Levels and Causes of Adolescent Mortality in South Africa

Nicole De Wet* and Clifford Odimegwu*

*University of the Witwatersrand, Department of Demography and Population Studies, Johannesburg, South Africa

Correspondence email: nicole.dewet@wits.ac.za

Abstract:

Most studies on mortality focus on under- five children and adults (18+). However between these ages lie an important population of adolescents, aged between 10 and 19 years old. A study on the causes of adolescent mortality from 1984 to 1986 found racial and gendered differences (Fischer, et al, 1992). However, this study admits to under-representing the African population and is out-dated. Although overall, the levels and numbers of adolescent mortality are not very high in South Africa, it is noted here that it is increasing over time. Research and measures need to be put into place now to avert the increasing adolescent mortality rates. This study uses descriptive statistics, age-specific mortality rates, proportional mortality ratios, a direct estimation of mortality, cause- specific mortality rates and associated single decrement life tables to examine the levels and causes of adolescent mortality in contemporary South Africa. Data from the 2001 Census and 2007 Community Survey are used. Findings from this paper show that adolescent mortality is highest among the African population group at 19,575 in 2001 and 51, 761 in 2007 and adolescents with only a primary level of education (approximately 50% in 2001 and 46% in 2007). Further, this paper shows that in 2007, life expectancy in the absence of unnatural causes of death would increase to 56 years among younger adolescents (10- 14 years old) and 51 years for older adolescents (15- 19 years old). In addition, the absence of certain infectious diseases including HIV/ AIDS and Tuberculosis, would increase life expectancy to an additional 57 years for younger adolescents according to 2007 data. Thus the prevention of these causes of death are of vital importance to national youth programmes and policies.

Introduction

The World Health Organisation (WHO) defines an adolescent as a person between the ages of 10 and 19 years old (WHO 2010). Even if the distribution of skills and autonomy varies within the age group, adolescents will still grow up and become fundamental contributors to development in any country. For this reason alone, it is necessary to investigate the levels and causes of adolescent mortality since this has a direct impact on the size and health of the future population. However, adolescents are faced with a number of challenges to achieving optimal health, skills and behaviours. In 2003 at the Adolescent Health and Development in Africa Conference it was noted that almost 40% of under- 18s in Sub- Saharan Africa were not in school (WorldBank 2003). Further the WHO estimates that more than 333 million new cases of curable STIs annually occur among individuals under the age of 25 years (WHO 1998). There are existing gender disparities among adolescents with regard to STI infection. In South Africa, a study showed that adolescent girls were 30% more likely to get an STI than boys (MacPhail, Williams, and Campbell 2002).

For causes of mortality, studies contend that a dominant cause of mortality of adolescents in the Sub- Saharan Africa 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). It is argued that, 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).

In South Africa specifically, a study on causes of mortality for adolescents highlighted racial and gender differences in mortality rates between 1984 and 1986 (Fisher, 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.

Another study done on the causes of mortality 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.

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).

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).

Seedat and others (2009) attempted to address the causes of youth mortality in South Africa, 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 were 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.

As evident, *aspects* of adolescent mortality have been studied globally and in South Africa. However the *levels and causes* of adolescent mortality, 10- 19 year olds, in South Africa, remains largely under- researched. A possible reason for this is because adolescents are split among either being considered children, 10 years old or younger or being youth, which is 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. In creating an over-large 'children' or 'adult' age- group a true reflection of the levels and causes of this transitional phase (adolescence) is not captured in research. However, adolescents constitute 20% of the world's population and 85% of adolescents live in developing countries (Lobel et al. 2004), making this age- group increasingly important to study as an autonomous age group.

If adolescent mortality levels and causes are not studied independent of child and adult mortality, the resulting research will be too wide-ranging to address the specific needs of those persons who are in the transitional phase. Research that only addresses children and adults broadly neglect the fact that in between these spheres lies a group of people who cannot be grouped with either end just yet. These people (adolescents) need to be studied on their own since their health, behaviours and skills are quite different to that of children and adults.

The main objectives of this study are: to estimate mortality levels of the adolescent population in South Africa and to assess causes of death among adolescents in the country.

Location of the Study

South Africa is situated at the southern most tip of the African continent. Its neighbouring countries include Zimbabwe, Mozambique and Botswana. 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 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.

However, despite the progress made and stability achieved, South Africa remains, much like the rest of Africa, plagued by the burden of disease and mortality. 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 (Statssa 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 (Statssa 2011). However some studies have included children under 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, Rutstein, and Johnson 2003; Hunter 1991). With adolescents in South Africa constituting approximately 20% of the total population, a substantial percentage of adolescents could then be orphans. Further, since this demographic 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 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, de Wet, and Stadler 2001). Added to this plight, it was found that adolescent girls were almost four times more likely to experience sexual violence than adolescent boys in the country (King et al. 2004).

Methods

Data from the 2001 Census and 2007 Community Survey (CS) are used. Although not a census, the Community Survey is nationally representative and contains the same information as the Census. In the 2001 Census, South Africa was divided into approximately 80,000 enumeration areas. For the Community Survey a total of 17,098 enumeration areas had been surveyed and this was distributed across all nine provinces of South Africa.

Adolescents, aged 10- 19 are covered in this study. Both males and females are examined. Adolescents from all four of South Africa's major population groups (African, White, Coloured and Indian) are represented in the study. Various socioeconomic and provincial attributes are also included.

The outcome being studied is adolescent mortality. That is, death of persons aged 10- 19 years old. In the Census and Community Survey, households were asked if anybody in the household had died. Further information regarding the sex and cause of death were asked. More importantly the age at the time of death was collected in both surveys. It is from this question that adolescents who have died are identified and used in this analysis. If the household has experienced an adolescent death in either survey, it has been coded as a '1' for 'yes' in the analysis. If there are no adolescent deaths, a code of '0' has been assigned. For each person in each survey, whether dead or alive, a unique identifier has been assigned called a '*serial number*' or '*sn*'. This number has been used to identify the households, demographic and socioeconomic characteristics of the deceased adolescents. This number has been further used to identify the characteristics of deceased adolescents by natural and unnatural causes of death in the population. A weighted total of 41,443 adolescent deaths were recorded in 2001 and 54,046 adolescent deaths were recorded for 2007.

For analysis, statistical techniques and demographic methods have been selected based on the quantitative, cross- sectional nature of the data. Percentage distributions are used to show broad distributions of adolescent mortality across South Africa from 2001- 2007. To illustrate levels of adolescent mortality, age- specific mortality rates, probability of dying and proportional mortality ratios are calculated for 10- 14 year olds and 15- 19 year olds respectively.

Age- specific mortality rates are here calculated for young (10- 14 years) adolescents and older (15- 19 years) adolescents, as well as for the total 10- 19 years old age- group. The purpose of the age- specific mortality rate is to provide the number of adolescents per 1,000 in the population who are dying. The formula for this is derived as follows:

$$ {}_nM_x = \frac{{}_nD_x}{{}_nP_x} $$

Where ${}_nD_x$ = deaths to persons aged x to x+n; ${}_nP_x$ = midyear population of persons aged x to x+n.

A direct estimation of mortality technique is used to derive the probability of dying from age 10 and before age 20. This approach is derived from life table notations and can be 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. The interval values (n) used in this equation reflects the age interval under review, which is 5 years. The average person years lived are borrowed values as specified by Preston and others (2001). The assumption upon which these borrowed values are based is that deaths will occur approximately halfway through the age interval (Preston, Heuveline, and Guillot 2001). Hence, since the age interval is 5 years, the average person years lived are 2.5 years at each interval.

Proportional Mortality Ratios (PMR) specify the contribution of either natural or unnatural causes deaths to overall mortality. 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. In this paper, the contribution of natural and unnatural causes of death to all- cause mortality is shown by 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 or natural) and ${}_nD_x$ is the total number of deaths from all causes.

The importance of these techniques is that policy can now estimate the expected losses of life in the adolescent population. Being able to do so is essential to national planning especially for the Youth Development Policy.

For the analysis of cause of death, cause- specific mortality rates are calculated for males and females separately. Cause- specific mortality rates show the number of deaths from either natural or unnatural causes of death, per 10,000 population at risk. The formula used for this is:

$$CSMR = \frac{{}_nD^i_x}{{}_nP_x}$$

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.

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 (CIDs) 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 MDGs.

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 appendix for a list of definitions and formulae). 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; ${}_nD^i_x$ is the observed total number of deaths from a particular cause; 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 (other than unnatural and CID causes of death) 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:

$${}_na_x^{-i} = n + R^{-i}\,\frac{{}_nq_x}{{}_nq_x^{-i}}({}_na_x - n)$$

Second for ages over 10 years old:

$${}_5a_x^{-i} = \frac{-\frac{5}{24}{}_5d_{x-5}^{-i} + 2.5\,{}_5d_x^{-i} + \frac{5}{24}{}_5d_{x+5}^{-i}}{{}_5d_x^{-i}}.$$

Source: Preston, et al. 2001

By way of limitations, 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 (Dorrington et al. 2001). 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, this will not present a major challenge to the study. Similarly, due to the rigorous nature of data collection and validation by Statistics South Africa, underreporting does not appear as a major factor in the reliability of the study (Statssa, 2003). A further limitation is the availability of specific causes of death from the 2001 Census. The two broad categories of natural and unnatural causes of death are captured in the survey, but there are no specific causes of death.

Results

Overview of mortality

In 2001, the actual number of living adolescents was 10,034,594 and the actual number of dead adolescents was 41,443. For 2007, the actual number of living adolescents in the country was 10,040,317 and the actual number of dead adolescents was 54,046. The size of the adolescent population in South Africa is increasing. In addition, the number of adolescent deaths in the country is also increasing. In the period 2001 to 2007, it is here estimated the adolescent mortality increased by approximately 1.3%.

Distribution of adolescent deaths by individual characteristics

Table 1: Percentage distribution of adolescent mortality by individual demographic and socioeconomic characteristics, South Africa, 2001 – 2007

	Deceased	
	2001	**2007**
Characteristic	% (N)	% (N)
Age		
10-14	31.72 (13,146)	33.05 (17,863)
15- 19	68.28 (28,298)	67 (36,183)
Sex		
Male	52.77 (21,868)	47.24 (25,529)
Female	47.23 (19,575)	52.76 (28,517)
Race		
Black	47.23 (19,575)	95.77 (51,761)
Coloured	4.8 (1,989)	2.18 (1,179)
Indian/ Asian	0.53 (220)	0.22 (121)
White	1.11 (460)	1.82 (985)
Unknown	46.33(19,200)	-
Education		
None	-	5.05 (2,727)
Primary	50.56 (20,955)	46.53 (25,149)
Secondary	14.68 (6,085)	22.85 (12,352)
Incomplete Secondary	0.90 (357)	-
Tertiary	-	-
NA	11.75 (4,867)	25.57 (13,818)
Unknown	22.10 (9,180)	-
Province		
Unspecified	99 (41,398)	58.67 (31,710)
Western Cape	0.03 (13)	2.31 (1,249)
Eastern Cape	-	7.02 (3,797)
Northern Cape	0.05 (22)	0.74 (401)
Free State	-	2.75 (1,484)
KwaZulu Natal	-	12.65 (6,837)
North West	0.02 (10)	2.73 (1,478)
Gauteng	-	6.33 (3,421)
Mpumalanga	-	3.5 (1,893)
Limpopo	-	3.29 (1,776)
Total - N	**41,443**	**54,046**

Table 1 shows the percentage distribution of adolescent mortality by individual characteristics in 2001 and 2007. Overall, mortality increased from about 41,443 adolescent deaths in 2001 to 54,046 adolescent deaths in 2007.

To begin, mortality among both younger (10-14) and older (15-19) adolescents increased in the period. Overall, it is seen that mortality among males and females, from 2001- 2007 is high. In particular, the table shows that male and female mortality increased from 2001- 2007. In both years, there were more adolescent male deaths than females.

By race, or population group, adolescent mortality increased among the Blacks, Coloureds and Whites in the country in the period. A slight reduction among Indian/ Asian adolescents was recorded and mortality in this race is noted as lower than all the other population groups. The numbers in the table indicate that adolescent mortality is highest among the Black race followed by Coloureds.

Adolescent mortality among those who attained a secondary education had increased from 2001 to 2007. Further, in 2001, there was no data on the adolescents with no education or tertiary education. Given the age group under review, 10- 19 years old, it is possible that all were enrolled in school at any particular grade, even if they had not completed any particular level and that none had achieved tertiary education.

For province of residence, the 2001 Census data do not allow for thorough analysis of the distribution of deaths by province. From what is available there is a higher concentration of deaths in the Northern Cape province. For 2007, however, the distribution of adolescent deaths by province shows that a high number of deaths in KwaZulu Natal. However, in this data again, there is a large distribution of deaths that are not classified by province.

Levels of Adolescent Mortality

Table 2: Number and percentage distribution of adolescent deaths 10- 14 and 15- 19 years old and age- specific mortality rates, 2001 – 2007, South Africa

Age Groups		Total Population 2001	Total Population 2007	Total Deaths 2001	Total Deaths 2007	Age- Specific Mortality Rates 2001	Age- Specific Mortality Rates 2007
10- 14'	N	5,052,183	4,947,002	13,146	17,863	0.0026	0.003611
	%	50.34	49.27	31.72	33.05		
15- 19	N	4,982,231	5,093,139	28,298	36,183	0.00568	0.007104
	%	49.66	50.73	68.28	66.95		
Total	**N**	**10,034,414**	**10,040,141**	**41,443**	**54,046**	**0.00413**	**0.005383**
	%	**100**	**100**	**100**	**100**		

Although generated to five decimal places, age- specific mortality rates (ASMRs) are multiplied by 1,000 to give the number of deaths per 1,000 population. As previously noted, adolescent mortality has increased in South Africa over time. This is reflected in the ASMRs over time, which have 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 3: Direct estimation of adolescent mortality showing probability of dying, 2001 – 2007, South Africa

Age Groups	Age Specific Mortality Rates ($_nm_x$) 2001	Age Specific Mortality Rates ($_nm_x$) 2007	Interval (n) 2001	Interval (n) 2007	Average number of years lived ($_na_x$) 2001	Average number of years lived ($_na_x$) 2007	Probability of dying ($_nq_x$) 2001	Probability of dying ($_nq_x$) 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 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 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.

Table 4(a): Proportional Mortality Ratio by sex, for natural causes of death, 2001- 2007, South Africa

Sex		**Total Adolescent Deaths**		**Adolescent Deaths from Natural Causes**		**Proportional Mortality Ratio (%)**	
		2001	2007	2001	2007	2001	2007
	N	21,868	25,529	12,979	12,429		
Male	*%*	52.77	47.24	44.07	36.27	59.35	48.69
	N	19,575	28,517	16,470	21,838		
Female	%	47.23	52.76	55.93	63.73	84.14	76.58
	N	**41,443**	**54,046**	**29,449**	**34,267**		
Total	**%**	**100**	**100**	**100**	**100**	**71.06**	**63.40**

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

Table 4(b): Proportional Mortality Ratio by sex, for unnatural causes of death, 2001- 2007, South Africa

Sex		**Total Adolescent Deaths**		**Adolescent Deaths from Unnatural Causes**		**Proportional Mortality Ratio (%)**	
		2001	2007	2001	2007	2001	2007
Male	N	21,868	25,529	8,889	13,100	40.65	51.31
	%	52.77	47.24	74.11	66.23		
Female	N	19,575	28,517	3,105	6,680	15.86	23.42
	%	47.23	52.76	25.89	33.77		
Total	**N**	**41,443**	**54,046**	**11,994**	**19,780**	**28.94**	**36.60**
	%	**100**	**100**	**100**	**100**		

For unnatural causes of death, the contribution of males to total all- cause adolescent deaths in 2001 was about 41% and this increased to 51% in 2007. The Proportional Mortality Ratio also shows that the percentage contribution of unnatural deaths among adolescent females increased from approximately 16% in 2001 to about 23% in 2007. Overall Table 4(b) shows that the contribution of unnatural deaths to total all- cause mortality increased from 2001 to 2007, at 29% overall to 37% overall.

Causes of Adolescent Deaths

Cause- Specific Mortality Rates for Males and Females

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 here generated.

Table 5(a) Cause- specific mortality rates, by sex, for natural deaths among adolescents, 2001 – 2007

		Total Adolescent Population		**Adolescent Deaths from Natural Causes**		**Cause- Specific Mortality Rates**	
Sex		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. 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. This increased in 2007, whereby approximately 43 natural cause deaths to female adolescents were recorded per 10,000 female adolescent population. Overall Table 5(a) shows that cause- specific mortality rates for natural causes of death increased from 2001 to 2007 among adolescents in South Africa.

Table 5(b) Cause- specific mortality rates by sex, for unnatural deaths among adolescents, 2001 – 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. In 2007, this increased to about 26 male deaths per 10,000. 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 and this increased to about 13 per 10,000 in 2007, indicating that the number of deaths had doubled. Overall Table 5(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.

Survival and Life Expectancy

Figure 1: Number of survivors at age x (lx) from unnatural causes of death, 2001- 2007

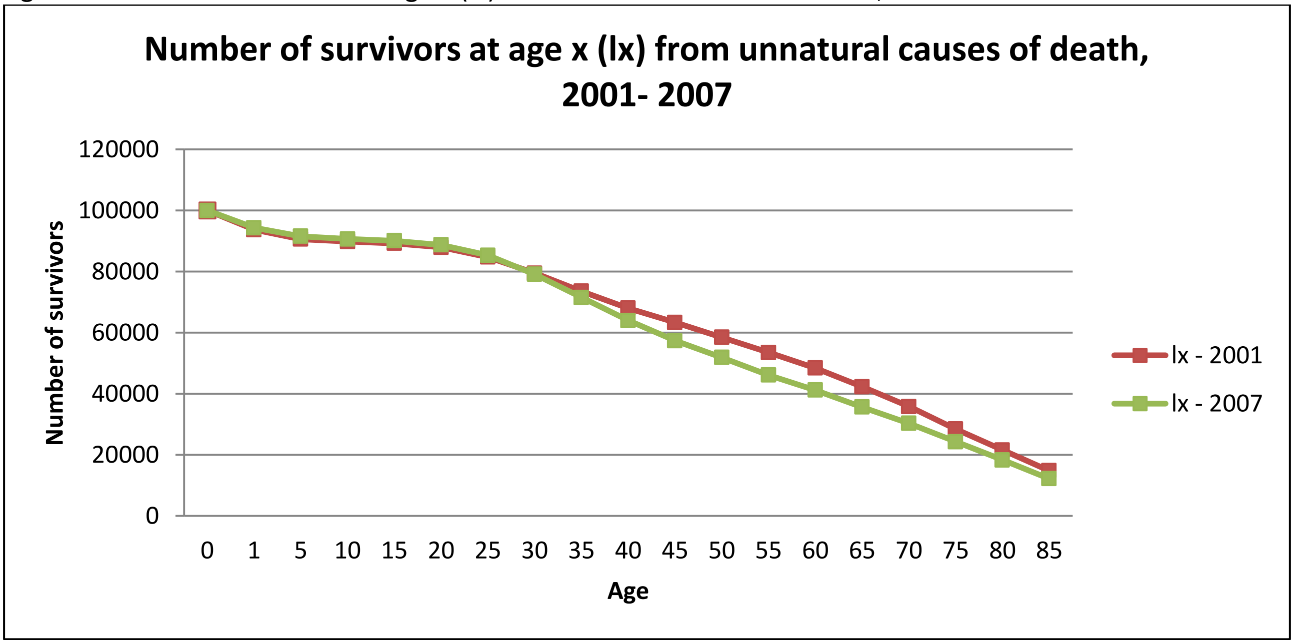

Figure 1 shows the number of survivors at each age in 2001 and 2007 who have survived unnatural causes of death. For the population of interest in this paper, 10- 19 years old, the figure shows that there has not been much difference in the number of survivors from 2001 to 2007. The figure shows that from age 20 onwards the number of survivors start to decline rapidly and in 2007 there were fewer survivors at older ages than in 2001.

Figure 2 (a): Life expectancy with and without unnatural causes of death, 2001 (South Africa)

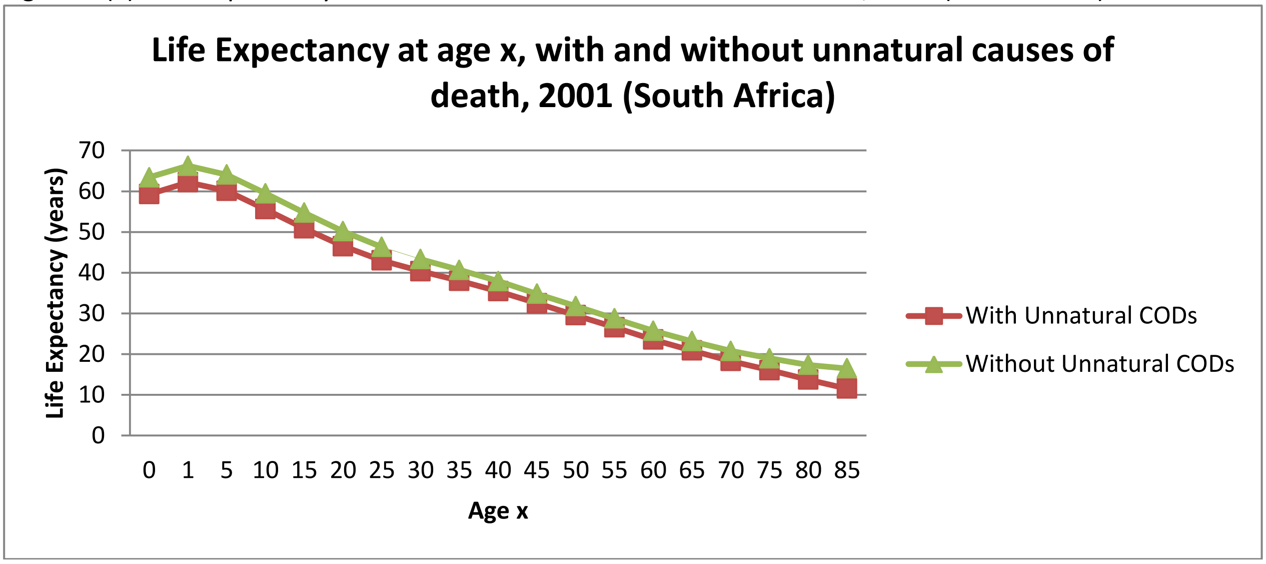

Figure 2 (a) shows the life expectancy of the South African population with unnatural causes of death and without unnatural causes of death in 2001. The figure shows that with unnatural causes of death, the life expectancy at all ages is lower than if unnatural causes of death were eliminated from the population. For the adolescent population it 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 additional years of years, compared to the approximate 55 years with unnatural causes.

Figure 2 (b): Life expectancy with and without unnatural causes of death, 2007 (South Africa)

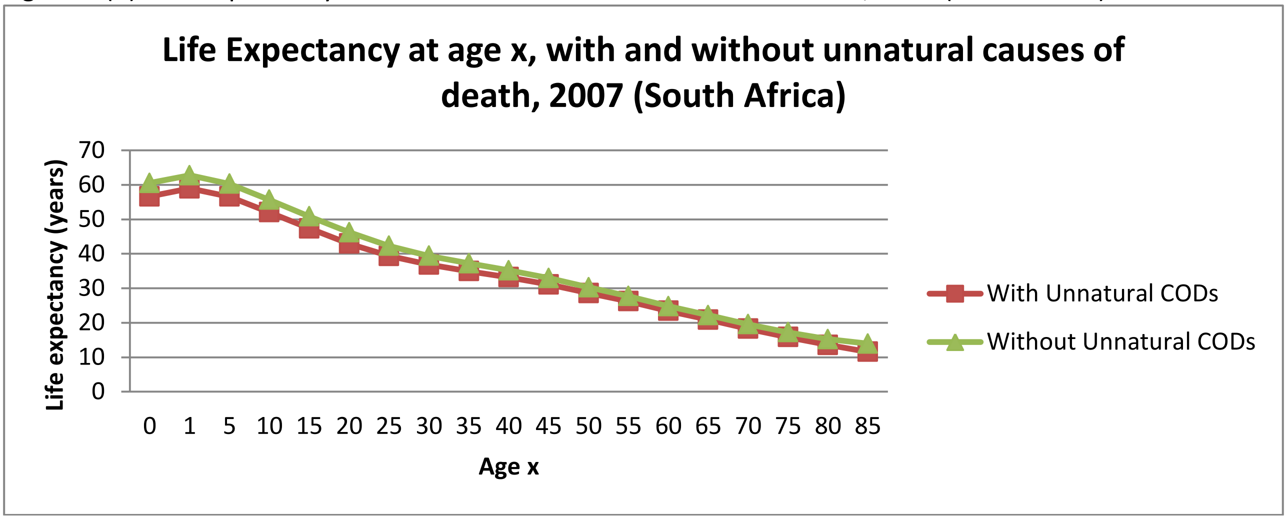

Figure 2 (b) shows life expectancy with and without unnatural causes of death in South Africa in 2007. The figure again shows that life expectancy is higher at all ages in the absence of unnatural causes of death, especially in the younger age groups. For adolescents, the figure shows that with unnatural 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 2(c): Life expectancy with and without certain infectious disease (CIDs) causes of death, 2007 (South Africa)

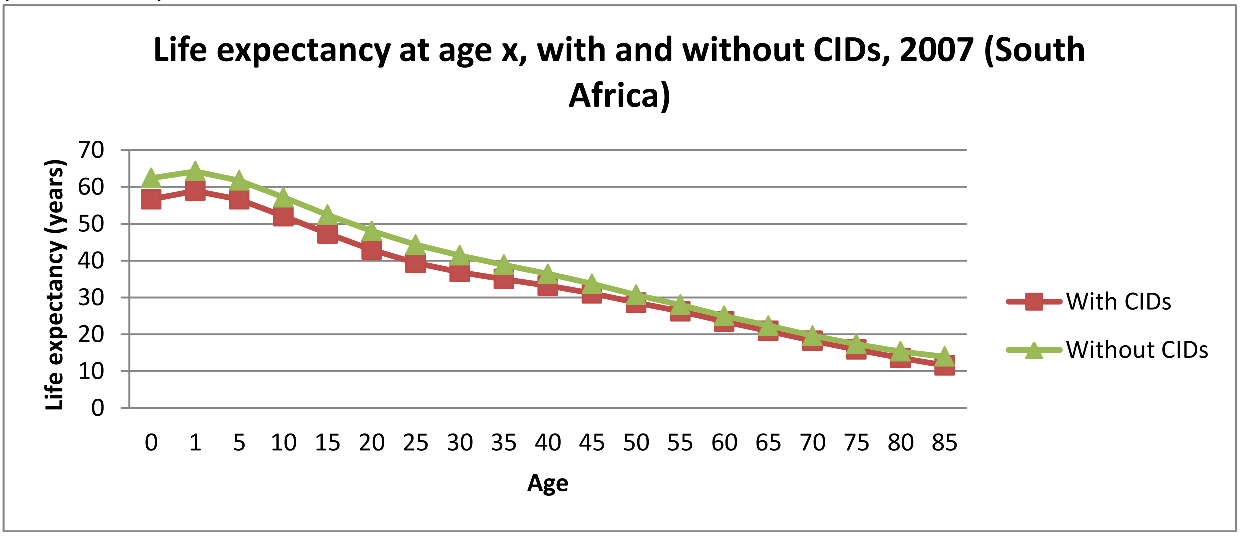

Figure 2 (c) shows life expectancy with and without certain infectious diseases (including tuberculosis and HIV/AIDS) as causes of death in South Africa in 2007. The figure shows that among older age- groups (45 years and over) the gains in life expectancy without CIDs is minimal compared to the younger ages. For the population of interest, the figure shows clearly that life expectancy would increase to 55 and 57 additional years of life.

Discussion

Levels of adolescent mortality

Levels of adolescent mortality is increasing over time. The age- specific mortality rates show that in 2001, 4 adolescents per 1,000 population had died, in 2007 this increased to 5 adolescents per 1,000. This is also reflected in the probability of dying showed in Table 3. Adolescents and youth in South Africa historically have had lower mortality than all other age groups (Mba, 2007). Mba estimated that in 1996, the age- specific mortality rate for 10- 14 year olds was 0.5 deaths per 1,000 population and for 15- 19 year olds was 1.6 deaths per 1,000 adolescent population (Mba 2007). This paper has demonstrated an increase in this level of mortality. Proving that the population with the lowest mortality historically is increasing is a fundamental find for policy and programme development in the country.

The Proportional Mortality Ratios generated here show that more adolescent deaths are due to natural causes than unnatural deaths (Table 4a and 4b). Mortality due to natural causes of death are higher among females than males in both years under review. This is consistent with other literature that found female mortality from natural causes to be higher than that of males (D'Souza and Chen 1980; Rajaratnam et al. 2010). For unnatural causes of death, the inverse is true (Table 4b), showing higher male mortality in both years than female mortality. This is also consistent with findings in existing literature (Lopez 1984; Pampel 2002). In 2001, the proportion of natural deaths was higher than in 2007 (71% and 63% respectively). This is attributable to the increase in unnatural causes of death among adolescent South Africans, especially males.

Preventable causes of death (Unnatural causes of death)

From figures 1 and 2 it is shown that gains in life expectancy can be made if unnatural causes of death were eliminated from the South African population. 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 development of certain diseases (for example, STIs and obesity) within this age- group. Should CIDs be eliminated from the population (including STIs such as HIV) adolescents in South Africa can experience even further gains in life expectancy (see Figure 2c).

Conclusions

Knowledge about the extent of adolescent mortality can help planners to allocate national funds to relevant health programmes. For example, this study found that mortality is consistently higher among African adolescents and those with only a primary school education. It is also found that age-specific mortality rates are increasing, especially among older adolescents (15- 19 years old) in the country. Further, this study has shown an increase in the number of unnatural causes of death from 2001 to 2007. Of further notable importance are the findings that life expectancy among adolescents is fairly low but does increase in the absence of unnatural causes of death. These are largely preventable and so programmes and funds should be focused on education and prevention in this regard.

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 (graph 1 and Tables 1, 4 and 5) in the form of showing percentage distributions and cross- tabulations. But can also be used in future for more inferential statistics, such as regression analysis. The data were also useful in conducting more complex analysis such as the adolescent mortality rates, ratios and life tables used in this paper. This form of inference adds needed forecasting in the form of probabilities and life expectancies to assist in informing policies and programmes.

This paper has also demonstrated, the gains in life expectancy South African adolescents can expect should unnatural and certain natural causes of death be eliminated from the population. It is only through addressing both the natural and unnatural causes of death that substantial gains in life expectancy can be achieved in South Africa. This has policy and programme importance as it shows the low probability of adolescents dying from unnatural causes and the increased life expectancy.

Finally, 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. Research and measures need to be put into place now to avert the increasing adolescent mortality rates. Addressing unnatural causes of death is a way to start. Through addressing preventable causes of death, mortality will in this population decrease and adolescent life expectancy will increase.

Acknowledgements
University of the Witwatersrand; Prof. Clifford Odimegwu; CARTA; NRF/ DAAD; Statssa

References:

Aliber, Michael. 2003. Chronic Poverty in South Africa: Incidence, Causes and Policies. *World Development* 31 (3):473-490.

Bicego, George, Shea Rutstein, and Kiersten Johnson. 2003. Dimensions of the emerging orphan crisis in sub- Saharan Africa. *Social Science & Medicine* 56:1235-1247.

Chiang, Chin Long. 1984. *The Life Table and Its Applications*, *International Journal of STD and AIDS*. Malabar, Florida.: Robert E. Krieger Publishing Company.

Coale, Ansley J, and Paul G Demeny. 1983. *Regional Model Life Tables and Stable Populations*. New York: Academic Press.

D'Souza, Stan, and Lincoln C. Chen. 1980. Sex Differentials in Mortality in Rural Bangladesh. *Population and Development Review* 6 (2):257-270.

Dorrington, R, D Bourne, D Bradshaw, R Laubscher, and I Timaeus. 2001. The Impact of HIV/AIDS on Adult Mortality in South Africa. In *Technical Report, Burden of Disease Research Unit, Medical Research Council*. South Africa.

Hunter, S. 1991. The impact of AIDS on children in sub- Saharan African urban centres. *African Urban Quarterly* 6:108-128.

Kaufman, Carol E, Thea de Wet, and Jonathan Stadler. 2001. Adolescent Pregnancy and Parenthood in South Africa. *Studies in Family Planning* 32 (2):147-160.

King, Gary, Alan J Flisher, Farzad Noubary, Robert Reece, Adele Marais, and Carl Lombard. 2004. Substance abuse and behavioral correlates of sexual assault among South African adolescents. *Child Abuse & Neglect* 28 (6):685-698.

Kiragu, Karungari. 2001. Youth and HIV/AIDS: Can we avoid catastrophe? *Population Reports, Series L* (12.).

Lobel, Thalma E, Nohar Nov- Krispin, Daniela Schiller, Orly Lobel, and Amit Feldman. 2004. Gender Discriminatory Behavior During Adolescence and Young Adulthood: A Developmental Analysis. *Journal of Youth and Adolescence* 33 (6):535 -546.

Lopez, Alan D. 1984. Sex differentials in mortality. *WHO Chronicle* 38 (5):217-224.

MacPhail, Catherine, B.G Williams, and Catherine Campbell. 2002. Relative Risk of HIV Infection among Young Men and Women in a South African Township. *International Journal of STD and AIDS* 13 (5):331- 342.

Mba, Chuks J. 2007. Impact of HIV/AIDS mortality on South Africa's life expectancy and implications for the elderly population,. *African Journal of Health Sciences* 14.

Ngoma, Amuzweni Lerato. 2005. Youth Unemployment in South Africa. *Youth Development Journal*:18 - 23.

Pampel, Fred C. 2002. Cigarette Use and the Narrowing Sex Differential in Mortality. *Population and Development Review* 28 (1):77-104.

Pettifor, Audrey E, Helen V Rees, Immo Kleinschmidt, Annie E Steffenson, Catherine MacPhail, Lindiwe Hlongwa-Madikizela, and Nancy S Padian. 2005. Young people's sexual health in South Africa: HIV prevalence and sexual behaviors from a nationally representative household survey. *AIDS* 19 (14):1525-1534.

Preston, Samuel H, Patrick Heuveline, and Michel Guillot. 2001. *Demography: Measuring and Modeling Population Processes*. Vol. 57: Blackwell.

Rajaratnam, Julie Knoll, Jake R. Marcus, Alison Levin-Rector, Andrew N. Chalupka, Haidong Wang, Laura Dwyer, Megan Costa, Alan D. Lopez, and Christopher J. L. Murray. 2010. Worldwide mortality in men and women aged 15–59 years from 1970 to 2010: a systematic analysis. *The Lancet* 375 (9727):1704-1720.

Redelinghuys, N, and HCJ Van Rensburg. 2004. Health, Morbidity and Mortality: The health status of the South African population. In *Health and Healthcare in South Africa*, edited by H. Van Rensburg. Pretoria: Van Schaik.

Seedat, Mohammed, Ashley Van Niekerk, Rachel Jewkes, Shahnaaz Suffla, and Kopano Ratele. 2009. Violence and injuries in South Africa: prioritising an agenda for prevention. *The Lancet* 374 (9694):1011-1022.

Sibanda, Amson, and Gwendoline Lehloenya. 2005. Race and Gender Gaps in Education. In *The Demography of South Africa*, edited by T. Zuberi, A. Sibanda and E. Udjo. New York: M.E Sharpe, Inc.

Statssa. 2003. Census 2001: Census in Brief. edited by Statssa. Pretoria: Statssa.

Statssa. 2008. Community Survey 2007: Unit Records, Metadata. edited by Statssa. Pretoria: Statssa.

Statssa. 2011. Mid- year population estimates 2011. Pretoria: Statistics South Africa.

Swart, Lu-Ann, Mohammed Seedat, Garth Stevens, and Izabel Ricardo. 2002. Violence in adolescents' romantic relationships: findings from a survey amongst school-going youth in a South African community. *Journal of Adolescence* 25 (4):385-395.

Waldron, Ingrid. 1993. Recent trends in sex mortality ratios for adults in developed countries. *Social Science & Medicine* 36 (4):451-462.

WHO. 1998. *The Second Decade: Improving Adolescent Health and Development (WHO/FRH/ADH/98.18),* . Geneva: Adolescent Health and Development Programme, WHO.

WHO. *Fact File: 10 facts on adolescent health 2010* 2010. Available from http://www.who.int/features/factfiles/adolescent_health/facts/en/index.html.

WorldBank. *Adolescent Health and Development in Africa* 2003. Available from http://web.worldbank.org/.

Appendix A: Life Table Notations and Formulae

Life Table Notations:
n= interval;
n**a**x= Average number of person-years lived in the interval by those who died in the interval;
n**m**x= Mortality rate for people in the age group x to x+n;
n**q**x= Probability of dying between ages x and x+n;
n**p**x= Probability of surviving between ages x and x+n ;
lx= Number surviving at each age;
n**d**x= Number of deaths between ages x and x+n;
Lx= Person years lived between ages x and x+n;
Tx= Person years lived beyond age x;
ex= Life expectancy at age x;
n**q**x^{i}= Probability of dying from unnatural causes between ages x and x+n;
n**d**x^{i}= Number of deaths from unnatural causes between ages x and x+n;
Lx^{i}= Number surviving from unnatural deaths at each age ;
n**m**x^{i}= Mortality rate for people due to unnatural causes in the age group x to x+n
Associated Single Decrement Notations:
R^{-i}= Constant of proportionality for decrement other than unnatural causes in the interval x to x+n;
n***p**$^{-i}$x= Probability of surviving from age x to x+n in the absence of unnatural causes;
n***q**$^{-i}$x= Probability of dying from age x to x+n in the absence of unnatural causes;
***l**$^{-i}$x= Number of people left alive at age x in the absence of unnatural causes of death;
n***d**$^{-i}$x= Number of people dying between ages x and x+n in the absence of unnatural causes of death; n***a**$^{-i}$x= Average person years lived between ages x and x+n in the absence of unnatural causes of death; n***L**$^{-i}$x= Person years lived between ages x to x+n in the absence of unnatural causes of death;
n***T**$^{-i}$x= Person years lived above age x in the absence of unnatural causes of death;
***e**$^{-i}$x= Life Expectancy at age x in the absence of unnatural causes of death

Notation	Formula
n	Number of interval years
nmx	Deaths / Population
nqx	(n*nmx)/(1+(n-nax)*nmx)
npx	1- nqx
lx	npx*lx
ndx	lx- lx+n
Lx	(n*lx)+(nax*ndx)
Tx	Sum of Lx
ex	Tx/ lx
R-1	(Deaths-Unnatural Deaths)/ Deaths
n*p-ix	npx^R-i
n*q-ix	1 - n*p-ix
*l-ix	*l-ix * n*p-ix
n*d-ix	*l-ix * n*q-ix
n*L-ix	(n*lx-i)+(na-ix*n*d-ix)
n*T-ix	Sum of n*L-ix
*e-ix	n*T-ix / *lx-i

Appendix B: Completed Life Tables

Complete Multiple Decrement Life Table, South Africa, 2001

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		

Associated Single Decrement Life Table, South Africa, 2001

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		

Complete Multiple Decrement Life Table, South Africa, 2007

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		

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

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		

Associated single decrement life table: CIDs, 2007

age	Pop	CID	R-1	n*p-ix	n*q-ix	*l-ix	n*d-ix	n*a-ix	n*L-ix	n*T-ix	*e-ix
0	1,003,597	13060	0.7797	0.9559	0.0441	100000	4413.497	0.157	100694.4	6240061	62.40
1	3,981,579	5192	0.8285	0.9752	0.0248	95586.5	2370.989	1.611	386166.1	6139366	64.23
5	5,116,814	1542	0.8374	0.9923	0.0077	93215.51	720.5144	1.965	467493.2	5753200	61.72
10	**4,947,002**	948	**0.8546**	**0.9944**	**0.0056**	**92495**	**519.8233**	**2.722**	**463889.9**	**5285707**	**57.15**
15	**5,093,139**	1610	**0.8982**	**0.9861**	**0.0139**	**91975.18**	**1274.375**	**2.86**	**463525.9**	**4821817**	**52.43**
20	4,791,808	7512	0.7968	0.9697	0.0303	90700.8	2747.266	2.764	461099.5	4358291	48.05
25	4,064,793	16540	0.7322	0.9458	0.0542	87953.53	4765.465	2.624	452274	3897192	44.31
30	3,738,488	23443	0.6887	0.9328	0.0672	83188.07	5591.899	2.539	430137.2	3444918	41.41
35	3,217,631	21512	0.6984	0.9252	0.0748	77596.17	5807.731	2.490	402443.1	3014780	38.85
40	2,835,298.00	17697	0.7105	0.9259	0.0741	71788.44	5317.899	2.457	372008.5	2612337	36.39
45	2,408,282	13127	0.7286	0.9291	0.0709	66470.54	4711.03	2.511	344180.6	2240329	33.70

50	1,967,385	9371	0.7976	0.9100	0.0900	61759.51	5559.581	2.508	322741.2	1896148	30.70
55	1,566,153	6584	0.8129	0.9124	0.0876	56199.93	4925.44	2.522	293422.3	1573407	28.00
60	1,157,685	4120	0.8759	0.8814	0.1186	51274.49	6083.119	2.541	271827.7	1279985	24.96
65	962,195.84	3377	0.8916	0.8647	0.1353	45191.37	6113.351	2.538	241475.4	1008157	22.31
70	665,095.32	2158	0.9257	0.8154	0.1846	39078.02	7212.043	2.537	213685	766681.5	19.62
75	480,086.35	1851	0.9310	0.7683	0.2317	31865.97	7384.62	2.517	177917.4	552996.5	17.35
80	263,796.01	1147	0.9455	0.6807	0.3193	24481.35	7816.733	2.627	142945.6	375079.1	15.32
85	241,236.61	1656	0.9437	0.2697	0.7303	16664.62	12170.32	12.227	232133.4	232133.4	13.93
	48502064	152447							6240061		

Associated single decrement life table: HIV/AIDS, 2007

age	Pop	HIV	R-i	n*p-ix	n*q-ix	*l-ix	n*d-ix	*a-ix	n*L-ix	n*T-ix	*e-ix
0	1,003,597	49	0.999173	0.943796	0.056204	100000	5620.411	0.152	100854.4	5688857	56.89
1	3,981,579	28	0.999075	0.970164	0.029836	94379.59	2815.916	1.605	382038	5588003	59.21
5	5,116,814	27.00	0.997154	0.990803	0.009197	91563.67	842.0962	1.951	459460.9	5205965	56.86
10	**4,947,002**	13.00	**0.998007**	**0.99344**	**0.00656**	**90721.58**	**595.1068**	**2.691**	**455209.3**	**4746504**	**52.32**
15	**5,093,139**	16.00	**0.998988**	**0.984602**	**0.015398**	**90126.47**	**1387.802**	**2.913**	**454675.1**	**4291295**	**47.61**
20	4,791,808	150.00	0.995943	0.962286	0.037714	88738.67	3346.652	2.801	453067.4	3836620	43.24
25	4,064,793	328	0.99469	0.927121	0.072879	85392.02	6223.308	2.641	443396.3	3383552	39.62
30	3,738,488	494	0.99344	0.904497	0.095503	79168.71	7560.887	2.535	415012.6	2940156	37.14
35	3,217,631	438	0.993859	0.895203	0.104797	71607.82	7504.319	2.472	376589.2	2525143	35.26
40	2,835,298	310	0.994928	0.897826	0.102174	64103.5	6549.725	2.436	336473.9	2148554	33.52
45	2,408,282	228	0.995287	0.904465	0.095535	57553.78	5498.411	2.471	301357.1	1812080	31.48
50	1,967,385	119	0.99743	0.888732	0.111268	52055.37	5792.096	2.479	274638	1510723	29.02
55	1,566,153	70	0.998011	0.8935	0.1065	46263.27	4927.057	2.490	243582.8	1236085	26.72
60	1,157,685	27	0.999186	0.865827	0.134173	41336.21	5546.189	2.517	220641	992502.3	24.01
65	962,196	17	0.999455	0.84966	0.15034	35790.02	5380.681	2.518	192499.2	771861.3	21.57
70	665,095	8	0.999724	0.802245	0.197755	30409.34	6013.593	2.522	167212.9	579362.1	19.05
75	480,086	3	0.999888	0.753421	0.246579	24395.75	6015.471	2.504	137044.3	412149.1	16.89
80	263,796	2	0.999905	0.665812	0.334188	18380.28	6142.472	2.608	107917.9	275104.9	14.97
85	241,237	3	0.999898	0.249447	0.750553	12237.81	9185.119	11.54	167186.9	167186.9	13.66
	48502064.23	2330							5688857		