Sex Differences in Adult Mortality (age 15-64) in South Africa, 1997-2005: HIV and other sources

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Main Points

- HIV mortality has increased in South Africa, especially since about 2000.
- Adult mortality has increased enormously since 1997, especially among women age 20-39.
- Between 1997 and 2005, overall adult male mortality increased by 1.8 times and overall adult female mortality by 2.6 times.
- In 2005, female mortality exceeded male mortality at age 20-34, reversing a typical pattern.
- Male age standardized death rates 15-64 remained higher than female rates, although the gap narrowed considerably over time.
- Female mortality increased by more than 2.5 times for a wide variety of causes of death, both communicable and non-communicable diseases
- Male mortality increased by more than 2.5 times for a smaller variety of causes, mainly communicable diseases.
- Below age 20 and above age 55 mortality increases were modest.
- Many deaths in which HIV is the underlying or a contributing cause of death are not identified as due to HIV.
- The shape of the age-specific mortality schedule has often been used to identify hidden HIV mortality, which is a useful approach but needs to be applied with caution.
- Rates for other important causes of death have been virtually unchanged (stroke, cancer), have declined (malaria) or have increased (diabetes), even though they are not directly related to HIV.
- Higher female than male death rates at young adult ages have sometimes been interpreted as evidence of HIV, but female rates were higher than male rates for many causes of death in 1997, especially for those age 15-29, a year when HIV mortality was likely still low.

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Females have typically had lower death rates than males at every age, except in situations of extreme female deprivation. Recently, in countries such as South Africa with high levels of HIV infection, female mortality has approached and for some age groups surpassed that of males. This paper looks at sex differences in age-specific mortality rates for South Africans age 15-64, 1997-2005. The focus is on overall mortality changes by sex as well as on changes in the shape of the age-specific mortality schedule.

Data

We start the analysis with 1997 because the completeness of registration of deaths improved substantially from 1996 to 1997. In 1996, only 67% of all deaths were estimated to have been registered (Statistics South Africa, 2000: vi), while in 1997, 80% of all deaths to males and 78% of all deaths to females were estimated to have been registered. Although valuable work has been done using the death registration data from 1996 (Bradshaw *et al*., 2002), data from 1997 and later present many fewer problems.

We restrict our consideration to the 15-64 age range because the completeness of registration of the deaths of children below age 15 is much lower than for the 15-64 age group. For 1997, we estimate that 92% of all deaths to males age 15-64 were registered, but only 41% of all deaths to males age 0-14 were registered; for females in 1997 84% of deaths to those age 15-64 were registered but 45% of deaths to females age 0-14 were registered. We do not use the data for people age 65 and older in this report because there is a substantial problem with inaccuracy of reported age for people age 65 or older (Phillips, Anderson, and Tsebe, 2003). Thus numerators for death rates by age and sex are from Death Registration data adjusted for completeness of death registration and denominators are from the mid-year population estimates from Statistics South Africa.

HIV in South Africa

Figure 1 shows the percent of pregnant women at public antenatal (prenatal) clinics who tested positive for HIV in South Africa by year 1990-2005 (South Africa, Department of Health, 2006: 10). There was a rapid increase from the early 1990s through the late 1990s, with a slowdown in the rate of increase from the late 1990s through 2005.

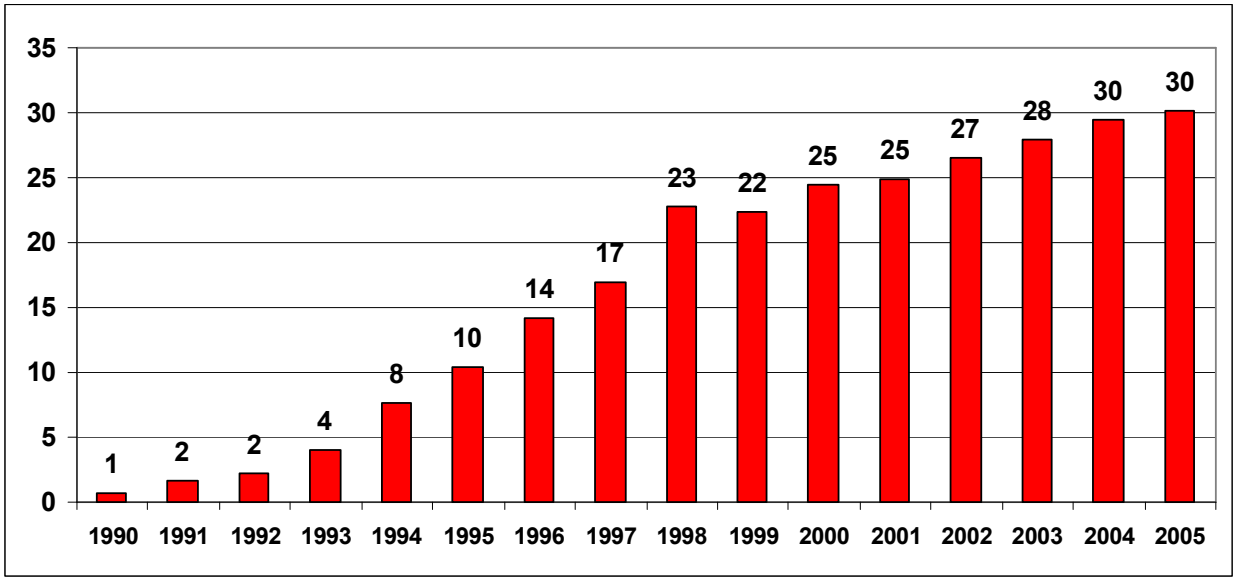
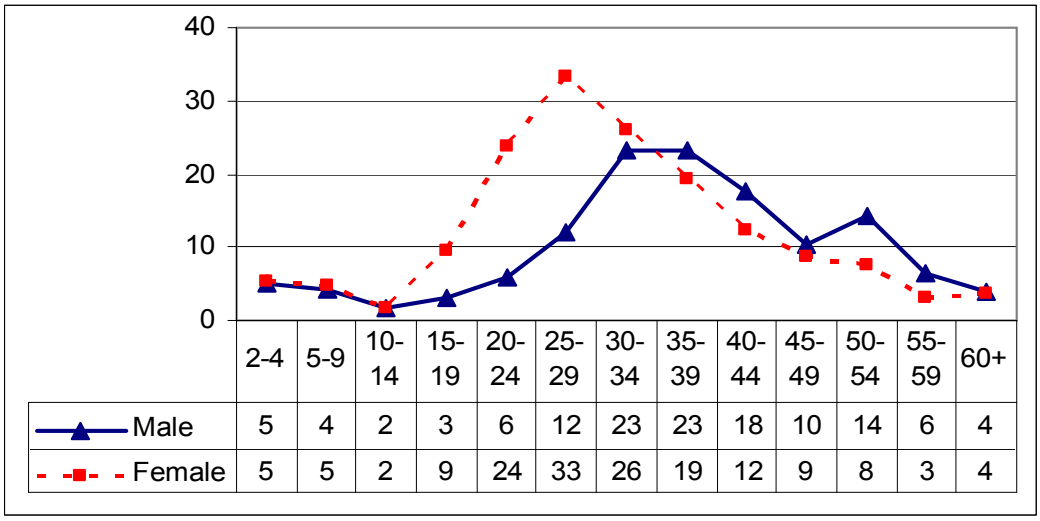


Figure 1. Percent HIV-Positive Among Public Antenatal (Prenatal) Clinic Attendees in South Africa

Figure 2 shows the percent HIV-positive among those age two or older by age and sex based on the 2005 HSRC Survey (Shisana *et al.,* 2005: xxv, 34). Overall, for those age 2+, 8% of males were HIV-positive and 13% of females were HIV positive (Shisana, *et al*., 2005, 34).



	2-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
Male	5	4	2	3	6	12	23	23	18	10	14	6	4
Female	5	5	2	9	24	33	26	19	12	9	8	3	4

Figure 2. Percent HIV-Positive from HSRC 2005 Survey

The high percentages of the population who were HIV-positive indicated in Figures 1 and 2 are disturbing, but these high levels do not automatically translate into deaths, mainly because it has been estimated that the average lag from being HIV-positive to death from HIV/AIDS is 8-10 years in sub-Saharan Africa (Hunter and Williamson, 2000: 23).

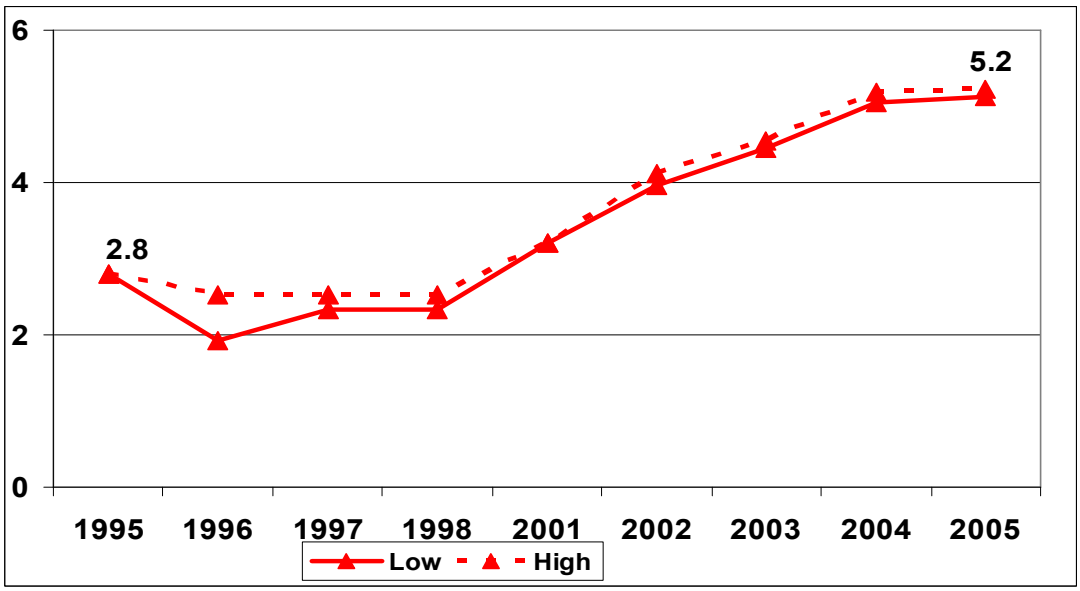


Figure 3. Estimates of Percent of All South Africans Age 0-14 with Mother Dead (Maternal Orphans)

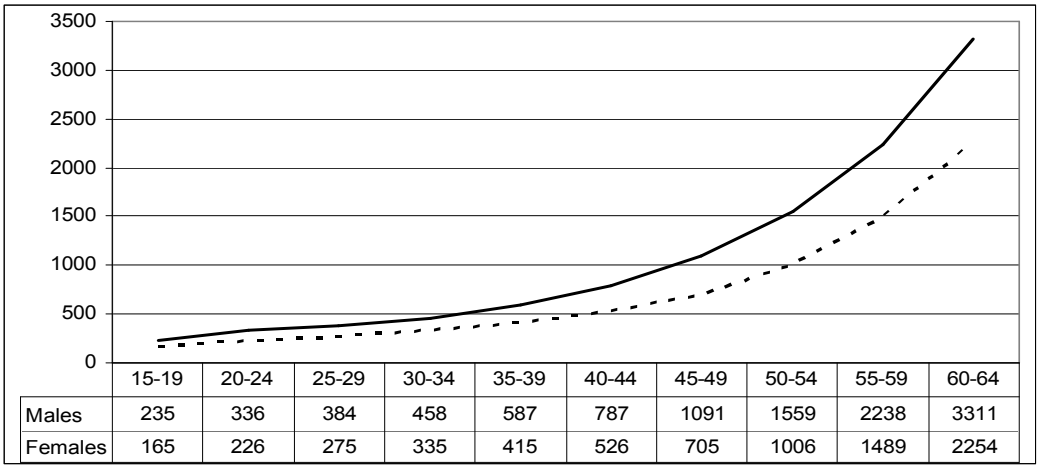
A major focus of the effects of HIV in sub-Saharan Africa has been the impact on children through the death of their parents, especially of their mothers. Figure 3 shows the estimated percent of South African children age 0-14 whose mother was dead, 1995-2005. A range of high and low

estimates for this is shown.[1] In developing country populations without HIV, it is expected that the mothers of about 2% of children age 0-14 will be dead (SIDA 2000).

Figure 3 shows virtually no increase in the percent of children who are maternal orphans until between 1998 and 2001, even though the percent of HIV-positive women at prenatal clinics had shown a substantial increase by 1993-94. The lag between what is shown in Figure 1 and in Figure 3 is almost certainly due to the long average lag time between becoming HIV-positive and death.

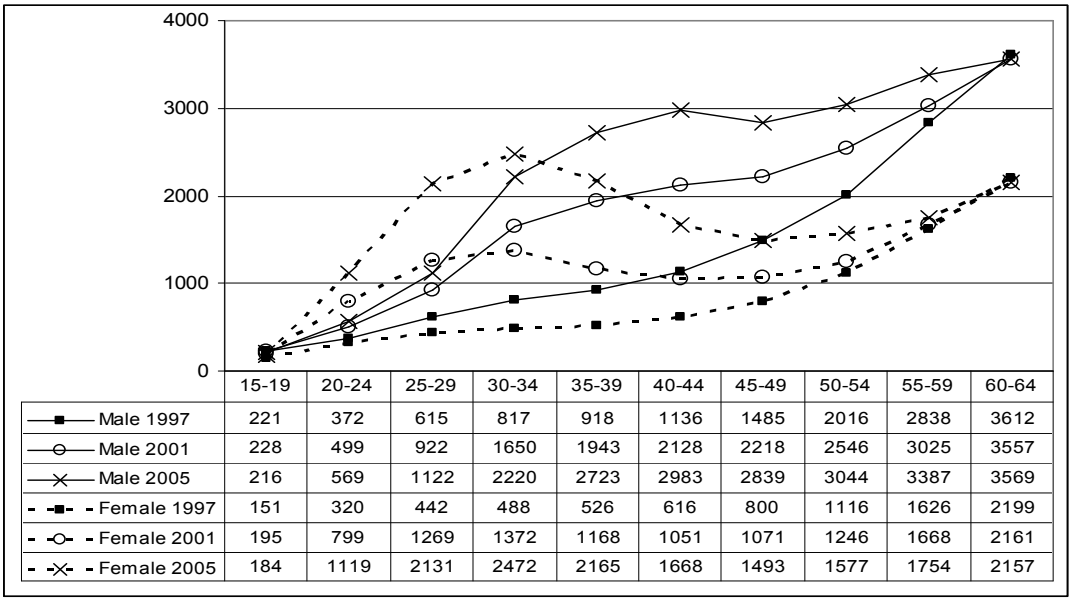
All Cause Mortality

Figure 4 shows a typical pattern of adult mortality by age and sex. At every age, male death rates are higher than female death rates. Also, the death rates increase with age, especially after age 40



	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Males	235	336	384	458	587	787	1091	1559	2238	3311
Females	165	226	275	335	415	526	705	1006	1489	2254

Figure 4. Death Rates per 100,000 Population by Age and Sex from a Typical Situation



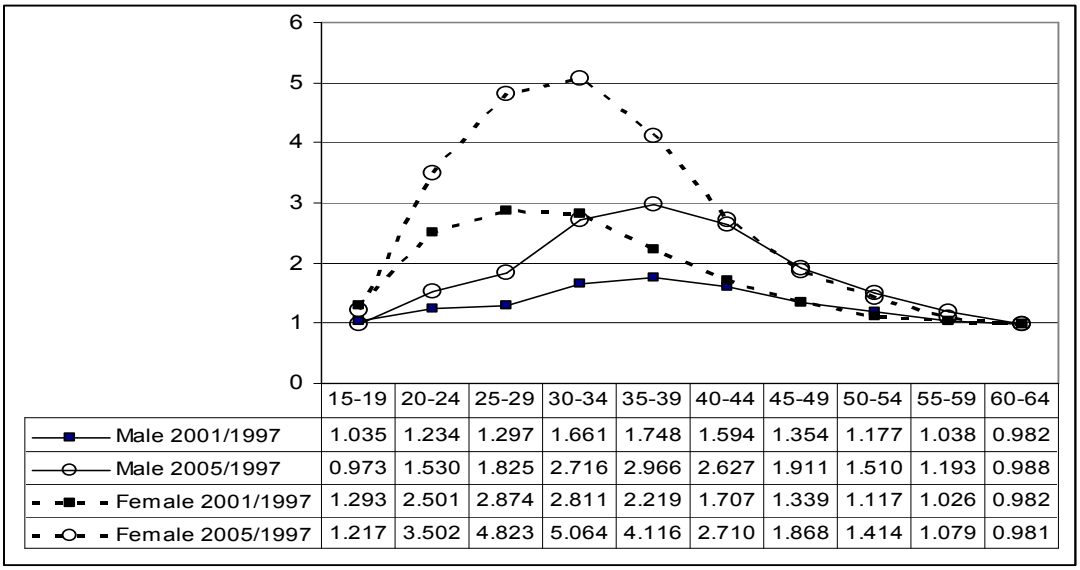
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 1997	221	372	615	817	918	1136	1485	2016	2838	3612
Male 2001	228	499	922	1650	1943	2128	2218	2546	3025	3557
Male 2005	216	569	1122	2220	2723	2983	2839	3044	3387	3569
Female 1997	151	320	442	488	526	616	800	1116	1626	2199
Female 2001	195	799	1269	1372	1168	1051	1071	1246	1668	2161
Female 2005	184	1119	2131	2472	2165	1668	1493	1577	1754	2157

Figure 5. Death Rates by Age per 100,000 by Sex: 1997, 2001 and 2005

[1] The difference between the high and low estimates results from how those cases in which it is not known whether the mother is alive are handled. This makes fairly little difference for maternal orphanhood. It makes more difference for paternal orphanhood (Anderson and Phillips, 2006a). The estimates in Figure 3 are from surveys and from the 2001 South African Census. Surveys with the required items for calculating the percent of children who were maternal orphans were not conducted in 1999 and 2000.

Figure 5 shows death rates by sex for 1997 and 2005 in South Africa. For each sex and for every age group except males 15-19, death rates increased between 1997 and 2005. The increases for females age 20-39 are especially striking.

In 1997 death rates from all causes exhibit the typical pattern of death rates increasing by age and of male rates being higher than female rates. By 2001, male death still increased with age, but female death rates peaked at age 30-34, and female rates at age 20-29 were higher than male rates. By 2005, male rates peaked at age 40-44, the female peak was more pronounced, and female rates were higher than male rates at age 20-34.



	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 2001/1997	1.035	1.234	1.297	1.661	1.748	1.594	1.354	1.177	1.038	0.982
Male 2005/1997	0.973	1.530	1.825	2.716	2.966	2.627	1.911	1.510	1.193	0.988
Female 2001/1997	1.293	2.501	2.874	2.811	2.219	1.707	1.339	1.117	1.026	0.982
Female 2005/1997	1.217	3.502	4.823	5.064	4.116	2.710	1.868	1.414	1.079	0.981

Figure 6. Death Rates in 2001 and 2005 from All Causes by Sex Relative to Value in 1997 by Age and Sex (1997 Value=1.00)

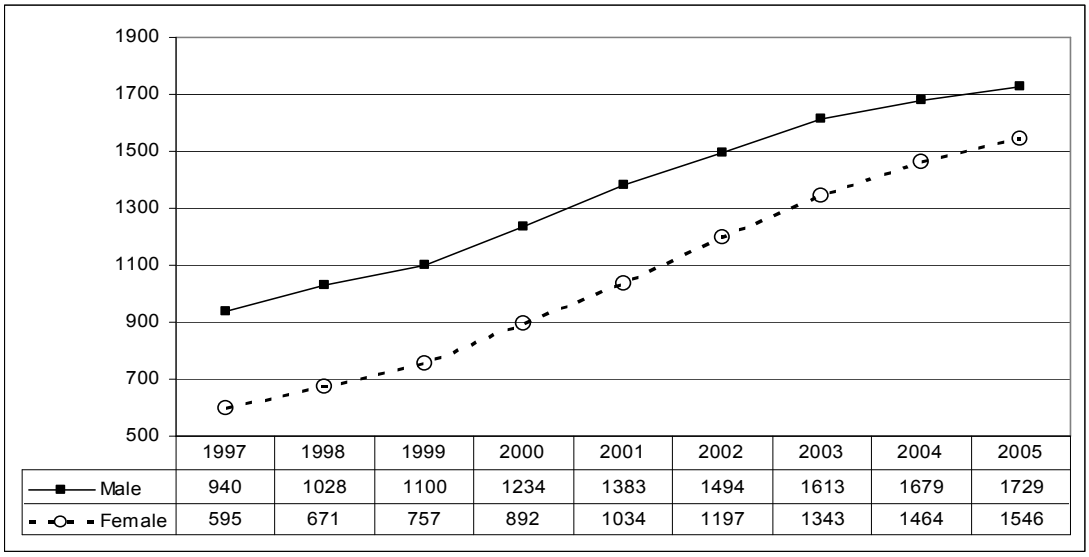
Figure 6 shows the death rates by age and sex in 2001 and in 2005 relative to the value for that age and sex in 1997. Female rates increased by more than 4 times at age 25-39 and males rates increased by more than 2.5 times at age 30-44 between 1997 and 2005.

To take account of changes in the age distribution within the 15-64 age range over time, we calculate an age-standardized death rate for each sex. To do this, first we choose a standard population. We use the 2001 mid-year population of South Africa for each sex by five-year age group, as estimated by Statistics South Africa, as the standard population. We then take the actual death rate for the given sex by five-year age group and calculate how many deaths these rates would have produced in the 2001 population by age for each sex. We take the implied number of deaths to the 2001 population age 15-64 of the given sex and divide that number of deaths by the number of people of the given sex age 15-64 in mid-2001. We do this for each year. What results is a series of rates for which the age distribution (by sex) is held constant. Thus, the age-standardized rate does not go up or down because the population of the given sex has gotten older or younger over time. The age-standardized death rate for age 15-64 for a given sex is what the overall death rate would be for that sex in those ages per 100,000 population –

$$\frac{100{,}000*(\text{deaths to people of the given sex age 15-64})}{(\text{number of people of the given sex age 15-64})}$$

--if the people in that year of that sex had the same age distribution as people of that sex did in South Africa as a whole in 2001.

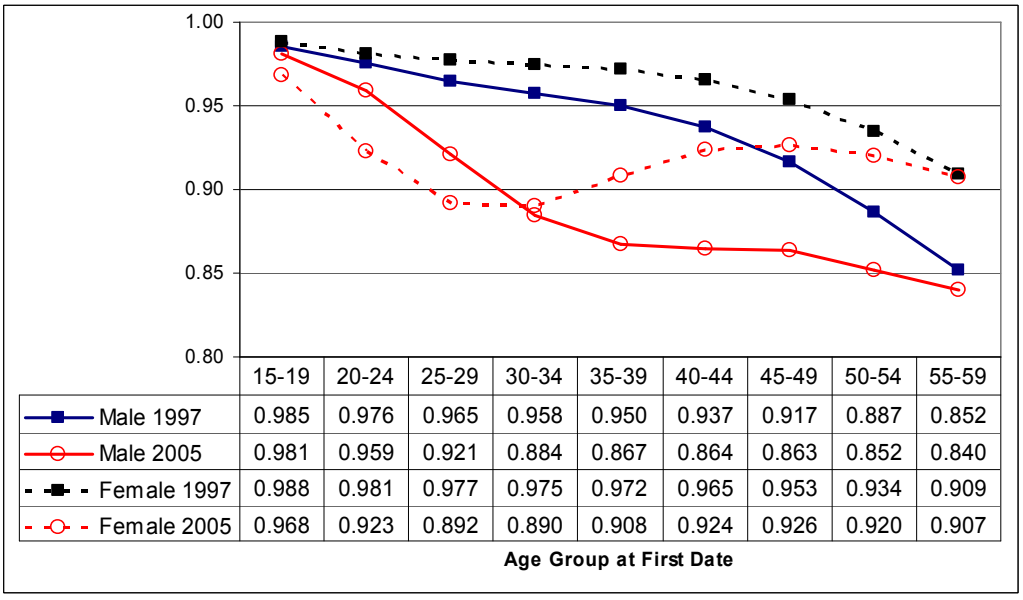
Figure 7 shows age-standardized death rates by sex. Although the male age-standardized rate is always higher than the female rate, the gap has narrowed considerably over time. Between 1997 and 2005, the male rate increased by 1.8 times, and the female rate increased by 2.6 times.



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Male	940	1028	1100	1234	1383	1494	1613	1679	1729
Female	595	671	757	892	1034	1197	1343	1464	1546

Figure 7. Age-Standardized Death Rates per 100,000 from All Causes by Sex, Age 15-64: 1997-2005

Figure 8 shows ${}_5p_x$, the chance that a person in a given age group will still be alive five years later, for each sex. It makes even clearer that for females the deterioration in survival since 1997 is mainly restricted to those age 20-44. Women age 45-59 in 2005 had almost as high a chance of surviving in 2005 as women that age did in 1997.



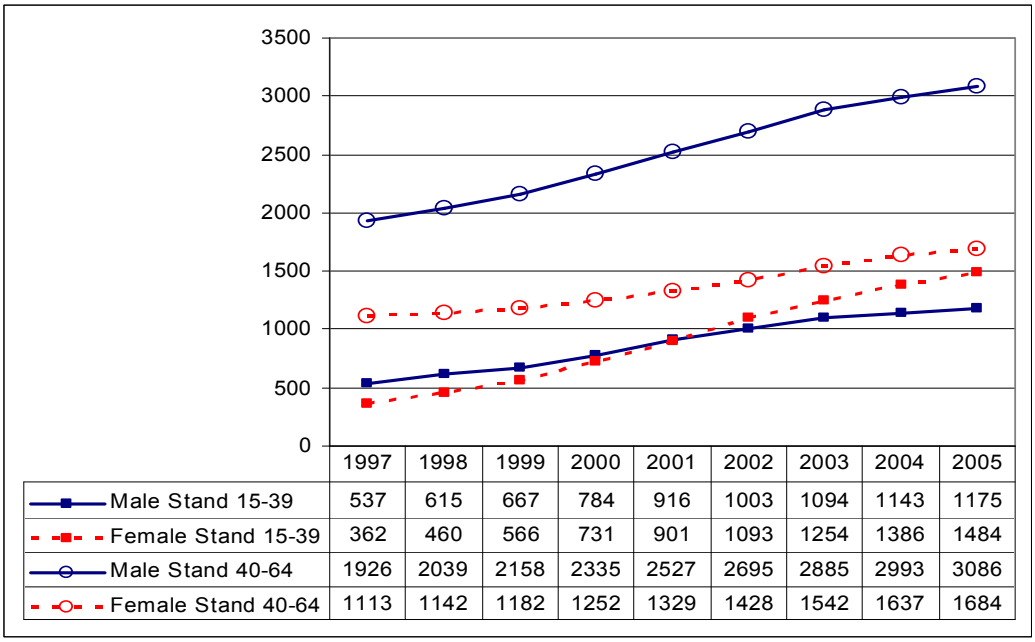
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
Male 1997	0.985	0.976	0.965	0.958	0.950	0.937	0.917	0.887	0.852
Male 2005	0.981	0.959	0.921	0.884	0.867	0.864	0.863	0.852	0.840
Female 1997	0.988	0.981	0.977	0.975	0.972	0.965	0.953	0.934	0.909
Female 2005	0.968	0.923	0.892	0.890	0.908	0.924	0.926	0.920	0.907

Age Group at First Date

Figure 8. Among People in a Given Age Group, the Proportion Alive Five Years Later by Sex: 1997 and 2005

Just as Figure 7 showed age-standardized death rates by sex over the entire 15-64 age range, we can calculate age-standardized death rates by sex separately for the 15-39 age range and the 40-64 age range. In each of these age ranges we calculate for the given sex for a given year what the death rate in that age range would be if the group had the death rates by age and sex of the given year but had the age distribution that was present for the given sex in mid-year 2001.

Figure 9 shows age-standardized death rates by sex for those age 15-39 and for those age 40-64 by sex. The age-standardized death rates age 15-39 are similar for the two sexes, although by 2002, the female death rate is higher than the male death rate. For those age 40-64, the male age-standardized death rate is always higher than the female rate, and the gap between the two sexes increases over time.



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Male Stand 15-39	537	615	667	784	916	1003	1094	1143	1175
Female Stand 15-39	362	460	566	731	901	1093	1254	1386	1484
Male Stand 40-64	1926	2039	2158	2335	2527	2695	2885	2993	3086
Female Stand 40-64	1113	1142	1182	1252	1329	1428	1542	1637	1684

Figure 9. Age-Standardized Death Rates per 100,000 by Sex: Age 15-39 and Age 40-64: 1997-2005

Looking at Changes in Death Rates by Cause

We have seen the large increases in all-cause mortality from 1997 to 2005. Next we look at changes in more detailed causes of death

A basic division of mortality is into natural and external causes of death. Natural causes include disease, whether infectious or not, and whether acute or chronic. External causes are not naturally caused deaths.[2] They are the result of intentional harm by others (homicide), intentional self-harm (suicide), or accidents. Natural causes of death are those in ICD-10 codes A00-R99, and external causes of death are those in ICD-10 codes V01-Y89.

The World Health Organization Global Burden of Disease Project groups causes of death into three categories: (1) communicable diseases, maternal conditions, perinatal conditions, and nutritional deficiencies (ICD-10 categories A00-B99, G00-G04, N70-N73, J00-J06, J10-J18, J20-J22, H65-H66, O00-O99, P00-P96, E00-E02, E40-E46, E50, D50-D53, E51-E64. The reference also includes D64.9 in this classification, but since South Africa does not use 4-digit ICD-10 coding, we coded all of D64 as non-communicable), (2) non-communicable diseases (ICD-10 categories C00-C97, D00-D48, D55-D64, D65-D89, E03-E07, E10-E16, E20-E34, E65-E88, F01-F99, G06-G98, H00-H61, H68-H93, I00-I99, J30-J98, K00-K92, N00-N64, H75-N98, L00-L98, M00-M99, Q00-Q99), and (3) external causes (ICD-10 categories V01-Y89).[3] For simplicity, we will refer to the first category as “communicable and related diseases”. Communicable diseases are diseases that can be spread from one person to another. Non-communicable diseases cannot be spread between people. They include the chronic debilitating diseases common among older people that often cause or contribute to death.

[2] External causes are also sometimes called unnatural causes or deaths from violence.

[3] ICD-10 categories for this classification are from Mathers *et al.* 2002: Table 3, pp. 55-59.

In South Africa, this distinction between communicable and non-communicable diseases is especially useful because almost all of the causes of death thought to be mistakenly coded when HIV is the actual cause of death are communicable diseases. Although a few non-communicable diseases, such as Kaposi's sarcoma (Peto, 2001; IARC, 1997) are likely sites of misclassification of HIV deaths, non-communicable diseases are thought to play a smaller role in this misclassification than communicable and related diseases.

The detailed causes of death examined in this paper are indicated in Table 1.

Table 1. Categories of Causes of Death Considered in this Paper

- All causes
  - External causes (also called unnatural causes)
  - Natural causes
    - Communicable & related
      - Infectious
      - Stated HIV
      - TB
      - Parasitic
        - Parasitic opportunistic infections
        - Malaria
      - Maternal conditions
      - Nutritional deficiencies
    - Non-communicable
      - Stroke
      - Circulatory except stroke
      - Cancer
        - Lung cancer
        - Cancer of reproductive system
      - Diabetes and obesity
      - Disorders of the immune system
      - Non-communicable respiratory
      - Other non-communicable

Causes of Death which Increased Substantially Between 1997 and 2005 by Age and Sex

Tables 2 and 3 show by cause of death those age groups for which the death rate increased by at least 2.5 times between 1997 and 2005. Table 2 shows this for females and Table 3 for males. We see that the many communicable and relate causes of death had a very large increase for each sex and across a wide age range – 20-59 for females and 20-54 for males. Also, for females, there were large increases for some non-communicable diseases.

Table 2. Causes of Death for Which the Death Rate in 2005 by Age was More than 2.5 Times the 1997 Value – Females
(Indicated by X if 2005 Death Rate> 2.5*1997 Death Rate, Blank Otherwise)

FEMALES	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
All causes		X	X	X	X	X				
External causes										
Natural causes		X	X	X	X	X				
Comm & rel		X	X	X	X	X	X	X		
-Infectious		X	X	X	X	X	X	X	X	
-Stated HIV			X	X	X	X		X	X	
-TB		X	X	X	X	X	X	X		
-Parasitic	X	X	X	X	X	X	X	X	X	X
--Parasitic opp. inf	X	X	X	X	X	X	X	X	X	X
--Malaria		X		X						
-Maternal cond.			X							
-Nutritional def.			X		X					
Non-communicable		X	X	X	X					
-Stroke		X	X	X						
-Circ except stroke										
-Cancer										
--Lung cancer			X	X						
--Cancer repro sys										
-Diabetes & obesity										
-Dis. immune sys.		X	X	X	X	X	X	X	X	X
-Non-comm resp		X	X	X	X	X				
-Other non-comm		X	X	X	X					

Table 3. Causes of Death for Which the Death Rate in 2005 by Age was More than 2.5 Times the 1997 Value – Males
(Indicated by X if 2005 Death Rate> 2.5*1997 Death Rate, Blank Otherwise)

MALES	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
All causes				X	X	X				
External causes										
Natural causes			X	X	X	X				
Comm & rel		X	X	X	X	X	X	X		
-Infectious		X	X	X	X	X	X	X		
-Stated HIV				X	X	X				
-TB		X	X	X	X	X	X			
-Parasitic		X	X	X	X	X	X	X	X	X
--Parasitic opp. inf	X	X	X	X	X	X	X	X	X	X
--Malaria										
-Nutritional def.					X					
Non-communicable				X						
-Stroke										
-Circ except stroke										
-Cancer										
--Lung cancer										
--Cancer repro sys										
-Diabetes & obesity										
-Dis. immune sys.	X	X	X	X	X	X	X	X	X	X
-Non-comm resp			X	X	X	X				
-Other non-comm					X					

Causes of Death Which Increased Moderately or Decreased Between 1997 and 2005 by Age and Sex

Tables 4 and 5 indicate causes of death for which the death rate increased by less than 20% between 1997 and 2005 (indicated by X) as well as those causes of death for which the rate decreased between 1997 and 2005 (indicated by **X**). Table 4 presents the information for females and Table 5 for males.

For each sex death rates either increased modestly or decreased for those age 15-19 and for those 55-64. Death rates increased modestly for many non-communicable diseases for those above age 40. The relative small mortality increase among young adults and among those age 55-64 deserves further study.

Table 4. Causes of Death for Which the Death Rate in 2005 by Age was Less that 1.2 Times the 1997 Value -Females

(Indicated by X if 2005 value <1997 value, indicated by X if 2005 value between the 1997 value and 1.2 * 1997 value, blank if 2005 value > 1.2 * 1997 value)

FEMALES	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
All causes									X	X
External causes	X		X	X	X	X	X	X	X	X
Natural causes									X	X
Comm. & rel										
-Infectious										
-Stated HIV	X									
-TB										
-Parasitic										
--Par. opp. inf										
--Malaria	X						X	X	X	X
-Maternal cond.	X					X	X	X	X	
-Nutritional def.						X	X		X	X
Non-communicable	X							X	X	X
-Stroke							X	X	X	X
-Circ except stroke	X				X	X	X	X	X	X
-Cancer	X					X	X	X	X	X
--Lung cancer	X				X	X	X	X	X	X
--Cancer repro sys	X					X	X	X	X	X
-Diabetes & obesity										X
-Dis. immune sys.										
-Non-comm resp										X
-Other non-comm	X								X	X

Table 5. Causes of Death for Which the Death Rate in 2005 by Age was Less that 1.2 Times the 1997 Value (Indicated by X, indicated by X if 2005 value <1997 value) – Males

(Indicated by X if 2005 value <1997 value, indicated by X if 2005 value between the 1997 value and 1.2 * 1997 value, blank if 2005 value > 1.2 * 1997 value)

MALES	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
All causes	X								X	X
External causes	X		X	X	X	X	X	X	X	X
Natural causes	X									X
Communicable & rel	X									
-Infectious										
-Stated HIV	X									
-TB										
-Parasitic	X									
--Parasitic opp. inf										
--Malaria	X		X						X	
-Nutritional def.	X						X		X	X
Non-communicable	X								X	X
-Stroke	X								X	X
-Circ except stroke	X							X	X	X
-Cancer	X					X	X	X	X	X
--Lung cancer		X	X	X	X	X	X	X	X	X
--Cancer repro sys	X	X	X			X	X	X	X	X
-Diabetes & obesity	X									X
-Dis. immune sys.										
-Non-comm resp									X	
-Other non-comm	X								X	X

Underlying Cause of Death, Deaths Registered as Being Due to HIV on the Death Notification Forms, and Age Patterns of HIV Mortality

When we look at cause of death, we consider the "underlying cause of death", which is "the one that started the chain of events leading to the death" or "the circumstances of the accident or violence which produced the fatal injury" (Statistics Canada, 1999). Often many different causes contribute to death. For example, some people contract amyotrophic lateral sclerosis (ALS), which is a fatal motor neuron disease. There is no known cure. In the course of ALS, there is progressive paralysis, and most people with ALS die from respiratory failure within four years (NINDS, 2006). Although respiratory failure is the immediate cause of these deaths, ALS is the underlying cause of these deaths.

It is known that if a person is TB-positive and becomes HIV-positive or if a person is HIV-positive and becomes TB-positive, the person's chance of dying in a given time period is increased in both cases Badri *et al.,* 2001; Connolly *et al*., 1998; Corbett *et al.,* 2000). If the person is TB-positive first, then the underlying cause of death would properly be TB rather than HIV, even though HIV

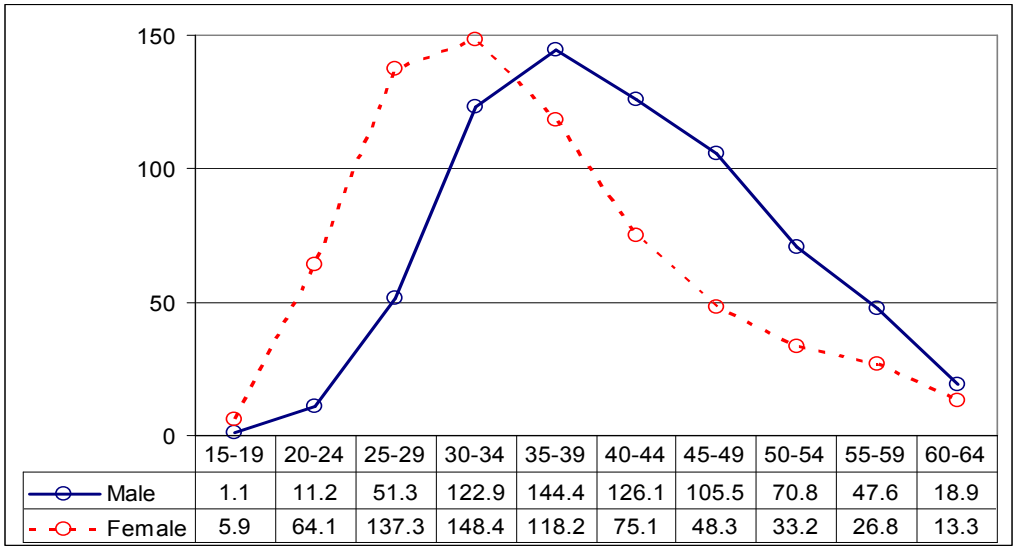
increased the person's chance of dying. In examining the effect of HIV on mortality asking whether HIV is the underlying cause of death is a different question than asking whether HIV played ***any*** role in a person's death.

Also, even if a person is HIV-positive, this does not necessarily mean than HIV played a role in that person's death. For example, some HIV-positive persons will die from causes unrelated to their HIV-positive status. For example, an HIV-positive person could die in a traffic accident, which was unrelated to that person's HIV status.

Many medical researchers are interested in "pre-AIDS mortality". This occurs when a person dies who is HIV-positive but for whom HIV has not yet developed into AIDS. It has become a research topic whether particular deaths in pre-AIDS mortality are or are not related to HIV status. This has become a crucial issue as the development of highly active antiretroviral therapy (HAART) has moved HIV in the direction of becoming a chronic disease in some parts of the world. In those situations, HIV-positive persons will at some point die of some cause, but it would not necessarily be reasonable to attribute all of those deaths to HIV (Laurichesse *et al*., 1998; Louie *et a*l., 2002; Prins *et al*., 1997; Prins *et al*., 2000).

It is clear that many deaths due to HIV are registered as having something else as the underlying cause. Still, it is worthwhile to examine the death rates and the age pattern by sex from deaths reported as due to HIV. In this section, we consider as HIV deaths only deaths for which the underlying cause was coded as HIV (ICD-10 codes B20-B24) based on information on the Death Notification Form. We do not include other reported causes of death for which HIV is almost certainly the underlying cause, such as parasitic opportunistic infections such as candidiasis, which is rarely fatal in people who do not have a compromised immune system. Although we know that the age-specific death rates from HIV that we obtaini are too low, but we think it is useful to look at the age and sex patterns from narrowly reported HIV deaths.

There have been studies that have aimed to identify all deaths actually due to HIV by age and sex (Dorrington et al., 2001; Udjo, 2005; Bah, 2005; Groenwald, 2005), some of which used the shape of the age-specific mortality schedule overall and from particular causes. These studies have focused on the extent to which the shape of the mortality schedule overall or from particular causes resembled the shape of the age-specific mortality schedule from HIV.



	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male	1.1	11.2	51.3	122.9	144.4	126.1	105.5	70.8	47.6	18.9
Female	5.9	64.1	137.3	148.4	118.2	75.1	48.3	33.2	26.8	13.3

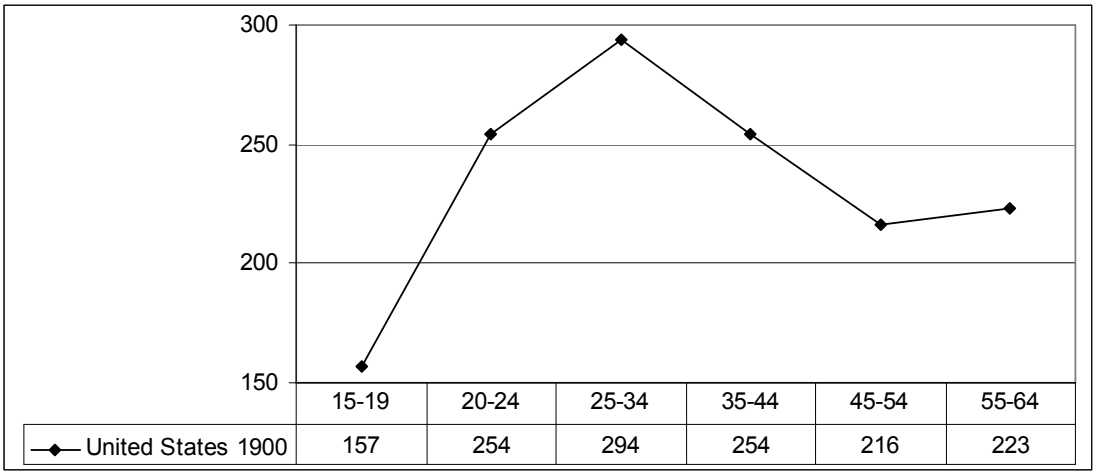
Figure 10. Death Rates by Age and Sex per 100,000 from Deaths Registered as Due to HIV in South Africa: 2005

Figure 10 shows the age-specific death rates from deaths reported on the Death Notification

Form as due to HIV in 2005. Both male and female death rates increase rapidly to a peak and then fall. This occurs about five years later for males than for females. The decline with age after the peak is slightly slower for males than for females. This kind of age pattern has often been identified as typical of HIV mortality (Blacker, 2004: S24).

Age Patterns of TB Mortality

Tuberculosis is a disease that, like HIV, has long had especially high death rates among young adults. Figure 11 shows death rates age 15-64 from tuberculosis in the United States in 1900 (White 1999: 290). A typical pattern for tuberculosis by age when the death rate from this disease is high is shown. The rates increase to those in their twenties or thirties and then decline somewhat at older ages (Collins, 1982; Downes, 1931; Frost, 1940). TB is an example of a cause of death that in situations of high prevalence, age-specific death rates attain a peak at a young adult age, even when HIV is not present.



	15-19	20-24	25-34	35-44	45-54	55-64
United States 1900	157	254	294	254	216	223

Figure 11. Death Rates by Age per 100,000 from Tuberculosis: United States 1900

Looking for an Age Peak in Death Rates by Cause and the Speed of Decline from the Peak Age

For both females and males death rates by age from stated HIV rise to a peak and then decline fairly rapidly with age. The peak for males occurs about five years later than for females.

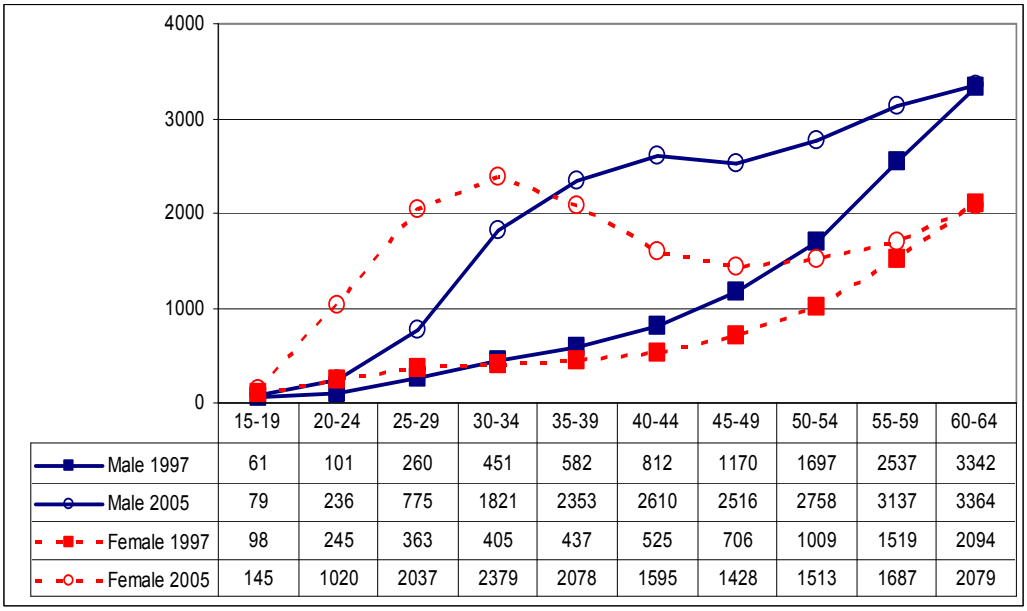
The search for hidden HIV deaths under other stated causes of death has often begun with looking for such a peaked pattern. By a “peak” we mean a five-year age group that has a higher death rate from the stated cause than does the next older age group. We think that when there is no peak age, it is unlikely that hidden HIV is playing a substantial role in the given cause of death.

One way of looking at the extent of a peak in death rates by age is to examine the rate at the peak value in comparison with the rate fifteen years after the peak. By calculating the value fifteen years after the peak divided by the value at the peak, an indicator of the extent of peakedness is obtained. The lower the value, the more rapid the decline from the peak. The rate of decline from HIV is very rapid, with a value in 2005 of .49 for males and .33 for females.

Next we look at age-specific death rates from various causes and comment on whether the age pattern exhibits a peak and the sharpness of that peak. Recall Figure 5 which showed death rates from all causes in 1997 and 2005. For each sex, by 2005, adult death rates exhibited a peaked pattern, almost certainly mainly due to the increasing role of HIV mortality. However, if we calculate the rate fifteen years after the peak age divided by the rate at the peak age, we obtain 1.14 for males and .60 for females. Thus, for males, even though there was a peak, by 15 years later, the normal increase in

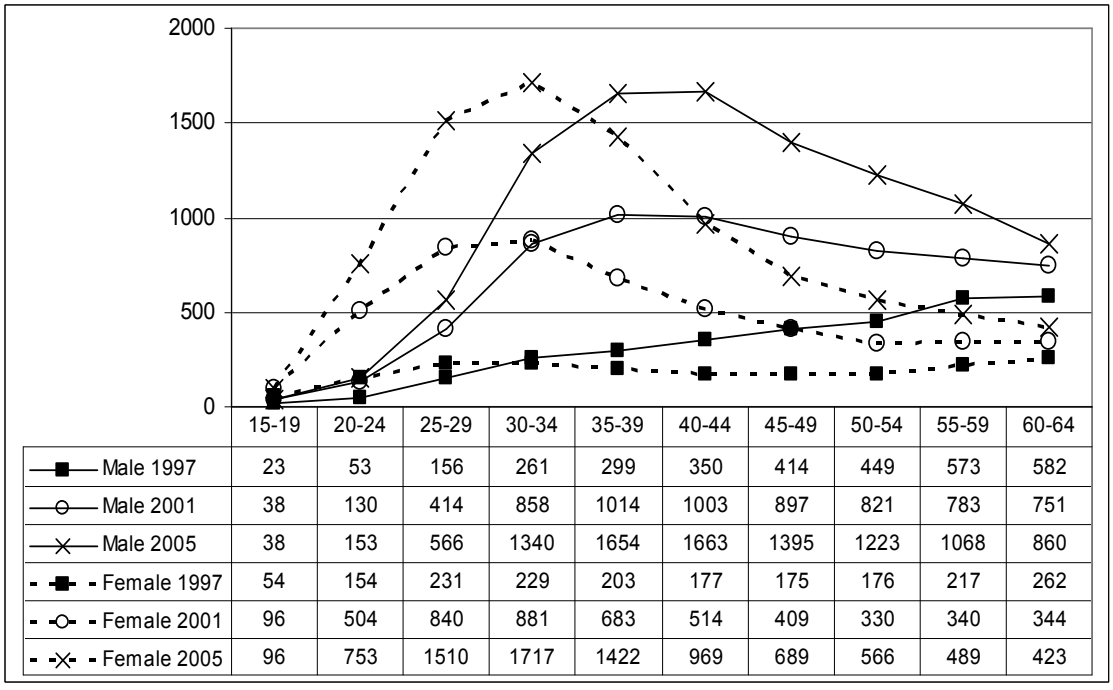
mortality by age had come to dominate the age-specific mortality pattern. As we shall see, for males mortality from natural causes is very much influenced by mortality from non-communicable causes.

Figure 12 shows death rates from natural causes by sex in 1997 and 2005. For each sex, age-specific mortality rates became peaked between 1997 and 2001 and even more by 2005. For natural causes, the value 15 years after the peak divided by the value at the peak age is .64 for males and .34 for females, considerably more peaked than the death rates from all causes.



	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 1997	61	101	260	451	582	812	1170	1697	2537	3342
Male 2005	79	236	775	1821	2353	2610	2516	2758	3137	3364
Female 1997	98	245	363	405	437	525	706	1009	1519	2094
Female 2005	145	1020	2037	2379	2078	1595	1428	1513	1687	2079

Figure 12. Death Rates by Age and Sex per 100,000 from Natural Causes: 1997 and 2005



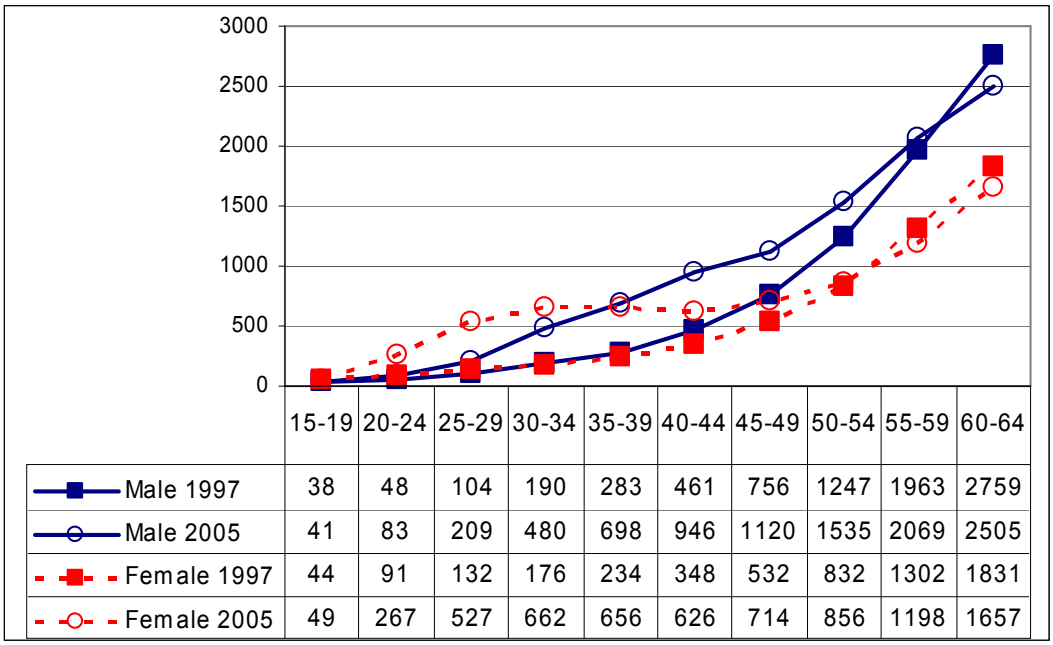
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 1997	23	53	156	261	299	350	414	449	573	582
Male 2001	38	130	414	858	1014	1003	897	821	783	751
Male 2005	38	153	566	1340	1654	1663	1395	1223	1068	860
Female 1997	54	154	231	229	203	177	175	176	217	262
Female 2001	96	504	840	881	683	514	409	330	340	344
Female 2005	96	753	1510	1717	1422	969	689	566	489	423

Figure 13. Death Rates by Age and Sex per 100,000 from Communicable and Related Diseases: 1997, 2001 and 2005

Figure 13 shows death rates by age and sex from communicable and related diseases in 1997 and 2005. Figure 13 looks somewhat similar to Figure 6 for death rates from natural causes. However,

while in Figure 6, there was no peak followed by a decline for males, there is a definite peak in Figure 13. Also, the peak for females in Figure 13 is much clearer than in Figure 6.

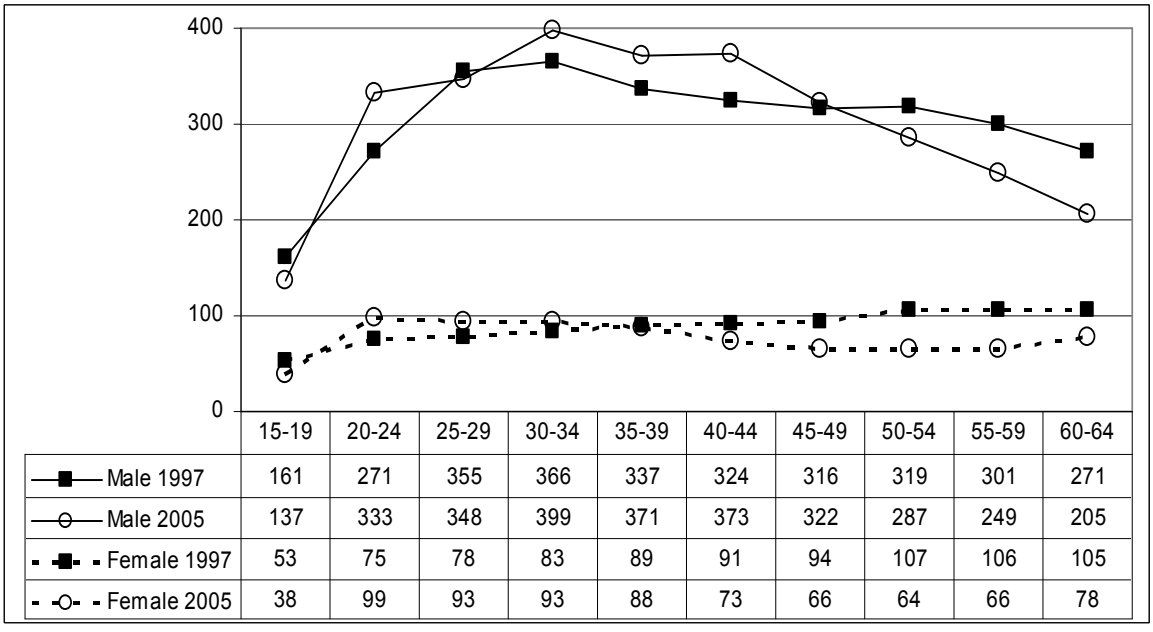
Figure 14 shows death rates by age and sex from non-communicable diseases in 1997 and 2005. This figure looks very different than that for communicable and related diseases. There is only a slight peak or hump in death rates by age for females in 2005. Other wise Figure 14 resembles a typical mortality pattern with rates rising exponentially by age after age 15.



	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 1997	38	48	104	190	283	461	756	1247	1963	2759
Male 2005	41	83	209	480	698	946	1120	1535	2069	2505
Female 1997	44	91	132	176	234	348	532	832	1302	1831
Female 2005	49	267	527	662	656	626	714	856	1198	1657

Figure 14. Death Rates by Age and Sex per 100,000 Population from Non-Communicable Diseases: 1997 and 2005

Figure 15 shows similar information for death rates from external causes. There is a marked peak for males in both years, as well as a minor peak for females in 2005. These peaks, especially for males, are due to the high level of involvement in risky behavior among young adult males and is not due to HIV.



	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 1997	161	271	355	366	337	324	316	319	301	271
Male 2005	137	333	348	399	371	373	322	287	249	205
Female 1997	53	75	78	83	89	91	94	107	106	105
Female 2005	38	99	93	93	88	73	66	64	66	78

Figure 15. Death Rates by Age and Sex per 100,000 Population from External Causes: 1997 and 2005

Table 6. Whether Death Rates from All Causes and Natural Causes Declined from a Peak and Age of Peak Value: 2005 and 1997

	2005		1997	
	Male	Female	Male	Female
All Causes	40-44	30-34		
Natural Causes	35-39	30-34		
Com. & Related	40-44	30-34		25-29
Non-Com.		30-34		
Infectious	40-44	30-34		25-29
Stated HIV	35-39	30-34	35-39	30-34
TB	40-44	30-34	55-59	30-34
Parasitic	35-39	30-34	40-44	25-29
Par. Opp. Infs.	35-39	30-34	30-34	25-29
Malaria	35-39	30-34	45-49	25-29
Maternal Conditions	n.a.	25-29	n.a.	30-34
Nutritional Def.	40-44	25-29	45-49	30-34
Lung Cancer				15-19
Disorders Immune Mechanism	35-39	30-34	30-34	25-29
Non-Comm Respiratory		35-39		
Other Non-Com.		30-34		

Both males and females in 2005 show a peak for all causes of death. For females both in 2005 and 1997 and for males in 2005 all of the communicable and related causes of death examined in detail had a peak age. This is also true for males in 1997 except for communicable and related causes in total. Thus, peaking for these kinds of causes of death is not a recent phenomenon in South Africa.

Most of the non-communicable diseases do not exhibit a peak age. Certain disorders of the immune mechanism shows a peak for each sex in both years. As we noted, we think that almost all of the deaths in that category are actually due to HIV. Non-communicable respiratory diseases and other non-communicable diseases show a peak only for females in 2005. We think that although HIV could play a role in those causes of death, it is likely that something else was leading to mortality from those causes, especially for males.

Table 7 shows more information for the causes of death for which there was a peak. As noted, for HIV, death rates fall off rapidly after the peak age. In Table 7, for each cause of death for which there is peak, the value 15 years after the peak age divided by the value at the peak age is shown.

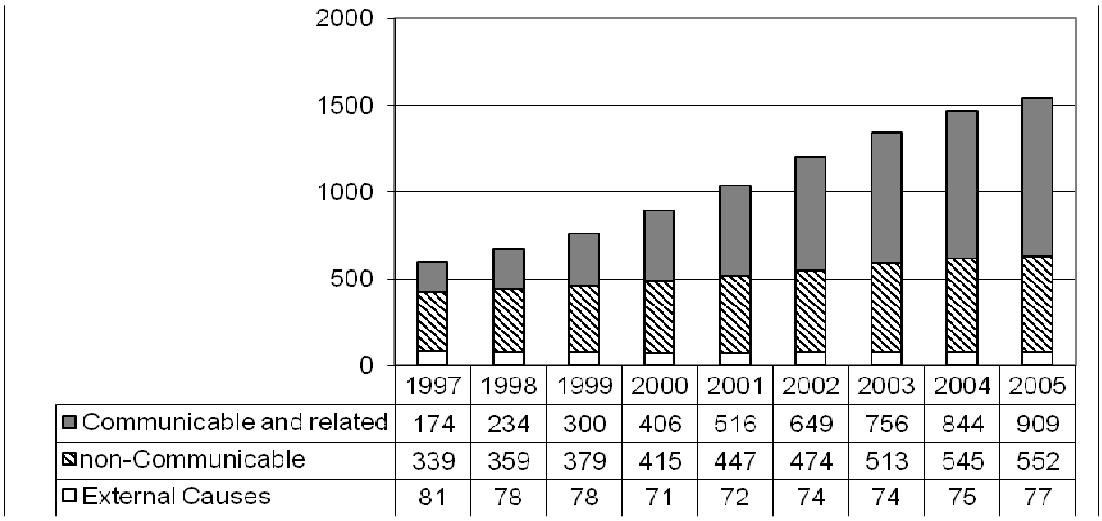
For HIV, for parasitic opportunistic infections and for certain disorders of the immune mechanism, the values in Table 7 are low, indicating a rapid fall in the death rates by age after the peak age. The values for the other causes of death with a peak are higher, suggesting that even though HIV could play a role, something else is likely causing the persistent high death rates at older ages.

Table 7. All Causes and Natural Causes with a Mortality Peak, Pace of Decline from the Peak - (Value 15 Years After Peak Age)/(Value at Peak Age) - Bolded and Underlined if ratio < .55

	2005		1997	
	Male	Female	Male	Female
Stated HIV	**.49**	**.33**	**.49**	**.35**
Parasitic opp. Infs.	**.40**	**.26**	**.54**	**.45**
Disorders immune mech.	**.50**	**.34**	.71	**.50**
All causes	1.14	.60		
-Natural causes	1.20	.60		
--Comm. and related	.64	**.40**		.74
----Infectious	.65	**.41**		.77
----TB	.66	**.42**	Peak 55-59	.87
----Parasitic	**.46**	**.27**	.94	.63
----Malaria	.97	**.37**	.87	.77
----Maternal conditions	n.a.	.22	n.a	.22
----Nutritional deficiencies	.96	.71	2.4	1.02
-Non-communicable		1.08		
----Non-comm respiratory		.88		
----Other non-comm		.72		

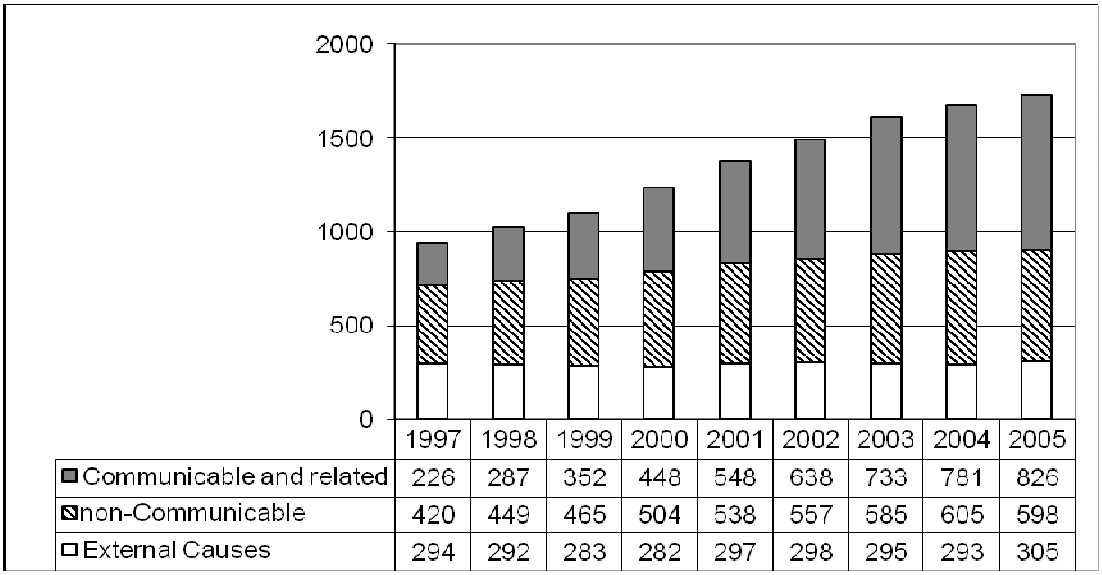
Contribution to Overall Mortality of the Three Global Burden of Disease Categories

Figures 16 (for females) and 17 (for males) show the contribution of the three Global Burden of Disease categories to overall age-standardized mortality rates. It is clear that the increase in overall mortality has primarily been due to the increase in death rates from communicable and related diseases, mainly due to HIV mortality. Also, the reversal of the typical sex differential in mortality is completely due to the increase in death rates for communicable and related diseases; in every year, the age-standardized death rates from external causes and from non-communicable diseases for males are higher than for females.



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Communicable and related	174	234	300	406	516	649	756	844	909
non-Communicable	339	359	379	415	447	474	513	545	552
External Causes	81	78	78	71	72	74	74	75	77

Figure 16. Contribution of the Global Burden of Disease Categories to the Female Age-Standardized Death Rate: 1997-2005



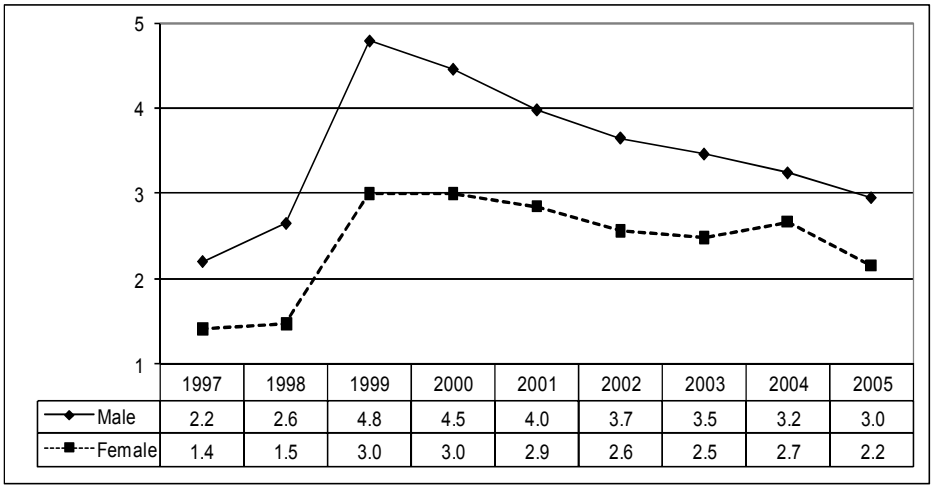
	1997	1998	1999	2000	2001	2002	2003	2004	2005
Communicable and related	226	287	352	448	548	638	733	781	826
non-Communicable	420	449	465	504	538	557	585	605	598
External Causes	294	292	283	282	297	298	295	293	305

Figure 17. Contribution of the Global Burden of Disease Categories to the Male Age-Standardized Death Rate: 1997-2005

Death Rates from Some Other Causes of Death

We will next look briefly at trends in death rates from some other important causes of death: malaria, stroke, cancer and diabetes. While death rates from some of these causes have increased, for others, they have remained constant or declined somewhat.

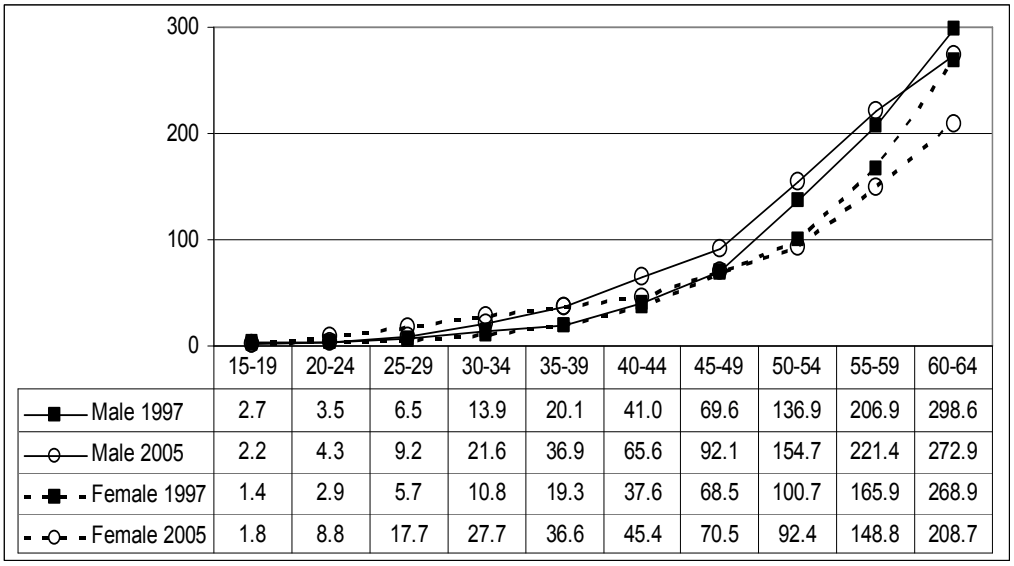
Figure 18 shows age-standardized death rates from malaria 1997-2005. After increasing between 1997 and 1999, the rates declined from 2000. This decline was almost certainly due to resumption of limited use of DDT.



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Male	2.2	2.6	4.8	4.5	4.0	3.7	3.5	3.2	3.0
Female	1.4	1.5	3.0	3.0	2.9	2.6	2.5	2.7	2.2

Figure 18. Age-Standardized Death Rates by Sex per 100,000 from Malaria: 1997-2005

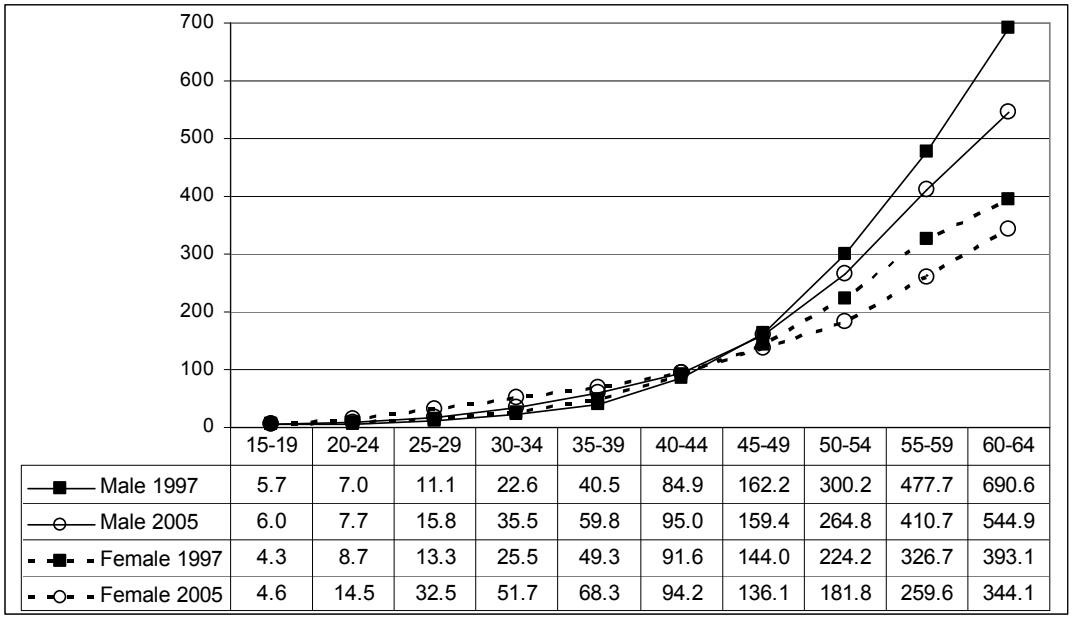
Stroke is the 2nd largest cause of death in the world, and stroke death rates are rising in many less-developed countries. Figure 19 shows that stroke mortality changed modestly between 1997 and 2005. The age-standardized rates for males increased by 17% and for females by 8% between 1997 and 2005. There is no evidence being HIV-positive increases the overall risk of stroke mortality (Hoffman *et al.* 2000).



	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 1997	2.7	3.5	6.5	13.9	20.1	41.0	69.6	136.9	206.9	298.6
Male 2005	2.2	4.3	9.2	21.6	36.9	65.6	92.1	154.7	221.4	272.9
Female 1997	1.4	2.9	5.7	10.8	19.3	37.6	68.5	100.7	165.9	268.9
Female 2005	1.8	8.8	17.7	27.7	36.6	45.4	70.5	92.4	148.8	208.7

Figure 19. Death Rate by Age and Sex from Stroke per 100,000 Population: 1997 and 2005

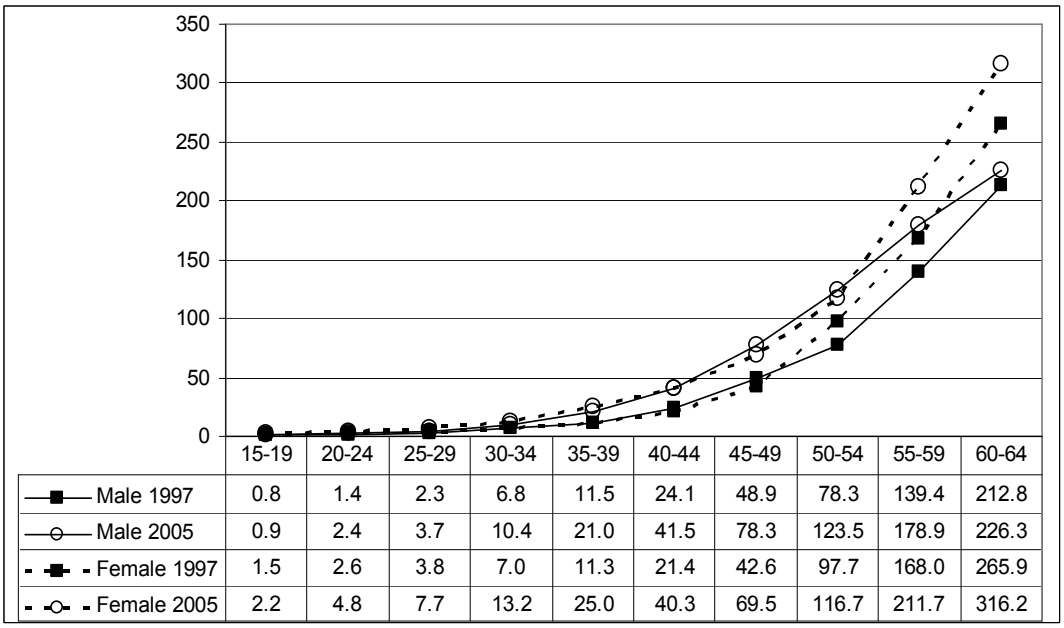
Figure 20 shows death rates from cancer. There was little change in cancer mortality overall and noticeable declines at age 50-64, especially for males.



	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 1997	5.7	7.0	11.1	22.6	40.5	84.9	162.2	300.2	477.7	690.6
Male 2005	6.0	7.7	15.8	35.5	59.8	95.0	159.4	264.8	410.7	544.9
Female 1997	4.3	8.7	13.3	25.5	49.3	91.6	144.0	224.2	326.7	393.1
Female 2005	4.6	14.5	32.5	51.7	68.3	94.2	136.1	181.8	259.6	344.1

Figure 20. Death Rates by Age and Sex per 100,000 from Cancer: 1997 and 2005

An area of substantial concern not directly related to HIV is increasing mortality from diabetes. Figure 21 shows death rates by age and sex from diabetes and obesity, and Figure 22 shows the age-standardized death rates from diabetes and obesity.[4]

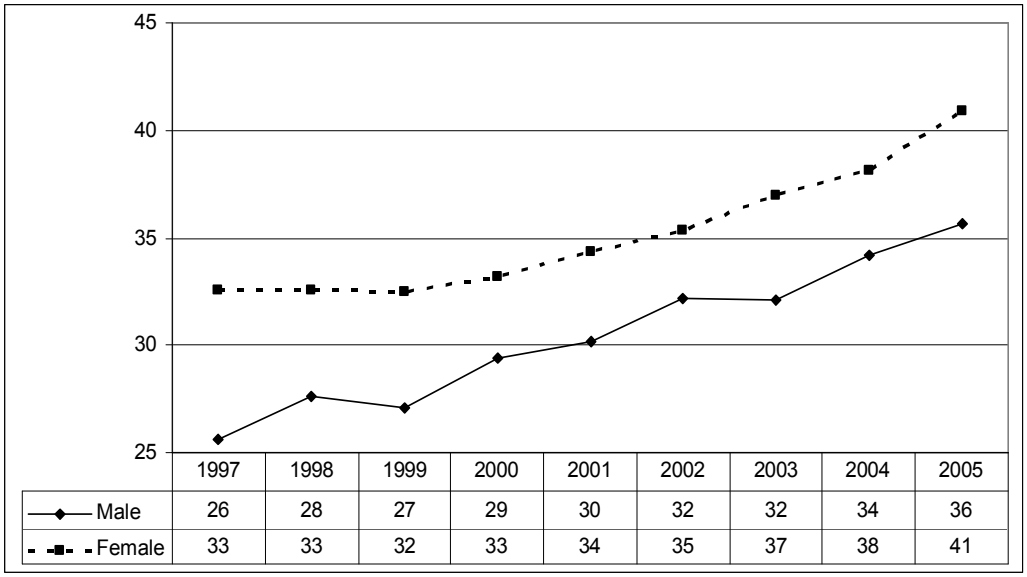


	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Male 1997	0.8	1.4	2.3	6.8	11.5	24.1	48.9	78.3	139.4	212.8
Male 2005	0.9	2.4	3.7	10.4	21.0	41.5	78.3	123.5	178.9	226.3
Female 1997	1.5	2.6	3.8	7.0	11.3	21.4	42.6	97.7	168.0	265.9
Female 2005	2.2	4.8	7.7	13.2	25.0	40.3	69.5	116.7	211.7	316.2

Figure 21. Death Rates by Age and Sex per 100,000 Population from Diabetes and Obesity: 1997 and 2005

[4] A small percent of deaths were classified as due to "obesity". They were grouped together with deaths from diabetes. In 2004, 98% of deaths in this category were from diabetes.

The increase in diabetes mortality is likely related to changes in diet, such as more consumption of fast food (c.f. Gwatkin 1980). Although the female rate is always higher than the male rate, the male rate is approaching female rate.



	1997	1998	1999	2000	2001	2002	2003	2004	2005
Male	26	28	27	29	30	32	32	34	36
Female	33	33	32	33	34	35	37	38	41

Figure 22. Age-Standardized Death Rates by Sex from Diabetes and Obesity: 1997-2005

Sex Differences in Death Rates by Cause Among Young Adults in 1997

Higher female than male death rates at younger ages have also sometimes been taken as indicative of HIV. However, even in 1997 females had a higher chance of dying from natural causes from their 15th birthday to their 40th birthday than males. Only the much higher mortality from external causes of males than females in 1997 allowed females to overall have better survival conditions than males in the15-39 age segment.

It is interesting to note for which causes of death young females had higher death rates than males in 1997. This is indicated by an X mark in Table 8 for ages 15-19, 20-24 and 25-29. We see in Table 8 that young females had higher death rates than young males in 1997 from almost every cause of death examined in detail. Young adult female mortality was not higher than male mortality from all causes, but this was only because of higher male than female external cause mortality. Females had higher natural cause mortality than males. External causes, malaria, stroke, cancer and lung cancer for those 20-24. More examination of what was happening in mortality conditions of young adults in 1997 to reverse the typical sex differential in mortality would be warranted.

Table 8. Causes of Death for Which the Female Death Rate was Higher than the Male Death Rate in 1997 at Young Ages

	15-19	20-24	25-29
All Causes			
Natural Causes	X	X	X
External Causes			
Communicable and Related	X	X	X
Non-Communicable	X	X	X
Infectious	X	X	X
Stated HIV	X	X	X
Tuberculosis	X	X	X
Parasitic	X	X	X
Parasitic Opportunistic Infections	X	X	X
Malaria			X
Perinatal Period	X	X	X
Nutritional Deficiencies	X	X	X
Stroke			
Circulatory Except Stroke	X	X	X
Cancer		X	X
Lung Cancer	X		X
Cancer Reproductive System	X	X	X
Diabetes and Obesity	X	X	X
Disorders Immune Mechanism	X	X	X
Non-Communicable Respiratory	X	X	X
Other Non-Communicable	X	X	X

Concluding Thoughts

The overall mortality increases, especially for females are very disturbing. However, the lower increases at the youngest adult ages and above age 50 are also noteworthy. These patterns, along with higher female than male death rates from most causes in 1997 pose questions that merit further investigation.

Another positive aspect of the mortality situation in South Africa is the surprisingly small increase in mortality for females in the 40-64 age segment. Despite deterioration in the survival of females in their twenties and thirties, the slight worsening in the survival chances of females who survive to their 40th birthday is somewhat surprising and also deserves further study.

The worst survival is that of males age 40-64 both in 1997 and in 2005. Further examination of their situation is warranted. It would be important to understand what contributes to their high mortality in addition to the effects of HIV.

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