation in adolescent mortality across communities remained significant ($\tau = 2.541$, $p = 0.05$). The intra-community correlation was 43.9%, indicating that the clustering of adolescent mortality between communities was as a result of the composition of the communities by community characteristics.

The final model (model IV) contains both the individual/household and community variables. Results show that the inclusion of community variables had independent effects on adolescent mortality as well as moderating effects on the association between household factors and adolescent mortality. For example, assets are no longer statistically significant, now that community variables have been added.

The results of this model show high income households have the lowest odds of experiencing all- cause adolescent mortality at 0.61. In addition, household with more than or 6 resident members are still more likely to experience adolescent mortality compared to households with 5 residents or fewer. In addition, tenure shows that households which are not owned (rent or occupied for free) have higher odds of experiencing adolescent mortality. Province of residence shows some statistical significance compared to Model II. Here it is seen, that the odds of all-cause adolescent mortality is almost even in the Free State and Mpumalanga provinces.

Further, the results showed that living in rural communities with high proportion of ethnic diversity is associated with higher likelihood of all- cause adolescent mortality in South Africa in 2001. However living in communities with a low proportion of poverty (as measured by household income in communities) is associated with decreased odds of adolescent mortality.

Comparatively the variance at the community level in model IV remained significant ($\tau = 2.149$; $p<0.05$). The intra-community correlation decreased to 38.7% indicating that the inclusion of community variables was important for obtaining a better explanatory model. The clustering of the likelihood of adolescent mortality at the community level is as a result of the composition of the communities by community characteristics. Further, it also indicates that part of the clustering between communities was due to the composition of communities by individual characteristics.

7.3 Contextual determinants of unnatural causes of adolescent mortality

Table 7.3 Multilevel logistic regression odds ratio of the effects of individual and community factors on Adolescent mortality from unnatural causes of death, South Africa 2001

Characteristics	*Model I Empty model*	*Model II Individual*	*Model III Community*	*Model IV Individual & community*
		OR	OR	OR
Fixed effects				
Household characteristics				
Assets				
Low		1.00		1.00
Middle		1.06		1.02
High		1.01	-	0.91
Income				
Low		1.00		1.00
Average		1.13*	-	1.12*
High		1.06*		1.03*
Number of people living in residence				
Less than or 5		1.00	-	1.00
More than 6		1.17*		1.16*
Tenure				
Owned		1.00		1.00
Rent		1.24*		1.31*
Occupy, rent- free		1.13*		1.17*
Province of Residence				
Eastern Cape		1.00	-	1.00
Free State		0.92		0.69*
Gauteng		0.58		0.97
KwaZulu-Natal		0.85		0.72
Mpumalanga		0.70		0.91*
North West		0.62		0.63*
Northern Cape		0.49		0.54
Limpopo		0.52		0.59
Western Cape		0.69		0.78*
Type of place of residence				
Urban			1.00	1.00
Rural			0.97*	1.54*
Poverty				
Low			1.00	1.00
Medium			0.56*	0.79*
High			0.52*	0.85*

Ethnic Diversity				
Low			1.00	1.00
Medium			1.25*	1.02*
High			1.86*	1.21*
Random effects parameters	***Empty***	***Individual***	***Community***	***Individual/ Community***
Community level				
Variance (SE)	11.526*	2.743*	2.422*	2.069*
VPC=ICC (%)	(3.821)	(1.102)	(0.824)	(0.542)
PCV (%)	77	39.4	38.6	30.5
	Reference	70.2	60.9	81.6
Log-likelihood	**-7266.0036**	**-7907.2167**	**-8601.8436**	**-7747.3054**
Model fit statistics				
AIC	15,416.0	12,650.2	14,215.5	12,886.6
BIC	15,439.2	12,795.6	14,338.0	12,692.4

Note: SE refers to the *Standard Error*, VPC refers to the *Variance Partition Coefficient*, PCV refers to the *Proportional Change in Variance*, AIC refers to the *Akaike Information Criterion*, BIC refers to the *Bayesian Information Criterion;* * denotes $p<0.05$

Results in Table 7.3 (Model I) shows significant variation in the likelihood of occurrences of adolescent mortality due to unnatural causes of death across communities ($\tau = 11.526$, $p = 0.05$). As shown by the variance partition coefficient, the intra-community correlation coefficient was estimated at 77%.

Model II showed the results of the effects of the individual level variables. Household income, number of people living in the residence and tenure are significantly associated with unnatural cause adolescent mortality. The table shows that adolescent mortality is more likely to occur in households with average income at 1.13 times more likely than low income homes. The model also shows that households with high income have almost even odds of adolescent mortality from unnatural causes of death occurring. In addition, if there are more than or 6 people living in a single residence the odds of adolescent mortality increase to 1.17 times more than residences with fewer than or 5 people. If occupants are renting (1.24) or residing for free (1.13) the odds of adolescent mortality occurring from unnatural causes of death increases.

In comparison to the empty model, the variation in occurrences of unnatural cause adolescent mortality was significant across communities (τ = 2.743; $p<0.05$). The intra-community correlation was 39.4% indicating that the clustering of the outcome variable across communities was as a result of the composition of the communities by individual level characteristics.

Model III shows that all the community variables are positively and significantly associated with unnatural- cause adolescent mortality. The likelihood of experiences of these causes of adolescent mortality is almost even in rural areas (0.97). Community poverty is significantly associated with unnatural- cause adolescent mortality. Living in communities with high proportion poor households is associated with higher odds of adolescent mortality. Results further showed communities with a high proportion of ethnic diversity are 1.86 times more likely to experience adolescent mortality than areas of low ethnic diversity. Compared to model 2 the variation in adolescent mortality across communities remained significant (τ = 2.422, p = 0.05). The intra-community correlation was 38.6 %.

The final model (model IV) contained both the household and community variables. In this model household assets have remained statistically insignificant. However, certain provinces of residence are now statistically significant. To begin, the results of this model show high income households have the lowest odds of experiencing this type of adolescent mortality at 1.03 which is almost even odds. In addition, household with more than or 6 resident members (1.16) are still more likely to experience adolescent mortality compared to households with 5 residents or fewer. In addition, tenure shows that households which are not owned (rent or occupied for free) have higher odds of experiencing adolescent mortality from unnatural causes of death compared to home owners. Province of residence shows some statistical significance compared to Model II.

Further, the results showed that living in rural communities with high proportion of ethnic diversity is associated with higher likelihood of unnatural- cause adolescent mortality. However living in communities with a low proportion of poverty (as measured by household income in communities) is associated with decreased odds of adolescent mortality. Finally, again it is seen that areas with high ethnic diversity (1.21) are more likely to experience unnatural adolescent mortality.

Comparatively the variance at the community level in model IV remained significant ($\tau = 2.069$; $p<0.05$). The intra-community correlation decreased to 30.5% indicating that the inclusion of community variables was important for obtaining a better explanatory model. The clustering of the likelihood of adolescent mortality at the community level is as a result of the composition of the communities by community characteristics. Again, this indicates that part of the clustering between communities was due to the composition of communities by individual characteristics.

7.4 Contextual determinants of natural causes of adolescent mortality

Table 7.4 Multilevel logistic regression odds ratio of the effects of individual and community factors on Adolescent mortality from natural causes of death, South Africa

Characteristics	*Model I Empty model*	*Model II Individual*	*Model III Community*	*Model IV Individual & community*
		OR	**OR**	**OR**
Fixed effects				
Household characteristics				
Assets				
Low		1.00		1.00
Middle		1.27		1.27
High		1.47	-	1.49
Income				
Low		1.00		1.00
Average		0.60*	-	0.64*
High		0.22*		0.22*
Number of people living in residence				
Less than or 5		1.00	-	1.00
More than 6		1.20*		1.17*
Tenure				
Owned		1.00		1.00
Rent		1.01		1.02*
Occupy, rent- free		1.23		1.05*
Province of Residence				
Eastern Cape		1.00	-	1.00
Free State		0.86*		0.75
Gauteng		1.05*		1.02*
KwaZulu-Natal		1.02*		1.20*
Mpumalanga		0.87*		1.36
North West		1.05*		0.82*
Northern Cape		1.23*		0.90*
Limpopo		1.50*		0.91
Western Cape		0.94*		0.72
Type of place of residence				
Urban			1.00	1.00
Rural			1.27*	1.03*
Poverty				
Low			1.00	1.00
Medium			1.23*	1.25*
High			1.21*	1.38*

Ethnic Diversity Low Medium High			1.00 0.99* 0.94*	1.00 0.88* 0.75*
Random effects parameters	***Empty***	***Individual***	***Community***	***Individual/ Community***
Community level Variance (SE) VPC=ICC (%) PCV (%)	 14.693* (2.712) 75 Reference	 4.842* (1.036) 52.1 72.3	 2.601* (0.849) 40.4 69.7	 2.052* (0.551) 35.6 60.8
Log-likelihood	**-5118.2501**	**-6912.5976**	**-5917.3276**	**-6306.9523**
Model fit statistics ***AIC*** ***BIC***	 17,421.1 17,494.3	 14,761.3 14,806.7	 16,326.6 16,441.1	 14,742.8 14,693.5

Note: SE refers to the *Standard Error*, VPC refers to the *Variance Partition Coefficient*, PCV refers to the *Proportional Change in Variance*, AIC refers to the *Akaike Information Criterion*, BIC refers to the *Bayesian Information Criterion;* * denotes $p<0.05$

Results in Table 7.4 (Model I) showed significant variation in the likelihood of occurrences of adolescent mortality from natural causes across communities (τ = 14.693, p = 0.05). As shown by the variance partition coefficient, the intra-community correlation coefficient was estimated at 75%.

Model II showed the results of the effects of the household level variables. Household assets and tenure are not significantly associated with adolescent mortality. The table shows households where income is high have lesser odds of experiencing adolescent mortality than poor households with odds ratios of 0.60 for households of average income and 0.22 for households which are wealthy. In addition, if there are more than or 6 people living in a single residence the odds of adolescent mortality increase to 1.20 times more than residences with fewer than or 5 people. Province of residence shows the Gauteng (1.05), KwaZulu Natal (1.02) and North West (1.05) provinces have almost even odds of adolescent mortality from natural causes occurring. While Limpopo (1.50) and the Northern Cape (1.23) show a higher likelihood of adolescent mortality.

In comparison to the empty model, the variation in occurrences of adolescent mortality was significant across communities (τ = 4.842; $p<0.05$). The intra-community correlation was 52.1%.

Model III shows the results of the effects of community variables. Community poverty is seen not to be associated with adolescent mortality from natural causes of death. The likelihood of experiences of all- cause adolescent mortality increases in rural areas (1.27) compared to urban areas. Results further showed communities with a medium or high proportion of ethnic diversity are at almost even odds of experiencing natural- cause adolescent mortality. Compared to model II the variation in adolescent mortality across communities remained significant (τ = 2.601, $p = 0.05$). The intra-community correlation was 40.4 %.

The final model (model IV) contained both the household and community variables. Results show again that the inclusion of community variables had independent effects on adolescent mortality as well as moderating effects on the association between household factors and adolescent mortality from natural causes of death. Household assets and community poverty remain statistically insignificant, now that community variables have been added. However, household tenure is now statistically significant. To begin, the results of this model show high income households have the lowest odds of experiencing all- cause adolescent mortality at

0.22. In addition, household with more than or 6 resident members are still more likely to experience adolescent mortality compared to households with 5 residents or fewer with similar odds of 1.17 as in Model II. In addition, tenure shows that households which are rented (1.02) or occupied for free (1.05) have almost even odds of experiencing adolescent mortality when taking into consideration community characteristics. Province of residence shows some statistical significance compared to Model II. Here it is seen, that the odds of all- cause adolescent mortality is almost even in Gauteng (1.02) and less in the North West (0.82) province.

Further, the results showed that living in rural (1.03) communities with a medium proportion of ethnic diversity (0.88) is associated an almost even likelihood of natural- cause adolescent mortality in South Africa in 2001.

Comparatively the variance at the community level in model IV remained significant ($\tau = 2.052$; $p<0.05$). The intra-community correlation decreased to 39.5% indicating that the inclusion of community variables was important for obtaining a better explanatory model. The clustering of the likelihood of adolescent mortality at the community level is as a result of the composition of the communities by community characteristics.

Chapter 8

DISCUSSION

8.1 Introduction

In presenting this discussion, the various main findings from each of the result chapters (chapters four to seven) are brought together and unified. To begin, the levels of adolescent mortality are discussed in review of existing literature from South Africa and the region. Second, the causes of adolescent mortality are evaluated in relation to studies which report on the patterns of disease and unnatural mortality in the country. Following this, a section on the individual determinants of adolescent mortality is discussed; these determinants are placed in the context of what is known about the determinants of child and adult mortality. This is done so as to place the transitional phase of adolescence within the progression of the life course. Subsequently, the main results of the multilevel modelling of adolescent mortality are reviewed in relation to studies on various contextual determinants of mortality.

This chapter then re-visits the study hypotheses and evaluate the acceptance or rejection of these based on the study results. Following is an evaluation of the earlier adapted theoretical framework of the study. Further, methodological issues and the contribution to knowledge are discussed. Thereafter, the study's strengths and limitations are also highlighted.

8.2 Research Findings

8.2.1 Levels of adolescent mortality in South Africa, 2001- 2007

This study has found that the levels of adolescent mortality in South Africa increased from 2001 to 2007 by approximately 1.3%. It has been reported that mortality in the population, of all ages, had increased from 318, 287 deaths in 1997 to almost 601, 133 reported deaths in 2007 (Stats SA, 2009a). This increasing trend in mortality is substantiated by a study conducted on infant mortality in South Africa in 2007 whereby results indicate the infant mortality rate of South Africa to be 59 deaths per 1, 000 live births. The authors argue that this rate is not much less than the rates seen in the 1990's and early 2000's (Sartorius et al., 2011). A similar study conducted on the rural South African population in Bushbuckridge (north- east region) found increases in male and female mortality since the mid-1990s (Kahn et al., 2007). In particular, this study found that mortality increased among child (0–4) and young adult (20–49) age groups incrementally, in which increases of two- and fivefold respectively have been observed in the past decade (Kahn et al., 2007). In addition, Statistics SA corroborated the pattern of increasing mortality in the country (Stats SA, 2007). According to Statistics SA the age distribution of death remained fairly constant from 2002 to 2006 with peaks in the age groups 0–4 and 30–34 years old (Stats SA, 2007).

Among adolescents, it is also seen that the levels of male mortality exceed that of their female counterparts in 2001, however the reverse is true of 2007, where female adolescent mortality exceeds that of males (Figure 4.2). This is in tandem with many studies on mortality finding discrepancies between male and female mortality levels. To begin, Anderson and Phillips (2008) found that, in the age- group 20 – 34 years old, female mortality in South Africa exceeded male mortality. The authors called this "reversing a typical pattern" whereby overall they found that adult male mortality increased by 1.8 times and adult female mortality by 2.6 times in the period 1997 to 2005 (Anderson and Phillips, 2008).

However, in a national study of causes of death in South Africa, it was found that between 2006 and 2009, there were slightly more male than female deaths at all ages. The exception was at ages 20 – 34 years old where female deaths exceeded male deaths in the country (Stats SA, 2010b). This finding makes sense since these are women of reproductive ages who are compounded by complications relating to pregnancy and childbearing (maternal mortality). Statistics SA also acknowledge that the "gap between the proportion of male and female deaths was observed to be narrowing over time" (Stats SA, 2007).

Finally, in their work on adult mortality in the KwaZulu Natal province, Hosegood et al (2004) found that the number of female deaths aged 20- 39 years old, exceeded the number of male deaths. However they found, similar to this study's findings, among 15- 19 year olds in the province it was found that the number of male deaths in the province exceeded that of females (Hosegood et al., 2004b). This is not reflected in the national pattern.

With regard to age, the age-specific mortality rates (ASMRs) in this study shows that from 2001 to 2007 rates for adolescents have increased over time (see Table 4.2). This result shows that mortality is increasing over time, by sub- age-groups of the adolescents. So, where 10-14 year olds were suffering 2.61 deaths per 10,000 population in 2001, this number increased to 3.61 deaths per 10,000 population in 2007. Since adolescents and youth in any population, generally have the lowest mortality of all other age- groups this finding is important as it may signal a change in the age- specific mortality trends in South Africa. This proposition is supported by Kahn and others (2007) who found that age- specific death rates among adults (20+ years old) had increased in the period 1992/93 to 2002/03 (Kahn et al., 2007). Further research from the last two decades, such as the work by Nannan et al (2000) showed an increase in infant mortality from 39 deaths per 1, 000 live births in 1992 to 56 infant deaths per 1,000 live births in 1997 (Nannan et al., 2000). In line with this, Garrib et al (2006) estimated the infant mortality ratio at 59.6 per 1000 live births from 2000 to 2002 (Garrib et al., 2006). These studies, although done on different age groups in the population demonstrate the argument that mortality in South Africa increased over the period.

This study has estimated the contribution of natural and unnatural causes of death to adolescent mortality in South Africa. Of notable importance, are the findings that male deaths due to natural causes have declined and female deaths due to natural causes increased over the period. A study on adult mortality has found the opposite trend to be true, that males are more likely to die from certain natural or disease related causes of death than females. In Case and Paxson (2004) whereby sex differentials for adult mortality was studied, it was found that men who report having cardiovascular disease and certain lung disorders are significantly more likely to die than women many chronic conditions despite the probability of death being the same for women and men (Case and Paxson, 2004). This study was based on data from the National Health Interview Surveys (NHIS) conducted between 1986 and 1994, and 1997 to 2001 and does not necessarily reflect the mortality experiences in Africa, but rather those of the developed world. To gain a better insight into the South African experience, a study conducted in a rural area of northern KwaZulu Natal province, showed that, adolescent female mortality due to natural causes of death were increasing in the country, whereby researchers observed female mortality due to communicable and nutritional deaths where higher among women aged 15- 44 years old than men (Hosegood et al., 2004b).

The rate of adolescent mortality by education (Table 4.4) shows that as adolescent's education level increases, the number of adolescent deaths decreases. However, as noted in the Methodology this data is almost 50% incomplete for adolescents. This finding is similar to other research conducted on the protective effect education has on mortality levels. The effect of parent education and subsequent better employment opportunities, particularly that of mothers, has been documented as having a positive effect on the survival of their children. Literature has contended that a higher educational status of a parent or head of the household is beneficial in determining the health and survival status of their children (Cleland and van Ginneken, 2008). Similarly, research on the employment status of the household heads and survival of their children argue that the proportion of deaths of under- five children is lower to mothers who are employed (2.5) than non- working mothers (2.9), from 1998- 2002, in South Africa (Buwembo, 2010). This is of notable importance here since adolescents are in the transitional phase of remaining partially dependent on parents for care, as well as becoming parents themselves.

8.2.2 Causes of adolescent mortality in South Africa, 2001- 2007

The standardized death rates, which allow for comparisons across countries, show that rates for males and females increased over time (Table 5.1). This is similar to the findings by Adjuik et al (2006), who estimated standardised death rates for a number of Demographic and Surveillance Sites' (in Africa, including South Africa and abroad). In their study the authors found the all-cause mortality rates were high among infants consistently over the period of 1999 to 2002, and there were high incidences of maternal, perinatal and infectious disease mortality at the study sites (Adjuik et al., 2006). In addition, with regard to the South African population specifically, Anderson and Phillips (2008) found that age standardized death rates for males aged 15-64 years old, remained higher than female rates, yet both increased for all age-groups, in the period from 1997 to 2005.

This study has shown that the cause- specific mortality rates for natural causes of death increased in the period for adolescents in the country. This is contrary to Makiwane and Kwizera (2009) who found that teenage natural mortality (15 -19 years old) had remained low and constant in South Africa, from 1997 to 2004. However, the authors note, among 20- 34 year olds there had been dramatic increase in natural mortality during the same period (Makiwane and Kwizera, 2009).

Natural causes of death, which are causes due to disease and infirmary, in South Africa, remain a prominent cause of death among both under-five children and adults. In their national study of causes of death in South Africa, researchers from Statistics SA, found the majority of deaths in the country were due to natural causes (from 1997 to 2006), with a range of 82.9% of all deaths in 1997 to 91.3% of all deaths in 2006 (Stats SA, 2007). In addition it was found that the percentage of deaths due to natural causes had increased (from 262, 505 deaths to 554, 570 deaths) over time while non-natural deaths remained constant between 50,000 and 55,000 deaths. Further between 2005 and 2006, natural deaths increased by 2.7% while non-natural deaths decreased by 1.4% (Stats SA, 2007).

In addition, Dorrington et al (2001) found in the period 1985 to 1995, infectious or natural causes of death increased from 9% to 10%. In addition, they found that in 1995 non-communicable diseases constituted 20% of all mortality in the country (Dorrington et al., 2001).

A related finding in this study is that a larger number of adolescents were surviving natural causes of death in 2007 than 2001 (see Figures 5.6- 5.10). Public health studies have focused on the improvements made in the areas of treatment and prevention of disease among children and adolescents in South Africa (Harrison et al., 2010, Daftary and Padayatchi, 2013, Nsibande et al., 2013). These studies have focused on improvements made in the delivery of HIV care and the uptake of referrals by community health care workers in the country. With the positive outcomes expressed in these studies, it is easy to understand why the number of adolescent survivors has increased from 2001 to 2007.

In comparison to natural causes, cause- specific mortality rates for unnatural causes of death are higher among adolescent males compared to their female counterparts (See Table 5.3(b)). Unnatural causes of death include violence, injury and accident- related causes of death. It is not an uncommon finding that these causes of death are generally higher among males in the South African population compared to females. It has been shown that violent deaths are a major cause of death amongst the youth (Norman et al., 2007a). Swart, et al (2005) found that in the Johannesburg region alone, 304 adolescent homicides were reported from 2001 to 2005. In addition, the authors found almost 70% of the victims were aged between 18 and 19 years old and 83.1% of the victims were males (Swart et al., 2005). Examining national crime statistics for 2000, Swart et al (2002) argue that violence in the country is 'profoundly gendered' with males aged 15- 29 years old being the most engaged in such activities as both perpetrators and victims, compared to females of the same age (Swart et al., 2002).

The life table results in this study produced a number of findings for adolescent mortality that are beneficial to understanding the prominent causes of death as well as the burden of diseases in the population.

For specific causes of adolescent mortality, it is here observed that the elimination of causes of death such as Tuberculosis and pneumonia could produce substantial gains in life expectancy. These particular causes of death, are related to AIDS deaths (Lin and Nichol, 2001, Bradshaw et al., 2008) and for this reason, other findings regarding HIV/AIDS are now discussed. In his study of the life expectancy of the South African population in 1996, Mba (2007) found that in the absence of HIV/AIDS, a gain in life expectancy at birth of 26 years could be attained. This increases the life expectancy of South Africans, from 63.6 years for all causes combined to 89.8 years in the absence of HIV/AIDS alone (Mba, 2007).

This study has found that the plight of Tuberculosis- related deaths is more concentrated among females than males. In addition, the probability of adolescent females dying from Tuberculosis increased for 1.45 in 2001 to 1.75 in 2007 in South Africa. Tuberculosis as a major contributor to female mortality in the country is well documented in literature. It was found that in 1995, that 4.6% of all deaths to girls aged 10- 14 years old, was due to Tuberculosis, compared to the 2.9% contribution of the disease among males of the same age (Bradshaw et al., 2003). Further, among older females (15-44 years old) 9.5% of all deaths was due to Tuberculosis. For males of the same age the percentage contribution was less at 7.1% (Bradshaw et al., 2000a).

For pneumonia, results from the Agincourt study site have shown that Acute Respiratory Infection (including pneumonia) produced 38 deaths per 100,000 among 0- 4 year olds and 41 deaths per 100,000 among persons aged 75 and older (Kahn et al., 1999).

For adolescent male mortality the more prominent broad- underlying cause of death has been identified as ‘events of undetermined intent’, according the Death Notification Form analysis in 2001. ‘Events of undetermined intent’ include among other deaths drowning, falling and exposure to smoke and flames. In a Statistics SA report on the causes of mortality among the

South African population, it was found that 53.9% of all deaths to 0- 14 year olds and 70% of all deaths to 15- 65 year olds was classified as 'events of undetermined intent' in 2006 (Stats SA, 2007). The classification of causes that constitute 'events of undetermined intent' (see Table 8.1 below) closely resemble possible suicide or self- harm related deaths and it is possible that in the absence of proof (such as a suicide note) these deaths have been misclassified (Ohberg and Lonnqvist, 1998). This claim of the misclassification of suicide is substantiated by global figures that report every year more than 10,000 young people commit suicide with rates peaking in the 20 to 34-year age group (Morrow et al., 2005).

Table 8.1 Events of undetermined intent - code and definition

Causes of death (Based on the Tenth Revision, International Classification of Disease, 1992)	
Y10	Poisoning by and exposure to non-opioid analgesics, antipyretics and antirheumatics
Y11	Poisoning by and exposure to anti-epileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified
Y12	Poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified
Y13	Poisoning by and exposure to other drugs acting on the autonomic nervous system
Y14	Poisoning by and exposure to other and unspecified drugs, medicaments and biological substances
Y15	Poisoning by and exposure to alcohol
Y16	Poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours
Y17	Poisoning by and exposure to other gases and vapours
Y18	Poisoning by and exposure to pesticides
Y19	Poisoning by and exposure to other and unspecified chemicals and noxious substances
Y20	Hanging, strangulation and suffocation
Y21	Drowning and submersion
Y22	Handgun discharge
Y23	Rifle, shotgun and larger firearm discharge
Y24	Other and unspecified firearm discharge
Y25	Contact with explosive material
Y26	Exposure to smoke, fire and flames
Y27	Contact with steam, hot vapours and hot objects
Y28	Contact with sharp object
Y29	Contact with blunt object
Y30	Falling, jumping or pushed from a high place
Y31	Falling, lying or running before or into moving object
Y32	Crashing of motor vehicle
Y33	Other specified events
Y34	Unspecified event

Source:(Stats SA, 2007)

Preventable causes of death:

This study has shown the gains in life expectancy should certain causes of death be eliminated among the adolescent population. These causes include, unnatural causes and certain infectious diseases, all of which are largely preventable among adolescents. For younger adolescents, up to 3 additional years of life could be gained if unnatural causes of death were eliminated from the population. For older adolescents (15- 19 years old) up to 4 additional years can be gained. These are causes not related to medical or health conditions and are arguably easier to prevent among adolescents. Prevention of unnatural causes of death among adolescents relates to the development of their skills and behaviours during this age. The promotion of healthy lifestyles (physical and mental) and good choices could prevent deaths by these causes, as well as the contraction of certain diseases (for example, STIs and obesity) within this age- group. Should certain infectious diseases be eliminated from the population (including Tuberculosis and pneumonia) adolescents in South Africa can experience even further gains in life expectancy.

8.2.3 Determinants of adolescent mortality in South Africa, 2001 – 2007

Key determinants shaping child health and mortality in South Africa have been identified as poverty, poor maternal education, racial and gender inequalities, undernutrition and HIV infection (Sanders et al., 2010). Studies have noted that determinants of adult health and mortality in the country include unemployment, cultural practices, living and working conditions and HIV/AIDS (Hosegood et al., 2004b, Kahn et al., 2007, Bradshaw, 2008). This study has attempted to identify the individual determinants of all-cause, natural and unnatural causes of adolescent death in South Africa. The issue of determinants of adolescent mortality is not well documented in literature. A possible explanation for this is the dearth of information regarding adolescents in the country. Using the information provided on Death Notification Forms, Census and Community Surveys, this study has identified, few but key determinants of adolescent mortality in the country.

Sex differentials:

This study has identified that adolescent females are less likely to die than males. For all-cause mortality, this is similar to Bugard and Treiman (2006) who found that adult males are 1.31 times more likely to die than females. This study identifies further sex differentials with regard to determinants by cause of mortality (Burgard and Treiman, 2006). For instance, it is seen that females are more likely to die from natural causes than males (Table 6.2(a)). This has been substantiated through earlier discussion on female rates of death from causes such as Tuberculosis being higher than that of males (see page 189).

Further with regard to sex differentials, this study has found females to have consistently lower odds of adolescent mortality from unnatural causes of death compared to males. Makiwane and Kwizera (2009) found that although unnatural mortality declined marginally between 1997 and 2004, male unnatural death rates are considerably higher than that of females (which remained almost constant throughout the period). Which the authors argue is firstly in line with rates elsewhere in the world and secondly, a result of the risky behaviours more commonly associated males than females (Makiwane and Kwizera, 2009).

Education as a protective factor:

This study has determined that education decreases the odds of all causes of adolescent mortality for both males and females. Research has found that education not only decreases the odds of individual mortality but also that of their offspring. For infants in the country, Buwembo (2010), who studied levels and determinants of infant mortality in two periods, 1993-1997 and 1998 – 2002, found mothers education to be associated with infant mortality in South Africa, and in fact it decreases the odds of infant mortality (Buwembo, 2010). In contrast, Bugard and Treiman (2006) found that mothers education produces almost even odds (0.980) of infant mortality occurring.

For natural causes of death, which include diseases, education decreases the odds of both sexes dying from natural causes of death. The effect of maternal education on child survival has been documented in many studies (Amoateng and Heaton, 2007). Barret and Brown (1996) argue that women with higher education are more likely to secure steady, better- paying jobs and are more likely to marry husbands with higher educational levels (Barrett and Brown, 1996). This translates into better living conditions and better decision-making within the household. As Bhuiya and others (1990) argue, education better equips people, especially women with better knowledge and attitudes about health and health-seeking practices (Bhuiya et al., 1990).

Interestingly, this study did not find evidence that education decreases the odds of dying from unnatural causes of death. In South Africa, over the past three decades educational opportunities have expanded massively to the benefit of African youth and women in general. However literature has revealed that while secondary school enrolment has increased for disadvantaged groups, little advancement has been made in reducing the number of young people with little or no education (Makiwane and Kwizera, 2009). It is these young people who are particularly vulnerable to unemployment and premature mortality. While race has not been covered in this study, it is argued that African/Black youth in South Africa are more likely to incomplete their education due to financial constraints than any other racial group, while gender inequalities are also cited as contributing to the under- education of the countries young people (Makiwane and Kwizera, 2009). However, this study did find that the odds of male and female adolescents dying from unnatural causes of death did decline from 2001 to 2007 in the country, thus proving that the situation in the country is improving.

Marriage is associated with decreased odds of adolescent mortality

This study has shown that the condition of being married decreases the odds of all causes, natural and unnatural causes of adolescent mortality (Tables 6.1 -6.4). Similarly, Nikoi (2009) found that single adults in his study were observed to be on average twice more likely to die when compared to adults who are married (115% more). In addition, adults who are divorced had 57% more likelihood to die when compared to those who are married. Though adults whose spouses have died had a 35% more risk to death when compared with adults who are married (Nikoi, 2009).

In studies pertaining to the association between marital status and child survival, the protective effect of marriage is also seen. For example, Collinson (2006) found that mothers who have never married (single) tend to suffer higher under- five child mortality than any other marital type (Collinson, 2006). In addition, Remes and Martikainen (2012) examined the impact of living arrangements on the causes of death of young adults (aged 17 to 29 years old). Their study found that single parent families are associated with higher risk of mortality (Remes and Martikainen, 2012).

8.2.4 Contextual determinants of adolescent mortality in South Africa, 2001

Contextual determinants of all causes of mortality:

This study has found that having a few household assets, six or more people living in a residence, and high ethnic diversity is associated with increased odds of adolescent mortality in South Africa in 2001.

The acquisition of household assets is argued to vary between population groups in South Africa. The Department of Social Development (2003) created an asset index made up of amenities such as were flush toilet, telephone, electricity from the mains, refuse collection, tapped water, and ownership of a motor car from the 1999 October Household Survey in South Africa. Among their results they found that African households possessed only two of six amenities compared to a median of four in coloured households and a median of six in Indian and white households (DoSD, 2003). In addition to this finding, Anderson et al (2002) found a contrast between the overall conditions of life of African and Coloured children. It was found that a substantially larger proportion of Coloured households (93%) had access to running tap water in the dwelling or on site, compared to only 42% of African households (Anderson et al., 2002). Thus compromising the health and well- being of households with fewer assets.

Odds of adolescent mortality increase when households have six or member residents. It is well- known from existing literature that a child's health can be compromised in large households. According to Amoateng and Heaton social and financial resources may not be sufficient for each individual's emotional and economic needs within the household. Size of the household in poor areas is especially critical because within this context it is difficult for large families to cope because of the neighbourhood impoverishment (Amoateng and Heaton, 2007). As a result of this, children in large families are vulnerable to malnourishment, failure to recognise illness, inadequate attention and unsanitary living conditions (Amoateng and Heaton, 2007).

To clarify the finding on racial diversity, it is important to note that in South Africa the *Population Registration Act of 1950* coined the phrase 'population group' and demarcated the population into four races. The term 'population group', which has both social and biological connotations, has become the standard analytical concept in public discourse. According to the 2001 South African population Census, Africans are the largest group comprising 79.02% of the total population. The other ethnicities are White, Coloured and Indian/ Asian populations (Amoateng and Richter, 2007). This study examined the odds of adolescent mortality in communities where the population groups are mixed and thus found in areas in high racial diversity or mix, the odds of all-cause mortality are higher. South Africa's past Apartheid policies of racial segregation meant that racial groups were forced to live together. Since the end of Apartheid, South Africans have been free to move and live wherever they want to. This created some communities of racial diversity. For those moving into previously racial - homogenous communities and thus creating diversity, they are separated from family, community and social support structures. The health outcomes of such people are then arguably the same as immigrants who leave family and 'home' behind. Research has found that immigrants suffer worse health outcomes because of the loss of support and the restricted access to healthcare in new areas (Lurie et al., 2003).

Contextual determinants of unnatural causes of mortality:

Households with six or more residents, living rent- free in rural areas with high racial diversity are associated with increased odds of adolescent mortality.

The health benefits of living in urban as opposed to rural areas have been uncovered by many researchers. Urban women often have fewer children than rural women, and typically have greater access to contraception and education, have higher socio-economic status, and frequently have more family decision-making power (Dodoo and Tempenis, 2002, Kirk and Pillet, 1998). Additionally, women living in urban areas usually have more immediate access to healthcare than rural women which has translated into better child survival for urban mothers (Amoateng and Heaton, 2007). In another study, it was found that there is a statistically significant difference both within urban residents and within rural residents on wealth and infant mortality with urban residents having significant reduction in odds of Swaziland. It is also observed that Namibia has the highest odds of reducing child mortality in urban areas

(Anyamele, 2009). The result of this study has shown that there are additional survival benefits for adolescents living in urban as opposed to rural areas.

Contextual determinants of natural causes of mortality:

High income households in areas with high racial diversity are associated with decreased likelihood of adolescent mortality occurring due to natural causes.

The trend of high income households in South Africa is fluctuating. There is evidence from Statistics SA's Income and Expenditure Surveys which suggests that total household income and expenditure fell on average in South Africa between 1995 and 2000. The survey found a 12% decrease in real average household income, and a 3% decrease in real average per capita income between 1995 and 2000. Real median income was also lower in 2000 than in 1995, suggesting that the poorest 50% of the population were even poorer five years later (Stats SA, 2002). These statistics were estimated on information collected on all sources of income (earned and non-earned) and on all types of expenditure. Since natural causes of death encompass communicable diseases which are more prevalent among adolescents than non-communicable diseases (such as cancers), it is largely preventable through healthy lifestyle promotion and curable through medication. It thus makes sense that high income households are better equipped to purchase medication and healthy foods, therefore decreasing the odds of mortality by these causes. Further justification for this point is made by Anyamele (2009) who found in his study of several African countries that among the richest households there is a high association between wealth and reductions in child mortality. This was found to be true in

13 African countries including Rwanda, Benin, Niger, Tanzania, Mali, DRC, and Mozambique (Anyamele, 2009).

This is related to a final result of this study, with regard to natural causes of mortality is that, communities with a high proportion of poverty are associated with increased odds of adolescent mortality. It has been argued that the previous economic recessions in the country worsened unemployment, especially in 2001 (Stats SA, 2003b). Further it was reported that 87% of the bottom 40% of South Africa's households had none or one working family member and relied heavily on pensions or remittances for their livelihoods in 2001. Within this context, it becomes clear as to why survival probabilities would be lower in communities with a high proportion of poor households. A study on low income households in in three South African areas (Langa, Diepsloot and Lugangeni) found that deaths in already poor households are made worse by funeral costs and the loss of income when an adult member dies (Collins and Leibbrandt, 2007). It has been argued that lack of access to basic services remains associated with reason low income households in South Africa. This continues among some households even though provision of clean water and adequate sanitation has been provided for most South Africans since 1994 (Woolard, 2002).

8.3 Reviewing and testing the study hypotheses

The first hypothesis of this study is that the levels and rates of adolescent mortality in South Africa are decreasing over time (see page 20). The p- values obtained in Chapter 4, for the cross- tabulations of adolescent characteristics by adolescents deaths were statistically significant at $p<0.05$ (see Tables 4.1, 4.2 and 4.4). This hypothesis was based on the assumption that South Africa is undergoing a mortality transition and, similar to that of developing countries, mortality is decreasing over time. This hypothesis can be confirmed in light of the results presented in Chapter 4. That is, mortality levels and trends for adolescents are changing over time, but it has not declined. It is seen here that adolescent mortality in the country increased by approximately 1.3% from 2001 to 2007. Further the study has shown that by sub-ages, 10 -14 years old and 15- 19 years old, age- specific mortality has increased over time too.

The second study hypothesis is that all causes of adolescent mortality contribute equally to the overall adolescent mortality rates in South Africa (see page 20). The p- values obtained in Chapter 5, for the cross- tabulations of adolescent characteristics by different causes of adolescent deaths were statistically significant at $p<0.05$ (see Tables 5.2- 5.4). This is based on the assumption that due to the limited and small age- group of adolescents, the exposures to potential causes of death would be similar for all 10- 19 year olds of both sexes. Unlike the broader age- groups of adults (20+ years old) where social and biological determinants of mortality vary as age increases, it was here assumed that having a smaller age interval would control for variation in causes of death. This hypothesis cannot be confirmed as results in Chapter 5 show that different causes of mortality contribute varyingly to adolescent mortality in South Africa, especially by sex. This study has shown that rates of unnatural causes of death, as reported by the Census of 2001 and the Community Survey of 2007, are higher for adolescent males than females. Conversely, adolescent females have higher rates of natural causes of death than adolescent males. The analysis of Death Notification Forms show that female mortality due to Tuberculosis is high and males are dying from 'events of undetermined intent' more than adolescent females.

The third study hypothesis is that contextual factors account for significant differences in regional patterns of adolescent mortality in the country. The p- values obtained in for the logistic regression and multilevel logistic regression models were statistically significant at $p<0.05$ (see Tables 6.1- 6.4 and 7.1- 7.4). This is based on the presumption that regional and socioeconomic inequalities impact mortality outcomes differently. This hypothesis can be confirmed with results in Chapters 6 and 7 showing the variation in likelihood of adolescent mortality by both region and socioeconomic characteristics of individuals (education) and households (assets and income). This study has shown that education is associated with declining adolescent mortality. Further, when controlling for household characteristics, such as number of residents, income and assets, living in rural areas are associated with increasing adolescent mortality. Finally, communities with high proportions of poor households and high proportions of ethnic diversity are also associated with increased mortality, when contextual factors (at a household level) are controlled.

8.4 Theoretical and Conceptual Frameworks

8.4.1 Background on development of conceptual framework

The conceptual framework which was developed for this study was adapted from two existing frameworks. The first model (*WHO Commission on Social Determinants of Health)* sought to understand the social determinants of health, including material circumstances, socioeconomic status and behaviours (see page 35). The second model (*Ecological model for Public Health)*, accounts for the interaction effects between various levels of health determinants - individual, social and community, work conditions and broader policies (see page 37). From these perspectives, a model identifying independent or predictor variables and the proximate determinants through which adolescent mortality would be determined was developed (page 44). Further this model places independent variables at the levels of community, household and individual level characteristics.

8.4.2 Advantages of the Conceptual Model

Firstly, the model has clearly defined spheres of influence. The incorporation of an ecological approach to research is much needed in the study of demographic outcomes. In studying the composition of populations, with regard to mortality it remains fundamental that research acknowledges that individuals are nested within households and communities, both of which influence health and mortality outcomes separately. This study has, to an extent, proved this by showing that adolescents are more likely to die if they live in in households with six or more people (Table 7.4). Further this study showed the effect of regional variation on adolescent mortality, with adolescents being more likely to die from unnatural causes in rural areas (Table 7.3).

Second, the framework contains a comprehensive list of variables that could determine adolescent mortality. These variables pertain to the individual, the household and the community. More importantly the variables are both demographic and socioeconomic. Since mortality outcomes are related to more than disease contraction, sickness and accidents, there is need to know if certain demographic and socioeconomic factors are related to adolescent mortality. For example, this study found that adolescents with only a primary education have a higher rate of dying from Tuberculosis (Table 4.5). These results are further proof that in order to understand mortality dynamics, an exhaustive list of characteristics pertaining to the individual as well as their environment (households and communities) is needed. This framework provides a good basis of demographic and socioeconomic variables to study.

Finally, the conceptual framework, similar to others, shows a clear pathway for the study of adolescent mortality. The complexities of adolescence need to be studied in a uniform way. This framework shows the clear way in which predictor variables work through proximate determinants in leading to adolescent mortality. The benefit of such an approach is the development of a framework that can be used to study adolescent mortality outcomes in different regions of the world and is not specifically for South Africa alone.

8.4.3 Limitations of the Conceptual Model

Upon completion of the study, it is seen that there are limitations to the conceived model. To begin, not all variables at individual, household and community levels were available for use in this study. A purpose of this framework is to create a platform for multilevel modelling. As a result, a two- level multilevel model was built (Chapter 7) instead of three- levels. In addition, to missing variables, the only data source that could be used to build the multilevel model was the 2001 Census. The Community Survey was not used because a fundamental variable, 'place of residence' (rural/urban) was lacking. Regional variation could not be established without this variable.

Second, given the results of this study, the framework does not highlight the importance of cause of death and sex in the study of adolescent mortality, despite these variables being included. Probability of dying results (Table 5.5) shows the increased likelihood that adolescents would die from Tuberculosis and ill-defined and unknown causes of mortality before their 20^{th} birthdays. In contrast, for 2007, probability of dying shows that other external causes of accidental injury (males =2.73 and females 1.05) is higher than other causes among adolescents in the country. This is indicative of the strength of the proximate variable, cause of death. Further, this study has produced important sex differentials with regard to adolescent mortality. Such as male probability of dying being higher than that of females in 2001 and female probability of dying being higher than that of males in 2007 (Table 5.5(b)). Given these stark differences by sex, the framework does not highlight the strength of sex as a determinant of adolescent mortality.

Third, behaviours were not examined in this study and not included in the conceptual framework. Variables pertaining to adolescent behaviours should be included in frameworks and models that study adolescent mortality. Due to the limited data available in surveys and Death Notification Forms, behavioural attributes, such as smoking, drug and alcohol abuse were not initially conceptualised for the framework. However, in order to develop a model for the comprehensive understanding of adolescent mortality, such behaviours should be included and tested as proximate determinants of mortality.

8.4.4 Proposed new Conceptual Model for the study of adolescent mortality

Bearing the results and the pre-conceived framework for the study of adolescent mortality in mind, the following changes to the adapted conceptual framework are recommended:

1. Keep the clearly defined spheres of influence at individual, household and community levels. There is need to fully test all determinants in a three- level hierarchical model in the future, with data that allows for this.
2. Retain all the demographic and socioeconomic variables in the study. In addition, behavioural characteristics should be added to the proximate determinants. Variables pertaining to number of schools, clinics and employment opportunities (especially for older adolescents) should be added to the community variables. This will provide a comprehensive model to test the effect of regional differences on adolescent mortality.
3. Aside from having the general adapted framework for the study of adolescent mortality, sex and age specific frameworks should be developed for the study of the determinants. These frameworks should highlight the potential determinants that are specific to males and females and should bear in mind the different risks to which these adolescents are exposed. Such specificity will ensure that no adolescents will be under-researched and all individuals will be represented and researched fully.
4. Cause of death, which remains a proximate determinant of adolescent mortality, should be represented as additional layer / sphere, after behavioural characteristics in the framework (See Figure 8.1 below). Certain adolescent behaviours, in addition to wealth or asset index, will lead to certain causes of death (either disease or injury) before

leading to the outcome of mortality. For this reason, it is proposed that an additional path of proximate determinants be added to the framework.

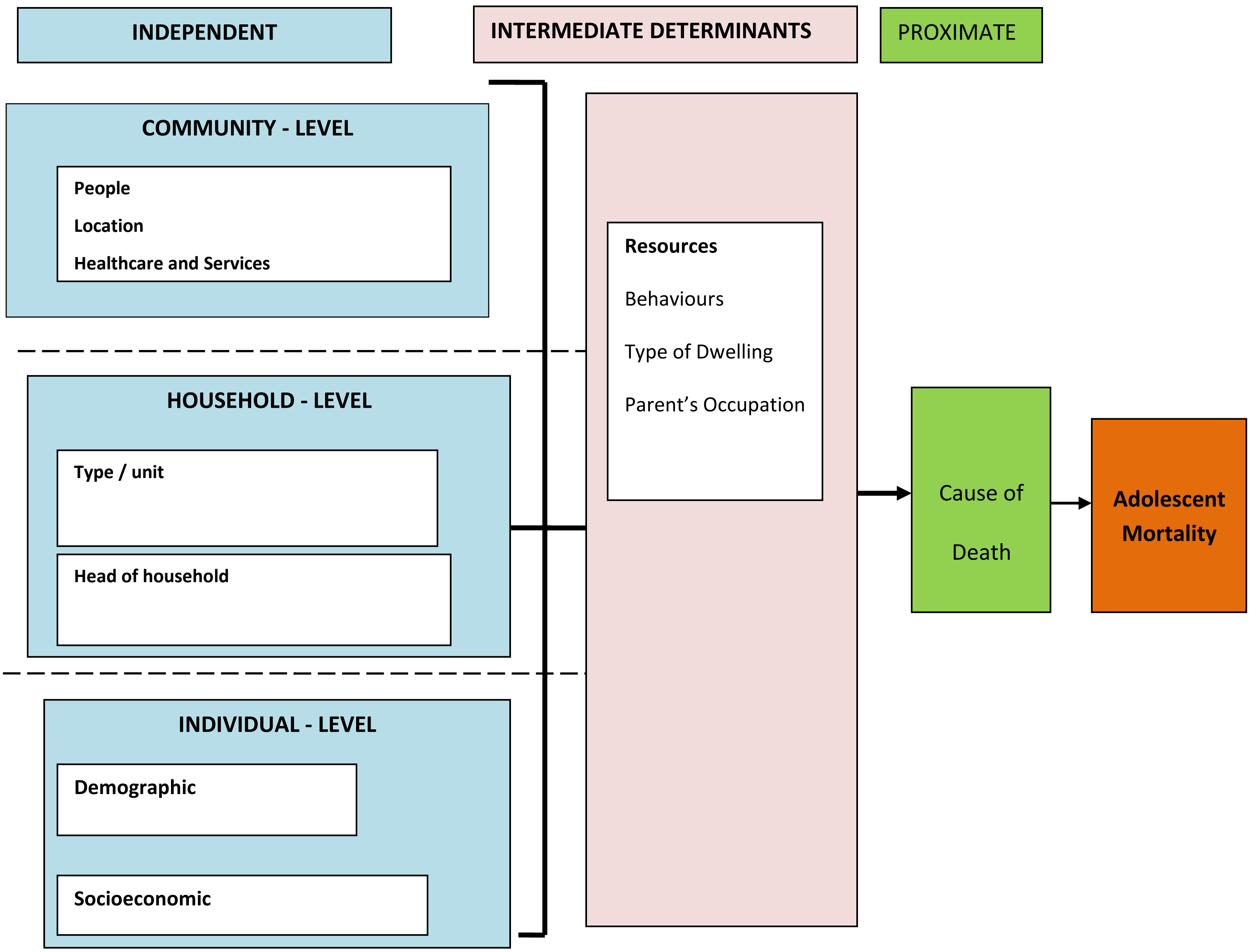

Figure 8.1: New Conceptual Framework for the study the relationship between multilevel factors and adolescent mortality (adapted CSDH, 2007 and Gebbie and others, 2003)

8.5 Methodological issues and contribution to knowledge

Reliability and validity:

The study has demonstrated research reliability in that many of the methods used have been repeated on different data sets. The study has used three different data sources. Rates and ratios seen in Chapters 4 and 5, have been repeated using Census and Community Survey data for the 2001 and 2007 comparative. Further, the life table analysis in Chapter 5 used all three sources of data interchangeably. For the regression analyses (Chapters 6 and 7) not all data sets could be used because of the lack of variables. For example, Chapter 7 did not analyse the Community Survey since a key geographic variable which differentiates rural and urban areas is missing. For this reason, and to sustain the reliability of the study, multilevel determinants of adolescent mortality in South Africa for 2007 were not done.

The validity of the study, which measures the study's success at measuring the objectives of the study, can be confirmed through two important points. First, the study design did not exclude any characteristics that are possible causes and/or determinants of adolescent mortality. This was subject to availability in the data sources. Due to the limitations in each source of data, three sources were used to create a robust and holistic research on the understanding of adolescent mortality in South Africa. Further, many robust methods from the fields of statistics and demography were used to ensure an accurate account of levels, causes and determinants of adolescent mortality. Second, the limitations of the data sources and inability of the study to make causal inferences is understood. These aspects of the study have allowed for the identification of further areas of future research (see 9.2.3 below).

Dependability of the data:

A major concern that was raised after the 2001 Census in South Africa, was the issue of undercount. The 1996 Census reported an undercount of 10%, this increased to 17% in 2001 (Stats SA, 2010a). Statistics SA has openly acknowledged the following problems that contributed to the undercount, among others, in 2001:

- "Regional offices experienced shortages of qualified managers and therefore field staff did not have adequate support to accomplish desirable outcome- quality field operations. Proper supervision was therefore lacking.
- The pilot presents an opportunity to test and double check methodologies and plans for appropriateness and effectiveness for use in the main data collection processes.
- The major shortcoming for Census 2001 was that there was less than seven months lead time between Census 2001 pilot (March 2001) and the main census in October of the same year. This delay in planning and implementing the Census 2001 pilot was particularly damaging as it did not only compromise planning and budgeting for the main census but it also negatively impacted on all other downstream sub-processes that were linked to these two major processes.
- In 2001, there were no clear documentation on quality assurance and therefore the quality of information collected, how it was collected must have been compromised.

- Some communities have become inaccessible due to security concerns, political agenda and lack of service delivery, making it difficult for the organization to access all households and enumerate them. In census 2001, there were no clear strategies on how to enumerate such groups".

  Source: (Stats SA, 2010a)

Contribution to knowledge:

This study has made a contribution to knowledge in two important ways. First, the study has examined the mortality experiences of an under- researched population, adolescents. This is important because South Africa is experiencing a youth bulge at present. The potential benefits of a youth bulge include large labour force participation and hence economic development. However, the benefits of the youth bulge cannot be realized without basic, fundamental information regarding adolescent survival and the factors contributing to adolescent mortality in South Africa. The study hypotheses, based on assumptions of mortality from other older and younger age- groups, are each accepted in this study. Of particular importance to realizing the potential of the young population in South Africa, are the results that show the determinants of adolescent mortality (Chapters 6 and 7). These results show that adolescents who are under-educated and poor (low household income and high community poverty) are particularly susceptible to premature mortality. In addition, cause of death analysis (Chapter 5) shows that infectious diseases such as Tuberculosis and unnatural causes of death, such events of undetermined intent are particularly prevalent among adolescents. These contributions to the growing body of literature concerning adolescent health and survival are vital for socioeconomic policies, prevention and treatment programmes in the country.

The second main contribution of this study, is the adapted framework which can be used to assess adolescent health and mortality outcomes. The framework has been compiled using a combination of paradigms of health research theory. Together, these approaches have created a single appropriate conceptual framework for the study and understanding of adolescence. The reason why a framework is needed for the specific age- group of 10- 19 year olds, is because this is a stage of transition. Adolescents are exposed to new and different factors socially and economically during this time. Unlike children, adolescents experience initial bouts of decision- making autonomy during this transition. It is here that healthy and safe behavioural choices are first experimented with and will no doubt impact their adult lives. Also, unlike adults, who have a considerable amount of financial autonomy from their parents, adolescents are beginning to embark on financial independence for the first time. However, their current economic status as seen by the communities in which they live, cannot be ignored, since this is a predictor of how their socioeconomic status might change or stay the same. Bearing factors such as these in mind, the framework does not exclude parental or household influence, nor does it exclude community factors such as poverty. The framework takes into account the individual, household and community effects on adolescent mortality.

8.8 Study strengths and limitations

The first strength of this study is the use of three sources of demographic data in studying a single outcome. This study uses Census, survey and vital registration data in combination to study adolescent mortality in South Africa. Where other studies have employed only one data source in researching a demographic outcome, this study has been successful in combining three different sources to answer a single research question. The reason this amalgamated approach is successful is because the three sources, each with their own limitations, when used together provide a more generalised and encompassing answer to the research problem. Census 2001 had a 17% undercount, the Community Survey 2007 is a sample of the population and Death Notification Forms underreport deaths (see Methodology). Thus a single data source alone would not provide full-coverage of the extent, causes and determinants of adolescent mortality in the country. However, compartmentalising and linking each of the data sources proved suitable to answer the different facets of the research question.

The second strength of this study is the extensive use of methods. The study does not rely on a single method for the understanding of mortality dynamics in South Africa. In order to meet each study objective a number of methods were used so as to compile an all-inclusive quantitative view of adolescent mortality in 2001 and 2007. This is contrast to other studies on mortality which have made use of one or two study methods (Hosegood et al., 2004a, Barnes et al., 2009). For example, Hosegood et al (2004) used only the verbal autopsy method in the study of levels and causes of adult mortality in South Africa. Further, Barnes et al (2009) used only percentage distributions in their analysis of the burden of malaria deaths in the Sub-Saharan African region, including South Africa. Overall 12 different methods of analysis are used in this study. These robust methods produce both descriptive and inferential results which cover all aspects of adolescent mortality.

A further strength that comes out of the combination of data sources and robust use of demographic and statistical methods, is the empirical results that are produced in the study. Among other results, the main findings of this study are:

1. The levels of adolescent mortality in South Africa increased from 2001 to 2007 by approximately 1.3%.
2. Among adolescents, the levels of male mortality exceed that of their female counterparts in 2001, however the reverse is true of 2007, where female adolescent mortality exceeds that of males.
3. Cause- specific mortality rates for unnatural causes of death are higher among adolescent males compared to their female counterparts.
4. For specific causes of adolescent mortality the elimination of causes of death such as Tuberculosis and pneumonia could produce substantial gains in life expectancy.
5. The plight of Tuberculosis- related deaths is more concentrated among females than males. In addition, the probability of adolescent females dying from Tuberculosis increased for 1.45 in 2001 to 1.75 in 2007 in South Africa.
6. Females to have consistently lower odds of adolescent mortality from unnatural causes of death compared to males.
7. Education decreases the odds of all causes of adolescent mortality for both males and females.

8. The condition of being married decreases the odds of all causes, natural and unnatural causes of adolescent mortality
9. Having a few household assets, 6 or more people living in a residence, and high ethnic diversity within the community is associated with increased odds of adolescent mortality in South Africa in 2001.

These results can be used to inform policy and develop adolescent- specific programmes and strategies to ensure the optimal health and development of adolescents in the country.

To begin on the limitations, the fundamental outcome of interest to this study is adolescent mortality. Registration of deaths is a challenge to many developing African countries and South Africa is not exempt from this. Mortality is underreported and often misrepresented with the actual age of the deceased being reported incorrectly. This is true of data from vital registration systems in the country and is certainly true of survey data. Since this study is using survey data, these two occurrences must be noted. A consequence of underreporting is that inaccurate mortality estimates of adolescents could be derived. A consequence of misrepresentation of age at death is that deaths in the 10- 19 year old age group may appear skewed, with lots of deaths showing either at one or two specific years of age. However, since the specific year of age is not the focal point of this study, but rather the age- group, is not present a major challenge to the study. Similarly, due to the rigorous nature of data collection and validation of the Census and Community Survey by Statistics SA, underreporting does not appear as a major factor prohibiting the study from being done.

In addition, death registration in South Africa takes place at the Department of Home Affairs. After a death is registered, the Department issues a death certificate and where applicable, updates the population register. The forms are then collected by Statistics SA for processing. If the deceased is not in possession of a South African identity number or birth certificate their death cannot be registered on our National Population Register. This leaves a substantial amount of under- reporting of deaths among the poor (who do not have access to the Department of Home Affairs and were thus not issued birth certificates and identity numbers) and foreign nationals who reside in the country (Stats SA, 2007). Statistics SA have attempted to rectify this limitation, by supplementing this data with that which is collected by Census and other nationally representative surveys. This has supplemented the Death Notification Form data used in this study. However, in order for data from the National Population Register to be useful in the study of mortality in the country, the registration of deaths to persons who are not in possession of the correct documentation needs to be done and updated on the National Population Register.

A second issue with the Death Notification form data relates to the classification of deaths. A WHO study revealed that South Africa has more than 20% of deaths being 'ill-defined deaths'. Furthermore, the country has struggled with the widespread misclassification of HIV/AIDS as an underlying cause (Birnbaum et al., 2011). This distorts the mortality profile of the country and inhibits the implementation of successful policies and programmes. A possible solution to this problem is to further educated medical doctors of the causes of death and the ICD-10 codes. Although a part of curricula in training medical doctors, additional courses on the classification of diseases in the country is needed. Statistics SA has taken up this challenge and offers additional, training of already practising medical professionals in this regard.

Chapter 9

CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusion

The main objective of this study is to quantify levels, causes and determinants of adolescent mortality in South Africa from 2001 and 2007. The four specific objectives (see page 19), were all achieved in this work. First, this study sought to estimate the levels of adolescent mortality in South Africa. Through the robust use of frequency tables, proportional mortality ratios and age- specific mortality rates this was achieved. The overall conclusion that is drawn from this objective is that adolescent mortality in the country has increased over time and that prevalent causes of death are changing and differ by demographic and socioeconomic characteristics. Despite adolescents having lower mortality than children and adults, there is still cause to worry as increased adolescent mortality jeopardises the country's future development as it may result in a declined labour force.

The second objective sought to identify causes of death among adolescents in the country. Using standardised death rates, cause- specific mortality rates and life table techniques this objective was achieved. Of particular importance here, it was found that sex differentials exist with regard to cause of death. Adolescent females are heavily burdened by Tuberculosis and other natural or disease causes of death, while adolescent males predominantly suffer unnatural or violent and accidental causes of death. Life expectancy results reflect this, showing that females can gain more years of life through the eradication of Tuberculosis than any other cause of death. Similarly, adolescent males can gain more additional years of life (cause-deleted life expectancy) through the correct classification of ill-defined and unknown causes of death, through the correct identification of causes of death. In 2007, Tuberculosis remains a leading cause of death among female adolescents, but there is an increase in female mortality due to unnatural causes of death too and an increase in male deaths due to influenza and pneumonia.

The third objective of the study aims to determine the sociodemographic factors that contribute to adolescent mortality. Given the little information that is collected on Death Notification Forms, this objective was not achieved as vigorously as it was hoped. This objective was meant to create a profile of all possible demographic and socioeconomic determinants that place some adolescents at higher risk of mortality than others. However, only a few determinants were identified due to the limited variables collected on the Death Notification Forms. For this objective, age, sex, marital status and province of residence were the only demographic characteristics available for analysis. Further, only highest level of education was used a proxy for socioeconomic status. There are many more characteristics that need to be assessed with regard to risk of death per cause, such as, population group or race, parents' living or deceased, household income, relationship to the household head and so forth. However, this information is not captured on the Death Notification Forms. With the variables that are available, this study was successful in identifying that higher levels of education reduce the likelihood of adolescent mortality and that males are more likely to die than females during their adolescent years.

The final objective of this study is to assess the extent to which contextual factors account for variations in regional patterns of adolescent mortality. Similar to the third objective, it was not possible to fully identify a host of contextual determinants that account for regional differences in mortality due to lack of information within the data sources. For this objective only the Census of 2001 was used. The household variables were confined to the characteristics reported by the living household member. Further, for community variables, only community poverty (created through household incomes in a community) and ethnic diversity (created through the population group/ race of the household head) were used. In order to fully realise the extent to which contextual factors account for regional variations in adolescent mortality, there are more characteristics that are needed, for example, number of schools and hospitals in the community. Given the variables that were used, this study was successful in showing that poverty and high ethnic diversity are associated with increased mortality among adolescents in such communities in South Africa.

Finally, in response to the initial research question: What are the levels, causes and determinants of adolescent mortality in South Africa? The fore-mentioned empirical findings of the study, lead to the following general conclusions of the study:

1. With adolescent mortality in the country increasing future economic growth is compromised. Adolescents will soon enter the labour force and contribute to the country's growth. With fewer adolescent's surviving to adulthood this means the country's economic growth with be slow. This will compromise the country's ability to

achieve demographic dividend rewards. In addition, increasing adolescent mortality compromises the economic support available to dependent populations. With fewer economically active adults, the country's dependency ratio will be high, thus increasing the burden placed on government to provide for the elderly and children.

2. The burden of disease on adolescent females is similar to that of adult women in the population (see discussion of results on page 189). Women in South Africa, and elsewhere, are predominantly care-givers in their households and communities. With excess female mortality in the country, the elderly and children are left without anyone to nurture and care for them. Also, with adolescent mortality due to diseases such as Tuberculosis and unnatural causes (other causes of accidental injury) being high, the country cannot move forward in achieving demographic transition, which is moving toward low mortality rates, predominantly due to non- communicable disease causes of death.
3. The identified individual and contextual determinants of adolescent mortality in the country show that not all South African adolescents are at risk of premature mortality. These determinants show that mortality is associated with low socioeconomic status (rural areas, communities with high levels of poverty, low income households and low educational attainment of adolescents). Should mortality remain persistently probable among these factions of the population, poverty in the country will deepen. These at-risk populations will also be unable to lift themselves out of poverty with fewer future educated and economically active persons to assist within households and communities.

4. Finally, this study has demonstrated that relevant research can be done using existing data sources. The cross- sectional nature of the data used in this analysis was useful in producing both descriptive and inferential analysis of adolescent mortality. With this data, as seen in the analysis, both statistical and demographic techniques can be employed to derive much needed information regarding mortality in the country. This data is clearly useful for overall mortality analysis in the form of showing the levels and distribution of adolescent deaths in the country (Chapter 4). The data are also useful in conducting more complex analysis such as the adolescent mortality rates, ratios and life tables used in this study. This form of inference adds needed forecasting in the form of probabilities and life expectancies to assist in informing policies and programmes. But can also be used for more inferential statistics, such as regression analysis (Chapters 6 and 7).

9.2 Implications and Recommendations

9.2.1 Research implications

In evaluating the research implications of the study, first the difference between this and other studies needs to be made. This study is the first on adolescent mortality trends in South Africa since 1992. While a second study has been found, it was published in 1992 and examined only external causes of death among the White, Coloured and Indian/Asian populations of South Africa from 1982 to 1986 (Flisher et al., 1992). This study is different in that it includes all causes of mortality, including external causes and it uses more current data. Further, although race or population group is not specified, the data collected by Statistics SA represents all South African races. Finally, this study, in comparison to Flisher et al, uses a six year interval and not four.

Second, with regard to research implications, is who might be interested in these results. The results of this study would be of interest to the Department of Social Development since this study shows the socioeconomic determinants of adolescent mortality. For the Department of Social Development this is key to ensuring the full development of adolescents into healthy adults. Second, the results would be of interest to parents, caregivers, teachers and other parties invested in the survival and development of adolescents. Through the cause of death findings, this study has shown the need for parents and the like to educate and invest in teaching children and adolescents the benefits of healthy and safe behaviours and decision-making. Third, researchers in the broad fields of health, development and research methods would be interested in these research findings because of the data sources and methods used. The study uses a range of statistical and demographic methods using Census and survey data. This demonstrates the robust usefulness of both data sources in the analysis of mortality. These sources of data and methods can also be applied to the study of other health outcomes and other populations. For example, child (1- 9 years old) and adult (20+ years old) mortality levels, causes and determinants of mortality can be studied using these sources and a variation of these methods. In particular, the use of multilevel modeling which is under-utilized in health research can be used using the Census data and the two-level models used in this study.

9.2.2 Policy implications

Although overall, the levels and numbers of adolescent mortality are not very high in South Africa, it is noted that it is increasing over time. Policy and measures need to be put into place now to avert the increasing adolescent mortality rates. To begin, policies such as the Tuberculosis Strategic Plan for South Africa, could benefit from this study's findings on Tuberculosis mortality among adolescents. An aim of this policy is to prevent Tuberculosis and to ensure that those who do contract the disease have easy access to effective, efficient and high quality diagnosis, treatment and care that reduces suffering (DOH, 2006). In order to achieve this, findings, shown in this study, as to who in the population are most at risk of Tuberculosis infection, is of paramount importance. It has been found that early detection and the identification of risk factors is a problem in tuberculosis management globally and within South Africa (Jassal and Bishai, 2010, Sissolak et al., 2011).

Secondly, a specific strategy of the Policy Guidelines for Youth and Adolescent Health is to promote safe and supportive environments for adolescents, which includes relationships with families, social norms and cultural practices (DOH, 2001). In order for the policy to implement this strategy successfully parents, teachers, caregivers and adolescent peers must all be included in discussions around health issues, in particular, the barriers adolescents experience in obtaining optimal health statuses. This study provides information on causes of death specific to sex, age, other demographic and socioeconomic characteristics. This study forms a basis for the discussions parents and other interested parties should have with adolescents.

Third, as previously noted, unnatural (violent and accidental) causes of death are easily prevented through positive lifestyle and behavioural choices. However, interpersonal violence and unintended injuries can also be avoided through government doing more to ensure the safety of adolescents. South Africa has one of the lowest percentages of paved roads at 21%. This is lower than Sub-Saharan Africa (25%) and low income countries (30%) (Bogetic and Fedderke, 2005). In the period 2001 – 2006, 27, 772 deaths were recorded nationwide due to road traffic accidents in South Africa (Stats SA, 2009b). Studies in South Africa have found alcohol consumption to be strongly associated with road traffic deaths (about 46,5%) (Norman et al., 2007b, Plüddemann et al., 2004) . Thus better road infrastructure in the form of tarred streets, working traffic robots and apprehension of drunk drivers, will bring down mortality due to road accidents.

Finally, policy should address any outstanding access to healthcare issues adolescents in South Africa may face. This is identified as a major aim of the Policy on Quality in Health Care for South Africa (NDH, 2007). Policy should take into account the challenges faced by low income households and rural communities, in light of the effect these areas have on adolescent mortality. Healthcare availability and utilization in such areas should be carefully mapped and better understood. In addition, the type of care available to low income and rural communities should be kept in mind. This study has shown a high burden of disease among adolescents in the country, in particular Tuberculosis, influenza and pneumonia. Therefore healthcare facilities, nationwide, need to be equipped to treat symptoms of these diseases.

9.2.3 Technical recommendations

The type of information requested on surveys and Death Notification Forms in the country requires further revision. The latest version of the form is DHA-1663 which is similar to the form used in this analysis (see Appendix 7). First, information regarding the deceased's parents, households and communities are not collected on Death Notification Forms. These characteristics provide contextual background into the deceased living conditions and can be useful in identifying further determinants of mortality. Since households have their own characteristics, community influences may be altered when filtered to individuals. This is why characteristics of the household head, resources and assets in the household are so important. These vary between households, even if the households are all situated within the same community. Therefore the influence of these variations needs to be examined in relation to individuals and mortality outcomes. This is also significant as it measures which structure exerts the greatest amount of influence on individuals, whether it is the community or the household. Different disciplines have argued separately in this regard. For adolescent mortality outcomes in South Africa, the data is needed in order to verify a perspective.

Second, since 1991, information regarding population group or race is collected on Death Notification Forms but not made available in the public domain. Given the political transition of the time and the fact that race was used to separate the South African population, this is understandable. In addition, the Census 2001 and Community Survey 2007 did not collect information regarding the race of the deceased. Racial inequality is a major aspect of South Africa's political history and little research was done on previously disadvantaged racial groups in the past. Further, race is commonly used as a proxy measure for socioeconomic status in the country, making it an important demographic variable to study. Thus, given the extent to which race is a prominent feature in South Africa, there is need to examine if any racial differences exist in the adolescent mortality of contemporary South Africa. For this reason, race should be included in the same way that age and sex are adopted as purely demographic variables, in the description of adolescent mortality trends in the country.

9.2.4 Frontiers of further research

This study has provided quantitative results on the levels, causes and determinants of adolescent mortality in South Africa. However, further research is needed on adolescent health and survival in order to fully understand the dynamics of mortality in the country. The following are suggested as areas of future research:

1. There is need to investigate the role of parents and care- givers in the survival of adolescents. Based on the assumption that adolescents are to varying degrees reliant on parents for financial and social care, there is need to understand the exact extent to which parents and care- givers are able to support and develop adolescents. Through a better understanding of parents financial capabilities and the nature of their relationship with their adolescent offspring, better programmes can be designed to incorporate parents and care-givers at the appropriate level.
2. Research needs to vigorously identify and address the behaviours of adolescents that place them at higher risk of mortality. Some of the specific behaviours that should be

examined are smoking, alcohol and drug abuse, exposure to unsafe work environments and exposure to unsafe living conditions (exposed live wires in the home, domestic violence, etc). Policy and programmes will be better equipped to advise on adolescent survival if there is more information on the behaviours that are increasing adolescents' risks of mortality. Further, since some situations are not controlled by adolescents themselves, such as work and living conditions, policy would benefit from having a comprehensive understanding of the various environments that place adolescents at higher mortality risk.

3. There is need for research to study the knowledge, attitudes and perceptions around healthcare utilization among adolescents in the country. Adolescent mortality due to diseases such as Tuberculosis, influenza and pneumonia (and other communicable diseases) can be easily prevented and treated through healthcare utilization. Therefore research is needed on why adolescents are not accessing these services, based on the mortality from infectious and communicable disease findings presented here. Through understanding adolescents' perceptions of healthcare (facilities, workers, etc) and what they know about their health status, programmes can be placed in schools to debunk healthcare myths and encourage healthcare utilization.
4. A study should be done on the misclassification of suicide and self- harm deaths in the country. Studies have already shown that HIV/AIDS in the country have been misclassified. This is in part due to the stigma of the disease. Suicide is equally stigmatised in African societies and it is assumed that these deaths would also be misclassified in South Africa. Suicide is in fact recognised as a large contributor to

adolescent and youth mortality in other countries (Portzky et al., 2005, Van Heeringen, 2001). Literature has argued that this is because of the transitional phase from child to adulthood and the trauma and instability that this can cause in adolescents (McKeown et al., 1998). This gives rise to a need to test the data accuracy of Death Notification Forms with specific reference then to suicide and self- harm, to see if South African adolescents are equally affected as others around the world. Related to this is the issue of ill-defined causes of death. There is need to address the large proportions of ill-defined causes of death in the country. Without addressing this, informed recommendations about the infectious and communicable disease burden on mortality in South Africa cannot be made.

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Synopsis of mortality literature from South Africa

Table 0.1

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
1	Family environmental factors as correlates for adolescent suicidal behaviours in the Limpopo province of South Africa	Madu and Matla (2004)	Primary data collection from all secondary schools in Pietersburg, Limpopo	Frequency tables, chi-square and logistic regression	Families	Conflict in a family correlated with suicidal behaviour; family independence and organization correlate negatively with suicidal behaviour	Lacks information regarding the types of suicidal behaviour and cannot draw causal information from the correlation statistics presented. Consider a longitudinal study design for this type of work
2	Health, Morbidity and Mortality: the health status of the South African population	Redelinghuys, et al (2004)	Department of Health; SADHS; NIMSS	IMR; under- five mortality; cause-specific mortality; age-specific mortality		HIV/AIDS remains a leading cause of death of 0-14 year olds in South Africa. The age- group 5-19 years old is among the lowest mortality risk of any age-group. Risky sexual behaviour is a risk factor of morbidity and mortality for adolescents – with about 70% of South Africans having their first sexual encounter before the age	The paper does not offer a comprehensive examination of risk factors and determinants of adolescent mortality in South Africa. There is need for inferential analysis of a broad scope of determinants.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
						of 20 years.	
3	Impacts of Prime-age adult mortality on labour supply: Evidence from Adolescents and women in South Africa	Yamauchi, et al (2008)	KwaZulu Natal Income Dynamics Study	Probit analysis	Individual	Deaths of prime-age adults significantly increase both male and female adolescents' labour force participation as they stop their schooling. Secondly, the death of prime-age adults in general also decreases school enrolment and female adults tend to join the labour force following the death of prime-age adult males.	This study is based on the findings from 1 South African province – KwaZulu Natal. There is need for a national study on the impacts of mortality on labour supply and its implications for women and adolescents
4	Youth and Well-Being: A South African Case Study	Makiwane & Kwizera (2009)	Status of the Youth dataset & South African Social Attitudes Survey; Statistics SA	Frequency tables, proportion distributions, mortality rates	Households	Overall the quality of life among majority of young people remains low, reflecting the historical racial cleavages of South African society	There is no focus on specific health conditions such as malnutrition Determinants of health and well-being are not clearly shown in the paper.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
5	Mortality from external causes in South African adolescents, 1984- 1986	Flisher, et al (1992)	Central Statistics Services	Mortality rates; cause of death analysis	Individual	The study found that the mortality of Coloured adolescents was 1.7 that of their White counterparts. The study noted that the mortality of Black adolescents was not included in the analysis because of inaccurate data at the time. A main result of the paper was that adolescent mortality was high and that many deaths were a result of risky behaviour.	Study is outdated – does not include analysis of the African/ Black population since the data pertains to the Apartheid era. Determinants of external causes of death are not investigated – the socioeconomic characteristics of those most affected is not analysed in this study.
6	Estimates of provincial fertility and mortality in South Africa, 1985- 1996	Dorrington, et al (2004)	1996 Census; 1998 SADHS; Statistics SA; ASSA2000	IMR, under-five mortality rate, adult mortality rate	Households	Child mortality declined from 1986 – 1992 and thereafter increased. Significant differences in adult mortality exist per province. There are differences in adult mortality estimates between different data sources	Adults and children are examined autonomously, but adolescents are not included in the analysis.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
7	Determinants of health and their trends	Bradshaw (2008)	Statistics SA Community Surveys, SADHS	Frequency distributions, proportional change over the years	Household	Uncertainty about the exact levels of mortality and the causes, it is clear that the health of the South African population has worsened; South Africa can be considered to have a quadruple burden of disease including, diseases and conditions related to poverty and under-development, chronic diseases, injuries and HIV and AIDS	Inequalities in health status have not been well documented, but nonetheless differentials have been observed between population groups, wealth groups, urban-rural and education levels. Small area statistics are largely missing, but where available indicate large mortality differentials.
8	Reversal in adult mortality trends in South Africa	Bradshaw, et al (2000)	1996 Census; surveys	Age-specific mortality rates	Household	Between the early 1990s and 1997, men's probability of dying between exact ages 15 and 60 increased from 30-35 per cent to about 45 per cent. During the same period, women's probability of dying in this age range increased from 15-20 per cent to about 30 per cent;	Determinants of infection and mortality are not examined in this study.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
						The rise in mortality in the country is due to HIV/AIDS	
9	Mortality patterns of chronic diseases of lifestyle in South Africa	Bradshaw, et al (2005)	South African National Burden of Disease (SA NBD)	Frequency tables, age-standardized death rates, age- specific death rates	Individuals	No complete historical South African cause of death data available to observe clear, overall health transition trends and more specifically, transition patterns; South Africa is in the midst of the health transition. Compared with the whites, the African population is earlier in the transition, while the coloured group may be in the additional stage of the transition; The poorer provinces appear to be in the earlier stages of the transition with high mortality from stroke.	The available data do not allow clear classification of the economic differences within the groups and consequent variation in the health transitional stage.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
10	Every death counts: use of mortality audit data for decision making to save the lives of mothers, babies, and children in South Africa	Patterson, et al (2008) for the 'South Africa Every Death Counts Writing Group'	National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD); Perinatal Problem Identification Programme,Child Healthcare Problem Identification Programme	Maternal mortality rate, infant mortality rate, child mortality rate		The country is off -track for the health-related Millennium Development Goals. Mortality in children younger than 5 years has increased, whereas maternal and neonatal mortality remain constant. This situation indicates the challenge of strengthening the health system because of high inequity and HIV/AIDS.	The study used data from 164 national health facilities – the location of these facilities (province and rural/urban) is unknown.
11	Identifying deaths from AIDS in South Africa	Groenewald, et al (2005)	Retrospective analysis of vital registration data	Cause- specific death rates	Individual	As a large proportion of AIDS deaths appear to be classified to AIDS related conditions, without reference to HIV, interpretation of death statistics in South	This study acknowledges that classification of AIDS deaths in the country remains a problem

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
						Africa cannot be made on face value as a large proportion of deaths caused by HIV infection are misclassified.	
12	Levels and causes of adult mortality in rural South Africa: the impact of HIV/ AIDS	Hosegood, et al (2004)	Africa Centre Demographic Information System	Verbal Autopsy		In 2000 the probability of dying between ages 15 and 60 was 58% for women and 75% for men. AIDS, with or without tuberculosis, is the leading cause of death in adulthood (48%). Injuries, mostly resulting from road traffic accidents or violence, cause 20% of deaths of men aged 15–44 years. In the age group 60 years or more, non-communicable diseases account for 76 and 71% of deaths of women and men respectively.	Only adult mortality was investigated There is no interrogation of the background, socioeconomic and health differences between adolescents and adults in the country

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
13	Mortality trends in a new South Africa: hard to make a fresh start	Kahn, et al (2007)	Agincourt DSS	Age-specific mortality rates; under- five mortality rates; life expectancy	Community	Findings demonstrate significant increases in mortality for both sexes since the mid-1990s, with a rapid decline in life expectancy of 12 years in females and 14 years in males. The increases are most prominent in children (0–4) and young adult (20–49) age groups, in which increases of two- and fivefold respectively have been observed in the past decade. Sex differences in mortality patterns are evident with increases more marked in females in most adult age groups.	The DSS findings are not generalisable – there is need for a national study of the trends of mortality in South Africa
14	Maternal mortality associated with tuberculosis-HIV-1 co-	Khan, et al (2001)	Hospital data from January 1996- December 1998 was analysed	Estimation of attributable fraction of maternal deaths; cross-sectional	Individual	The attributable fraction of overall deaths as a result of HIV- 1 was 15.9% Fourteen of the 15 mothers with tuberculosis were HIV-1 co-infected.	Maternal education was considered in the profile analysis but was not elaborated on to determine survival probabilities of the different ages of women

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
	infection in Durban, South Africa			analysis of deaths of HIV positive and negative women		The mortality rate for tuberculosis and HIV-1 co-infection was 121.7/1000; for tuberculosis without HIV-1 co-infection, 38.5/1000. Fifty-four per cent of maternal deaths caused by tuberculosis were attributable to HIV-1 infection. Thirty-five per cent of maternal deaths were associated with stillbirths; perinatal outcomes	
15	Violence and injuries in South Africa: prioritising an agenda for prevention	Seedat, et al (2009)	National Injury Mortality Surveillance System	Frequency tables; cause of death mortality rates	Individual	Violence and injuries are the second leading cause of death and lost disability-adjusted life years in South Africa. South Africa's injury death rate is nearly twice the global average.	The distribution of deaths across the provinces and racial groups are unknown

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
						The high injury death rate is driven mainly by interpersonal and gender-based violence, followed by traffic injuries, self-inflicted injuries, and other unintentional injuries arising from fires, drowning, and falls. The social factors driving the problem include poverty and unemployment, patriarchal notions of masculinity, vulnerabilities of families and exposure to violence in childhood, widespread access to firearms, alcohol and drug misuse, and a weak culture of enforcement and failure to uphold safety as a basic right	

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
16	Mortality and causes of death in South Africa, 1997 – 2003: Findings from death notification	Stats SA (2005)	Department of Home Affairs	Frequency and distribution tables; age-specific mortality; cause-specific mortality	Individual	The number of reported deaths has been increasing steadily, which is partly associated with population growth and with improved notification. The proportion of deaths in the age group 20-49 is increasing. While an increasing number of deaths are associated with lifestyle diseases (such as heart disease and diabetes) as the underlying cause, the dominant contributors to the growth in mortality are deaths associated with tuberculosis, and influenza and pneumonia. Malnutrition was among the ten leading causes of death among children aged under 4 years old.	Comprehensive report of the trends and distribution of mortality in the country, but there are no inferential statistics. This should be the next stage, to estimate probabilities of survival and hazard ratios for the respective populations at risk. This should also be done using a multilevel approach, combining determinants from different social strata is important to mortality outcome studies.
17	Mid- year	Stats SA (2011)	Statistics SA	All key	National		This report provides a good

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
	population estimates			demographic indicators – mortality, fertility and migration rates		The mid-year population as 50.59 million. Approximately fifty-two per cent (approximately 26.07 million) of the population is female. Gauteng comprises the largest share of the South African population. Nearly one-third (31.3%) of the population is aged younger than 15 years and approximately 7.7% (3.9 million) is 60 years or older. Of those younger than 15 years, approximately 23% (3.66 million) live in KwaZulu-Natal and 19.4% (3,07 million) live in Gauteng. Life expectancy at birth for 2011 is estimated at 54.9 years for males and 59.1 years for females. The infant mortality rate for 2011 is estimated at 37.9.	quantitative overview of the demographics of South Africa. There is need for more contextual analysis of the findings though. There is need for an examination of the determinants of mortality in the country.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
18	Revealing the full extent of households' experiences of HIV and AIDS in rural South Africa	Hosegood, et al (2007)	Primary data collection – interviews from 2002 - 2004	Qualitative analysis of interviews – thematic analysis	Households	While over 50% of all adult deaths are due to AIDS, households continue to face other causes of illness and death. The study shows how these other causes compound the impact of AIDS, particularly where the deceased was the main income earner and/or primary carer for young children. HIV-related illness and AIDS deaths of household members are only part of the households' cumulative experience of HIV and AIDS. Illness and death of non-household members, for example, former partners who are parents of children within the households or relatives who provide financial support, also	Study was based on the experiences of 12 households – this sample is too small to be generalizable. There is need for a quantitative study to substantiate these findings

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
						impact negatively on households	
19	Spatial and Temporal Clustering of Mortality in Digkale HDSS in rural northern South Africa.	Kanjala et al. (2010)	Digkale HDSS, South Africa.	Frequency tables; Poison regression; Space-time clustering	Community	Mortality in the region is high and attributed to HIV/ AIDS	DSS findings are not generalizable – there is need for a national study on this in South Africa
20	Early antiretroviral therapy and mortality among HIV infected infants	Violari, et al (2008)	Records from two hospitals in South Africa	Randomised control trial; Cox-proportional hazards model	Individual	Early HIV diagnosis and early antiretroviral therapy reduced early infant mortality by 76% and HIV progression by 75%.	Despite the hospital being selected being two of the largest in the country, these are urban hospitals. The study excludes HIV treatment being offered in rural areas. There is need for assessment in rural areas, since infection and mortality rates are high there too.
21	The status of child health in South Africa	Sanders & Bradshaw (2010)	Surveys, Census and Vital Registration	Frequency tables; Under-five mortality rates estimates		There has been a downward trend in child mortality from the 1980s but was reversed in the 1990s.	This study gives an overview of the mortality and health of children in the country but no determinants are examined and no inferential statistics are

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
						Injuries account for a growing proportion of the total deaths as children grow older, and accounted for 50% of the deaths of 15 – 17-year-old boys. A study of the causes of fatal injuries in selected cities shows that the leading causes were road traffic injuries, drowning, burns and, in some cities, firearm injuries.	given on the relationship between different determinants and mortality outcomes in South Africa.
22	Child mortality and socioeconomic status: an examination of differentials by migrant status in South	Thomas (2007)	1996 South Africa Census	Binomial regression	Individual	Among migrants, child mortality decreased faster as socioeconomic status increased than among non-migrants. The results also show a crossover in the likelihood of child mortality by immigration	This study is out-dated – there is need for new research regarding this topic.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
	Africa					status as socioeconomic status increased. In the poorest socioeconomic quintiles immigrants had a greater likelihood of child mortality than the native born while in the wealthiest quintiles child mortality was greater among the native-born.	Other than migrant status – no other demographic and socioeconomic determinants of child mortality are analysed in this study.
23	Trends and racial differences in infant mortality in South Africa	Bugard & Treiman (2006)	SADHS	Logistic regression	Household	Persistent inequalities in the personal and household resources of South Africa's four main racial groups substantially account for racial differences in infant survival rates in both periods.	This study only examines infants and should be extended to children, adolescents and adults.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
24	AIDS mortality and the mobility of children in KwaZulu Natal, South Africa	Ford & Hosegood (2005)	Africa Centre Demographic Information System	Logistic Regression	Individual	Child mobility following maternal deaths from AIDS was lower than child mobility following maternal deaths from other causes. Younger children, boys and children whose mothers or fathers were resident members of the children's households were also less likely to move	This analysis is based on findings from DSS which is not generalizable – there should be a national study of the AIDS mortality and mobility of children in South Africa
25	Progress for meeting child survival targets in South Africa	Health-e (2008)		Under- five mortality rates		Under- five mortality in South Africa is rising. The proximal underlying factors for common childhood infections include: inadequate sanitation; poor hygiene practices and poorly ventilated and crowded living spaces. Distal risk factors include lack of resources such as financial, physical, educational or organisational	Data source is not specified and although the underlying determinants of child mortality are offered, there is no analysis of the quantified relationship between child mortality and the underlying and distal determinants.

S/N	Title	Author(s) & year	Data Source	Method	Level of Analysis	Findings	Missing Gaps
26	Health status and Determinants	Bradshaw, et al (2001)	Census, SADHS, National Injury Surveillance System	Life expectancy, TFR, IMR, under-five mortality rate; relative risk; cause-specific death rates		AIDS epidemic remains a challenge in South Africa. There is need to target youth and focus on promoting safe sexual practices, preventing smoking, alcohol abuse and violence	More inferential analysis of mortality data needs to be done. Generating hazard ratios and survival probabilities would assist in a more comprehensive understanding of health and determinants in the country.

Appendix 1: ICD- 10 Classifications (AAPC, 2011)

Certain infectious and parasitic diseases **A00-B99** >

Use Additional
- code to identify resistance to antimicrobial drugs (Z16-)

Type 1 Excludes
- certain localized infections - see body system-related chapters
- infectious and parasitic diseases complicating pregnancy, childbirth and the puerperium (O98.-)
- influenza and other acute respiratory infections (J00-J22)

Type 2 Excludes
- carrier or suspected carrier of infectious disease (Z22.-)
- infectious and parasitic diseases specific to the perinatal period (P35-P39)

Includes
- diseases generally recognized as communicable or transmissible

- A00-A09 Intestinal infectious diseases
- A15-A19 Tuberculosis
- A20-A28 Certain zoonotic bacterial diseases
- A30-A49 Other bacterial diseases
- A50-A64 Infections with a predominantly sexual mode of transmission
- A65-A69 Other spirochetal diseases
- A70-A74 Other diseases caused by chlamydiae
- A75-A79 Rickettsioses
- A80-A89 Viral and prion infections of the central nervous system
- A90-A99 Arthropod-borne viral fevers and viral hemorrhagic fevers
- B00-B09 Viral infections characterized by skin and mucous membrane lesions
- B10-B10 Other human herpesviruses
- B15-B19 Viral hepatitis
- B20-B20 Human immunodeficiency virus [HIV] disease
- B25-B34 Other viral diseases
- B35-B49 Mycoses
- B50-B64 Protozoal diseases
- B65-B83 Helminthiases
- B85-B89 Pediculosis, acariasis and other infestations
- B90-B94 Sequelae of infectious and parasitic diseases
- B95-B97 Bacterial and viral infectious agents
- B99-B99 Other infectious diseases

Endocrine, nutritional and metabolic diseases E00-E89 >

Note

- All neoplasms, whether functionally active or not, are classified in Chapter 2. Appropriate codes in this chapter (i.e. E05.8, E07.0, E16-E31, E34.-) may be used as additional codes to indicate either functional activity by neoplasms and ectopic endocrine tissue or hyperfunction and hypofunction of endocrine glands associated with neoplasms and other conditions classified elsewhere.

Type 1 Excludes

- transitory endocrine and metabolic disorders specific to newborn (P70-P74)

- E00-E07 Disorders of thyroid gland
- E08-E13 Diabetes mellitus
- E15-E16 Other disorders of glucose regulation and pancreatic internal secretion
- E20-E35 Disorders of other endocrine glands
- E36-E36 Intraoperative complications of endocrine system
- E40-E46 Malnutrition
- E50-E64 Other nutritional deficiencies
- E65-E68 Overweight, obesity and other hyperalimentation
- E70-E88 Metabolic disorders
- E89-E89 Postprocedural endocrine and metabolic complications and disorders, not elsewhere classified

Diseases of the nervous system G00-G99 >

Type 2 Excludes

- certain conditions originating in the perinatal period (P04 -P96)
- certain infectious and parasitic diseases (A00-B99)
- complications of pregnancy, childbirth and the puerperium (O00-O9A)
- congenital malformations, deformations, and chromosomal abnormalities (Q00-Q99)
- endocrine, nutritional and metabolic diseases (E00 -E88)
- injury, poisoning and certain other consequences of external causes (S00-T88)
- neoplasms (C00-D49)
- symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00 -R94)

- G00-G09 Inflammatory diseases of the central nervous system
- G10-G14 Systemic atrophies primarily affecting the central nervous system
- G20-G26 Extrapyramidal and movement disorders
- G30-G32 Other degenerative diseases of the nervous system
- G35-G37 Demyelinating diseases of the central nervous system
- G40-G47 Episodic and paroxysmal disorders
- G50-G59 Nerve, nerve root and plexus disorders
- G60-G65 Polyneuropathies and other disorders of the peripheral nervous system
- G70-G73 Diseases of myoneural junction and muscle
- G80-G83 Cerebral palsy and other paralytic syndromes
- G89-G99 Other disorders of the nervous system

Diseases of the circulatory system **I00-I99** >

Type 2 Excludes

- certain conditions originating in the perinatal period (P04 -P96)
- certain infectious and parasitic diseases (A00-B99)
- complications of pregnancy, childbirth and the puerperium (O00-O9A)
- congenital malformations, deformations, and chromosomal abnormalities (Q00-Q99)
- endocrine, nutritional and metabolic diseases (E00 -E88)
- injury, poisoning and certain other consequences of external causes (S00-T88)
- neoplasms (C00-D49)
- symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00 -R94)
- systemic connective tissue disorders (M30-M36)
- transient cerebral ischemic attacks and related syndromes (G45.-)

- I00-I02 Acute rheumatic fever
- I05-I09 Chronic rheumatic heart diseases
- I10-I15 Hypertensive diseases
- I20-I25 Ischemic heart diseases
- I26-I28 Pulmonary heart disease and diseases of pulmonary circulation
- I30-I52 Other forms of heart disease
- I60-I69 Cerebrovascular diseases
- I70-I79 Diseases of arteries, arterioles and capillaries
- I80-I89 Diseases of veins, lymphatic vessels and lymph nodes, not elsewhere classified
- I95-I99 Other and unspecified disorders of the circulatory system

Diseases of the respiratory system J00-J99 >

Note

- When a respiratory condition is described as occurring in more than one site and is not specifically indexed, it should be classified to the lower anatomic site (e.g. tracheobronchitis to bronchitis in J40).

Use Additional

- code, where applicable, to identify:
- exposure to environmental tobacco smoke (Z77.22)
- exposure to tobacco smoke in the perinatal period (P96.81)
- history of tobacco use (Z87.891)
- occupational exposure to environmental tobacco smoke (Z57.31)
- tobacco dependence (F17.-)
- tobacco use (Z72.0)

Type 2 Excludes

- certain conditions originating in the perinatal period (P04-P96)
- certain infectious and parasitic diseases (A00-B99)
- complications of pregnancy, childbirth and the puerperium (O00-O9A)
- congenital malformations, deformations and chromosomal abnormalities (Q00-Q99)
- endocrine, nutritional and metabolic diseases (E00-E88)
- injury, poisoning and certain other consequences of external causes (S00-T88)
- neoplasms (C00-D49)
- smoke inhalation (T59.81-)
- symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R94)

- J00-J06 Acute upper respiratory infections
- J09-J18 Influenza and pneumonia
- J20-J22 Other acute lower respiratory infections
- J30-J39 Other diseases of upper respiratory tract
- J40-J47 Chronic lower respiratory diseases
- J60-J70 Lung diseases due to external agents
- J80-J84 Other respiratory diseases principally affecting the interstitium
- J85-J86 Suppurative and necrotic conditions of the lower respiratory tract
- J90-J94 Other diseases of the pleura
- J95-J95 Intraoperative and postprocedural complications and disorders of respiratory system, not elsewhere classified
- J96-J99 Other diseases of the respiratory system

Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified R00-R99 >

Note

- This chapter includes symptoms, signs, abnormal results of clinical or other investigative procedures, and ill-defined conditions regarding which no diagnosis classifiable elsewhere is recorded.
- Signs and symptoms that point rather definitely to a given diagnosis have been assigned to a category in other chapters of the classification. In general, categories in this chapter include the less well-defined conditions and symptoms that, without the necessary study of the case to establish a final diagnosis, point perhaps equally to two or more diseases or to two or more systems of the body. Practically all categories in the chapter could be designated 'not otherwise specified', 'unknown etiology' or 'transient'. The Alphabetical Index should be consulted to determine which symptoms and signs are to be allocated here and which to other chapters. The residual subcategories, numbered .8, are generally provided for other relevant symptoms that cannot be allocated elsewhere in the classification.
- The conditions and signs or symptoms included in categories R00-R94 consist of:
- (a) cases for which no more specific diagnosis can be made even after all the facts bearing on the case have been investigated:
- (b) signs or symptoms existing at the time of initial encounter that proved to be transient and whose causes could not be determined;
- (c) provisional diagnosis in a patient who failed to return for further investigation or care;
- (d) cases referred elsewhere for investigation or treatment before the diagnosis was made;
- (e) cases in which a more precise diagnosis was not available for any other reason;
- (f) certain symptoms, for which supplementary information is provided, that represent important problems in medical care in their own right.

Type 2 Excludes

- abnormal findings on antenatal screening of mother (O28.-)
- certain conditions originating in the perinatal period (P04-P96)
- signs and symptoms classified in the body system chapters
- signs and symptoms of breast (N63, N64.5)

- R00-R09 Symptoms and signs involving the circulatory and respiratory systems
- R10-R19 Symptoms and signs involving the digestive system and abdomen
- R20-R23 Symptoms and signs involving the skin and subcutaneous tissue
- R25-R29 Symptoms and signs involving the nervous and musculoskeletal systems
- R30-R39 Symptoms and signs involving the genitourinary system
- R40-R46 Symptoms and signs involving cognition, perception, emotional state and behavior
- R47-R49 Symptoms and signs involving speech and voice
- R50-R69 General symptoms and signs
- R70-R79 Abnormal findings on examination of blood, without diagnosis
- R80-R82 Abnormal findings on examination of urine, without diagnosis
- R83-R89 Abnormal findings on examination of other body fluids, substances and tissues, without diagnosis
- R90-R94 Abnormal findings on diagnostic imaging and in function studies, without diagnosis
- R97-R97 Abnormal tumor markers
- R99-R99 Ill-defined and unknown cause of mortality

External causes of morbidity V00-Y99 >

Note

- This chapter permits the classification of environmental events and circumstances as the cause of injury, and other adverse effects. Where a code from this section is applicable, it is intended that it shall be used secondary to a code from another chapter of the Classification indicating the nature of the condition. Most often, the condition will be classifiable to Chapter 19, Injury, poisoning and certain other consequences of external causes (S00-T88). Other conditions that may be stated to be due to external causes are classified in Chapters I to XVIII. For these conditions, codes from Chapter 20 should be used to provide additional information as to the cause of the condition.

- V00-V09 Pedestrian injured in transport accident
- V10-V19 Pedal cycle rider injured in transport accident
- V20-V29 Motorcycle rider injured in transport accident
- V30-V39 Occupant of three-wheeled motor vehicle injured in transport accident
- V40-V49 Car occupant injured in transport accident
- V50-V59 Occupant of pick-up truck or van injured in transport accident
- V60-V69 Occupant of heavy transport vehicle injured in transport accident
- V70-V79 Bus occupant injured in transport accident
- V80-V89 Other land transport accidents
- V90-V94 Water transport accidents
- V95-V97 Air and space transport accidents
- V98-V99 Other and unspecified transport accidents
- W00-W19 Slipping, tripping, stumbling and falls
- W20-W49 Exposure to inanimate mechanical forces
- W50-W64 Exposure to animate mechanical forces
- W65-W74 Accidental non-transport drowning and submersion
- W85-W99 Exposure to electric current, radiation and extreme ambient air temperature and pressure
- X00-X08 Exposure to smoke, fire and flames
- X10-X19 Contact with heat and hot substances
- X30-X39 Exposure to forces of nature
- X52-X58 Accidental exposure to other specified factors
- X71-X83 Intentional self-harm
- X92-Y09 Assault
- Y21-Y33 Event of undetermined intent
- Y35-Y38 Legal intervention, operations of war, military operations, and terrorism
- Y62-Y69 Misadventures to patients during surgical and medical care
- Y70-Y82 Medical devices associated with adverse incidents in diagnostic and therapeutic use
- Y83-Y84 Surgical and other medical procedures as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
- Y90-Y99 Supplementary factors related to causes of morbidity classified elsewhere

Appendix 2: Census and Community Survey life tables (both sexes combined)

Table 1: Complete Multiple Decrement Life Table, South Africa, 2001, Census

n	age	Population	Deaths	Unnatural Deaths	nax	nmx	nqx	npx	lx	ndx	Lx	Tx	ex
1	0	906121.2	59906.66	4756.666	0.152	0.066113	0.062603	0.937397	100000	6260.349	100951.5731	5928495	59.28495
4	1	3523318	29670	3543.333	1.605	0.008421	0.033018	0.966982	93739.65	3095.117	379926.2658	5827544	62.16733
5	5	4849976	8526.666	1756.667	2.275	0.001758	0.008749	0.991251	90644.53	793.0045	455026.7515	5447618	60.09869
5	10	5052183	6483.333	1566.667	2.843	0.001283	0.006399	0.993601	89851.53	574.929	450892.1673	4992591	55.5649
5	15	4982231	14510	5030	2.657	0.002912	0.014463	0.985537	89276.6	1291.213	449813.7509	4541699	50.87222
5	20	4289618	31986.66	9579.999	2.547	0.007457	0.036614	0.963386	87985.39	3221.505	448132.1084	4091885	46.50642
5	25	3927885	50710	10593.33	2.55	0.01291	0.062572	0.937428	84763.88	5303.855	437344.2419	3643753	42.98709
5	30	3338392	51530	8689.999	2.616	0.015436	0.074439	0.925561	79460.03	5914.897	412773.5073	3206409	40.35247
5	35	3074299	47660	7479.999	2.677	0.015503	0.074819	0.925181	73545.13	5502.584	382456.0717	2793635	37.98532
5	40	2607577	37020	5963.333	2.685	0.014197	0.068727	0.931273	68042.55	4676.336	352768.6966	2411179	35.43634
5	45	2088714	33363.33	4326.666	2.681	0.015973	0.077013	0.922987	63366.21	4880.024	329914.3953	2058410	32.48435
5	50	1641995	29036.66	3243.333	2.655	0.017684	0.084898	0.915102	58486.19	4965.375	305614.0055	1728496	29.55392
5	55	1202192	24016.66	2626.666	2.647	0.019977	0.095402	0.904598	53520.81	5106.014	281119.6773	1422882	26.58558
5	60	1070290	28733.33	2223.333	2.646	0.026846	0.126253	0.873747	48414.8	6112.503	258247.668	1141762	23.58292
5	65	788383.7	26020	1956.667	2.631	0.033004	0.153054	0.846946	42302.29	6474.548	228546.0053	883514.6	20.88574
5	70	626900.6	28683.33	1880	2.628	0.045754	0.206373	0.793627	35827.75	7393.897	198569.8916	654968.6	18.28104
5	75	369070.7	20190	1203.333	2.618	0.054705	0.241992	0.758008	28433.85	6880.752	160183.0579	456398.7	16.05124
5	80	271922.8	19976.67	916.6666	2.57	0.073464	0.311681	0.688319	21553.1	6717.701	125029.9799	296215.6	13.74353
5	85	160849.3	23786.66	1043.333	6.539	0.147882	0.957275	0.042725	14835.4	14835.4	171185.6461	171185.6	11.539
	Total	44771918	571809.9	78379.99							5928495.461		

Table 2: Associated Single Decrement Life Table, South Africa, 2001, Census

n	age	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	0	0.9206	0.9422	0.0578	100000	5777.93	0.154151	100890.7	6342192	63.42
4	1	0.8806	0.9709	0.0291	94222.07	2744.98	1.609772	381307.1	6241302	66.24
5	5	0.7940	0.9930	0.0070	91477.09	635.99	1.745322	458495.5	5859995	64.06
5	10	0.7584	0.9951	0.0049	90841.11	441.14	2.60408	455354.3	5401499	59.46
5	15	0.6533	0.9905	0.0095	90399.96	856.37	2.954504	454530	4946145	54.71
5	20	0.7005	0.9742	0.0258	89543.59	2309.43	2.8149	454218.7	4491615	50.16
5	25	0.7911	0.9502	0.0498	87234.16	4347.12	2.63674	447633	4037396	46.28
5	30	0.8314	0.9377	0.0623	82887.04	5162.66	2.523612	427463.8	3589763	43.31
5	35	0.8431	0.9365	0.0635	77724.38	4932.24	2.460215	400756.3	3162299	40.69
5	40	0.8389	0.9420	0.0580	72792.14	4220.77	2.484573	374447.5	2761543	37.94
5	45	0.8703	0.9326	0.0674	68571.37	4619.69	2.528221	354536.4	2387096	34.81
5	50	0.8883	0.9242	0.0758	63951.68	4846.56	2.518465	331964.3	2032559	31.78
5	55	0.8906	0.9146	0.0854	59105.12	5049.24	2.561161	308457.5	1700595	28.77
5	60	0.9226	0.8829	0.1171	54055.88	6328.87	2.557523	286465.6	1392137	25.75
5	65	0.9248	0.8576	0.1424	47727.01	6796.71	2.549724	255964.8	1105672	23.17
5	70	0.9345	0.8057	0.1943	40930.3	7951.06	2.520117	224689.1	849706.9	20.76
5	75	0.9404	0.7706	0.2294	32979.24	7564.47	2.490852	183738.2	625017.8	18.95
5	80	0.9541	0.7002	0.2998	25414.77	7618.91	2.755895	148070.7	441279.7	17.36
5	85	0.9561	0.0491	0.9509	17795.86	16922.76	12.06834	293208.9	293208.9	16.48
	Total							6342192		

Table 3: Complete Multiple Decrement Life Table, South Africa, 2007, CS

n	**age**	**Population**	**Deaths**	**Unnatural Deaths**	**nax**	**nmx**	**nqx**	**npx**	**lx**	**ndx**	**Lx**	**Tx**	**ex**
1	0	1,003,597	59,279	5,099	0.152	0.059067	0.056249	0.943751	100000	5624.928	100854.989	5663302	56.63302
4	1	3,981,579	30,267	4,085	1.605	0.007602	0.029863	0.970137	94375.07	2818.349	382023.7389	5562447	58.93979
5	5	5,116,814	9,486	2,606	2.275	0.001854	0.009223	0.990777	91556.72	844.4247	459704.6816	5180423	56.58157
5	**10**	**4,947,002**	**6,522**	**2,507**	**2.843**	**0.001318**	**0.006573**	**0.993427**	**90712.3**	**596.2305**	**455256.5755**	**4720718**	**52.04056**
5	**15**	**5,093,139**	**15,815**	**6,438**	**2.657**	**0.003105**	**0.015414**	**0.984586**	**90116.07**	**1389.036**	**454271.0083**	**4265462**	**47.33298**
5	20	4,791,808	36,974	11,165	2.547	0.007716	0.037864	0.962136	88727.03	3359.582	452192.0144	3811191	42.95411
5	25	4,064,793	61,769	13,046	2.55	0.015196	0.073254	0.926746	85367.45	6253.483	442783.6318	3358999	39.34754
5	30	3,738,488	75,306	12,399	2.616	0.020144	0.096103	0.903897	79113.97	7603.072	415459.4707	2916215	36.86094
5	35	3,217,631	71,327	10,418	2.677	0.022168	0.10541	0.89459	71510.89	7537.935	377733.5241	2500756	34.97028
5	40	2,835,298.10	61,124.04	7,982.92	2.685	0.021558	0.102667	0.897333	63972.96	6567.934	337499.7018	2123022	33.18624
5	45	2,408,282	48,375	6,791	2.681	0.020087	0.095965	0.904035	57405.03	5508.883	301794.4411	1785523	31.10394
5	50	1,967,385	46,310	6,337	2.655	0.023539	0.111538	0.888462	51896.14	5788.393	274848.8976	1483728	28.59034
5	55	1,566,153	35,189	4,149	2.647	0.022468	0.106701	0.893299	46107.75	4919.74	243561.2992	1208879	26.21857
5	60	1,157,685	33,187	3,483	2.646	0.028667	0.134274	0.865726	41188.01	5530.488	220573.7208	965317.9	23.43687
5	65	962,195.84	31,167.07	2,916.82	2.631	0.032392	0.150416	0.849584	35657.52	5363.454	192398.8602	744744.2	20.88603
5	70	665,095.32	29,036.35	2,150.77	2.628	0.043657	0.197803	0.802197	30294.07	5992.273	167218.0351	552345.3	18.23279
5	75	480,086.35	26,830.14	1,383.48	2.618	0.055886	0.246602	0.753398	24301.8	5992.883	137198.3475	385127.3	15.84769
5	80	263,796.01	21,052.35	589.79	2.57	0.079805	0.334214	0.665786	18308.91	6119.093	107270.6332	247929	13.54144
5	85	241,236.61	29,417.51	1,630.39	6.539	0.121945	0.750588	0.249412	12189.82	12189.82	140658.3272	140658.3	11.539
	Total	48502064.23	728435.8	105176.4							5663301.898		

Table 4: Associated Single Decrement Life Table for unnatural causes of death, South Africa, 2007, CS

n	age	R-i	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	0	0.9140	0.9485	0.0515	100000	5153.81	0.154089	100794.1	6054007	60.54
4	1	0.8651	0.9741	0.0259	94846.19	2455.18	1.609871	383337.3	5953213	62.77
5	5	0.7252	0.9933	0.0067	92391.01	618.78	1.798564	463068	5569876	60.29
5	**10**	**0.6156**	**0.9959**	**0.0041**	**91772.23**	**371.81**	**2.622813**	**459836.3**	**5106808**	**55.65**
5	**15**	**0.5929**	**0.9908**	**0.0092**	**91400.43**	**837.96**	**3.006113**	**459521.1**	**4646971**	**50.84**
5	20	0.6980	0.9734	0.0266	90562.46	2407.51	2.871792	459726.2	4187450	46.24
5	25	0.7888	0.9418	0.0582	88154.96	5134.41	2.674969	454509.2	3727724	42.29
5	30	0.8353	0.9191	0.0809	83020.55	6719.64	2.555461	432274.5	3273215	39.43
5	35	0.8539	0.9093	0.0907	76300.92	6923.27	2.48544	398711.9	2840940	37.23
5	40	0.8694	0.9101	0.0899	69377.65	6235.78	2.443937	362128.1	2442229	35.20
5	45	0.8596	0.9169	0.0831	63141.87	5245.21	2.475483	328693.8	2080100	32.94
5	50	0.8632	0.9030	0.0970	57896.65	5618.51	2.489155	303468.6	1751407	30.25
5	55	0.8821	0.9053	0.0947	52278.14	4952.74	2.504686	273795.8	1447938	27.70
5	60	0.8951	0.8789	0.1211	47325.4	5729.90	2.527656	251110.2	1174142	24.81
5	65	0.9064	0.8626	0.1374	41595.49	5713.38	2.532596	222447.2	923032	22.19
5	70	0.9259	0.8154	0.1846	35882.12	6623.83	2.537037	196215.5	700584.9	19.52
5	75	0.9484	0.7645	0.2355	29258.29	6890.95	2.520587	163660.7	504369.4	17.24
5	80	0.9720	0.6734	0.3266	22367.34	7304.79	2.617339	130955.8	340708.7	15.23
5	85	0.9446	0.2694	0.7306	15062.54	11005.22	12.21604	209752.9	209752.9	13.93
	Total							6054007		

Appendix 3: Male life tables from Death Notification Forms, 2001 (by broad-underlying causes of death)

Table 1: Multiple decrement life table of South African males, all causes and events of undetermined intent (Y10-Y34), DNF

n	age	py	Dall	Y10- Y34	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	X	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	450,721	23,130	204	0.152	0.051318	0.0492	0.9508	100000	4919	95830	5514828	55.1	0.0004	43	7841	0.0005	0.99118	0.99998	0.0000	100000	3.548823	0.154151	100000.55	6196558.75	61.96559
4	4	1,763,682	5,876	525	1.605	0.003332	0.0132	0.9868	95082	1258	377320	5527062	58.1	0.0012	112	7,797	0.0003	0.910654	0.99998	0.0000	99997.81	2.32109	1.609772	399994.99	6096558.20	60.96692
5	5-9'	2,423,956	2,120	474	2.275	0.000875	0.0044	0.9956	93825	410	468013	5149742	54.9	0.0010	92	7,685	0.0002	0.776415	1.00000	0.0000	95080.74	1.502814	1.841439	475406.45	5696563.21	59.91291
5	10-14'	2,510,361	1,746	564	2.843	0.000696	0.0035	0.9965	93416	325	466382	4681730	50.1	0.0011	105	7,594	0.0002	0.676976	1.00000	0.0000	93824.73	1.70605	2.681779	469128.24	5221156.76	55.64798
5	15-19	2,454,402	4,471	1,950	2.657	0.001822	0.0091	0.9909	93091	845	463482	4215347	45.3	0.0040	368	7,489	0.0008	0.563856	0.99996	0.0000	93415.44	5.949814	2.929793	467094.66	4752028.53	50.86984
5	20-24	2,100,212	8,934	4,277	2.547	0.004254	0.0210	0.9790	92247	1943	456475	3751866	40.7	0.0101	930	7,121	0.0020	0.521267	0.99979	0.0002	93088.08	14.50084	2.76377	465480.47	4284933.87	46.03096
5	25-29	1,893,518	16,839	4,214	2.550	0.008893	0.0435	0.9565	90305	3931	441901	3295391	36.5	0.0109	983	6,191	0.0022	0.749748	0.99952	0.0005	92227.38	13.77803	2.610359	461172.84	3819453.40	41.41345
5	30-34	1,597,003	20,896	3,615	2.616	0.013085	0.0634	0.9366	86376	5481	418816	2853489	33.0	0.0110	948	5,208	0.0023	0.827	0.99928	0.0007	90261.64	11.78795	2.512049	451337.79	3358280.56	37.20607
5	35-39	1,438,600	21,078	2,782	2.677	0.014652	0.0708	0.9292	80896	5732	391167	2434673	30.1	0.0094	756	4,260	0.0019	0.868014	0.99931	0.0007	86313.47	8.237215	2.458183	431587.60	2906942.77	33.6789
5	40-44	1,230,608	19,326	2,418	2.685	0.015704	0.0758	0.9242	75164	5696	362641	2043506	27.2	0.0095	713	3,503	0.0020	0.874884	0.99925	0.0007	80840.05	6.883185	2.477746	404217.30	2475355.17	30.62041
5	45-49	962,809	17,887	1,822	2.681	0.018578	0.0891	0.9109	69469	6187	333003	1680865	24.2	0.0091	630	2,791	0.0019	0.898138	0.99915	0.0008	75108.25	5.280802	2.516831	375554.55	2071137.87	27.57537
5	50-54	770,793	16,885	1,388	2.655	0.021906	0.1042	0.8958	63283	6594	300957	1347862	21.3	0.0086	542	2,160	0.0018	0.917797	0.99906	0.0009	69410.6	3.890323	2.513732	347062.78	1695583.31	24.4283
5	55-59	551,195	14,551	984	2.647	0.026399	0.1243	0.8757	56690	7046	266876	1046905	18.5	0.0084	476	1,618	0.0018	0.932376	0.99889	0.0011	63223.3	2.889288	2.551552	316123.88	1348520.53	21.32949
5	60-64	447,621	15,102	620	2.646	0.033738	0.1563	0.8437	49645	7760	229964	780029	15.7	0.0064	319	1,142	0.0014	0.958946	0.99891	0.0011	56626.99	1.58183	2.550858	283139.00	1032396.65	18.23153
5	65-69	305,214	13,014	437	2.631	0.042639	0.1936	0.8064	41886	8112	190221	550065	13.1	0.0065	272	824	0.0014	0.966421	0.99860	0.0014	49590.89	1.179089	2.546266	247957.46	749257.65	15.10878
5	70-74	230,204	14,037	287	2.628	0.060976	0.2664	0.7336	33776	8997	147542	359844	10.7	0.0054	184	551	0.0012	0.979554	0.99831	0.0017	41827.89	0.687145	2.51667	209141.18	501300.18	11.98483
5	75-79	136,989	10,848	218	2.618	0.079189	0.3331	0.6669	24779	8255	104238	212302	8.6	0.0067	166	367	0.0016	0.979904	0.99729	0.0027	33718.85	0.584382	2.486279	168595.69	292159.01	8.664561
5	80+	139,601	17,810	217	6.539	0.127578	1.0000	0.0000	16525	16526	108064	108064	6.5	0.0122	201	201	0.0016	0.987816	0.00000	1.0000	24712.23	0.312976	6.838972	123563.32	123563.32	5.000087
	Total	21,407,489	244,550	27,161																					210684.66	

Table 2: Multiple decrement life table of South African males, all causes and assault (X85- Y09), DNF

n	age	py	Dall	x85-Y09	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	X	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	450,721	23,130	4	0.152	0.051318	0.0492	0.9508	100000	4919	95830	5514828	55.1	0.0000	1	864	0.0000	0.999827	1.00000	0.0000	100000	0.007663	0.154151	100000.00	6199361.25	61.99361
4	4	1,763,682	5,876	8	1.605	0.003332	0.0132	0.9868	95082	1258	377320	5527062	58.1	0.0000	2	863	0.0000	0.998639	1.00000	0.0000	99999.96	0.003913	1.609772	399999.83	6099361.25	60.99364
5	5-9'	2,423,956	2,120	8	2.275	0.000875	0.0044	0.9956	93825	410	468013	5149742	54.9	0.0000	2	861	0.0000	0.996226	1.00000	0.0000	95082.21	0.002841	1.841439	475411.05	5699361.41	59.94141
5	**10-14'**	2,510,361	1,746	28	**2.843**	**0.000696**	**0.0035**	**0.9965**	**93416**	**325**	**466382**	**4681730**	50.1	**0.0001**	**5**	859	**0.0000**	**0.983963**	**1.00000**	**0.0000**	**93825.13**	**0.009586**	**2.681779**	**469125.65**	**5223950.37**	55.67752
5	**15-19**	2,454,402	4,471	391	**2.657**	**0.001822**	**0.0091**	**0.9909**	**93091**	**845**	**463482**	**4215347**	45.3	**0.0008**	**74**	854	**0.0002**	**0.912548**	**0.99999**	**0.0000**	**93415.79**	**0.13608**	**2.929793**	**467079.35**	**4754824.71**	50.89958
5	20-24	2,100,212	8,934	653	2.547	0.004254	0.0210	0.9790	92247	1943	456475	3751866	40.7	0.0015	142	780	0.0003	0.926908	0.99997	0.0000	93090.76	0.242635	2.76377	465454.48	4287745.36	46.05984
5	25-29	1,893,518	16,839	571	2.550	0.008893	0.0435	0.9565	90305	3931	441901	3295391	36.5	0.0015	133	638	0.0003	0.966091	0.99993	0.0001	92244.13	0.192527	2.610359	461221.15	3822290.88	41.43668
5	30-34	1,597,003	20,896	458	2.616	0.013085	0.0634	0.9366	86376	5481	418816	2853489	33.0	0.0014	120	505	0.0003	0.978082	0.99991	0.0001	90299.45	0.144882	2.512049	451497.62	3361069.73	37.22137
5	35-39	1,438,600	21,078	356	2.677	0.014652	0.0708	0.9292	80896	5732	391167	2434673	30.1	0.0012	97	385	0.0002	0.98311	0.99991	0.0001	86367.71	0.095293	2.458183	431838.80	2909572.11	33.68819
5	40-44	1,230,608	19,326	238	2.685	0.015704	0.0758	0.9242	75164	5696	362641	2043506	27.2	0.0009	70	288	0.0002	0.987685	0.99993	0.0001	80888.5	0.055754	2.477746	404442.65	2477733.30	30.63146
5	45-49	962,809	17,887	184	2.681	0.018578	0.0891	0.9109	69469	6187	333003	1680865	24.2	0.0009	64	218	0.0002	0.989713	0.99991	0.0001	75158.85	0.04169	2.516831	375794.35	2073290.65	27.58545
5	50-54	770,793	16,885	109	2.655	0.021906	0.1042	0.8958	63283	6594	300957	1347862	21.3	0.0007	43	155	0.0001	0.993545	0.99993	0.0001	69463.42	0.021849	2.513732	347317.14	1697496.30	24.43727
5	55-59	551,195	14,551	59	2.647	0.026399	0.1243	0.8757	56690	7046	266876	1046905	18.5	0.0005	29	112	0.0001	0.995945	0.99993	0.0001	63278.21	0.011983	2.551552	316391.10	1350179.17	21.33719
5	60-64	447,621	15,102	34	2.646	0.033738	0.1563	0.8437	49645	7760	229964	780029	15.7	0.0004	17	83	0.0001	0.997749	0.99994	0.0001	56686.39	0.006334	2.550858	283431.97	1033788.07	18.23697
5	65-69	305,214	13,014	18	2.631	0.042639	0.1936	0.8064	41886	8112	190221	550065	13.1	0.0003	11	66	0.0001	0.998617	0.99994	0.0001	49642.02	0.003887	2.546266	248210.12	750356.10	15.11534
5	70-74	230,204	14,037	27	2.628	0.060976	0.2664	0.7336	33776	8997	147542	359844	10.7	0.0005	17	55	0.0001	0.998077	0.99984	0.0002	41884.05	0.006415	2.51667	209420.26	502145.98	11.98895
5	75-79	136,989	10,848	15	2.618	0.079189	0.3331	0.6669	24779	8255	104238	212302	8.6	0.0005	11	37	0.0001	0.998617	0.99981	0.0002	33770.41	0.004094	2.486279	168852.07	292725.72	8.668112
5	80+	139,601	17,810	28	6.539	0.127578	1.0000	0.0000	16525	16526	108064	108064	6.5	0.0016	26	26	0.0002	0.998428	0.00000	1.0000	24774.72	0.005211	6.838972	123873.64	123873.64	5.000001
	Total	21,407,489	244,550	3,189																					210684.66	

Table 3: Multiple decrement life table of South African males, all causes and ill-defined and unknown causes of mortality (R95-R99), DNF

n	age	py	Dall	R95-R99	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	x	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	450,721	23,130	614	0.152	0.051318	0.0492	0.9508	100000	4919	95830	5514828	55.1	0.0013	131	10630	0.0014	0.973454	0.99993	0.0001	100000	14.48084	0.154151	100002.23	6193180.73	61.93181
4	4	1,763,682	5,876	688	1.605	0.003332	0.0132	0.9868	95082	1258	377320	5527062	58.1	0.0015	147	10,499	0.0004	0.882914	0.99998	0.0000	99993.42	4.095764	1.609772	399980.26	6093178.50	60.9358
5	5-9'	2,423,956	2,120	199	2.275	0.000875	0.0044	0.9956	93825	410	468013	5149742	54.9	0.0004	38	10,352	0.0001	0.906132	1.00000	0.0000	95080.27	0.849892	1.841439	475402.92	5693198.24	59.87781
5	**10-14'**	2,510,361	1,746	160	**2.843**	**0.000696**	**0.0035**	**0.9965**	**93416**	**325**	**466382**	**4681730**	50.1	**0.0003**	**30**	10,314	**0.0001**	**0.908362**	**1.00000**	**0.0000**	**93824.96**	**0.657362**	**2.681779**	**469126.59**	**5217795.32**	55.61201
5	**15-19**	2,454,402	4,471	235	**2.657**	**0.001822**	**0.0091**	**0.9909**	**93091**	**845**	**463482**	**4215347**	45.3	**0.0005**	**44**	10,284	**0.0001**	**0.947439**	**1.00000**	**0.0000**	**93415.71**	**0.984667**	**2.929793**	**467081.41**	**4748668.73**	50.83373
5	20-24	2,100,212	8,934	466	2.547	0.004254	0.0210	0.9790	92247	1943	456475	3751866	40.7	0.0011	101	10,240	0.0002	0.94784	0.99998	0.0000	93091.03	2.272018	2.76377	465461.43	4281587.32	45.99355
5	25-29	1,893,518	16,839	1,390	2.550	0.008893	0.0435	0.9565	90305	3931	441901	3295391	36.5	0.0036	324	10,138	0.0007	0.917454	0.99984	0.0002	92244.99	7.442474	2.610359	461244.40	3816125.89	41.36946
5	30-34	1,597,003	20,896	1,945	2.616	0.013085	0.0634	0.9366	86376	5481	418816	2853489	33.0	0.0059	510	9,814	0.0012	0.90692	0.99961	0.0004	90290.95	11.95262	2.512049	451484.77	3354881.49	37.15634
5	35-39	1,438,600	21,078	2,115	2.677	0.014652	0.0708	0.9292	80896	5732	391167	2434673	30.1	0.0071	575	9,304	0.0015	0.899658	0.99948	0.0005	86342.16	13.67854	2.458183	431744.42	2903396.72	33.62664
5	40-44	1,230,608	19,326	2,050	2.685	0.015704	0.0758	0.9242	75164	5696	362641	2043506	27.2	0.0080	604	8,729	0.0017	0.893925	0.99937	0.0006	80853.37	14.541	2.477746	404302.87	2471652.29	30.56957
5	45-49	962,809	17,887	1,982	2.681	0.018578	0.0891	0.9109	69469	6187	333003	1680865	24.2	0.0099	686	8,125	0.0021	0.889193	0.99908	0.0009	75116.79	16.72541	2.516831	375626.05	2067349.43	27.5218
5	50-54	770,793	16,885	1,875	2.655	0.021906	0.1042	0.8958	63283	6594	300957	1347862	21.3	0.0116	732	7,439	0.0024	0.888955	0.99873	0.0013	69405.44	18.09657	2.513732	347072.71	1691723.37	24.37451
5	55-59	551,195	14,551	1,599	2.647	0.026399	0.1243	0.8757	56690	7046	266876	1046905	18.5	0.0137	774	6,707	0.0029	0.890111	0.99819	0.0018	63202.41	19.45743	2.551552	316061.68	1344650.66	21.27531
5	60-64	447,621	15,102	1,653	2.646	0.033738	0.1563	0.8437	49645	7760	229964	780029	15.7	0.0171	849	5,933	0.0037	0.890544	0.99710	0.0029	56587.54	21.90985	2.550858	282993.57	1028588.99	18.17695
5	65-69	305,214	13,014	1,439	2.631	0.042639	0.1936	0.8064	41886	8112	190221	550065	13.1	0.0214	897	5,084	0.0047	0.889427	0.99540	0.0046	49500.89	23.96878	2.546266	247565.47	745595.41	15.06226
5	70-74	230,204	14,037	1,695	2.628	0.060976	0.2664	0.7336	33776	8997	147542	359844	10.7	0.0322	1086	4,187	0.0074	0.879248	0.99009	0.0099	41693.89	30.82901	2.51667	208547.05	498029.94	11.94491
5	75-79	136,989	10,848	1,263	2.618	0.079189	0.3331	0.6669	24779	8255	104238	212302	8.6	0.0388	961	3,101	0.0092	0.883573	0.98441	0.0156	33440.97	28.58705	2.486279	167275.91	289482.88	8.656534
5	80+	139,601	17,810	2,306	6.539	0.127578	1.0000	0.0000	16525	16526	108064	108064	6.5	0.1295	2140	2,140	0.0165	0.870522	0.00000	1.0000	24393.05	35.34358	6.838972	122206.97	122206.97	5.009909
	Total	21,407,489	244,550	23,674																					210684.66	

Table 4: Multiple decrement life table of South African males, all causes and transport accidents (V01-V99), DNF

n	age	py	Dall	v01- v99	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	X	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	450,721	23,130	14	0.152	0.051318	0.0492	0.9508	100000	4919	95830	5514828	55.1	0.0000	3	974	0.0000	0.999395	1.00000	0.0000	100000	0.030239	0.154151	100000.00	6199244.68	61.99245
4	4	1,763,682	5,876	97	1.605	0.003332	0.0132	0.9868	95082	1258	377320	5527062	58.1	0.0002	21	971	0.0001	0.983492	1.00000	0.0000	99999.85	0.053379	1.609772	399999.49	6099244.68	60.99254
5	5-9'	2,423,956	2,120	132	2.275	0.000875	0.0044	0.9956	93825	410	468013	5149742	54.9	0.0003	25	950	0.0001	0.937736	1.00000	0.0000	95081.95	0.051723	1.841439	475409.87	5699245.19	59.94035
5	10-14'	2,510,361	1,746	108	2.843	0.000696	0.0035	0.9965	93416	325	466382	4681730	50.1	0.0002	20	924	0.0000	0.938144	1.00000	0.0000	93825.02	0.039766	2.681779	469125.21	5223835.32	55.67636
5	15-19	2,454,402	4,471	215	2.657	0.001822	0.0091	0.9909	93091	845	463482	4215347	45.3	0.0004	41	904	0.0001	0.951912	1.00000	0.0000	93415.74	0.07921	2.929793	467078.93	4754710.11	50.89838
5	20-24	2,100,212	8,934	341	2.547	0.004254	0.0210	0.9790	92247	1943	456475	3751866	40.7	0.0008	74	864	0.0002	0.961831	0.99998	0.0000	93091.06	0.140226	2.76377	465455.71	4287631.18	46.05846
5	25-29	1,893,518	16,839	449	2.550	0.008893	0.0435	0.9565	90305	3931	441901	3295391	36.5	0.0012	105	790	0.0002	0.973336	0.99995	0.0001	92245.57	0.187218	2.610359	461228.35	3822175.47	41.43479
5	30-34	1,597,003	20,896	387	2.616	0.013085	0.0634	0.9366	86376	5481	418816	2853489	33.0	0.0012	101	685	0.0002	0.98148	0.99992	0.0001	90300.72	0.165935	2.512049	451504.01	3360947.12	37.21949
5	35-39	1,438,600	21,078	369	2.677	0.014652	0.0708	0.9292	80896	5732	391167	2434673	30.1	0.0012	100	583	0.0003	0.982494	0.99991	0.0001	86368.93	0.149606	2.458183	431845.04	2909443.11	33.68622
5	40-44	1,230,608	19,326	336	2.685	0.015704	0.0758	0.9242	75164	5696	362641	2043506	27.2	0.0013	99	483	0.0003	0.982614	0.99990	0.0001	80888.24	0.131856	2.477746	404441.54	2477598.07	30.62989
5	45-49	962,809	17,887	253	2.681	0.018578	0.0891	0.9109	69469	6187	333003	1680865	24.2	0.0013	88	384	0.0003	0.985856	0.99988	0.0001	75156.57	0.100882	2.516831	375783.12	2073156.53	27.5845
5	50-54	770,793	16,885	192	2.655	0.021906	0.1042	0.8958	63283	6594	300957	1347862	21.3	0.0012	75	296	0.0002	0.988629	0.99987	0.0001	69461.19	0.073834	2.513732	347306.14	1697373.41	24.43628
5	55-59	551,195	14,551	119	2.647	0.026399	0.1243	0.8757	56690	7046	266876	1046905	18.5	0.0010	58	221	0.0002	0.991822	0.99987	0.0001	63274.65	0.047808	2.551552	316373.36	1350067.27	21.33662
5	60-64	447,621	15,102	97	2.646	0.033738	0.1563	0.8437	49645	7760	229964	780029	15.7	0.0010	50	164	0.0002	0.993577	0.99983	0.0002	56682.54	0.035501	2.550858	283412.77	1033693.91	18.23655
5	65-69	305,214	13,014	52	2.631	0.042639	0.1936	0.8064	41886	8112	190221	550065	13.1	0.0008	32	114	0.0002	0.996004	0.99983	0.0002	49636.52	0.019421	2.546266	248182.66	750281.14	15.11551
5	70-74	230,204	14,037	38	2.628	0.060976	0.2664	0.7336	33776	8997	147542	359844	10.7	0.0007	24	82	0.0002	0.997293	0.99978	0.0002	41879.49	0.013468	2.51667	209397.48	502098.47	11.98913
5	75-79	136,989	10,848	24	2.618	0.079189	0.3331	0.6669	24779	8255	104238	212302	8.6	0.0007	18	57	0.0002	0.997788	0.99970	0.0003	33768.23	0.010027	2.486279	168841.17	292700.99	8.66794
5	80+	139,601	17,810	42	6.539	0.127578	1.0000	0.0000	16525	16526	108064	108064	6.5	0.0024	39	39	0.0003	0.997642	0.00000	1.0000	24771.95	0.011724	6.838972	123859.82	123859.82	5.000003
	Total	21,407,489	244,550	3,265																					210684.66	

Table 5: Multiple decrement life table of South African males, all causes and other external causes of accidental injury (W00-X59), DNF

n	age	py	Dall	W00-X59	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	X	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	450,721	23,130	65	0.152	0.051318	0.0492	0.9508	100000	4919	95830	5514828	55.1	0.0001	14	1139	0.0001	0.99719	0.99999	0.0000	100000	0.164323	0.154151	100000.03	6199157.56	61.99158
4	4	1,763,682	5,876	142	1.605	0.003332	0.0132	0.9868	95082	1258	377320	5527062	58.1	0.0003	30	1,126	0.0001	0.975834	1.00000	0.0000	99999.3	0.090628	1.609772	399997.36	6099157.53	60.992
5	5-9'	2,423,956	2,120	90	2.275	0.000875	0.0044	0.9956	93825	410	468013	5149742	54.9	0.0002	17	1,095	0.0000	0.957547	1.00000	0.0000	95081.83	0.040666	1.841439	475409.21	5699160.17	59.93953
5	10-14'	2,510,361	1,746	80	2.843	0.000696	0.0035	0.9965	93416	325	466382	4681730	50.1	0.0002	15	1,078	0.0000	0.954181	1.00000	0.0000	93825.06	0.034349	2.681779	469125.38	5223750.97	55.67544
5	15-19	2,454,402	4,471	226	2.657	0.001822	0.0091	0.9909	93091	845	463482	4215347	45.3	0.0005	43	1,063	0.0001	0.949452	1.00000	0.0000	93415.76	0.097881	2.929793	467079.07	4754625.59	50.89747
5	20-24	2,100,212	8,934	412	2.547	0.004254	0.0210	0.9790	92247	1943	456475	3751866	40.7	0.0010	90	1,020	0.0002	0.953884	0.99998	0.0000	93091.05	0.200159	2.76377	465455.78	4287546.52	46.05756
5	25-29	1,893,518	16,839	491	2.550	0.008893	0.0435	0.9565	90305	3931	441901	3295391	36.5	0.0013	115	931	0.0003	0.970841	0.99994	0.0001	92245.24	0.241358	2.610359	461226.85	3822090.74	41.43401
5	30-34	1,597,003	20,896	424	2.616	0.013085	0.0634	0.9366	86376	5481	418816	2853489	33.0	0.0013	111	816	0.0003	0.979709	0.99992	0.0001	90300.28	0.216698	2.512049	451501.96	3360863.89	37.21875
5	35-39	1,438,600	21,078	331	2.677	0.014652	0.0708	0.9292	80896	5732	391167	2434673	30.1	0.0011	90	705	0.0002	0.984296	0.99992	0.0001	86368.3	0.162211	2.458183	431841.89	2909361.93	33.68553
5	40-44	1,230,608	19,326	248	2.685	0.015704	0.0758	0.9242	75164	5696	362641	2043506	27.2	0.0010	73	615	0.0002	0.987168	0.99992	0.0001	80889	0.123939	2.477746	404445.32	2477520.04	30.62864
5	45-49	962,809	17,887	208	2.681	0.018578	0.0891	0.9109	69469	6187	333003	1680865	24.2	0.0010	72	542	0.0002	0.988371	0.99990	0.0001	75158.62	0.117074	2.516831	375793.38	2073074.72	27.58266
5	50-54	770,793	16,885	155	2.655	0.021906	0.1042	0.8958	63283	6594	300957	1347862	21.3	0.0010	61	470	0.0002	0.99082	0.99989	0.0001	69462.64	0.094509	2.513732	347313.45	1697281.35	24.43445
5	55-59	551,195	14,551	106	2.647	0.026399	0.1243	0.8757	56690	7046	266876	1046905	18.5	0.0009	51	409	0.0002	0.992715	0.99988	0.0001	63276.24	0.078743	2.551552	316381.39	1349967.90	21.33452
5	60-64	447,621	15,102	114	2.646	0.033738	0.1563	0.8437	49645	7760	229964	780029	15.7	0.0012	59	358	0.0003	0.992451	0.99980	0.0002	56683.37	0.091211	2.550858	283417.09	1033586.51	18.23439
5	65-69	305,214	13,014	69	2.631	0.042639	0.1936	0.8064	41886	8112	190221	550065	13.1	0.0010	43	300	0.0002	0.994698	0.99978	0.0002	49635.04	0.067725	2.546266	248175.37	750169.42	15.11371
5	70-74	230,204	14,037	76	2.628	0.060976	0.2664	0.7336	33776	8997	147542	359844	10.7	0.0014	49	257	0.0003	0.994586	0.99955	0.0004	41877.21	0.084705	2.51667	209386.26	501994.05	11.98729
5	75-79	136,989	10,848	61	2.618	0.079189	0.3331	0.6669	24779	8255	104238	212302	8.6	0.0019	46	208	0.0004	0.994377	0.99924	0.0008	33760.69	0.092559	2.486279	168803.67	292607.79	8.667116
5	80+	139,601	17,810	174	6.539	0.127578	1.0000	0.0000	16525	16526	108064	108064	6.5	0.0098	161	161	0.0012	0.99023	0.00000	1.0000	24760.55	0.201229	6.838972	123804.12	123804.12	5.000056
	Total	21,407,489	244,550	3,472																					210684.66	

Appendix 4: Female life tables from Death Notification Forms, 2001 (by broad-underlying causes of death)

Table 1: Multiple decrement life table of South African females, all causes and events of undetermined intent (Y10-Y34), DNF

n	age	py	Dall	Y10- Y34	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	x	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	455,400	20,376	204	0.152	0.044743	0.0431	0.9569	100000	4312	96345	6012567	60.1	0.0004	43	7504	0.0004	0.989988	0.99998	0.0000	100000	3.361677	0.154151	100000.52	6661931.26	66.61931
4	4	1,759,636	5,299	525	1.605	0.003011	0.0120	0.9880	95689	1145	380018	6122543	64.0	0.0012	113	7,461	0.0003	0.900925	0.99999	0.0000	99998.1	2.226131	1.609772	399995.98	6561930.75	65.62056
5	5-9'	2,426,019	1,706	474	2.275	0.000703	0.0035	0.9965	94545	333	471822	5742525	60.7	0.0010	92	7,348	0.0002	0.722157	1.00000	0.0000	95687.89	1.435649	1.841439	478442.08	6161934.77	64.39618
5	10-14'	2,541,823	1,463	564	2.843	0.000576	0.0029	0.9971	94213	272	470484	5270703	55.9	0.0011	104	7,256	0.0002	0.614491	1.00000	0.0000	94544.54	1.609959	2.681779	472727.02	5683492.68	60.11445
5	15-19	2,527,828	3,903	1,950	2.657	0.001544	0.0077	0.9923	93942	724	468021	4800219	51.1	0.0038	361	7,151	0.0008	0.500384	0.99997	0.0000	94212.78	5.516634	2.929793	471080.04	5210765.66	55.30848
5	20-24	2,189,406	10,915	4,277	2.547	0.004985	0.0246	0.9754	93220	2297	460470	4332198	46.5	0.0096	900	6,790	0.0020	0.608154	0.99976	0.0002	93939.49	13.26483	2.76377	469734.12	4739685.62	50.45466
5	25-29	2,034,366	19,269	4,214	2.550	0.009472	0.0463	0.9537	90924	4209	444312	3871728	42.6	0.0101	920	5,891	0.0021	0.781307	0.99952	0.0005	93197.23	12.2022	2.610359	466017.99	4269951.50	45.81629
5	30-34	1,741,389	18,717	3,615	2.616	0.010748	0.0524	0.9476	86716	4545	422749	3427416	39.5	0.0101	878	4,970	0.0021	0.80686	0.99946	0.0005	90880.45	10.31826	2.512049	454428.17	3803933.51	41.85646
5	35-39	1,635,699	15,852	2,782	2.677	0.009691	0.0474	0.9526	82172	3895	401816	3004667	36.6	0.0083	683	4,093	0.0017	0.824502	0.99960	0.0004	86668.45	6.961111	2.458183	433359.34	3349505.34	38.64735
5	40-44	1,376,969	12,840	2,418	2.685	0.009325	0.0456	0.9544	78278	3574	383121	2602851	33.3	0.0086	673	3,409	0.0018	0.811682	0.99960	0.0004	82138.69	5.987074	2.477746	410708.27	2916146.00	35.50271
5	45-49	1,125,905	10,934	1,822	2.681	0.009711	0.0475	0.9525	74705	3549	365302	2219730	29.7	0.0079	591	2,737	0.0016	0.833364	0.99962	0.0004	78246.36	4.428623	2.516831	391242.93	2505437.73	32.01986
5	50-54	871,202	10,135	1,388	2.655	0.011633	0.0566	0.9434	71158	4030	346343	1854428	26.1	0.0078	552	2,146	0.0016	0.863049	0.99955	0.0005	74676.51	3.418246	2.513732	373391.13	2114194.80	28.31138
5	55-59	650,996	9,124	984	2.647	0.014015	0.0678	0.9322	67129	4555	324930	1508085	22.5	0.0073	491	1,594	0.0015	0.892153	0.99949	0.0005	71125.57	2.40897	2.551552	355634.02	1740803.67	24.47507
5	60-64	622,670	12,062	620	2.646	0.019371	0.0926	0.9074	62575	5797	299231	1183154	18.9	0.0048	298	1,103	0.0010	0.948599	0.99954	0.0005	67094.13	1.097865	2.550858	335473.47	1385169.65	20.64517
5	65-69	483,170	12,793	437	2.631	0.026477	0.1246	0.8754	56778	7074	267137	883923	15.6	0.0043	242	805	0.0009	0.965841	0.99943	0.0006	62545.67	0.727759	2.546266	312730.20	1049696.18	16.78288
5	70-74	396,697	15,120	287	2.628	0.038115	0.1748	0.8252	49705	8688	227923	616786	12.4	0.0033	165	563	0.0007	0.981019	0.99936	0.0006	56746.01	0.407344	2.51667	283731.09	736965.98	12.9871
5	75-79	232,081	12,036	218	2.618	0.051861	0.2308	0.7692	41018	9468	182543	388863	9.5	0.0042	171	398	0.0009	0.981888	0.99890	0.0011	49673.49	0.373988	2.486279	248368.36	453234.89	9.124282
5	80+	293,171	30,204	217	6.539	0.103025	1.0000	0.0000	31551	31552	206320	206320	6.5	0.0072	227	227	0.0007	0.992816	0.00000	1.0000	40973.08	0.167784	6.838972	204866.53	204866.53	5.000028
	Total	23,364,427	222,748	27,161																					210684.658	

Table 2 Multiple decrement life table of South African females, all causes and Tuberculosis (A15-A19), DNF

n	age	py	Dall	A15- A19	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	X	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	455,400	20,376	1	0.152	0.044743	0.0431	0.9569	100000	4312	96345	6012567	60.1	0.0000	0	6495	0.0000	0.999951	1.00000	0.0000	100000	0.014262	0.154151	100000.00	6662013.63	66.62014
4	4	1,759,636	5,299	297	1.605	0.003011	0.0120	0.9880	95689	1145	380018	6122543	64.0	0.0007	64	6,495	0.0002	0.943952	0.99999	0.0000	99999.99	1.096187	1.609772	400001.73	6562013.63	65.62014
5	5-9'	2,426,019	1,706	117	2.275	0.000703	0.0035	0.9965	94545	333	471822	5742525	60.7	0.0002	23	6,430	0.0000	0.931419	1.00000	0.0000	95688.48	0.310122	1.841439	478442.97	6162011.90	64.39659
5	10-14'	2,541,823	1,463	112	2.843	0.000576	0.0029	0.9971	94213	272	470484	5270703	55.9	0.0002	21	6,408	0.0000	0.923445	1.00000	0.0000	94544.78	0.282341	2.681779	472724.68	5683568.93	60.1151
5	15-19	2,527,828	3,903	623	2.657	0.001544	0.0077	0.9923	93942	724	468021	4800219	51.1	0.0012	115	6,387	0.0002	0.840379	0.99999	0.0000	94213.02	1.574108	2.929793	471069.69	5210844.25	55.30918
5	20-24	2,189,406	10,915	2,246	2.547	0.004985	0.0246	0.9754	93220	2297	460470	4332198	46.5	0.0051	472	6,272	0.0010	0.794228	0.99987	0.0001	93941.39	6.433725	2.76377	469724.73	4739774.55	50.45459
5	25-29	2,034,366	19,269	4,205	2.550	0.009472	0.0463	0.9537	90924	4209	444312	3871728	42.6	0.0101	918	5,799	0.0021	0.781774	0.99952	0.0005	93207.88	11.98693	2.610359	466070.67	4270049.82	45.81211
5	30-34	1,741,389	18,717	3,899	2.616	0.010748	0.0524	0.9476	86716	4545	422749	3427416	39.5	0.0109	947	4,881	0.0022	0.791687	0.99941	0.0006	90880.54	10.92833	2.512049	454430.17	3803979.15	41.85691
5	35-39	1,635,699	15,852	3,103	2.677	0.009691	0.0474	0.9526	82172	3895	401816	3004667	36.6	0.0093	762	3,934	0.0019	0.804252	0.99955	0.0005	86664.74	7.463602	2.458183	433342.03	3349548.98	38.6495
5	40-44	1,376,969	12,840	2,145	2.685	0.009325	0.0456	0.9544	78278	3574	383121	2602851	33.3	0.0076	597	3,172	0.0016	0.832944	0.99964	0.0004	82134.86	4.941345	2.477746	410686.54	2916206.95	35.50511
5	45-49	1,125,905	10,934	1,469	2.681	0.009711	0.0475	0.9525	74705	3549	365302	2219730	29.7	0.0064	477	2,575	0.0013	0.865648	0.99969	0.0003	78249.9	3.360007	2.516831	391257.97	2505520.40	32.01947
5	50-54	871,202	10,135	967	2.655	0.011633	0.0566	0.9434	71158	4030	346343	1854428	26.1	0.0054	384	2,099	0.0011	0.904588	0.99969	0.0003	74682.08	2.329406	2.513732	373416.25	2114262.43	28.31017
5	55-59	650,996	9,124	611	2.647	0.014015	0.0678	0.9322	67129	4555	324930	1508085	22.5	0.0045	305	1,714	0.0009	0.933034	0.99968	0.0003	71135.33	1.608895	2.551552	355680.73	1740846.18	24.47232
5	60-64	622,670	12,062	560	2.646	0.019371	0.0926	0.9074	62575	5797	299231	1183154	18.9	0.0043	269	1,409	0.0009	0.953573	0.99958	0.0004	67107.21	1.267413	2.550858	335539.27	1385165.45	20.64108
5	65-69	483,170	12,793	454	2.631	0.026477	0.1246	0.8754	56778	7074	267137	883923	15.6	0.0044	251	1,140	0.0009	0.964512	0.99941	0.0006	62548.47	1.071306	2.546266	312745.08	1049626.18	16.781
5	70-74	396,697	15,120	399	2.628	0.038115	0.1748	0.8252	49705	8688	227923	616786	12.4	0.0046	229	889	0.0010	0.973611	0.99911	0.0009	56744.76	0.894291	2.51667	283726.06	736881.10	12.98589
5	75-79	232,081	12,036	240	2.618	0.051861	0.2308	0.7692	41018	9468	182543	388863	9.5	0.0046	189	660	0.0010	0.98006	0.99879	0.0012	49661.13	0.682402	2.486279	248307.37	453155.03	9.124943
5	80+	293,171	30,204	451	6.539	0.103025	1.0000	0.0000	31551	31552	206320	206320	6.5	0.0149	471	471	0.0015	0.985068	0.00000	1.0000	40968.54	0.724744	6.838972	204847.66	204847.66	5.000121
	Total	23,364,427	222,748	21,899																					210684.658	

Table 3: Multiple decrement life table of South African females, all causes and ill-defined and unknown causes of mortality (R95-R99), DNF

n	age	py	Dall	R95-R99	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	X	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	455,400	20,376	530	0.152	0.044743	0.0431	0.9569	100000	4312	96345	6012567	60.1	0.0011	112	13033	0.0012	0.973989	0.99995	0.0000	100000	15.16826	0.154151	100002.34	6660362.15	66.60362
4	4	1,759,636	5,299	663	1.605	0.003011	0.0120	0.9880	95689	1145	380018	6122543	64.0	0.0015	143	12,921	0.0004	0.874882	0.99998	0.0000	99995.06	4.868457	1.609772	399988.07	6560359.81	65.60684
5	5-9'	2,426,019	1,706	190	2.275	0.000703	0.0035	0.9965	94545	333	471822	5742525	60.7	0.0004	37	12,778	0.0001	0.888628	1.00000	0.0000	95687.53	1.000739	1.841439	478439.49	6160371.73	64.38009
5	10-14'	2,541,823	1,463	167	2.843	0.000576	0.0029	0.9971	94213	272	470484	5270703	55.9	0.0003	31	12,741	0.0001	0.885851	1.00000	0.0000	94544.73	0.837095	2.681779	472725.92	5681932.24	60.09782
5	15-19	2,527,828	3,903	435	2.657	0.001544	0.0077	0.9923	93942	724	468021	4800219	51.1	0.0009	81	12,710	0.0002	0.888547	0.99999	0.0000	94212.99	2.187209	2.929793	471071.34	5209206.32	55.29181
5	20-24	2,189,406	10,915	1,324	2.547	0.004985	0.0246	0.9754	93220	2297	460470	4332198	46.5	0.0030	278	12,630	0.0006	0.878699	0.99993	0.0001	93941.66	7.637471	2.76377	469729.40	4738134.98	50.437
5	25-29	2,034,366	19,269	2,557	2.550	0.009472	0.0463	0.9537	90924	4209	444312	3871728	42.6	0.0061	558	12,351	0.0013	0.8673	0.99971	0.0003	93212.71	15.52412	2.610359	466104.08	4268405.58	45.7921
5	30-34	1,741,389	18,717	2,531	2.616	0.010748	0.0524	0.9476	86716	4545	422749	3427416	39.5	0.0071	614	11,793	0.0015	0.864775	0.99962	0.0004	90897.59	17.13986	2.512049	454531.02	3802301.50	41.83061
5	35-39	1,635,699	15,852	2,042	2.677	0.009691	0.0474	0.9526	82172	3895	401816	3004667	36.6	0.0061	502	11,178	0.0012	0.871183	0.99970	0.0003	86682.6	13.95482	2.458183	433447.31	3347770.47	38.62102
5	40-44	1,376,969	12,840	1,561	2.685	0.009325	0.0456	0.9544	78278	3574	383121	2602851	33.3	0.0055	434	10,677	0.0011	0.878427	0.99974	0.0003	82147.51	12.1035	2.477746	410767.54	2914323.16	35.47671
5	45-49	1,125,905	10,934	1,280	2.681	0.009711	0.0475	0.9525	74705	3549	365302	2219730	29.7	0.0056	415	10,242	0.0011	0.882934	0.99973	0.0003	78257.49	11.64405	2.516831	391316.76	2503555.62	31.99126
5	50-54	871,202	10,135	1,140	2.655	0.011633	0.0566	0.9434	71158	4030	346343	1854428	26.1	0.0064	453	9,827	0.0013	0.887519	0.99963	0.0004	74685.06	12.85895	2.513732	373457.63	2112238.86	28.28195
5	55-59	650,996	9,124	902	2.647	0.014015	0.0678	0.9322	67129	4555	324930	1508085	22.5	0.0067	450	9,374	0.0014	0.90114	0.99953	0.0005	71131.32	12.98799	2.551552	355689.73	1738781.23	24.44466
5	60-64	622,670	12,062	1,370	2.646	0.019371	0.0926	0.9074	62575	5797	299231	1183154	18.9	0.0105	658	8,924	0.0022	0.88642	0.99898	0.0010	67097.01	19.63364	2.550858	335535.13	1383091.50	20.61331
5	65-69	483,170	12,793	1,598	2.631	0.026477	0.1246	0.8754	56778	7074	267137	883923	15.6	0.0156	884	8,265	0.0033	0.875088	0.99793	0.0021	62510.66	27.3357	2.546266	312622.90	1047556.38	16.75804
5	70-74	396,697	15,120	2,057	2.628	0.038115	0.1748	0.8252	49705	8688	227923	616786	12.4	0.0238	1182	7,382	0.0052	0.863955	0.99544	0.0046	56660.73	38.27641	2.51667	283399.95	734933.48	12.97077
5	75-79	232,081	12,036	1,562	2.618	0.051861	0.2308	0.7692	41018	9468	182543	388863	9.5	0.0300	1229	6,200	0.0067	0.870223	0.99217	0.0078	49478.64	41.72748	2.486279	247496.96	451533.52	9.125827
5	80+	293,171	30,204	4,759	6.539	0.103025	1.0000	0.0000	31551	31552	206320	206320	6.5	0.1576	4971	4,971	0.0162	0.842438	0.00000	1.0000	40696.93	80.69805	6.838972	204036.56	204036.56	5.013561
	Total	23,364,427	222,748	26,668																					210684.658	

Table 4: Multiple decrement life table of South African females, all causes and pneumonia (J10-J18), DNF

n	age	py	Dall	J10-J18	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	X	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	455,400	20,376	3	0.152	0.044743	0.0431	0.9569	100000	4312	96345	6012567	60.1	0.0000	1	6525	0.0000	0.999853	1.00000	0.0000	100000	0.042985	0.154151	100000.01	6662019.86	66.6202
4	4	1,759,636	5,299	731	1.605	0.003011	0.0120	0.9880	95689	1145	380018	6122543	64.0	0.0016	158	6,525	0.0004	0.862049	0.99998	0.0000	99999.97	2.710478	1.609772	400004.25	6562019.85	65.62022
5	5-9'	2,426,019	1,706	151	2.275	0.000703	0.0035	0.9965	94545	333	471822	5742525	60.7	0.0003	29	6,367	0.0001	0.911489	1.00000	0.0000	95687.35	0.396275	1.841439	478437.49	6162015.60	64.39739
5	10-14'	2,541,823	1,463	94	2.843	0.000576	0.0029	0.9971	94213	272	470484	5270703	55.9	0.0002	17	6,337	0.0000	0.935748	1.00000	0.0000	94544.76	0.234363	2.681779	472724.44	5683578.11	60.11521
5	15-19	2,527,828	3,903	342	2.657	0.001544	0.0077	0.9923	93942	724	468021	4800219	51.1	0.0007	63	6,320	0.0001	0.912375	0.99999	0.0000	94213.03	0.855048	2.929793	471067.64	5210853.67	55.30927
5	20-24	2,189,406	10,915	1,310	2.547	0.004985	0.0246	0.9754	93220	2297	460470	4332198	46.5	0.0030	276	6,257	0.0006	0.879982	0.99993	0.0001	93941.79	3.743551	2.76377	469719.30	4739786.04	50.4545
5	25-29	2,034,366	19,269	2,377	2.550	0.009472	0.0463	0.9537	90924	4209	444312	3871728	42.6	0.0057	519	5,981	0.0012	0.876641	0.99973	0.0003	93212.78	6.988445	2.610359	466082.17	4270066.73	45.80988
5	30-34	1,741,389	18,717	2,304	2.616	0.010748	0.0524	0.9476	86716	4545	422749	3427416	39.5	0.0065	559	5,462	0.0013	0.876903	0.99965	0.0003	90899.46	7.226607	2.512049	454515.43	3803984.57	41.84827
5	35-39	1,635,699	15,852	1,771	2.677	0.009691	0.0474	0.9526	82172	3895	401816	3004667	36.6	0.0053	435	4,903	0.0011	0.888279	0.99974	0.0003	86685.57	5.308156	2.458183	433440.88	3349469.13	38.63929
5	40-44	1,376,969	12,840	1,263	2.685	0.009325	0.0456	0.9544	78278	3574	383121	2602851	33.3	0.0045	351	4,468	0.0009	0.901636	0.99979	0.0002	82150.74	4.0978	2.477746	410763.85	2916028.25	35.49607
5	45-49	1,125,905	10,934	847	2.681	0.009711	0.0475	0.9525	74705	3549	365302	2219730	29.7	0.0037	275	4,116	0.0008	0.922535	0.99982	0.0002	78261.36	3.096523	2.516831	391314.61	2505264.39	32.01151
5	50-54	871,202	10,135	549	2.655	0.011633	0.0566	0.9434	71158	4030	346343	1854428	26.1	0.0031	218	3,841	0.0006	0.945831	0.99982	0.0002	74691.89	2.420684	2.513732	373465.56	2113949.78	28.30226
5	55-59	650,996	9,124	473	2.647	0.014015	0.0678	0.9322	67129	4555	324930	1508085	22.5	0.0035	236	3,623	0.0007	0.948159	0.99975	0.0002	71145.01	2.63247	2.551552	355731.76	1740484.23	24.4639
5	60-64	622,670	12,062	525	2.646	0.019371	0.0926	0.9074	62575	5797	299231	1183154	18.9	0.0040	252	3,387	0.0008	0.956475	0.99961	0.0004	67112.05	2.855743	2.550858	335567.51	1384752.46	20.63344
5	65-69	483,170	12,793	566	2.631	0.026477	0.1246	0.8754	56778	7074	267137	883923	15.6	0.0055	313	3,135	0.0012	0.955757	0.99927	0.0007	62550.1	3.672117	2.546266	312759.87	1049184.95	16.77351
5	70-74	396,697	15,120	686	2.628	0.038115	0.1748	0.8252	49705	8688	227923	616786	12.4	0.0079	394	2,822	0.0017	0.95463	0.99848	0.0015	56736.53	4.879674	2.51667	283694.93	736425.08	12.97973
5	75-79	232,081	12,036	591	2.618	0.051861	0.2308	0.7692	41018	9468	182543	388863	9.5	0.0113	465	2,428	0.0025	0.950897	0.99703	0.0030	49629.5	6.182084	2.486279	248162.86	452730.15	9.122199
5	80+	293,171	30,204	1,879	6.539	0.103025	1.0000	0.0000	31551	31552	206320	206320	6.5	0.0622	1963	1,963	0.0064	0.93779	0.00000	1.0000	40896.25	12.58013	6.838972	204567.29	204567.29	5.002104
	Total	23,364,427	222,748	16,462																					210684.658	

Table 5: Multiple decrement life table of South African females, all causes and Intestinal infectious diseases (A00-A09)

n	age	py	Dall	A00-A09	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
1	X	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	15	16	17	18	19	20	21	22	23
1	0	455,400	20,376	12	0.152	0.044743	0.0431	0.9569	100000	4312	96345	6012567	60.1	0.0000	3	3297	0.0000	0.999411	1.00000	0.0000	100000	0.086871	0.154151	100000.01	6662852.46	66.62852
4	4	1,759,636	5,299	1,105	1.605	0.003011	0.0120	0.9880	95689	1145	380018	6122543	64.0	0.0025	239	3,294	0.0006	0.79147	0.99997	0.0000	99999.89	2.068667	1.609772	400002.88	6562852.44	65.6286
5	5-9'	2,426,019	1,706	152	2.275	0.000703	0.0035	0.9965	94545	333	471822	5742525	60.7	0.0003	30	3,056	0.0001	0.910903	1.00000	0.0000	95686.38	0.191444	1.841439	478432.26	6162849.56	64.40676
5	**10-14'**	2,541,823	1,463	91	**2.843**	**0.000576**	**0.0029**	**0.9971**	**94213**	**272**	**470484**	**5270703**	55.9	**0.0002**	**17**	3,026	**0.0000**	**0.937799**	**1.00000**	**0.0000**	**94544.76**	**0.108334**	**2.681779**	**472724.09**	**5684417.30**	60.12409
5	**15-19**	2,527,828	3,903	180	**2.657**	**0.001544**	**0.0077**	**0.9923**	**93942**	**724**	**468021**	**4800219**	51.1	**0.0004**	**33**	3,009	**0.0001**	**0.953882**	**1.00000**	**0.0000**	**94213.03**	**0.214275**	**2.929793**	**471065.77**	**5211693.21**	55.31818
5	20-24	2,189,406	10,915	636	2.547	0.004985	0.0246	0.9754	93220	2297	460470	4332198	46.5	0.0014	134	2,976	0.0003	0.941732	0.99996	0.0000	93942.02	0.86445	2.76377	469712.51	4740627.44	50.46333
5	25-29	2,034,366	19,269	1,181	2.550	0.009472	0.0463	0.9537	90924	4209	444312	3871728	42.6	0.0028	258	2,842	0.0006	0.93871	0.99987	0.0001	93216.32	1.649896	2.610359	466085.90	4270914.94	45.81725
5	30-34	1,741,389	18,717	1,071	2.616	0.010748	0.0524	0.9476	86716	4545	422749	3427416	39.5	0.0030	260	2,584	0.0006	0.942779	0.99984	0.0002	90911.83	1.589317	2.512049	454563.15	3804829.04	41.85186
5	35-39	1,635,699	15,852	887	2.677	0.009691	0.0474	0.9526	82172	3895	401816	3004667	36.6	0.0027	218	2,324	0.0005	0.944045	0.99987	0.0001	86701.67	1.260327	2.458183	433511.46	3350265.88	38.64131
5	40-44	1,376,969	12,840	649	2.685	0.009325	0.0456	0.9544	78278	3574	383121	2602851	33.3	0.0023	181	2,106	0.0005	0.949455	0.99989	0.0001	82161.28	0.992729	2.477746	410808.87	2916754.42	35.50035
5	45-49	1,125,905	10,934	481	2.681	0.009711	0.0475	0.9525	74705	3549	365302	2219730	29.7	0.0021	156	1,926	0.0004	0.956009	0.99990	0.0001	78269.34	0.822672	2.516831	391348.78	2505945.55	32.01695
5	50-54	871,202	10,135	339	2.655	0.011633	0.0566	0.9434	71158	4030	346343	1854428	26.1	0.0019	135	1,770	0.0004	0.966552	0.99989	0.0001	74697.67	0.688589	2.513732	373490.08	2114596.77	28.30874
5	55-59	650,996	9,124	257	2.647	0.014015	0.0678	0.9322	67129	4555	324930	1508085	22.5	0.0019	128	1,635	0.0004	0.971833	0.99987	0.0001	71149.87	0.645405	2.551552	355751.02	1741106.68	24.47097
5	60-64	622,670	12,062	311	2.646	0.019371	0.0926	0.9074	62575	5797	299231	1183154	18.9	0.0024	149	1,507	0.0005	0.974217	0.99977	0.0002	67119.62	0.752477	2.550858	335600.01	1385355.66	20.6401
5	65-69	483,170	12,793	274	2.631	0.026477	0.1246	0.8754	56778	7074	267137	883923	15.6	0.0027	151	1,357	0.0006	0.978582	0.99965	0.0004	62560.1	0.769609	2.546266	312802.45	1049755.66	16.77996
5	70-74	396,697	15,120	383	2.628	0.038115	0.1748	0.8252	49705	8688	227923	616786	12.4	0.0044	220	1,206	0.0010	0.974669	0.99915	0.0009	56758	1.164005	2.51667	283792.91	736953.20	12.98413
5	75-79	232,081	12,036	253	2.618	0.051861	0.2308	0.7692	41018	9468	182543	388863	9.5	0.0049	199	986	0.0011	0.97898	0.99873	0.0013	49662.9	1.074418	2.486279	248317.17	453160.29	9.124725
5	80+	293,171	30,204	753	6.539	0.103025	1.0000	0.0000	31551	31552	206320	206320	6.5	0.0249	787	787	0.0026	0.97507	0.00000	1.0000	40965.86	2.020327	6.838972	204843.13	204843.13	5.000337
	Total	23,364,427	222,748	9,015																					210684.658	

Appendix 5: Male life tables from Death Notification Forms, 2007 (by broad-underlying causes of death)

Table 1: Multiple decrement life table of South African males, all causes and other external causes of accidental (W00-X59), DNF

n	**age**	**py**	**D**	**W00-X59**	**nax**	**nmx**	**nqx**	**npx**	**lx**	**ndx**	**nlx**	**Tx**	**ex**	**nqix**	**ndix**	**lix**	**nmix**
1	x	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	0	602415	32,542	237	0.152	0.054019	0.0517	0.9483	100000	5166	95620	5442284	**54.4**	0.0004	38	3730	0.0004
4	4	2004585	7,768	432	1.605	0.003875	0.0154	0.9846	94835	1457	375852	5463032	**57.6**	0.0009	81	3,692	0.0002
5	5-9'	2515300	2,854	351	2.275	0.001135	0.0057	0.9943	93378	529	465454	5087180	**54.5**	0.0007	65	3,611	0.0001
5	**10-14'**	**2558400**	**2,233**	**306**	**2.843**	**0.000873**	**0.0044**	**0.9956**	**92850**	**405**	**463381**	**4621725**	**49.8**	**0.0006**	**55**	3,546	**0.0001**
5	**15-19**	**2496600**	**4,859**	**1,068**	**2.657**	**0.001946**	**0.0097**	**0.9903**	**92446**	**897**	**460133**	**4158345**	**45.0**	**0.0021**	**197**	3,491	**0.0004**
5	20-24	2345500	10,875	2,207	2.547	0.004637	0.0229	0.9771	91550	2100	452606	3698212	**40.4**	0.0047	426	3,294	0.0009
5	25-29	2204100	18,405	2,222	2.550	0.00835	0.0409	0.9591	89452	3661	438294	3245606	**36.3**	0.0049	442	2,868	0.0010
5	30-34	2957500	28,245	1,912	2.616	0.00955	0.0467	0.9533	85792	4006	419412	2807312	**32.7**	0.0032	271	2,426	0.0006
5	35-39	2461600	29,258	1,507	2.677	0.011886	0.0578	0.9422	81786	4731	397946	2387900	**29.2**	0.0030	244	2,155	0.0006
5	40-44	1145500	26,973	1,181	2.685	0.023547	0.1116	0.8884	77056	8604	365368	1989954	**25.8**	0.0049	377	1,911	0.0010
5	45-49	1050900	24,761	978	2.681	0.023562	0.1117	0.8883	68453	7648	324536	1624586	**23.7**	0.0044	302	1,535	0.0009
5	50-54	876400	22,790	732	2.655	0.026004	0.1225	0.8775	60807	7453	286561	1300050	**21.4**	0.0039	239	1,233	0.0008
5	55-59	682900	21,316	571	2.647	0.031214	0.1454	0.8546	53355	7758	248524	1013488	**19.0**	0.0039	208	993	0.0008
5	60-64	601800	17,410	390	2.646	0.02893	0.1354	0.8646	45598	6176	213454	764964	**16.8**	0.0030	138	785	0.0006
5	65-69	450000	17,878	322	2.631	0.039729	0.1816	0.8184	39422	7158	180159	551510	**14.0**	0.0033	129	647	0.0007
5	70-74	301200	13,771	205	2.628	0.04572	0.2062	0.7938	32265	6655	145544	371351	**11.5**	0.0031	99	518	0.0007
5	75-79	175500	12,534	190	2.618	0.071419	0.3052	0.6948	25611	7817	109439	225807	**8.8**	0.0046	118	419	0.0011
5	80+	132400	18,881	319	6.539	0.142606	1.0000	0.0000	17795	17796	116368	116368	**6.5**	0.0169	301	301	0.0024
	Total	**23562600**		15,222													

Table 2: Associated Single Decrement Life Table of South African males, all causes and other external causes of accidental (W00-X59), DNF

age	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
x	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
0	0.992717	0.99998	0.0000	100000	1.467286	0.154151	100000.23	6121743.09	**61.21743**
4	0.944387	0.99999	0.0000	99998	0.795644	1.609772	399993.30	6021742.87	**60.21863**
5-9'	0.877015	1.00000	0.0000	94833.44	0.503898	1.841439	474168.11	5621749.57	**59.28025**
10-14'	**0.862965**	**1.00000**	**0.0000**	**93377.86**	**0.424127**	**2.681779**	**466890.42**	**5147581.46**	**55.12636**
15-19	**0.780202**	**0.99998**	**0.0000**	**92849.86**	**1.493219**	**2.929793**	**464253.65**	**4680691.03**	**50.4114**
20-24	0.797057	0.99989	0.0001	92443.74	3.099279	2.76377	462227.27	4216437.38	**45.61085**
25-29	0.879272	0.99979	0.0002	91540.25	2.891188	2.610359	457708.82	3754210.11	**41.01158**
30-34	0.932307	0.99985	0.0002	89433.16	1.568419	2.512049	447169.75	3296501.29	**36.85994**
35-39	0.948493	0.99982	0.0002	85778.77	1.319238	2.458183	428897.09	2849331.54	**33.21721**
40-44	0.956215	0.99942	0.0006	81771.74	1.970511	2.477746	408863.56	2420434.45	**29.59989**
45-49	0.960502	0.99948	0.0005	77011.8	1.428137	2.516831	385062.59	2011570.89	**26.12029**
50-54	0.967881	0.99949	0.0005	68417.38	1.029485	2.513732	342089.51	1626508.29	**23.77332**
55-59	0.973213	0.99939	0.0006	60775.31	0.830476	2.551552	303878.65	1284418.78	**21.13389**
60-64	0.977599	0.99956	0.0004	53322.25	0.509001	2.550858	266612.54	980540.13	**18.38895**
65-69	0.981989	0.99935	0.0007	45577.43	0.463035	2.546266	227888.32	713927.59	**15.66406**
70-74	0.985114	0.99929	0.0007	39396.61	0.352683	2.51667	196983.93	486039.27	**12.33708**
75-79	0.984841	0.99832	0.0017	32242.15	0.453759	2.486279	161211.87	289055.35	**8.965139**
80+	0.983105	0.00000	1.0000	25567.7	0.724379	6.838972	127843.47	127843.47	**5.000194**
								210684.6575	

Table 3: Multiple decrement life table of South African males, all causes and events of undetermined intent (Y10-Y34)

n	age	py	Dall	DI	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix
1	x	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0	602415	32,542	179	0.152	0.054019	0.0517	0.9483	100000	5166	95620	5442284	**54.4**	0.0003	28	3601	0.0003
4	4	2004585	7,768	340	1.605	0.003875	0.0154	0.9846	94835	1457	375852	5463032	**57.6**	0.0007	64	3,572	0.0002
5	5-9'	2515300	2,854	233	2.275	0.001135	0.0057	0.9943	93378	529	465454	5087180	**54.5**	0.0005	43	3,509	0.0001
5	**10-14'**	**2558400**	**2,233**	**274**	**2.843**	**0.000873**	**0.0044**	**0.9956**	**92850**	**405**	**463381**	**4621725**	**49.8**	**0.0005**	**50**	3,465	**0.0001**
5	**15-19**	**2496600**	**4,859**	**1,069**	**2.657**	**0.001946**	**0.0097**	**0.9903**	**92446**	**897**	**460133**	**4158345**	**45.0**	**0.0021**	**197**	3,416	**0.0004**
5	20-24	2345500	10,875	2,293	2.547	0.004637	0.0229	0.9771	91550	2100	452606	3698212	**40.4**	0.0048	442	3,219	0.0010
5	25-29	2204100	18,405	2,390	2.550	0.00835	0.0409	0.9591	89452	3661	438294	3245606	**36.3**	0.0053	475	2,776	0.0011
5	30-34	2957500	28,245	2,094	2.616	0.00955	0.0467	0.9533	85792	4006	419412	2807312	**32.7**	0.0035	297	2,301	0.0007
5	35-39	2461600	29,258	1,614	2.677	0.011886	0.0578	0.9422	81786	4731	397946	2387900	**29.2**	0.0032	261	2,004	0.0007
5	40-44	1145500	26,973	1,315	2.685	0.023547	0.1116	0.8884	77056	8604	365368	1989954	**25.8**	0.0054	419	1,743	0.0011
5	45-49	1050900	24,761	1,048	2.681	0.023562	0.1117	0.8883	68453	7648	324536	1624586	**23.7**	0.0047	324	1,324	0.0010
5	50-54	876400	22,790	774	2.655	0.026004	0.1225	0.8775	60807	7453	286561	1300050	**21.4**	0.0042	253	1,000	0.0009
5	55-59	682900	21,316	582	2.647	0.031214	0.1454	0.8546	53355	7758	248524	1013488	**19.0**	0.0040	212	747	0.0009
5	60-64	601800	17,410	369	2.646	0.02893	0.1354	0.8646	45598	6176	213454	764964	**16.8**	0.0029	131	535	0.0006
5	65-69	450000	17,878	241	2.631	0.039729	0.1816	0.8184	39422	7158	180159	551510	**14.0**	0.0024	96	404	0.0005
5	70-74	301200	13,771	162	2.628	0.04572	0.2062	0.7938	32265	6655	145544	371351	**11.5**	0.0024	78	308	0.0005
5	75-79	175500	12,534	134	2.618	0.071419	0.3052	0.6948	25611	7817	109439	225807	**8.8**	0.0033	84	230	0.0008
5	80+	132400	18,881	155	6.539	0.142606	1.0000	0.0000	17795	17796	116368	116368	**6.5**	0.0082	146	146	0.0012
	Total	**23562600**															

Table 4: Associated Single Decrement Life Table of South African males, all causes and events of undetermined intent (Y10-Y34)

age	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
x	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
0	0.994499	0.99998	0.0000	100000	1.06992	0.154151	100000.16	6121794.61	**61.21795**
4	0.956231	0.99999	0.0000	99998.49	0.60591	1.609772	399994.95	6021794.44	**60.21885**
5-9'	0.91836	1.00000	0.0000	94833.7	0.325012	1.841439	474169.12	5621799.50	**59.28061**
10-14'	**0.877295**	**1.00000**	**0.0000**	**93377.98**	**0.371147**	**2.681779**	**466890.90**	**5147630.38**	**55.12681**
15-19	**0.779996**	**0.99998**	**0.0000**	**92849.88**	**1.462609**	**2.929793**	**464253.69**	**4680739.48**	**50.41191**
20-24	0.789149	0.99989	0.0001	92443.74	3.146788	2.76377	462227.39	4216485.79	**45.61137**
25-29	0.870144	0.99978	0.0002	91539.87	3.01053	2.610359	457707.21	3754258.40	**41.01228**
30-34	0.925863	0.99983	0.0002	89431.77	1.629253	2.512049	447162.93	3296551.19	**36.86108**
35-39	0.944836	0.99981	0.0002	85777.54	1.314064	2.458183	428890.91	2849388.26	**33.21835**
40-44	0.951248	0.99936	0.0006	81770.71	2.001177	2.477746	408858.49	2420497.35	**29.60103**
45-49	0.957675	0.99944	0.0006	77006.74	1.320149	2.516831	385037.03	2011638.86	**26.12289**
50-54	0.966038	0.99946	0.0005	68414.83	0.883304	2.513732	342076.35	1626601.83	**23.77558**
55-59	0.972697	0.99938	0.0006	60773.51	0.636704	2.551552	303869.19	1284525.48	**21.13627**
60-64	0.978805	0.99958	0.0004	53321.62	0.328216	2.550858	266608.94	980656.29	**18.39134**
65-69	0.98652	0.99951	0.0005	45578.51	0.216582	2.546266	227893.11	714047.36	**15.66632**
70-74	0.988236	0.99944	0.0006	39403.1	0.165615	2.51667	197015.92	486154.25	**12.33797**
75-79	0.989309	0.99881	0.0012	32246.94	0.17534	2.486279	161235.16	289138.33	**8.966379**
80+	0.991791	0.00000	1.0000	25580.4	0.17102	6.838972	127903.17	127903.17	**5.000046**
								210684.6575	

Table 5: Multiple decrement life table of South African males, all causes and ill-defined and unknown causes of mortality (R95-R99), DNF

n	**age**	**py**	**Dall**	**DI**	**nax**	**nmx**	**nqx**	**npx**	**lx**	**ndx**	**nlx**	**Tx**	**ex**	**nqix**	**ndix**	**lix**	**nmix**
1	x	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	0	602415	32,542	2,913	0.152	0.054019	0.0517	0.9483	100000	5166	95620	5442284	**54.4**	0.0046	462	12834	0.0048
4	4	2004585	7,768	1,186	1.605	0.003875	0.0154	0.9846	94835	1457	375852	5463032	**57.6**	0.0023	222	12,372	0.0006
5	5-9'	2515300	2,854	375	2.275	0.001135	0.0057	0.9943	93378	529	465454	5087180	**54.5**	0.0007	69	12,150	0.0001
5	**10-14'**	**2558400**	**2,233**	**260**	**2.843**	**0.000873**	**0.0044**	**0.9956**	**92850**	**405**	**463381**	**4621725**	**49.8**	**0.0005**	**47**	12,080	**0.0001**
5	**15-19**	**2496600**	**4,859**	**350**	**2.657**	**0.001946**	**0.0097**	**0.9903**	**92446**	**897**	**460133**	**4158345**	**45.0**	**0.0007**	**65**	12,033	**0.0001**
5	20-24	2345500	10,875	650	2.547	0.004637	0.0229	0.9771	91550	2100	452606	3698212	**40.4**	0.0014	125	11,969	0.0003
5	25-29	2204100	18,405	1,658	2.550	0.00835	0.0409	0.9591	89452	3661	438294	3245606	**36.3**	0.0037	330	11,843	0.0008
5	30-34	2957500	28,245	2,997	2.616	0.00955	0.0467	0.9533	85792	4006	419412	2807312	**32.7**	0.0050	425	11,513	0.0010
5	35-39	2461600	29,258	3,349	2.677	0.011886	0.0578	0.9422	81786	4731	397946	2387900	**29.2**	0.0066	541	11,088	0.0014
5	40-44	1145500	26,973	3,255	2.685	0.023547	0.1116	0.8884	77056	8604	365368	1989954	**25.8**	0.0135	1038	10,547	0.0028
5	45-49	1050900	24,761	3,118	2.681	0.023562	0.1117	0.8883	68453	7648	324536	1624586	**23.7**	0.0141	963	9,509	0.0030
5	50-54	876400	22,790	2,982	2.655	0.026004	0.1225	0.8775	60807	7453	286561	1300050	**21.4**	0.0160	975	8,546	0.0034
5	55-59	682900	21,316	2,685	2.647	0.031214	0.1454	0.8546	53355	7758	248524	1013488	**19.0**	0.0183	977	7,571	0.0039
5	60-64	601800	17,410	2,201	2.646	0.02893	0.1354	0.8646	45598	6176	213454	764964	**16.8**	0.0171	781	6,594	0.0037
5	65-69	450000	17,878	2,437	2.631	0.039729	0.1816	0.8184	39422	7158	180159	551510	**14.0**	0.0247	976	5,813	0.0054
5	70-74	301200	13,771	1,841	2.628	0.04572	0.2062	0.7938	32265	6655	145544	371351	**11.5**	0.0276	890	4,838	0.0061
5	75-79	175500	12,534	1,812	2.618	0.071419	0.3052	0.6948	25611	7817	109439	225807	**8.8**	0.0441	1130	3,948	0.0103
5	80+	132400	18,881	2,990	6.539	0.142606	1.0000	0.0000	17795	17796	116368	116368	**6.5**	0.1584	2818	2,818	0.0226
	Total	**23562600**															

Table 6: Associated Single Decrement Life Table of South African females, all causes and ill-defined and unknown causes of mortality (R95-R99), DNF

age	**R-1**	**n*p-ix**	**n*q-ix**	***l-ix**	**n*d-ix**	**n*a-ix**	**n*L-ix**	**n*T-ix**	***e-ix**
x	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
0	0.910485	0.99975	0.0002	100000	62.06094	0.154151	100009.57	6116793.22	**61.16793**
4	0.847322	0.99996	0.0000	99975.48	7.319797	1.609772	399913.71	6016783.65	**60.18259**
5-9'	0.868605	1.00000	0.0000	94831.25	1.811354	1.841439	474159.58	5616869.95	**59.23016**
10-14'	**0.883565**	**1.00000**	**0.0000**	**93377.83**	**1.227663**	**2.681779**	**466892.45**	**5142710.37**	**55.07421**
15-19	**0.927969**	**0.99999**	**0.0000**	**92849.89**	**1.68693**	**2.929793**	**464254.40**	**4675817.92**	**50.35889**
20-24	0.94023	0.99997	0.0000	92445.03	3.316818	2.76377	462234.31	4211563.51	**45.55749**
25-29	0.909916	0.99985	0.0002	91547.22	8.908849	2.610359	457759.36	3749329.20	**40.95514**
30-34	0.893893	0.99976	0.0002	89437.85	11.66726	2.512049	447218.54	3291569.84	**36.80287**
35-39	0.885536	0.99961	0.0004	85771.41	15.08584	2.458183	428894.16	2844351.30	**33.162**
40-44	0.879324	0.99841	0.0016	81754	29.97007	2.477746	408844.27	2415457.14	**29.54543**
45-49	0.874076	0.99834	0.0017	76933.57	28.21262	2.516831	384738.85	2006612.88	**26.08241**
50-54	0.869153	0.99791	0.0021	68339.19	29.07818	2.513732	341769.05	1621874.03	**23.73271**
55-59	0.874038	0.99713	0.0029	60679.25	29.76717	2.551552	303472.22	1280104.98	**21.09625**
60-64	0.873578	0.99751	0.0025	53201.59	24.11599	2.550858	266069.46	976632.76	**18.35721**
65-69	0.863687	0.99505	0.0049	45484.09	31.48145	2.546266	227500.62	710563.30	**15.62224**
70-74	0.866313	0.99365	0.0063	39227.44	29.56789	2.51667	196211.61	483062.68	**12.31441**
75-79	0.855433	0.98406	0.0159	32060.21	40.76149	2.486279	160402.38	286851.07	**8.947262**
80+	0.84164	0.00000	1.0000	25202.69	63.63948	6.838972	126448.69	126448.69	**5.017269**
								210684.6575	

Appendix 6: Female life tables from Death Notification Forms, 2007 (by broad-underlying causes of death)

Table 1: Multiple decrement life table of South African females, all causes and other external causes of accidental injury (W00-X59), DNF

n	age	py	Dall	W00-X59	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix
1	x	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	0	597297	27,510	197	0.152	0.046057	0.0443	0.9557	100000	4434	96241	5628574	**56.3**	0.0003	32	1528	0.0003
4	4	1972903	6,968	300	1.605	0.003532	0.0140	0.9860	95567	1340	379065	5691640	**59.6**	0.0006	58	1,497	0.0002
5	5-9'	2482500	2,489	194	2.275	0.001003	0.0050	0.9950	94229	472	469861	5312576	**56.4**	0.0004	37	1,439	0.0001
5	**10-14'**	**2532200**	**1,892**	**196**	**2.843**	**0.000747**	**0.0037**	**0.9963**	**93757**	**351**	**468036**	**4842714**	**51.7**	**0.0004**	**36**	1,402	**0.0001**
5	**15-19**	**2479300**	**4,164**	**329**	**2.657**	**0.00168**	**0.0084**	**0.9916**	**93408**	**782**	**465211**	**4374678**	**46.8**	**0.0007**	**62**	1,366	**0.0001**
5	20-24	2329700	13,664	409	2.547	0.005865	0.0289	0.9711	92626	2679	456566	3909467	**42.2**	0.0009	80	1,304	0.0002
5	25-29	2131500	24,430	404	2.550	0.011461	0.0557	0.9443	89949	5015	437462	3452901	**38.4**	0.0009	83	1,224	0.0002
5	30-34	1906400	28,959	353	2.616	0.01519	0.0733	0.9267	84935	6227	409835	3015439	**35.5**	0.0009	76	1,141	0.0002
5	35-39	1610800	24,756	332	2.677	0.015369	0.0742	0.9258	78709	5841	379983	2605604	**33.1**	0.0010	78	1,065	0.0002
5	40-44	1254800	21,108	289	2.685	0.016822	0.0810	0.9190	72869	5900	350693	2225621	**30.5**	0.0011	81	987	0.0002
5	45-49	1171400	17,805	263	2.681	0.0152	0.0734	0.9266	66970	4917	323452	1874928	**28.0**	0.0011	73	906	0.0002
5	50-54	995700	15,567	236	2.655	0.015634	0.0754	0.9246	62054	4680	299299	1551476	**25.0**	0.0011	71	834	0.0002
5	55-59	803100	14,548	191	2.647	0.018115	0.0869	0.9131	57375	4985	275148	1252177	**21.8**	0.0011	65	763	0.0002
5	60-64	704700	13,422	142	2.646	0.019046	0.0911	0.9089	52390	4776	250714	977030	**18.6**	0.0010	51	697	0.0002
5	65-69	662100	15,771	178	2.631	0.02382	0.1127	0.8873	47615	5369	225362	726316	**15.3**	0.0013	61	647	0.0003
5	70-74	396800	15,745	179	2.628	0.03968	0.1813	0.8187	42247	7662	193067	500954	**11.9**	0.0021	87	586	0.0005
5	75-79	247100	17,005	197	2.618	0.068818	0.2956	0.7044	34586	10226	148579	307887	**8.9**	0.0034	118	499	0.0008
5	80+	219800	33,803	528	6.539	0.15379	1.0000	0.0000	24362	24363	159307	159307	**6.5**	0.0156	381	381	0.0024
	Total	**24288100**															

Table 2: Associated Single Decrement Life Table of South African females, all causes and other external causes of accidental injury (W00-X59), DNF

age	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
x	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
0	0.992839	0.99999	0.0000	100000	0.504055	0.154151	100000.08	6295869.25	**62.96**
4	0.956946	0.99999	0.0000	99998.56	0.227563	1.609772	399994.61	6195869.17	**61.96**
5-9'	0.922057	1.00000	0.0000	95566.56	0.112445	1.841439	477833.02	5795874.56	**60.65**
10-14'	**0.896406**	**1.00000**	**0.0000**	**94228.4**	**0.108533**	**2.681779**	**471142.27**	**5318041.55**	**56.44**
15-19	**0.920989**	**0.99999**	**0.0000**	**93757.36**	**0.18126**	**2.929793**	**468787.31**	**4846899.27**	**51.70**
20-24	0.970067	0.99997	0.0000	93407.27	0.228967	2.76377	467036.98	4378111.96	**46.87**
25-29	0.983463	0.99995	0.0001	92624.12	0.232006	2.610359	463121.19	3911074.99	**42.23**
30-34	0.98781	0.99993	0.0001	89943.91	0.211301	2.512049	449720.06	3447953.80	**38.33**
35-39	0.986589	0.99992	0.0001	84928.98	0.21956	2.458183	424645.46	2998233.74	**35.30**
40-44	0.986309	0.99991	0.0001	78703.2	0.227308	2.477746	393516.58	2573588.28	**32.70**
45-49	0.985229	0.99992	0.0001	72862.6	0.203452	2.516831	364313.49	2180071.70	**29.92**
50-54	0.98484	0.99991	0.0001	66964.63	0.197568	2.513732	334823.67	1815758.21	**27.12**
55-59	0.986871	0.99990	0.0001	62048.25	0.181371	2.551552	310241.71	1480934.54	**23.87**
60-64	0.98942	0.99991	0.0001	57368.6	0.140484	2.550858	286843.36	1170692.83	**20.41**
65-69	0.988713	0.99985	0.0002	52385.52	0.173849	2.546266	261928.05	883849.47	**16.87**
70-74	0.988631	0.99959	0.0004	47607.96	0.264382	2.51667	238040.46	621921.42	**13.06**
75-79	0.988415	0.99880	0.0012	42229.8	0.39781	2.486279	211150.00	383880.95	**9.09**
80+	0.98438	0.00000	1.0000	34544.94	0.914095	6.838972	172730.95	172730.95	**5.00**
								210684.6575	

Table 3: Multiple decrement life table of South African females, all causes and events of undetermined intent (Y10-Y34), DNF

n	age	py	Dall	Y10-Y34	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix
1	x	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	0	597297	27,510	142	0.152	0.046057	0.0443	0.9557	100000	4434	96241	5628574	**56.3**	0.0002	23	1253	0.0002
4	4	1972903	6,968	245	1.605	0.003532	0.0140	0.9860	95567	1340	379065	5691640	**59.6**	0.0005	47	1,230	0.0001
5	5-9'	2482500	2,489	184	2.275	0.001003	0.0050	0.9950	94229	472	469861	5312576	**56.4**	0.0004	35	1,183	0.0001
5	**10-14'**	**2532200**	**1,892**	**134**	**2.843**	**0.000747**	**0.0037**	**0.9963**	**93757**	**351**	**468036**	**4842714**	**51.7**	**0.0003**	**25**	1,148	**0.0001**
5	**15-19**	**2479300**	**4,164**	**351**	**2.657**	**0.00168**	**0.0084**	**0.9916**	**93408**	**782**	**465211**	**4374678**	**46.8**	**0.0007**	**66**	1,123	**0.0001**
5	20-24	2329700	13,664	479	2.547	0.005865	0.0289	0.9711	92626	2679	456566	3909467	**42.2**	0.0010	94	1,057	0.0002
5	25-29	2131500	24,430	465	2.550	0.011461	0.0557	0.9443	89949	5015	437462	3452901	**38.4**	0.0011	95	964	0.0002
5	30-34	1906400	28,959	476	2.616	0.01519	0.0733	0.9267	84935	6227	409835	3015439	**35.5**	0.0012	102	868	0.0002
5	35-39	1610800	24,756	381	2.677	0.015369	0.0742	0.9258	78709	5841	379983	2605604	**33.1**	0.0011	90	766	0.0002
5	40-44	1254800	21,108	348	2.685	0.016822	0.0810	0.9190	72869	5900	350693	2225621	**30.5**	0.0013	97	676	0.0003
5	45-49	1171400	17,805	347	2.681	0.0152	0.0734	0.9266	66970	4917	323452	1874928	**28.0**	0.0014	96	579	0.0003
5	50-54	995700	15,567	265	2.655	0.015634	0.0754	0.9246	62054	4680	299299	1551476	**25.0**	0.0013	80	483	0.0003
5	55-59	803100	14,548	215	2.647	0.018115	0.0869	0.9131	57375	4985	275148	1252177	**21.8**	0.0013	74	403	0.0003
5	60-64	704700	13,422	147	2.646	0.019046	0.0911	0.9089	52390	4776	250714	977030	**18.6**	0.0010	52	330	0.0002
5	65-69	662100	15,771	148	2.631	0.02382	0.1127	0.8873	47615	5369	225362	726316	**15.3**	0.0011	50	277	0.0002
5	70-74	396800	15,745	109	2.628	0.03968	0.1813	0.8187	42247	7662	193067	500954	**11.9**	0.0013	53	227	0.0003
5	75-79	247100	17,005	107	2.618	0.068818	0.2956	0.7044	34586	10226	148579	307887	**8.9**	0.0019	64	174	0.0004
5	80+	219800	33,803	152	6.539	0.15379	1.0000	0.0000	24362	24363	159307	159307	**6.5**	0.0045	110	110	0.0007
	Total	**24288100**															

Table 4: Associated Single Decrement Life Table of South African females, all causes and events of undetermined intent (Y10-Y34), DNF

age	**R-1**	**n*p-ix**	**n*q-ix**	***l-ix**	**n*d-ix**	**n*a-ix**	**n*L-ix**	**n*T-ix**	***e-ix**
x	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
0	0.994838	0.99999	0.0000	100000	0.297861	0.154151	100000.05	6295954.06	**62.95954**
4	0.964839	0.99999	0.0000	99998.96	0.152747	1.609772	399996.10	6195954.01	**61.96018**
5-9'	0.926075	1.00000	0.0000	95566.71	0.087678	1.841439	477833.72	5795957.92	**60.64829**
10-14'	**0.929175**	**1.00000**	**0.0000**	**94228.41**	**0.060757**	**2.681779**	**471142.19**	**5318124.20**	**56.43865**
15-19	**0.915706**	**0.99999**	**0.0000**	**93757.4**	**0.159035**	**2.929793**	**468787.46**	**4846982.01**	**51.69706**
20-24	0.964944	0.99997	0.0000	93407.23	0.217426	2.76377	467036.77	4378194.55	**46.87211**
25-29	0.980966	0.99994	0.0001	92623.71	0.210219	2.610359	463119.12	3911157.77	**42.22631**
30-34	0.983563	0.99991	0.0001	89943.19	0.216773	2.512049	449716.48	3448038.66	**38.33574**
35-39	0.98461	0.99991	0.0001	84926.97	0.181147	2.458183	424635.30	2998322.18	**35.30471**
40-44	0.983513	0.99989	0.0001	78702.31	0.187473	2.477746	393512.03	2573686.88	**32.70154**
45-49	0.980511	0.99989	0.0001	72861.2	0.171432	2.516831	364306.45	2180174.85	**29.9223**
50-54	0.982977	0.99990	0.0001	66962.87	0.128523	2.513732	334814.65	1815868.39	**27.11754**
55-59	0.985221	0.99988	0.0001	62047.57	0.107955	2.551552	310238.11	1481053.74	**23.86965**
60-64	0.989048	0.99990	0.0001	57367.85	0.068752	2.550858	286839.44	1170815.63	**20.40892**
65-69	0.990616	0.99987	0.0001	52385.35	0.061983	2.546266	261926.92	883976.19	**16.87449**
70-74	0.993077	0.99975	0.0003	47609.18	0.062334	2.51667	238046.06	622049.28	**13.06574**
75-79	0.993708	0.99935	0.0007	42236.61	0.075295	2.486279	211183.26	384003.21	**9.091714**
80+	0.995503	0.00000	1.0000	34563.89	0.075755	6.838972	172819.96	172819.96	**5.000015**
								210684.658	

Table 5: Multiple decrement life table of South African females, all causes and ill-defined and unknown causes of mortality (R95-R99), DNF

n	age	py	Dall	R95-R99	nax	nmx	nqx	npx	lx	ndx	nlx	Tx	ex	nqix	ndix	lix	nmix
1	x	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0	597297	27,510	2,669	0.152	0.046057	0.0443	0.9557	100000	4434	96241	5628574	56.3	0.0043	430	14749	0.0045
4	4	1972903	6,968	1,099	1.605	0.003532	0.0140	0.9860	95567	1340	379065	5691640	59.6	0.0022	211	14,319	0.0006
5	5-9'	2482500	2,489	364	2.275	0.001003	0.0050	0.9950	94229	472	469861	5312576	56.4	0.0007	69	14,108	0.0001
5	10-14'	2532200	1,892	234	2.843	0.000747	0.0037	0.9963	93757	351	468036	4842714	51.7	0.0005	43	14,039	0.0001
5	15-19	2479300	4,164	505	2.657	0.00168	0.0084	0.9916	93408	782	465211	4374678	46.8	0.0010	95	13,996	0.0002
5	20-24	2329700	13,664	1,649	2.547	0.005865	0.0289	0.9711	92626	2679	456566	3909467	42.2	0.0035	323	13,901	0.0007
5	25-29	2131500	24,430	3,091	2.550	0.011461	0.0557	0.9443	89949	5015	437462	3452901	38.4	0.0071	634	13,578	0.0015
5	30-34	1906400	28,959	3,717	2.616	0.01519	0.0733	0.9267	84935	6227	409835	3015439	35.5	0.0094	799	12,943	0.0019
5	35-39	1610800	24,756	3,282	2.677	0.015369	0.0742	0.9258	78709	5841	379983	2605604	33.1	0.0098	774	12,144	0.0020
5	40-44	1254800	21,108	2,870	2.685	0.016822	0.0810	0.9190	72869	5900	350693	2225621	30.5	0.0110	802	11,370	0.0023
5	45-49	1171400	17,805	2,300	2.681	0.0152	0.0734	0.9266	66970	4917	323452	1874928	28.0	0.0095	635	10,568	0.0020
5	50-54	995700	15,567	1,998	2.655	0.015634	0.0754	0.9246	62054	4680	299299	1551476	25.0	0.0097	601	9,933	0.0020
5	55-59	803100	14,548	1,893	2.647	0.018115	0.0869	0.9131	57375	4985	275148	1252177	21.8	0.0113	649	9,332	0.0024
5	60-64	704700	13,422	1,714	2.646	0.019046	0.0911	0.9089	52390	4776	250714	977030	18.6	0.0116	610	8,684	0.0024
5	65-69	662100	15,771	2,243	2.631	0.02382	0.1127	0.8873	47615	5369	225362	726316	15.3	0.0160	763	8,074	0.0034
5	70-74	396800	15,745	2,342	2.628	0.03968	0.1813	0.8187	42247	7662	193067	500954	11.9	0.0270	1140	7,311	0.0059
5	75-79	247100	17,005	2,736	2.618	0.068818	0.2956	0.7044	34586	10226	148579	307887	8.9	0.0476	1645	6,171	0.0111
5	80+	219800	33,803	6,280	6.539	0.15379	1.0000	0.0000	24362	24363	159307	159307	6.5	0.1858	4526	4,526	0.0286
	Total	24288100															

Table 6: Associated Single Decrement Life Table of South African females, all causes and ill-defined and unknown causes of mortality (R95-R99), DNF

age	**R-1**	**n*p-ix**	**n*q-ix**	***l-ix**	**n*d-ix**	**n*a-ix**	**n*L-ix**	**n*T-ix**	***e-ix**
x	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
0	0.902981	0.99981	0.0002	100000	65.90564	0.154151	100010.16	6291403.91	**62.91404**
4	0.842279	0.99997	0.0000	99980.5	7.976364	1.609772	399934.86	6191393.75	**61.92601**
5-9'	0.853757	1.00000	0.0000	95564.4	2.068584	1.841439	477825.79	5791458.90	**60.60268**
10-14'	**0.876321**	**1.00000**	**0.0000**	**94228.24**	**1.297337**	**2.681779**	**471144.66**	**5313633.11**	**56.39109**
15-19	**0.878722**	**0.99999**	**0.0000**	**93757.33**	**2.850738**	**2.929793**	**468795.00**	**4842488.45**	**51.64917**
20-24	0.879318	0.99990	0.0001	93406.99	9.839324	2.76377	467062.15	4373693.45	**46.82405**
25-29	0.873475	0.99960	0.0004	92616.99	19.68987	2.610359	463136.34	3906631.30	**42.1805**
30-34	0.871646	0.99928	0.0007	89912.28	25.23639	2.512049	449624.81	3443494.96	**38.29838**
35-39	0.867426	0.99924	0.0008	84873.95	24.74405	2.458183	424430.60	2993870.15	**35.27431**
40-44	0.864033	0.99907	0.0009	78649.58	26.00595	2.477746	393312.33	2569439.56	**32.66946**
45-49	0.870823	0.99928	0.0007	72801.73	20.74992	2.516831	364060.88	2176127.23	**29.89115**
50-54	0.871652	0.99924	0.0008	66921.77	19.93173	2.513732	334658.93	1812066.35	**27.07738**
55-59	0.869879	0.99897	0.0010	62006.74	21.99747	2.551552	310089.84	1477407.41	**23.82656**
60-64	0.872299	0.99889	0.0011	57315.64	21.12114	2.550858	286632.07	1167317.57	**20.36648**
65-69	0.857777	0.99808	0.0019	52332.1	27.35243	2.546266	261730.17	880685.50	**16.82878**
70-74	0.851254	0.99462	0.0054	47523.97	43.14862	2.51667	237728.46	618955.33	**13.02406**
75-79	0.839106	0.98347	0.0165	42019.85	68.32878	2.486279	210269.12	381226.87	**9.072543**
80+	0.814218	0.00000	1.0000	34014.68	129.3132	6.838972	170957.75	170957.75	**5.026**
								210684.658	

Appendix 7: Death Notification Form (B1- 1663)

REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF HOME AFFAIRS

83/BI – 1663
Page 1

NOTIFICATION / REGISTER OF DEATH / STILLBIRTH

in terms of the Births and Deaths Registration Act, 1992 (Act No. 51 of 1992)

Space for Bar Code

9999

• *Must be completed in black ink (please tick ✓ where applicable)* SERIAL No: A06390177
• *Please refer to instructions*
FILE No: DATE:

CANCELLED

A PARTICULARS OF DECEASED INDIVIDUAL / STILLBORN CHILD

Identity number of deceased
Date of death
Date of birth
Surname
Age at last birthday years
Maiden Name (If female)
Sex
Forenames
If death occurred within 24 hours after birth number of hours alive

MARITAL STATUS OF DECEASED Single Civil Marriage Living as married Widowed Religious Law Marriage Divorced Customary Marriage

Left thumb print of deceased

PLACE OF BIRTH (Municipal district or country if abroad)

PLACE OF DEATH (City / Town / Village)

PLACE REGISTRATION OF DEATH

CITIZENSHIP OF DECEASED

B PARTICULARS OF INFORMANT

Identity number
Initials and Surname
Relationship to deceased Parent Spouse Child Other kin Other (specify)
Postal address
Postal Code
Dialling Code
Left thumb print of informant
Was the next of kin of the deceased a smoker* during the past five years? Yes No Refuse to answer
Telephone No.
Date YYYY MM DD
Signature

C PARTICULARS OF FUNERAL UNDERTAKER

Office Stamp of Funeral Undertaker

Initials and Surname
Designation No.
Place of burial / cremation
Date YYYY MM DD
Signature

D.1 CERTIFICATE BY ATTENDING MEDICAL PRACTITIONER / PROFESSIONAL NURSE

I, the undersigned, hereby certify that the deceased named in **Section A,** to the best of my knowledge and belief, died solely and exclusively due to NATURAL CAUSES, as specified in **Section G.**

I, the undersigned, am not in the position to certify that the deceased died exclusively due to natural causes.

Initials and Surname
Postal address
Postal Code
Date Signed YYYY MM DD
Signature
SAMDC / SANC Reg. No.

D.2 CERTIFICATE BY DISTRICT SURGEON / FORENSIC PATHOLOGIST

I, the undersigned, hereby certify that a medicolegal post-mortem examination has been conducted on the body of the person whose particulars are given in **Section A** and that the body is no longer required for the purpose of the Inquest Act, 1959 (Act No. 58 of 1959) and that the cause of death is:

Natural (Cause of Death as indicated in **Section G**) Unnatural Under investigation

Initials and Surname
Postal address
Postal Code
Place of post-mortem
Date YYYY MM DD
SAMDC Reg. No.
Mortuary reference
Date signed YYYY MM DD
Signature

E FOR OFFICIAL USE ONLY

Initials and Surname or Registrar
Registration of Death approved and Burial Order issued

Office Stamp

Postal address
Force No./ Designation No.
Persal No.
Postal Code
Date YYYY MM DD
Signature

* Someone who smokes tobacco on most days

Supplied by LITHOTECH SP Tel.: (012) 327-3239

NOTIFICATION / REGISTER OF DEATH / STILLBIRTH

83/BI – 1663
Page 2

INFORMATION FOR MEDICAL AND HEALTH USE ONLY

(After completion ***seal*** to ensure confidentiality)

Space for Bar Code

• *Must be completed in black ink (please tick ✓ where applicable)* SERIAL No:
• *Please refer to instructions*
FILE No: DATE: A06390177

F DEMOGRAPHIC DETAILS

Initials and Surname of deceased

Identity number

PLACE OF DEATH 1. Hospital: (Inpatient ☐ ER / Outpatient ☐ DOA ☐) 2. Nursing Home ☐ 3. Home ☐

4. Other *(Specify)* ☐ ....

FACILITY NAME:
(If not an institution, give street name and number ....

USUAL RESIDENTIAL ADDRESS OF DECEASED *(Where someone lived on most days)*

Street name and number
Name of Plot, Farm, etc.
Suburb / Village
Town / City
Province / Country
Postal Code

Magisterial district
Census enumerator area

DECEASED'S EDUCATION (Specify ✓ only highest class completed / achieved)

None	Gr1	Gr2	Gr3	Gr4	Gr5	Gr6	Gr7	Gr8	Gr9 Form 2	Gr10 Form 3 NTC1	Gr11 Form 4 NTC2	Gr12 Form 5 NTC3	Univ Tech	CODE

USUAL OCCUPATION OF DECEASED
(give type of work done during most of working life. *Do not use retired*

TYPE OF BUSINESS / INDUSTRY (e.g. Mining, Farming etc.)
Refer to instructions.

Was the deceased a smoker* five years ago? (✓) Yes ☐ No ☐ Do not know ☐ Not applicable (minor) ☐

CANCELLED

G MEDICAL CERTIFICATE OF CAUSE OF DEATH

PART 1 Enter the disease, injuries or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock or heart failure. **List only one cause on each line.**

Approximate interval between onset and Death (Days / Months / Years)

FOR OFFICE USE ONLY
ICD-10

IMMEDIATE CAUSE (Final disease or condition resulting in death) (a) ....
Due to (or a consequence of)

Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE last (Disease or injury that initiated events resulting in death)
(b) ....
Due to (or a consequence of)
(c) ....
Due to (or a consequence of)
(d) ....
Due to (or a consequence of)

PART 2 Other significant conditions contributing to death but not resulting in the underlying cause given in **Part 1** ....

If a **female**, was she pregnant 42 days prior to death? (✓) Yes ☐ No ☐

If **stillborn**, please write mass in grams

Do you consider the deceased to be: African ☐ White ☐ Indian ☐ Coloured ☐ Other ☐ *(Specify)* ....

Method of ascertainment of cause of death:

1. Autopsy ☐ 2. Opinion of attending medical practitioner ☐ 2. Opinion of attending medical practitioner on duty ☐

4. Opinion of registered professional nurse ☐ 5. Interview of family member ☐

6. Other ☐ *(Specify)* ....

* Someone who smokes tobacco on most days

Supplied by LITHOTECH SP Tel.: (012) 327-3239

Source: Statistics SA, 2011