Revised Burden of Disease Estimates for the Comparative Risk Factor Assessment, South Africa 2000

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Acronyms and Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ASSA2002	Actuarial Society of South Africa 2002, model
BOD	Burden of Disease
CMS	Cape Metropole Study
CRA	Comparative Risk Assessment
DALYs	Disability adjusted life years
DHS	Demographic and Health Survey
DISMOD	Disease model
GBD List	Global Burden of Disease list
GBD	Global Burden of Disease
Group I	Communicable diseases, maternal causes, perinatal conditions and nutritional deficiencies, including HIV/AIDS unless otherwise specified
Group II	Non-communicable diseases
Group III	Injuries
HIV	Human immuno-deficiency virus
ICD	International Classification of Disease
MRC	Medical Research Council
NIMSS	National Injury Mortality Surveillance Study
SA BOD list	South African Burden of Disease list
SADHS	South African Demographic and Health Survey
SA NBD	South African National Burden of Disease Study
SABDSS	South African Births Defects Surveillance System
SSA	Sub-Saharan Africa
Stats SA	Statistics South Africa
UNISA	University of South Africa
WHO	World Health Organisation
YLDs	Years lived with disability
YLLs	Years of life lost due to premature mortality

Executive Summary

The Initial South African Burden of Disease estimates for 2000 have been revised to provide the required information for the Comparative Risk Factor Assessment which requires DALY estimates for single causes. The opportunity was used to match the estimate to the calendar year of 2000 and not the previously used period of mid-2000 to mid-2001. This note outlines the method that has been used to revise the estimates and briefly compares the results with the initial estimates and the country estimates undertaken by the World Health Organisation (WHO).

1 Background

Burden of disease estimates that highlight the extent of the burden and their causes are essential to assist policymakers in devising policies and implementing interventions to promote health; as well as interventions to prevent, treat or ameliorate disease. South African data on causes of death have been shown to be deficient with significant under-registration and misclassification (Botha and Bradshaw 1985; Bradshaw *et al*., 1987; Bradshaw *et al*., 1992) and there is a paucity of reliable morbidity data to the extent that it was questionable whether the Disability Adjusted Life Year (DALY) was measurable in South Africa (Bradshaw 1996). Since 1994 there have been substantial improvements in the completeness of death registration. However, the statistics still require careful analysis as they still suffer from some deficiencies.

In the first national burden of disease study for South Africa (SA NBD), estimates were derived for the levels and underlying causes of mortality and morbidity from different data sources and using demographic models. While the main focus of the study was the causes of premature mortality (YLLs) experienced in the year 2000, attempts were made to estimate the additional burden contributed by morbidity and non-fatal injury, to estimate DALYs and to assess the impact of HIV/AIDS on premature mortality in the year 2010 (Bradshaw *et al*. 2003 a and b).

The study highlighted the substantial impact of HIV/AIDS as a cause of death in South Africa, and the major health transition that is under way, resulting in what has been called the 'quadruple' burden of disease. As countries become more developed the disease profile changes from one of infectious diseases, high child mortality and malnutrition to a predominance of degenerative, chronic diseases. However, developing countries often experience a double burden, resulting from the simultaneous occurrence of these disease spectrums. In the case of South Africa, there is the added burden of injuries and HIV/AIDS.

Although the main focus of the first SA NBD study was on mortality, attempts were made to estimate DALYs. This was done mainly for illustrative purposes to show how the inclusion of non-fatal outcomes changes the ranking of the causes of the burden of disease and to have some preliminary figures for DALYs in South Africa. The initial South African DALY estimates were for the disease categories only and not single diseases and conditions. For most disease categories DALYs were estimated by extrapolating from the Afro E region of the Global Burden of Disease (GBD) study for 2000, version 1 estimates, using age and sex specific ratios of YLDs/ to YLLs to calculate YLDs for South Africa 2000.

1.1 Comparative Risk Factor Assessment

The next step was to undertake the Comparative Risk Assessment (CRA) component of the national burden of disease study. In contrast to identifying the underlying medical conditions we wanted to identify the most important modifiable risks factors driving the burden and to quantify the burden attributed to exposure to these risk factors. The CRA study is underway and the results will be important to inform policy responses and to reduce the burden of disease in South Africa. Reliable and comparable analysis of risks to health is key for a health sector response to preventing disease and injury. This has been recognized by the South African government as an important strategy to improve the health of the nation (Minister of Health's Budget speech, May 2003).

The aim of the CRA study is to estimate the contributions of 17 selected risk factors, in various levels of causality, to burden of disease in South Africa in 2000. The list of risk factors was identified by consulting a range of stakeholders. The study follows standardized comparative risk assessment methodology developed by the World Heath Organization (WHO 2002, Ezzatti *et al*., 2002, 2004). Attributable burdens are calculated using potential impact fractions (PIFs) which are multi-level extensions of attributable fractions and take into account continuous risk factor-disease exposures by comparing these with the counterfactual or theoretical minimum distribution conferring the lowest possible risk, rather than merely exposed and unexposed categories. The estimation of potential impact fractions requires three main data inputs: information on risk factor distributions (both the observed current distribution and the counterfactual or theoretical minimum distributions), risk factor-disease relationships, and estimates of current disease burden.

It therefore became necessary to update the NBD 2000 estimates to derive DALYs by single cause for the health outcomes related to exposure to the 17 risk factors included in the analysis. In addition, more recent data have become available from Statistics South Africa (Stats SA 2005) and new model estimates have been developed by the Actuarial Society of South Africa (ASSA). Thus a full revision of the initial burden of disease estimates has been undertaken for use in the CRA study. The aim of this web document is to outline the methods used to refine the mortality, premature mortality and YLD component of the DALY estimates of the South African Burden of Disease study and describe the results.

2 Methods

2.1 Burden of disease list

The initial South African Burden of Disease (SA BOD) list (Bradshaw *et al.*, 2003) has been adapted slightly. It was originally developed from the GBD 1990 list of causes of death (Murray and Lopez, 1996) and adapted on the basis of the disease profile for South Africa, using the ICD-9 classification system (ICD-9 1995) with some adaptations from the Australian BOD study (Mathers *et al.*, 1999). Causes were divided into three broad groups: Group I, the pre-transitional causes, include communicable diseases, maternal causes, perinatal conditions, and nutritional deficiencies; Group II, the non-communicable causes, include chronic diseases of lifestyle; and Group III, the injuries. HIV/AIDS is part of Group I but is kept separate in this analysis due to the size of the burden that it contributes. Each group is divided into several major disease categories. In Group II, the initial list followed the Australian study with separate categories for mental and nervous system disorders. For the revised estimates, these two categories are combined in a neuropsychiatric category to match the GBD 2000 list.

The disease categories are further disaggregated into more specific causes. Mental disability, listed under neuropsychiatric conditions, refers to mental disability caused by exposure to lead. While the list of causes remains unchanged, foetal alcohol syndrome (FAS) has been moved from perinatal conditions to the congenital abnormalities category. Vitamin A and Iron deficiency anaemia have been separated from nutritional deficiencies and measles has been separated from the childhood immunisable cluster.

2.2 Mortality

A modelling approach, calibrated to empirical data, has been adopted to estimate mortality levels. The number of deaths for the year 2000 are estimated using the ASSA2002 model developed by the Actuarial Society of South Africa which is freely available on the web (http://www.assa.org.za/default.asp?id=1000000050). It is a demographic component projection model that incorporates behavioural factors and is calibrated to population estimates from the 1996 and 2001 censuses, the HIV sero-prevalence from annual antenatal clinic surveys up to the year 2002, empirical levels of child mortality from the 1996 census and the 1998 South African Demographic and Health Survey and adult mortality levels (deaths recorded by the Department of Home Affairs on the population register and deaths recorded by Statistics South Africa after adjusting for under-reporting). ASSA2002 models the heterosexual epidemic (Actuarial Society of South Africa, 2004).

The ASSA 2002 model was used to obtain estimates of the population size, the number of HIV/AIDS deaths, and the total levels of mortality for the calendar year 2000 by age and sex. The proportion of

deaths due to external causes from mortality data provided by Statistics South Africa for the same year (Statistics South Africa, 2005), was applied to the estimated total number of deaths to estimate the total number of injury deaths, by age and sex. The profile of the non-AIDS causes of death, were estimated from the 1996 cause of death data, which are assumed to have little impact from HIV/AIDS. Adjustments for ill-defined causes are outlined in the Initial SA NBD study (Bradshaw *et al*., 2003a and b). The UNISA/MRC national injury mortality surveillance system, (NIMSS) data, for the year 2000, were used to estimate the profile of causes of injury deaths (Burrows *et al*, 2001).

2.3 Premature Mortality (YLLs)

As in the Initial SA NBD study, premature mortality has been estimated using the standard GBD approach to calculate years of life lost (YLLs) (Murray and Lopez 1996 a). Age weighting, discounting of 3% and standard life expectancies based on the West model levels 25 and 26 have been used (Coale and Demeny, 1966).

2.4 Years lived with disability (YLDs)

The YLD is the disability component of the DALY based on non-fatal health outcomes. Disability has many dimensions including pain, discomfort, physical dysfunction, emotional distress, inability to carry out usual activities and loss of dignity, among others. The YLD takes the severity and duration of the disability into account using the basic formula (Mathers, *et al*., 2001):

YLD = I x DW x L

I is the number of incident cases for the reference period

DW is the disability weight in the range 0 – 1

L is the average duration of disability (measured in years)

Estimation of YLDs is the most difficult component of a national BOD study in developing countries due to the lack of data on the incidence, duration and severity of many conditions (Bobadilla 1996). Nevertheless, attempts were made to estimate local YLDs in two stages. Firstly estimates were derived for the disease categories and in the second step, estimates for single causes within the category were derived.

As in the initial estimates, the YLD component of the DALY was estimated for certain disease categories with high mortality components by using the YLD/YLL ratios from the GBD 2000 estimates representative of the Afro E region (WHO Global Burden of Disease study for 2000, Version 1) illustrated by the following relationship:

$YLD_{SA} = YLL_{SA} \times YLD_{GBD}/YLL_{GBD}$

The YLD/YLL ratios from the Afro E region are shown in Table 1. There are two mortality strata for Africa in the GBD 2000 namely Afro E and Afro D. Afro D has high child and high adult mortality and Afro E has high child and very high adult mortality. South Africa falls into the Afro E region and hence these estimates were considered to be the most appropriate for South Africa. As the South African BOD list does not correspond exactly with the GBD 2000 cause list, ratios for causes that appeared on the lists of other comparable GBD studies, namely, Zimbabwe (Chapman *et al.,* 2006), Mauritius and Australia were used, where necessary.

Table 1: Afro E ratios of YLD to YLL by disease category and sex

	Disease category	Male	Female	Persons
A.	Infectious and parasitic excl HIV	0.1190	0.1200	0.1195
B.	Respiratory infections	0.0293	0.0181	0.0242
C.	Maternal conditions		0.7833	0.7833
D.	Perinatal conditions	0.1653	0.1607	0.1633
E.	Nutritional deficiencies	1.1124	1.1120	1.1122
F.	Malignant neoplasms	0.0261	0.0622	0.0431
G.	Benign neoplasms	0.0000	0.0000	0.0000
H.	Diabetes mellitus	0.3099	0.1400	0.2023
I.	Endocrine and metabolic	0.7722	1.0767	0.8765
J/K	Neuropsychiatric	-	-	-
L.	Sense organs	-	-	-
M.	Cardiovascular disease	0.1431	0.1456	0.1444
N.	Respiratory disease	1.6499	1.9047	1.7542
O.	Diseases of the digestive system	0.7267	1.2731	0.9154
P.	Genito-urinary diseases	0.4602	0.4774	0.4671
Q.	Skin diseases	-	-	-
R.	Musculo-skeletal diseases	-	-	-
S.	Congenital abnormalities	Local	Local	Local
T.	Oral conditions	-	-	-
U.	Cot death	-	-	-
V.	Unintentional injuries	Local	Local	Local
W.	Intentional injuries	Local	Local	Local
X.	HIV/AIDS	Local	Local	Local

- Not estimated using ratio method
- Local= Local estimates available for these conditions

Estimates of YLDs by single causes were obtained by proportionately allocating the YLDs for each disease category (obtained using the ratio method outlined above) into the single disease contributions using the proportion from the WHO country specific burden of disease estimates for South Africa (WHO, 2004).

Some conditions result in morbidity but not mortality such as the neuropsychiatric (combined J mental disorders/ and K nervous system disorders), sense organ (L), skin diseases (Q), musculo-skeletal (R) and oral conditions (T) categories. In these cases it was not possible to use the YLD/YLL ratio approach. Instead, the YLD rate per 100 000 from WHO country specific estimates for South Africa results for 2000, was applied to South African population estimates for 2000 to estimate YLDs for single causes for these categories by age and sex. Counts for single causes were then added to estimate category totals.

Using the local prevalence of alcohol dependence from the South African Demographic and Health Survey 1998 adult data (DHS 1998 ref), we used the disease modeling tool, DisMod II (WHO 2001), to back calculate incidence from prevalence and worked out local YLDs for this disorder, using Dutch weights (Stouthard *et al* 1997). DisMod II, was then also used to back calculate the incidence of Mild Mental Disability (MMD) caused by lead exposure from the observed prevalence rate of exposure in children under 5 (calculated in the SA CRA study), using a relative risk of total mortality for mental disability of 2 (double that for the total population) and a remission rate of 0. For estimating the YLD due to MMD caused by lead, this calculated incidence of MMD was introduced into the YLD template MS Excel spreadsheets with duration and age at onset also derived from DisMod II and using the Dutch Disability weight for MMD of 0.290 (Stouthard *et al* 1997). For foetal alcohol syndrome, YLDs were calculated using an incidence of 20 per 1000 at birth, with age of onset at birth (0 years) and duration based on the life expectancy for South Africa 1990 (pre-AIDS) with no adjustment for increased mortality. The following Dutch disability weights, by level of mental disorder, were used:

Level of mental disorder	**Disability weight**
Mental retardation (IQ = 70-84)	0.09
Mild mental handicap (IQ = 50-69)	0.29
Moderate mental handicap (IQ =35-49)	0.43
Severe mental handicap (IQ =20-34)	0.82
Extreme mental handicap (IQ< 20)	0.76

Source: Stouthard *et al*. 1997

The mean IQ, of children with FAS, is 77.5 (standard deviation 13.4) as obtained from a study in a community in the Western Cape. By assuming that IQ is normally distributed, the proportions of children with FAS in each of the categories of mental retardation could be estimated and used to derive

a weighted disability weight for the children with FAS. Based on this data, an overall disability weight of 0.125 was derived and used in the YLD calculations.

For congenital abnormalities, HIV/AIDS and injuries, local epidemiological data sources were available to estimate local YLDs by single cause. The South African Birth Defects Surveillance System (SABDSS) has data representative of the period 1995 – 2000 (SABDSS, 2001). Estimates for HIV/AIDS generated from the ASSA2002 model made it possible to estimate local YLDs for this leading cause of death and disability. In addition, estimates of injury YLDs could be derived making use of the Cape Town Metropolitan study (Norman, 2002). The method used for estimating YLDs for congenital abnormalities category is described in detail elsewhere (Bradshaw *et al*., 2003). The methods for calculating YLDs for HIV/AIDS and injuries have recently been revised and are described in more detail below.

The HIV/AIDS case sequelae and disability weights have been adapted from those used in the Australian NBD study and are shown in Table 2. However, the incidence and duration of the disease at each stage for different age groups have been derived from a staging model adapted from ASSA2002 which classifies individuals according to the WHO clinical staging system (personal communication – Leigh Johnson). Although the model does not explicitly model diagnoses, it is possible to match the stages. The second stage has been designated a duration of 0 because in South Africa, (at least at the moment), the majority of people only discover their HIV status after becoming symptomatic. The 0 – 4 age interval comprises two groups with different duration assumptions for: (i) those born HIV-positive, and (ii) those infected through breast milk.

Table 2: Stages, disability weights and duration of HIV/AIDS for different age groups

	Stage	HIV+ no symptoms, no diagnosis	Diagnosed HIV+, no symptoms	Late HIV with symptoms	AIDS serious illness	AIDS terminal	Mean period to death (yrs)	
Age	Disability weight	0	0.2	0.31	0.5	0.95	M	F
0-4	HIV+ at birth	0.90	0.00	0.90	0.92	0.17	2	2
0-4	HIV+ via breast milk	2.46	0.00	2.46	0.92	0.17	6	6
5-24		5.85	0.00	4.48	1.97	0.21	11	11
25-54		4.68	0.00	3.58	1.57	0.17	10	10
55-64		2.85	0.00	2.18	0.96	0.10	9.25	10
65-74		1.87	0.00	1.43	0.63	0.07	4.69	7.82
75+		1.87	0.00	1.43	0.63	0.07	1.65	3.28

In the case of injuries, YLDs were estimated using the mortality and morbidity estimates based on the Cape Metropole tudy. The Cape Metropole study (CMS) was undertaken in 1990 and constituted the first complete cross-sectional metropolitan trauma study in Africa. It was designed to obtain a representative sample of the fatal and non-fatal injury cases that occurred in both the public and private sectors. In an attempt to quantify the burden due to injuries, YLLs and YLDs were calculated using the 1990 CMS data (Norman, 2002) and the CMS YLD/YLL ratio for each cause of injury was applied to YLLs obtained in the revised national burden of disease study for each sex and age category in order to estimate national YLDs and subsequently DALYs.

2.5 Disability Adjusted Life Years

The computation of the DALY for any given condition is simply the sum of YLLs and YLDs for that condition:

$$DALY_i = YLL_i + YLD_i$$

It was only possible to calculate DALYs for the single causes for which YLD estimates were available.

2.6 Population group estimates

The SA CRA study required population group estimates of mortality, YLLs and DALYs for selected conditions where population group differences in the level of exposure were clearly different and needed to be analysed separately. In particular, the tobacco, indoor smoke from solid fuels and high cholesterol analyses required burden of disease estimates by population group. However, data limitations constrained the approach used for this estimation. The ASSA model was used to obtain estimates of the total deaths and HIV/AIDS deaths for the calendar year 2000 by age and sex for each population group. The proportion of deaths due to external causes from a sample of cause of death data

provided by Statistics South Africa (Stats SA 2002) for each population group for the year 2000, was applied to the estimated total number of deaths to estimate the total number of injury deaths, by age, sex and population group. Since the 1996 cause of death data was not available by population group, a different approach to estimate the profile of the natural deaths was necessary. Stats SA sample data was used proportionally by age and sex to estimate the cause of death profile. Unfortunately, due to misclassification of HIV/AIDS deaths to indicator conditions in the sample data (Groenewald *et al*., 2005), the proportion of deaths due to infectious diseases maybe overestimated when considering the underlying cause profile. It was therefore only possible to estimate mortality for non-communicable (Group II) causes by population group. Ill-defined natural causes were redistributed as outlined in the Initial SA NBD study (Bradshaw *et al*., 2003). The profile of causes of injury deaths was also not estimated by population group. In a final step, the four population group estimates of deaths for each cause were normalized to add up to the revised national burden of disease estimates by age and sex.

Years of life lost were calculated for each population group using the same assumptions used in the GBD study and in the initial and revised burden of disease studies (Murray and Lopez 1996; Bradshaw *et al.*, 2003a and b and section 2.3 of this document). The national YLD estimates were divided proportionally into population groups according to the YLL profile by single cause.

3 Results

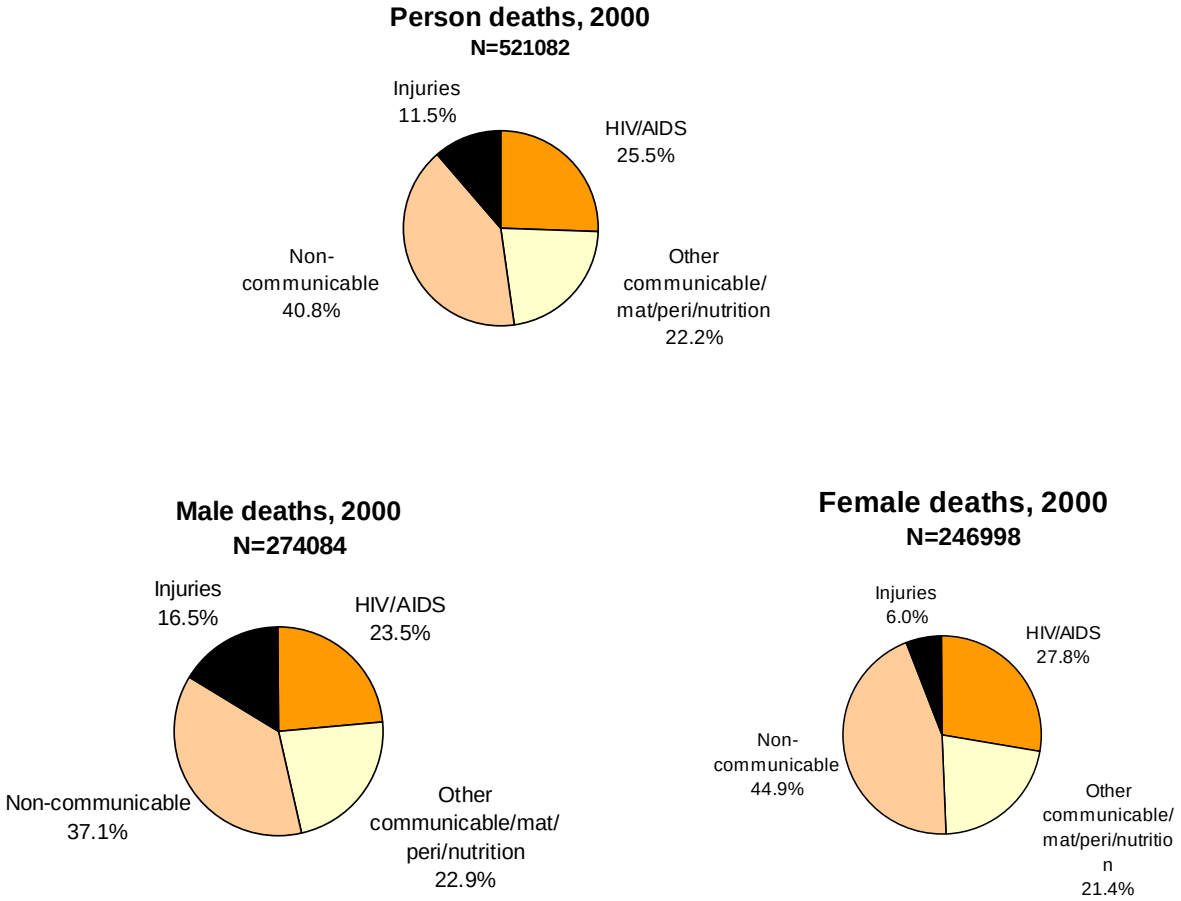
3.1 Mortality Profile

The revised mortality and population estimates for South Africa 2000, based on ASSA2002 are presented in Table 3. Previously, the mortality profile was based on 303 081 (54.5%) male and 253 604 (45.5) female deaths to give a total of 556 585 deaths. The revised estimates are based on 274 084 (52.6%) male and 246 998 (47.4%) female deaths for a total of 521 082 deaths. Figure 3.1 shows the revised proportions for the broad Groups I, II, III and AIDS (Appendix A). The proportion of Group I causes of death (other communicable, maternal, perinatal and nutrition related causes) and HIV/AIDS deaths are very similar for males and females. The greatest differences between males and females are in the proportions of deaths due to injuries, 16.5% for males 6% for females. There is also a marked difference in proportion of deaths from non-communicable diseases: males 37.1% and females 44.9%).

Table 3: Revised mortality and population estimates for South Africa, 2000

Indicator	Male	Female	Persons
Total deaths	274 084	246 998	521 082
Total population	21 107 197	22 861 582	43 968 779

Source: ASSA 2002



Mat = maternal, peri = perinatal conditions

Figure 3.1: Estimated deaths by group, South Africa 2000

The initial and revised estimated deaths by broad group are presented in Table 4. The number of HIV/AIDS and injury deaths have been revised down from the initial estimates. In the initial estimates, HIV/AIDS accounted for almost 30% of deaths while the revised proportion is lower (25.5%). Group II causes, which include chronic diseases of lifestyle, are responsible for the most deaths revised from 37% to almost 41% of all deaths in South Africa 2000. HIV/AIDS and other group I causes together account for almost half (48%) of all deaths. Group III causes or injury related deaths have been revised down by about 10 000 deaths from the initial 68 930 deaths to a revised estimate of 59 935 injury deaths.

Table 4: Initial and revised estimated number of deaths in each group and HIV/AIDS

Group	Initial		Revised	
	Deaths	Percentage	Deaths	Percentage
Other Group I	115 565	20.8%	115 562	22.2%
HIV/AIDS	165 859	29.8%	132 990	25.5%
Group II	206 231	37.0%	212 595	40.8%
Group III	68 930	12.4%	59 935	11.5%
Total	556 585	100.0%	521 082	100.0%

Figure 3.2 shows the Initial top 20 leading causes of death. HIV/AIDS accounted for 30% of all deaths (26% male and 34% female), followed by ischaemic heart disease, interpersonal violence and stroke. Interpersonal violence, tuberculosis and road traffic accidents were leading causes for male deaths. HIV/AIDS, stroke, hypertensive disease and diabetes mellitus were higher in females than in males. Figure 3.3 shows the revised top 20 leading causes of deaths. HIV/AIDS is still the leading cause of death for both males and females but accounts for lower proportions of deaths (23.5% and 27.8% of deaths in males and females, respectively) when compared with the initial estimates. Interpersonal violence, tuberculosis, ischaemic heart disease and stroke remain the next major causes of death among males. Females have higher proportions of deaths due to stroke, ischaemic heart disease, lower respiratory infections and hypertensive disease compared with males. For persons, interpersonal violence is the fifth leading cause of deaths in the revised estimates compared with third in the initial estimates. The estimated number of deaths for each cause by sex are given in Appendix A.

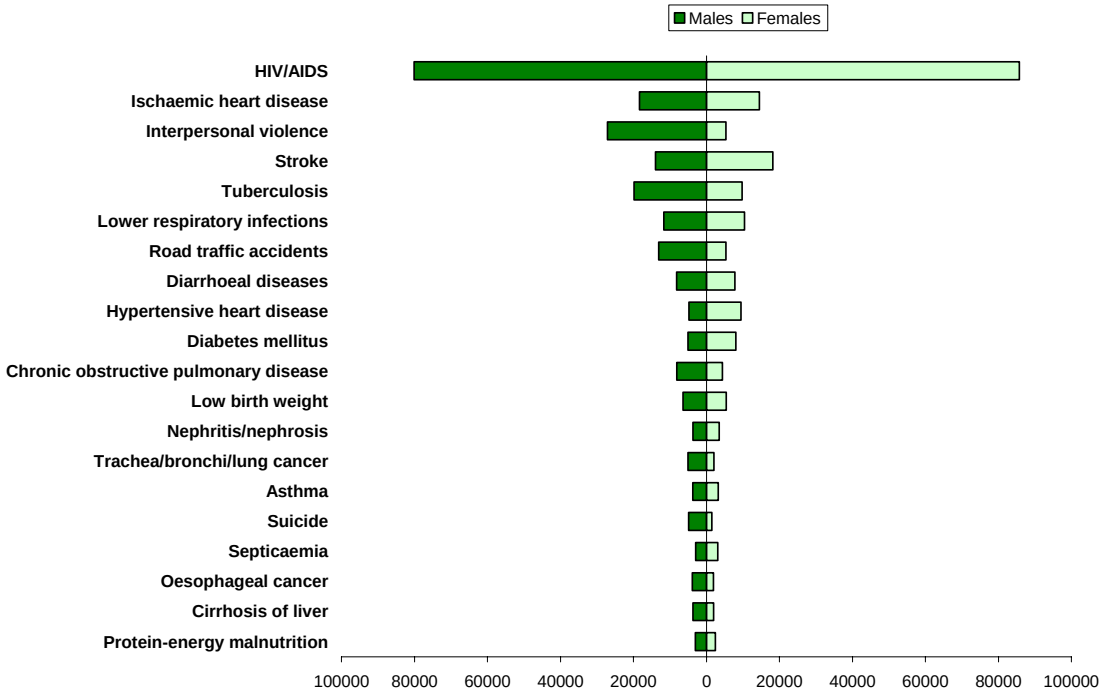


Figure 3.2: Initial leading specific causes of death, South Africa 2000

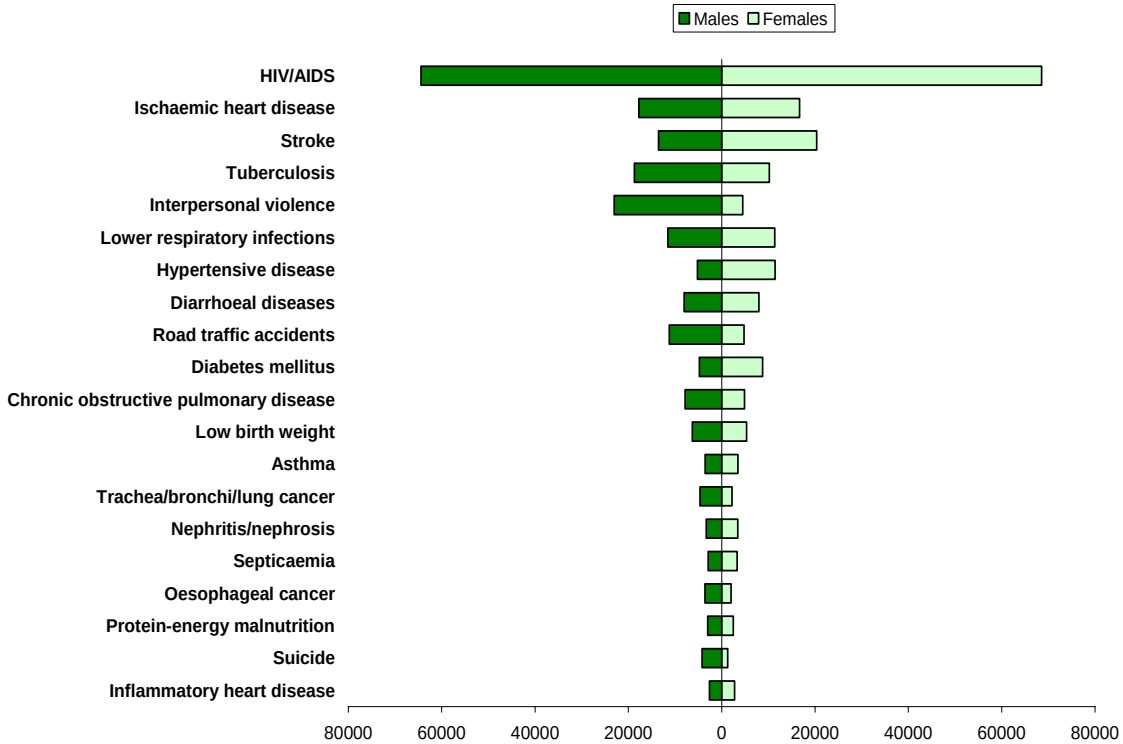
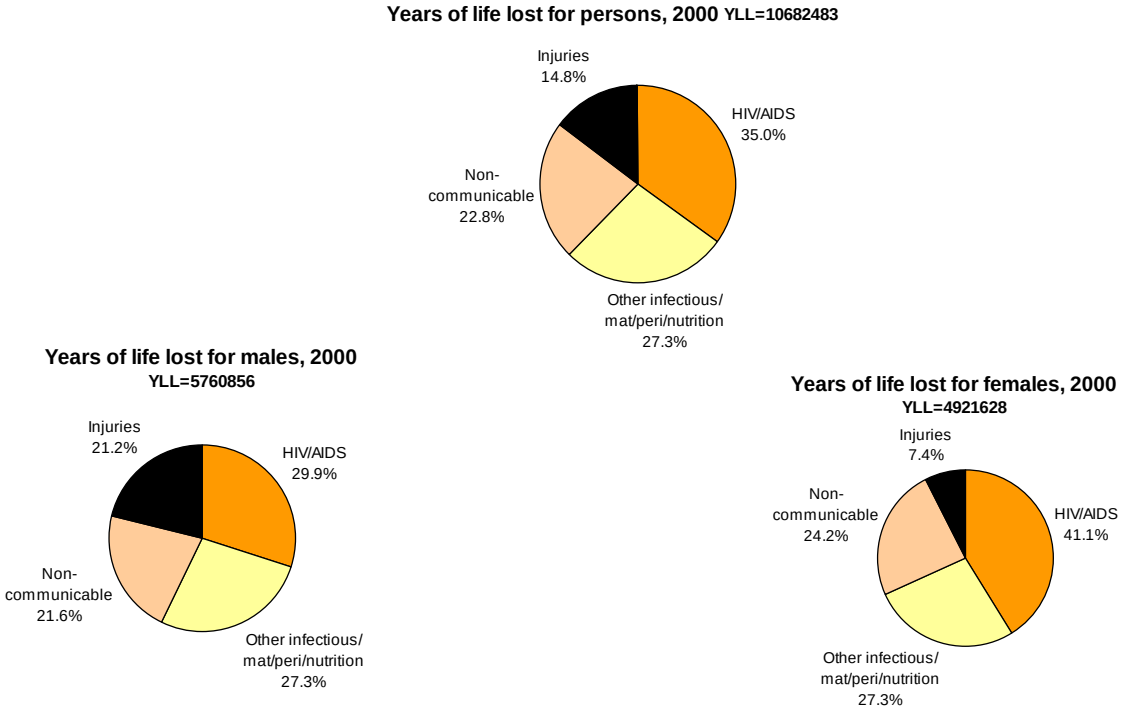


Figure 3.3: Revised leading specific causes of death, South Africa 2000

3.2 Years of life lost



Mat = maternal, peri = perinatal conditions.

Figure 3.4: Revised estimated years of life lost (YLLs) by broad group, South Africa 2000

The revised estimated years of life lost by broad group for South Africa, 2000 are presented in Figure 3.4. HIV/AIDS accounts for the largest proportion of male (29.9%) and female (41.1%) years of life lost.

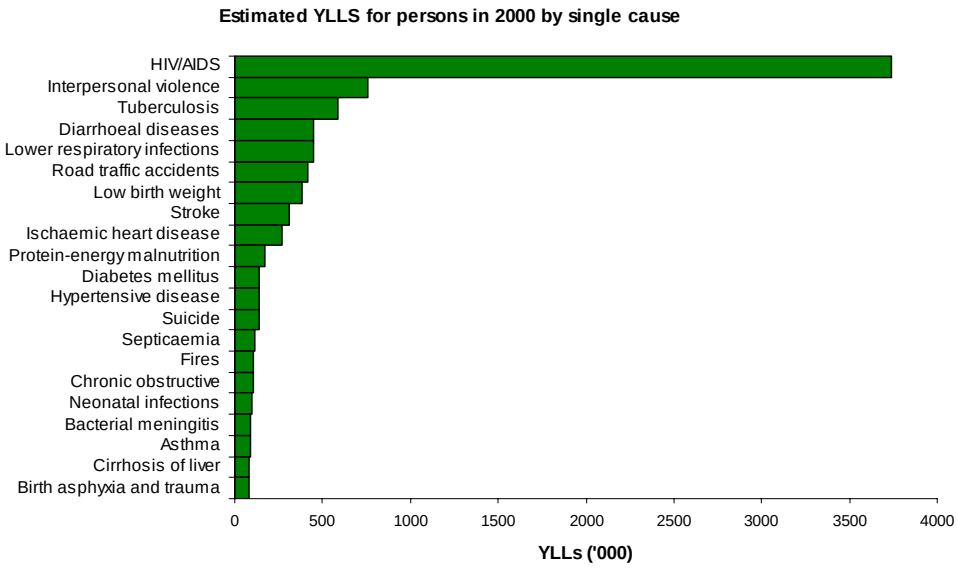


Figure 3.5: Revised estimates of years of life lost (YLLs) by single cause, South Africa 2000

HIV/AIDS remain the largest single cause of premature mortality accounting for 35% of all years of life lost, followed by interpersonal violence (7.1%) and tuberculosis (5.5%). Diarrhoeal disease is the fourth largest cause followed by lower respiratory infections in fifth. In the initial estimates road traffic injury was the fourth largest cause of years of life lost followed by diarrhoeal disease in fifth.

3.3 Years lived with disability (YLDs)

3.3.1 HIV/AIDS

South African estimates of incidence and average duration of HIV/AIDS are compared with sub-Saharan Africa (SSA) estimates from the GBD 1990 (Murray and Lopez, 1996 a and b) and Australian 1996 (Mathers *et al.*, 1999) studies in Table 5. South African incidence rates are markedly higher than other regions at all ages.

Table 5: Comparison of HIV/AIDS incidence rates and average duration for sub-Saharan Africa, South Africa and Australia

	Incidence/100 000			Average duration		
	SSA 1990	South Africa	Australia 1996	SSA	South Africa	Australia
Males						
0-4	4.6	1 355.6	0.45	6.0	8.9	19.5
5-14	0.2	0.0	0.19	12.0	12.51	18.4
15-44	55.7	2 033.9	12.44	12.0	10.84	15.7
45-59	13.6	1 590.3	6.49	12.0	8.7	9.7
60+	1.3	297.0	2.56	12.0	8.0	7.5
All ages	29.1	1 354.8	7.19	11.9	9.69	14.3
Females						
0-4	4.8	1 346.2	0.19	6.0	8.9	19.6
5-14	0.2	0.0	0.16	12.0	12.51	18.5
15-44	12.5	2 475.1	1.06	12.0	10.84	15.8
45-59	1.7	359.2	0.29	12.0	8.7	10
60+	0.1	0.0	0.14	12.0	8.0	7.9
All ages	6.1	1 404.0	0.58	11.7	10.52	15.4

South Africa's local estimates of total YLDs for HIV/AIDS are compared with those from other countries and regions in Table 6. It is clear that YLD estimates extrapolated from the Afro E region of the GBD 2000 study using the ratio method, underestimate YLDs especially in females (Table 6).

Table 6: Comparison of YLD rates for HIV/AIDS (per 100 000) for males and females, South Africa with other NBD estimates

	Males	Females	Persons
South Africa 2000 (local estimate)	2 608	3 108	2 797
Australia 1996	27	3	14
Mauritius 1993	16	4	10
EME (GBD1990)	68	13	40
SSA (GBD 1990)	267	262	265
AFRO E (GBD 2000)	1 179	957	1 310
South Africa (AFRO E estimate)	824	957	892
Zimbabwe 1997	2 358	2 043	2 194

A similar comparison of the proportions of YLD:DALY and the population estimates of DALYs show huge differences in the total number of DALYs and in the composition of the ratios (Table 7). Again the under-estimation of morbidity using the ratio method by applying the Afro E estimates is apparent. Interesting is the comparison of DALY rates for sub-Saharan Africa in 1990 with estimates from the GBD 2000 and the South Africa local estimate a decade later which illustrate the aggressive spread of the epidemic in this region. It is also noteworthy that the differences in DALYs for Zimbabwe in 1997 and the other regional estimates may well be reflecting different stages of the HIV/AIDS epidemic.

Table 7 Comparison of the YLD/DALY ratio and DALYs (per 100 000) for persons

Persons	YLD/DALY %	DALY/ 100 000
South Africa (local estimate)	22	10 896
Australia 1996	17	79
Mauritius 1993	58	18
EME (GBD 1990)	25	159
SSA (GBD 1990)	16	1 640
Afro E (GBD 2000)	8	16 510
South Africa (Afro E estimate)	8	11 241
Zimbabwe 1997	11	19 441

3.3.2 Injuries

Estimates of YLDs and DALYs for unintentional injuries using the Afro E ratio were very similar to estimates obtained using the CMS ratio (Figure 3.6). For intentional injuries, however, YLD and DALY estimates based on the CMS study were greater than the estimates based on the Afro E region of the GBD 2000. Another important difference was that DALYs from unintentional injuries were greater than DALYs from intentional injuries when applying the Afro E ratio to YLLs. With the alternative estimates based on the CMS ratio, however, the reverse was true. Overall, applying the Afro E ratio of YLD/YLL to calculate YLDs for injuries for South Africa in this study, results in an underestimation of the disability burden due to intentional injuries and therefore the total burden for injuries, when compared to estimates based on local data (Figure 3.6).

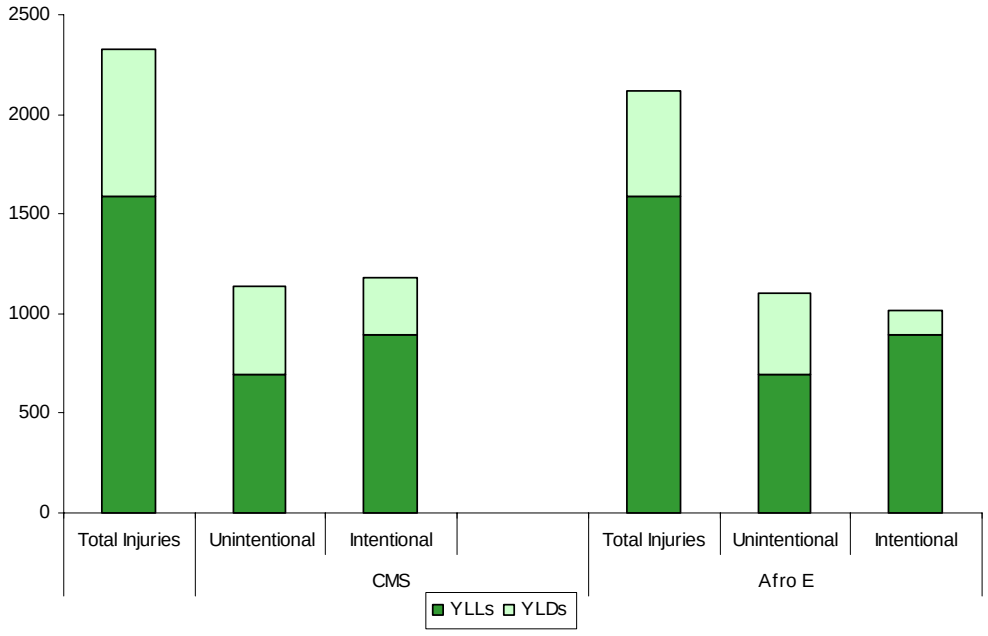


Figure 3.6 Comparison of DALY estimates for injuries based on CMS and Afro E ratios of YLD/YLL for persons, South Africa 2000

National DALY estimates based on CMS ratios by injury cause are shown in Figure 3.7 for males and females separately. For both males and females, injuries caused by interpersonal violence contribute the most DALYs, followed by road traffic injuries. Both YLLs and YLDs for these causes are greater in males than females. For road traffic and other transport accidents and self-inflicted injuries, most of the burden is from premature mortality while in the case of falls the majority of the burden is from disability caused by non-fatal outcomes.

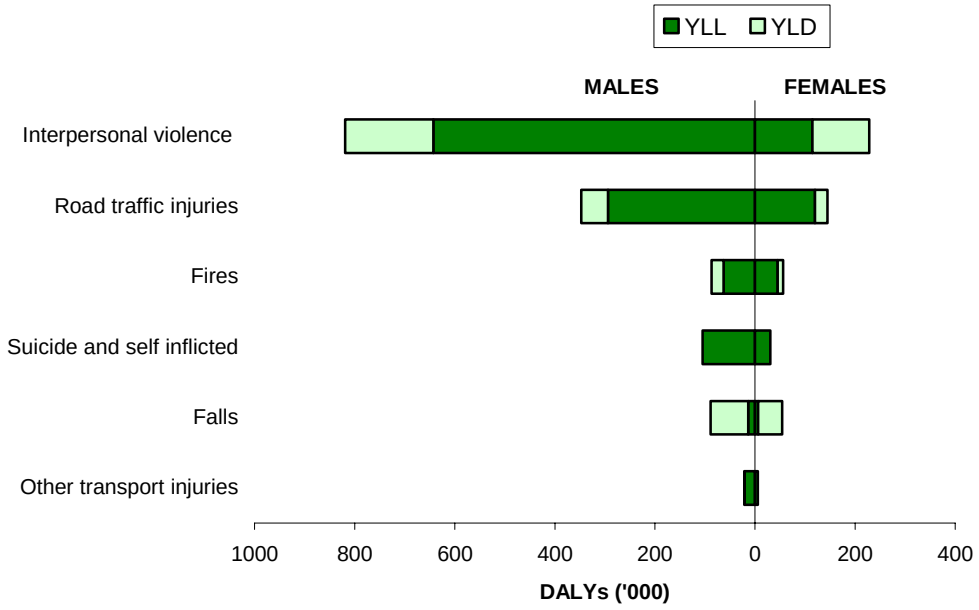


Figure 3.7 DALY estimates by cause of injury and sex, South Africa 2000

3.3.3 YLD ranks

The top 20 leading causes of YLDs are shown in Figure 3.8. HIV/AIDS is the leading cause of YLDs followed by unipolar depressive disorders and interpersonal violence. Other neuropsychiatric disorders which rank in the top 20 include: schizophrenia, alcohol use, drug use, obsessive compulsive, bipolar affective and panic disorders.

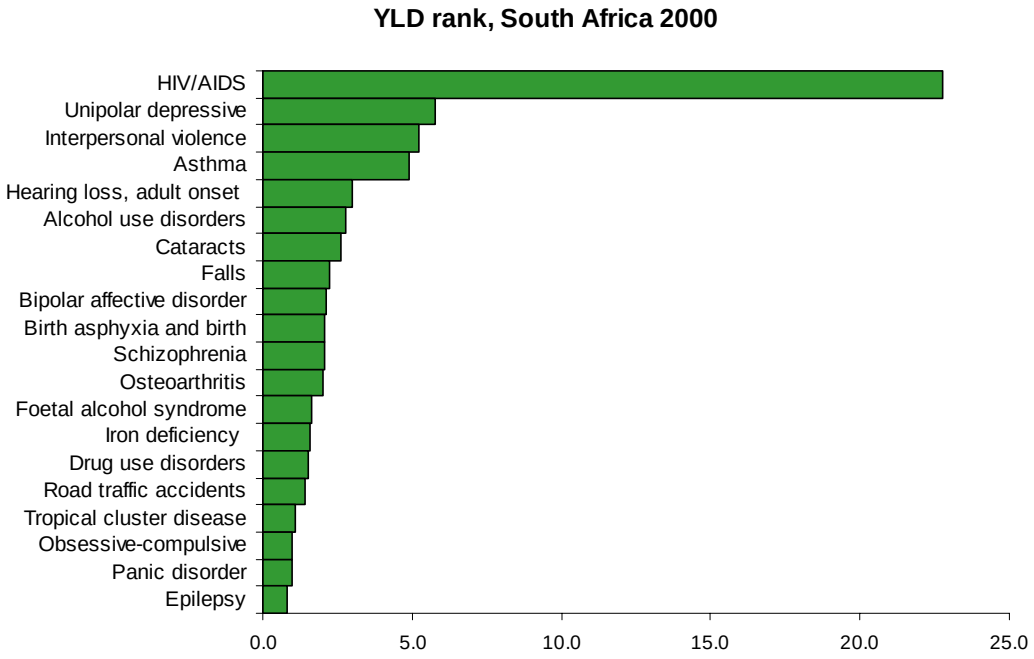


Figure 3.8. Estimated years of life lived with disability (YLDs), South Africa 2000

3.4 DALYs

Figure 3.9 shows the initial estimated DALYs, in descending order for all diseases by category for all persons. HIV/AIDS ranked first followed by infectious/parasitic diseases excluding HIV/AIDS and then followed by first unintentional and then intentional injuries. Neuropsychiatric disorders (the sum of the inititial estimates for mental and nervous system disorders) is the eighth leading cause of healthy years of life lost in the initial DALY estimates. The revised DALY estimates are presented by group, category and single cause in Appendix B. Figure 3.10 shows the revised estimated DALYs, in descending order for all disease categories for persons. Although HIV/AIDS still ranked first, neuropsychiatric conditions move from 8th in the initial to 3rd in the revised estimates. It is also important to note that using local estimates intentional injuries rank 4th, followed by unintentional injuries (the ranking is reversed in the initial estimates). With foetal alcohol syndrome in the congenital abnormalities category, this category now ranks higher than the sense organs category. The ranking order for the other categories remains unchanged.

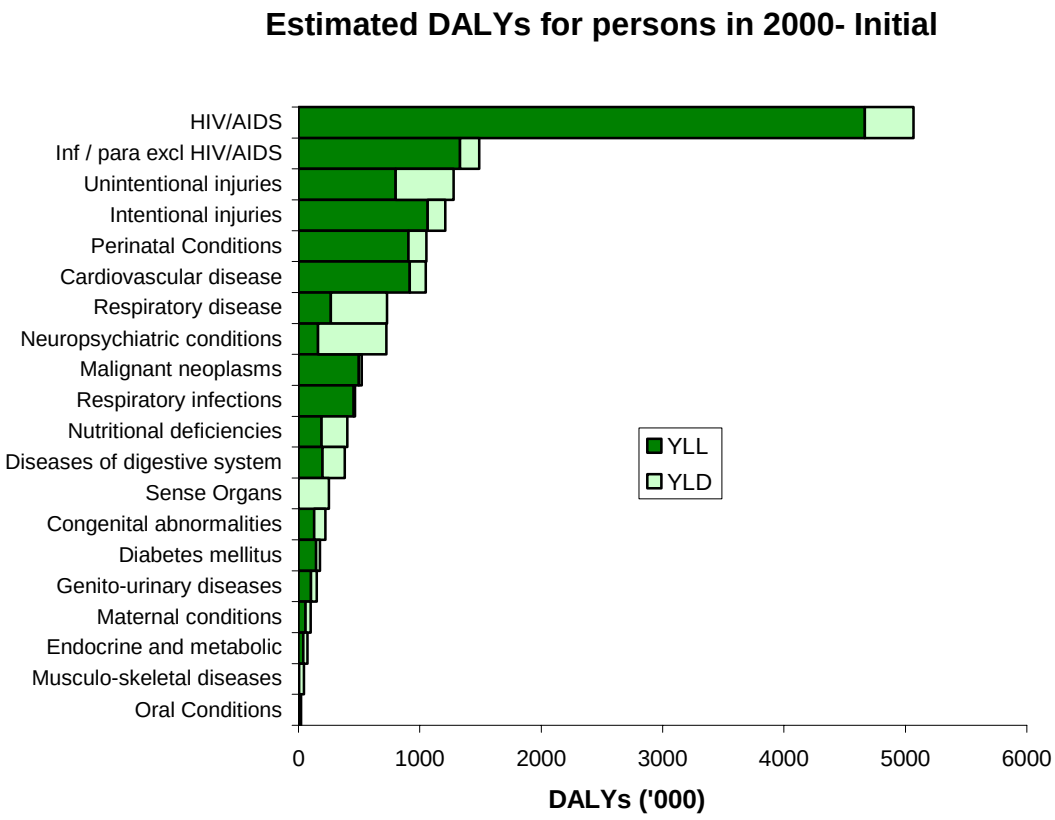


Figure 3.9: Initial estimated DALYs for persons by disease category, in 2000

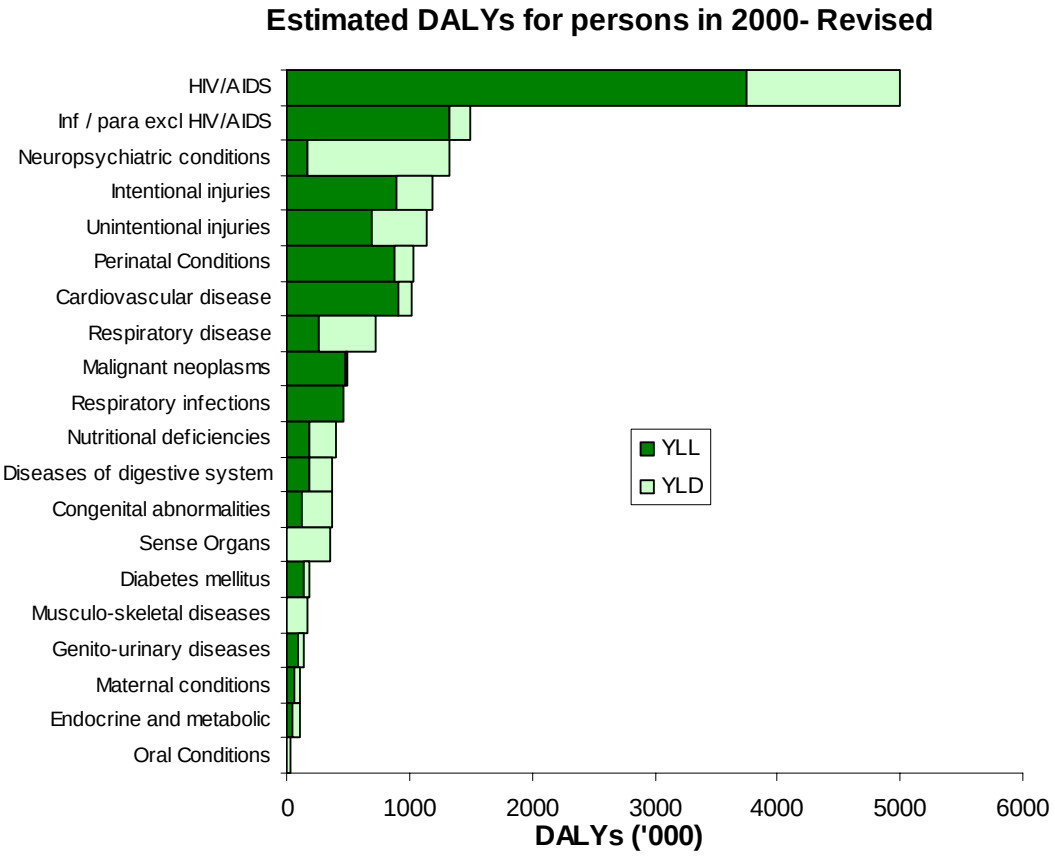


Figure 3.10: Revised estimated DALYs for persons in 2000

Table 8 summarises the revised estimates of deaths, YLLs and DALYs for persons in South Africa, 2000. HIV/AIDS is the leading cause of death, followed by ischaemic heart disease, stroke and tuberculosis. Interpersonal violence ranks fifth. HIV/AIDS is also the largest single cause of years of life lost (YLLs) followed by interpersonal violence, tuberculosis, diarrhoeal disease and lower respiratory infections. HIV/AIDS is also the leading cause of DALYs. The top 10 conditions for deaths, YLLs and DALYs are more or less the same with slight differences in the ranking. For example, RTA ranked 9th amongst deaths, 6th amongst YLLs and 4th amongst DALYs.

Table: 8 Revised estimates of deaths, YLLs and DALYs for all persons in South Africa, 2000

Deaths (Persons)				YLLs (Persons)				DALYs (Persons)			
Rank	**Cause**	**Total**	**%**	**Rank**	**Cause**	**Total**	**%**	**Rank**	**Cause**	**Total**	**%**
1	HIV/AIDS	132 990	25.5	1	HIV/AIDS	3 743 002	35.0	1	HIV/AIDS	5 003 852	30.9
2	Ischaemic heart disease	34 402	6.6	2	Interpersonal violence	757 224	7.1	2	Interpersonal violence	1 047 061	6.5
3	Stroke	33 866	6.5	3	Tuberculosis	588 446	5.5	3	Tuberculosis	599 857	3.7
4	Tuberculosis	28 907	5.5	4	Diarrhoeal diseases	449 561	4.2	4	Road traffic accidents	491 829	3.0
5	Interpersonal violence	27 563	5.3	5	Lower respiratory infections	448 403	4.2	5	Diarrhoeal diseases	462 355	2.9
6	Lower respiratory infections	22 910	4.4	6	Road traffic accidents	413 263	3.9	6	Lower respiratory infections	453 224	2.8
7	Hypertensive disease	16 648	3.2	7	Low birth weight	384 520	3.6	7	Low birth weight	413 237	2.6
8	Diarrhoeal diseases	16 006	3.1	8	Stroke	312 607	2.9	8	Asthma	361 390	2.2
9	Road traffic accidents	15 993	3.1	9	Ischaemic heart disease	271 843	2.5	9	Stroke	352 596	2.2
10	Diabetes mellitus	13 546	2.6	10	Protein-energy malnutrition	170 546	1.6	10	Unipolar depressive disorders	318 964	2.0
11	Chronic obstructive pulmonary disease	12 768	2.5	11	Diabetes mellitus	142 510	1.3	11	Ischaemic heart disease	292 978	1.8
12	Low birth weight	11 597	2.2	12	Hypertensive disease	142 024	1.3	12	Protein-energy malnutrition	215 254	1.3
13	Asthma	7 006	1.3	13	Suicide	135 434	1.3	13	Birth asphyxia and birth trauma	199 547	1.2
14	Trachea/bronchi/lung cancer	6 885	1.3	14	Septicaemia	115 336	1.1	14	Diabetes mellitus	181 178	1.1
15	Nephritis/nephrosis	6 760	1.3	15	Fires	108 842	1.0	15	Alcohol dependence	166 650	1.0
16	Septicaemia	6 234	1.2	16	Chronic obstructive pulmonary disease	108 611	1.0	16	Hearing loss, adult onset	164 908	1.0
17	Oesophageal cancer	5 579	1.1	17	Neonatal infections	94 542	0.9	17	Cataracts	146 137	0.9
18	Protein-energy malnutrition	5 499	1.1	18	Bacterial meningitis	92 023	0.9	18	Hypertensive heart disease	145 699	0.9
19	Suicide	5 461	1.0	19	Asthma	91 453	0.9	19	Fires	142 630	0.9
20	Cirrhosis of liver	5 442	1.0	20	Cirrhosis of liver	84 537	0.8	20	Falls	142 597	0.9
	Top twenty %		79.8		Top twenty %		81		Top twenty %		69.8
	All causes	521 082			All causes	10 682 483			All causes	16 216 041	

3.5 Comparison of SA NBD estimates with WHO estimates for South 2000

Table 9 compares the top 20 leading cause of death for persons of SA NBD with WHO estimates for South Africa 2000. The HIV/AIDs estimates from WHO are almost double those from the SA NBD (46.9% versus 25.5%). The top 5 causes are similar with slight differences in the ranking for ischaemic heart disease, cerebrovascular disease and interpersonal violence between the SA NBD and WHO estimates. In the WHO estimates, stroke is the second leading cause of death while ischaemic heart disease ranks fifth while in the SANBD estimates, ischaemic heart disease ranks second and stroke ranks third. Congenital and perinatal conditions have been aggregated into categories in the WHO listing which also affects the ranking. WHO ranked road traffic injuries as 6th compared to 9th in the SA NBD estimates.

Table 9: Cause of death estimates of SA NBD and WHO, 2000

	SA NBD estimates 2000		WHO estimates 2000	
	Persons	**% total deaths**	**Persons**	**% total deaths**
1	HIV/AIDS	25.5	HIV/AIDS	46.9
2	Ischaemic heart disease	6.6	Stroke	3.5
3	Stroke	6.5	Tuberculosis	3.4
4	Tuberculosis	5.5	Interpersonal violence	3.1
5	Interpersonal violence	5.3	Ischaemic heart disease	3.0
6	Lower respiratory infections	4.4	Road traffic accidents	2.4
7	Hypertensive disease	3.2	Diarrhoeal diseases	2.2
8	Diarrhoeal diseases	3.1	Lower respiratory infections	2.1
9	Road traffic accidents	3.1	Diabetes mellitus	2.1
10	Diabetes mellitus	2.6	Chronic obstructive pulmonary disease	1.3
11	Chronic obstructive pulmonary disease	2.5	Perinatal conditions	1.3
12	Low birth weight	2.2	Trachea, bronchus, lung cancers	0.9
13	Asthma	1.3	Nephritis and nephrosis	0.8
14	Trachea/bronchi/lung cancer	1.3	Oesophageal cancer	0.7
15	Nephritis/nephrosis	1.3	Asthma	0.7
16	Septicaemia	1.2	Hypertensive disease	0.6
17	Oesophageal cancer	1.1	Self-inflicted injuries	0.6
18	Protein-energy malnutrition	1.1	Protein-energy malnutrition	0.5
19	Suicide	1.0	Cervix uteri cancer	0.4
20	Cirrhosis of liver	1.0	Congenital anomalies	0.4

In Table 10, the DALY ranking for the first six conditions are exactly the same for the SA NBD and WHO. Asthma and stroke ranked 8th and 9th in the SANBD but 9th and 10th in the WHO estimates. Unipolar depressive disorders ranked 10th in SA NBD but 7th for the WHO. WHO estimated HIV/AIDS much higher at 46.5 of total DALYs compared with the 30.9 of total DALYs in the SA NBD. WHO may overestimate the HIV/AIDS burden but underestimates burden from interpersonal violence.

Table 10: DALY estimates of SA NBD and WHO estimates for South Africa, 2000

	SA NBD estimates 2000		WHO estimates 2000	
	Persons	**% total DALYs**	**Persons**	**% total DALYs**
1	HIV/AIDS	30.9	HIV/AIDS	46.5
2	Interpersonal violence	6.5	Interpersonal violence	4.0
3	Tuberculosis	3.7	Tuberculosis	2.8
4	Road traffic accidents	3.0	Road traffic accidents	2.6
5	Diarrhoeal diseases	2.9	Diarrhoeal diseases	2.5
6	Lower respiratory infections	2.8	Lower respiratory infections	1.8
7	Low birth weight	2.6	Unipolar depressive disorders	1.6
8	Asthma	2.2	Perinatal conditions	1.6
9	Stroke	2.2	Asthma	1.1
10	Unipolar depressive disorders	2.0	Stroke	1.0
11	Ischaemic heart disease	1.8	Hearing loss, adult onset	0.8
12	Protein-energy malnutrition	1.3	Ischaemic heart disease	0.8
13	Birth asphyxia and birth trauma	1.2	Congenital anomalies	0.8
14	Diabetes mellitus	1.1	Protein-energy malnutrition	0.8
15	Alcohol dependence	1.0	Diabetes mellitus	0.7
16	Hearing loss, adult onset	1.0	Cataracts	0.7
17	Cataracts	0.9	lymphatic filariasis	0.7
18	Hypertensive heart disease	0.9	Trachoma	0.6
19	Fires	0.9	Bipolar disorder	0.6
20	Falls	0.9	Schizophrenia	0.6

Table 11: YLD estimates of SA NBD and WHO estimates for South Africa, 2000

In Table 11, SA NBD YLD ranks are compared with WHO estimates for South Africa 2000. In both cases, HIV/AIDS and unipolar depressive disorders ranked first and second respectively. For these two conditions the WHO estimates are slightly higher than SA NBD estimates. For the other conditions the reverse is true. Interpersonal violence ranked much higher in the SA NBD estimates, compared with the WHO estimates (3rd vs 11th). Alcohol use disorders ranked 6th in SA NBD and did not appear in the top twenty in the WHO YLD estimates. Schistosomiasis appears as a single cause in the WHO estimates but it is included in the tropical cluster category in the SANBD list. Foetal alcohol syndrome have been calculated for the first time in South Africa and hence do not appear in the WHO list.

	SA NBD estimates 2000		WHO estimates 2000	
	Persons	**% total YLDs**	**Persons**	**% total YLDs**
1	HIV/AIDS	22.8	HIV/AIDS	23.6
2	Unipolar depressive disorders	5.8	Unipolar depressive disorders	7.4
3	Interpersonal violence	5.2	Trachoma	3.6
4	Asthma	4.9	Asthma	3.0
5	Hearing loss, adult onset	3.0	Hearing loss, adult onset	3.0
6	Alcohol use disorders	2.8	Cataracts	2.7
7	Cataracts	2.6	Osteoarthritis	2.4
8	Falls	2.2	Schizophrenia	2.3
9	Bipolar affective disorder	2.1	Bipolar disorder	2.2
10	Birth asphyxia and birth trauma	2.1	Road traffic accidents	2.2
11	Schizophrena	2.1	Interpersonal Violence	2.2
12	Osteoarthritis	2.0	Abortion	2.0
13	Foetal alcohol syndrome	1.6	Chlamydia	1.9
14	Iron deficiency anaemia	1.6	Anaemia	1.8
15	Drug use disorders	1.5	Gonorrhoea	1.6
16	Road traffic accidents	1.4	Schistosomiasis	1.4
17	Tropical cluster disease	1.1	Panic disorder	1.4
18	Obsessive-compulsive disorder	1.0	Obsessive-compulsive disorder	1.2
19	Panic disorder	1.0	Congenital anomalies	1.1
20	Epilepsy	0.8	Iodine deficiency	1.1

3.6 Non-communicable disease mortality by population group

Table 12 shows the age standardized mortality rates for Group II or non-communicable causes of death, by population group. Cardiovascular disease is the leading cause of non-communicable deaths in all population groups, but is highest in the Asian population group. Malignant neoplasms are highest amongst the Coloured population while diabetes is more common amongst Asian people. The white population group had the highest mortality rates for neuropsychiatric conditions. Respiratory disease is more common amongst the Coloured and African population and diseases of the digestive system are also more common in the African population group.

Table 12: Age standardized mortality rates for Group II causes in persons, by population group

	African	White	Asian	Coloured	South Africa
Malignant neoplasms	126.0	198.9	121.4	212.5	148.6
Benign neoplasms	2.2	3.0	1.6	1.4	2.3
Diabetes mellitus	58.5	23.0	111.4	64.0	49.4
Endocrine and metabolic	8.1	2.6	5.8	4.1	6.5
Neuropsychiatric conditions	21.9	25.4	21.6	18.0	23.7
Sense organs	0.0	0.0	0.0	0.0	0.0
Cardiovascular disease	375.3	384.4	606.9	406.2	360.5
Respiratory disease	92.8	69.9	64.2	103.1	83.3
Diseases of digestive system	46.1	29.5	30.7	31.2	40.9
Genito-urinary diseases	29.0	24.8	29.4	22.1	26.5
Skin diseases	0.2	0.0	0.0	0.4	0.2
Musculo-skeletal diseases	0.9	0.2	2.0	0.2	0.8
Congenital abnormalities	6.7	5.1	4.9	4.1	6.5
Oral conditions	0.0	0.0	0.0	0.0	0.0
Cot death	1.0	0.0	0.0	0.0	0.8

4 Discussion

The estimate of the total number of deaths in South Africa 2000 has been revised down by approximately 30 000 deaths, mainly due to selecting total mortality estimates by calendar year rather than the mid-2000 to mid-2001 estimates used for the initial estimate. The proportion of HIV/AIDS deaths out of all deaths increased from 25.5% for the 2000 calendar year to 29% for the mid-2000 to mid-2001 estimate, illustrating the rapidly changing cause of death profile (ASSA2002). HIV remains the leading cause of death in South Africa. As a result of the decline in injury deaths observed in recent empirical data, the revised estimate of injury deaths was also revised down, resulting in a lower ranking for interpersonal violence and road traffic accidents.

Neuropsychiatric conditions moved up from 8th to 3rd in the DALY rankings in the revised estimates, mainly due to the use of a different method for estimating the YLDs (rate method versus YLD/YLL

ratio) and the use of local data to estimate alcohol dependence, but also partly due to the reduction in injury deaths.

YLD and DALY estimates by single cause for South Africa 2000 are presented for the first time. Whilst the ranking of the five leading causes of death were similar for the SA NBD and WHO estimates for South Africa 2000, the ranking for YLDs is quite different for SA NBD and WHO rankings, apart from the top two diseases (HIV and unipolar depressive disorders). YLD estimates for interpersonal violence and alcohol dependence ranked much higher in the SA NBD presumably because local data was used for the estimation of YLDs for these two conditions. Despite these discrepancies, the WHO ranking of the 6 leading causes of DALYs in South Africa is exactly the same as the SA NBD revised estimates. However, the WHO DALY estimates for HIV/AIDS (46.5%) are much higher than the SA NBD revised estimates (30.9%). This is probably due to the WHO using the UNAIDS HIV death estimates which are higher than the ASSA2002 estimates. The difference between the YLD estimates for HIV is much smaller (23.6 WHO versus 22.8 SA). As the AIDS epidemic progresses the relative mortality / morbidity ratios will change and it is possible that the WHO model made different assumptions to the ASSA2002 model in this regard.

On one hand it is reassuring to know that our study confirms the WHO findings in terms of the leading causes of death. It does however raise the question of whether one could avoid the expense of conducting a local NBD and just rely on WHO estimates. There are a number of reasons why we would not recommend this. Firstly, the process of conducting the NBD study forced the researchers to identify, review and compare all available sources of mortality data for quality and consistency. During this process inconsistencies and inadequacies in the data were identified and it is now possible to attempt to improve the situation. Secondly, the capacity to conduct an NBD was developed within South Africa so that we no longer have to rely on WHO to provide burden of disease information. Furthermore, providing estimates based on local data may facilitate ownership and buy in from local policy makers.

The revised estimates confirm the previously observed quadruple burden of disease experienced in South Africa and the need to respond to diseases related to poverty and under-development, chronic diseases, injuries and AIDS. Whilst there have been improvements in the cause of death statistics in South Africa, representative data on morbidity and disability are still missing. It is essential that the capacity of the country to collect, analyse and utilize population health statistics, at all levels of the health service, is strengthened. This information is important for assessing the impact of health services and other interventions on the health of the population. In view of the rapid mortality transition, it is essential to assess the recent burden of disease in South Africa and develop estimates for 2005.

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APPENDIX A

Appendix deaths by age and sex like SANBD appendix D with population estimates

APPENDIX B

Revised deaths, YLLS and DALYS by cause for males, females and persons, South Africa 2000

APPENDIX C

Number of deaths by population group for Type 2 causes only with population estimates (Table C1 – C4).