Comparison of reported deaths and model projections

Numbers of deaths

Figure 10 compares the number of deaths projected by the ASSA600 model with the number of reported deaths and the number of reported deaths adjusted for under-reporting. From these figures it appears that the model has underestimated the number of deaths of men and exaggerated the number of deaths of women. In total the model appears to underestimate the adult deaths by 5-7% (see Table D1 in Appendix D).

The deficit of deaths of men is likely to be the result of two factors. The first is that the estimate of the national mortality derived by Dorrington *et al*[16] was based on deaths by year reported instead of by year occurred. The authors show that had year of occurrence data been used, the mortality rates for males would have been higher. The second is an underestimating of the non-AIDS deaths, particularly those due to violence and accidents, as the forecast assumes that non-HIV/AIDS mortality improves over time and this appears not to have happened during the late 1980s and early 1990s. Although the problem appears to correct itself by 1999/00, this could be because the reported deaths for this year have not been adequately adjusted for under-reporting, although some of it could be due to late registration of deaths not yet fully accounted for.

The excess in deaths of women appears to result from overestimation of AIDS deaths. Given that the median time to death of women with HIV is assumed to be 10 years, which is quite high (i.e. a low mortality rate), the excess suggests that the problem originates with either the ANC survey estimates or the extrapolations from these estimates to the total population. We believe that the early ANC results may have been biased upward, probably as a result of sampling predominantly urban clinics.

Nonetheless the model appears to track the total empirical deaths quite closely.

Age-specific death rates

Adjusting for the under-registration of deaths, age-specific rates in the age range 15-64 are shown in Figure 11. These rates show, with

Figure 10: Comparison of reported deaths (Stats SA) with model projections 1990 to 1999/00

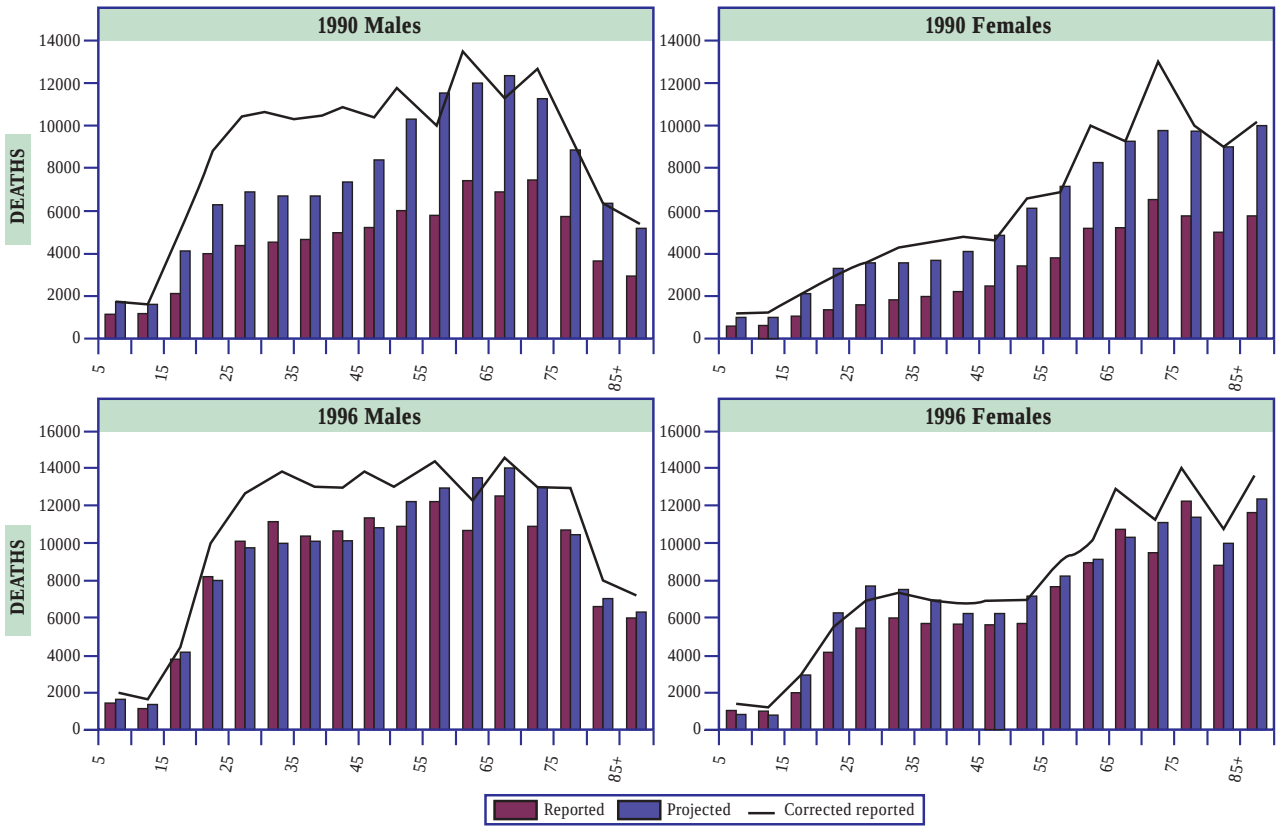
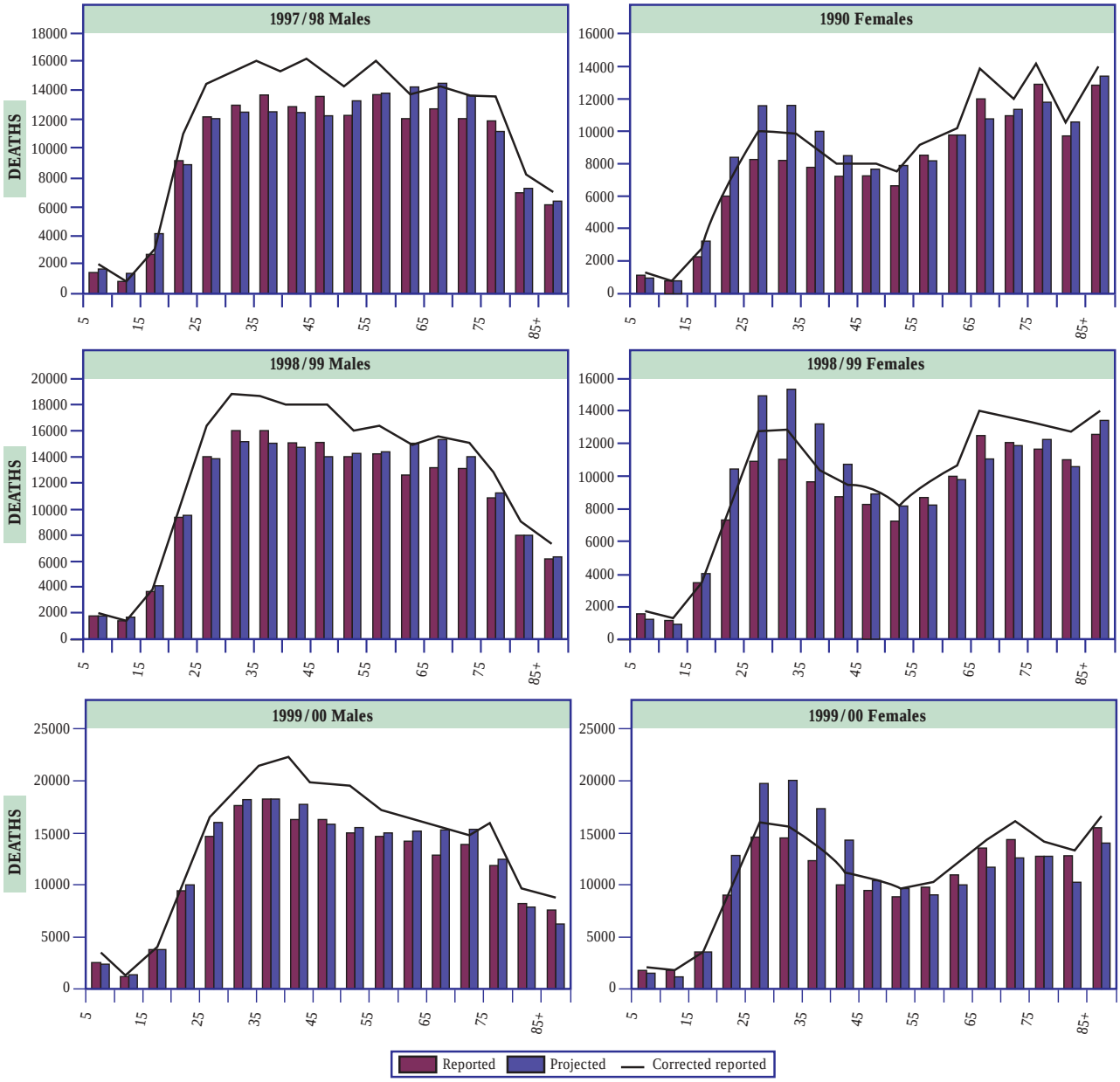


Figure 10 (continued): Comparison of reported deaths (DHA) with model projections 1996 to 1999/00



the exception of those for 1992, that there has been a slow increase in adult death rates. In the case of men, there was an increase over the 20-29 year age range in the early 1990's, followed by an increase in the age range 29-59 in the most recent years. In the case of women, there was a slight increase up until 1996, followed by a marked increase in the 20-49 year age range over the last two years, with the emergence of a young adult peak.

The relative rates for selected later years, compared with the rates for 1985, are shown in Figure 12. The later years have been selected as it is during the last few years that rapid change has occurred. It can be seen from these plots that the rate for women aged 25-29 is now more than 3 times higher than in 1985. The increase in the death rate for men in the 30-40 year age range is lower, mainly reflecting higher baseline mortality.

Comparison of reported deaths and model projections

Figure 11.1: Age-specific mortality rates for males 1985 - 2000

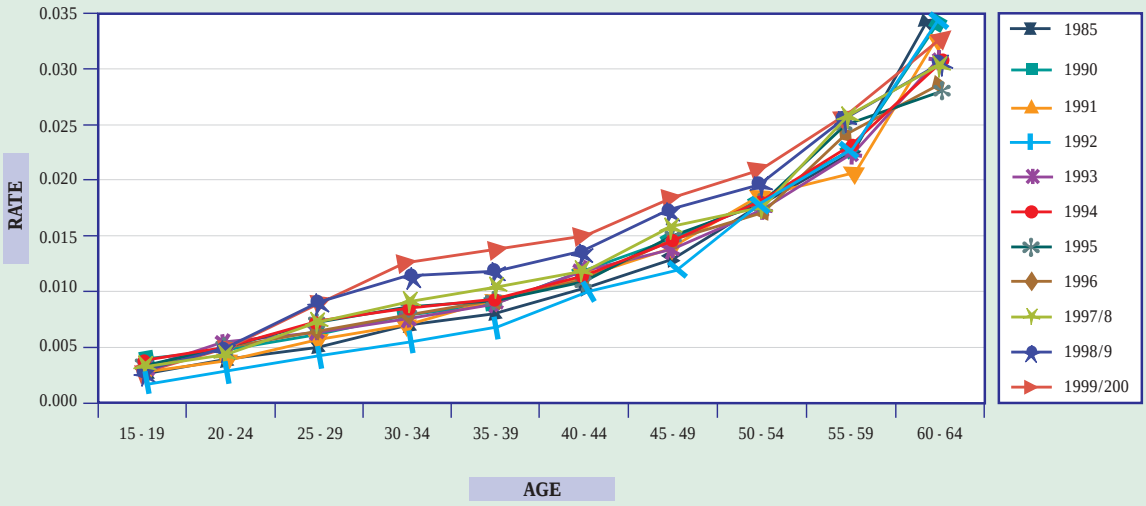


Figure 11.2: Age-specific mortality rates for females 1985 - 2000

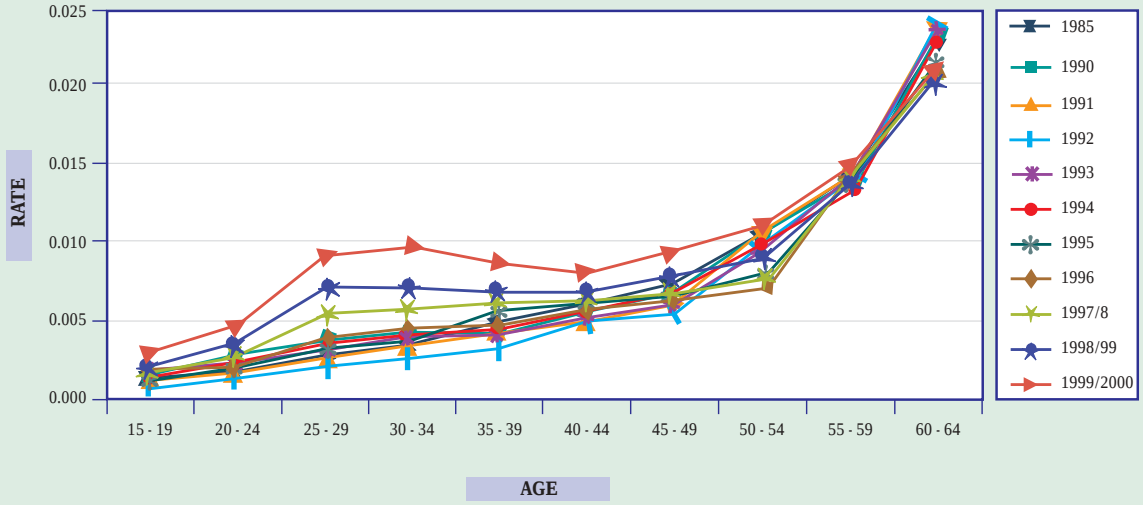


Figure 12.1: Relative mortality rates for males 1994 - 2000 compared to 1985

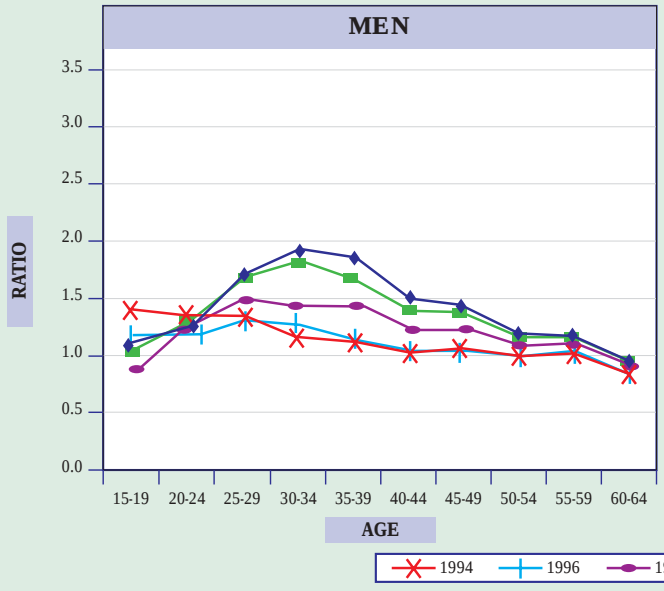
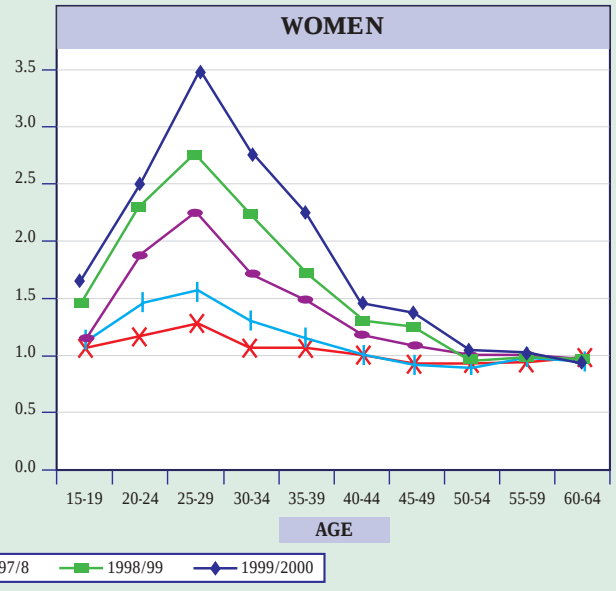
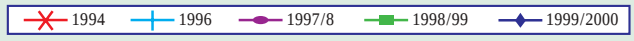


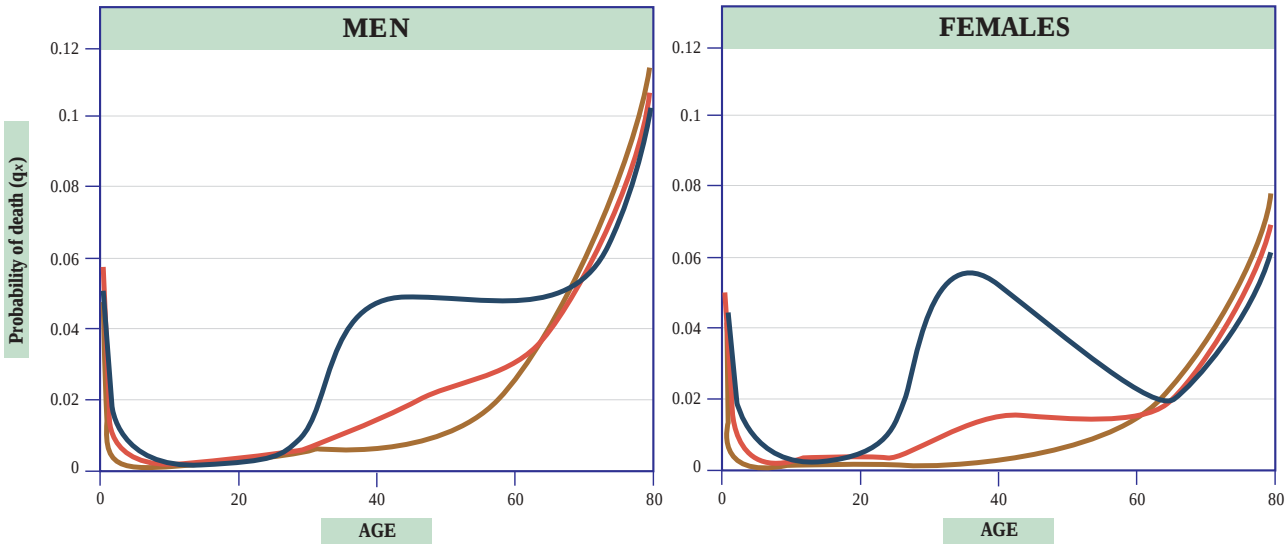
Figure 12.2: Relative mortality rates for females 1994 - 2000 compared to 1985





The patterns exhibited by the registration statistics are consistent with the projected patterns from the ASSA600 model shown in Figure 13. This pattern of mortality increase is not unique to the ASSA model but has been predicted by other models of the AIDS epidemic[29]. It is therefore reasonable to interpret the rise in the mortality of young and middle-aged adults in South Africa since the late 1980's as being largely, if not entirely, a consequence of HIV/AIDS.

Figure 13: Mortality rates for males and females for 1990, 2000 and 2010 ASSA600



Estimates of the number of deaths due to AIDS

In 1996, the most recent year for which we have cause of death details, a total of 7031 deaths had AIDS recorded as the underlying cause (ICD-9 code 209)[12]. Of these deaths, 6045 were age 15 years or older, accounting for 2.1% of the adult deaths reported in 1996.

There are two ways in which the proportion of deaths that are AIDS deaths can be estimated from the information presented in this study. The first is to use the estimates of AIDS and non-AIDS deaths from the ASSA600 model. Alternatively, if it is assumed that the excess mortality in the reported deaths, adjusted for under reporting that has occurred since 1985, is all AIDS-related, it is possible to estimate AIDS deaths from the registration statistics. Both these approaches are used and their limitations are discussed.

The ASSA600 forecast assumes that the underlying death rates from non-AIDS related causes has improved at a rate of 2.5-3% per year since 1985 in the young adult ages. This is in keeping with the Global Burden of Disease[30] projections of future mortality. Based on this forecast, the proportion of adult deaths related to AIDS has increased steadily from less than 10% in 1995/96 to 40% in 2000/01 (Table 6). Alternatively if the excess mortality, above that in 1985, is taken as AIDS related, then approximately 39% of adult deaths aged 15-49 and 17% of all adult deaths in 1999/00 were due to HIV/AIDS.

Table 6: Percentage of adult (15+) deaths due to aids estimated from ASSA600

Year Starting 1 July	% of deaths due to AIDS
1995	9%
1996	14%
1997	19%
1998	26%
1999	33%
2000	40%

Thus probably somewhere between 17% and 33% of adult (15+) deaths in 1999/2000 were due to HIV/AIDS. However, as was mentioned earlier the ASSA600 model probably underestimates the non-AIDS deaths and exaggerates, the AIDS deaths. So we can probably narrow the range to 17% to 25%. Comparison of the proportion of adult deaths in 1996 that were reported as AIDS (2.1%) with the estimated proportion based on ASSA600 (11%) shows that despite the exaggeration in ASSA600 there is probably substantial under-reporting of AIDS as an underlying cause of death. We estimate that around a third of AIDS deaths are recorded as such.