SOUTH AFRICAN TUBERCULOSIS MORTALITY DATA — SHOWING THE FIRST SIGN OF THE AIDS EPIDEMIC?

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Objective. To report on the magnitude and distribution of registered tuberculosis (TB) mortality rates in South Africa for 1994 and 1995 in the context of changes in overall mortality registration.

Design. Retrospective analysis of routinely collected data.

Setting. The South African population.

Subjects. Deceased persons with death certificates stating TB as cause of death.

Main outcome measures. Age-adjusted mortality rates for all causes and for TB.

Results. There are large, and to some extent unexpected, variations in registered TB mortality in South Africa. For the country as a whole TB mortality has risen from 38 to 53 per 100 000 for males and from 15 to 23 per 100 000 for females for the years 1994 to 1995. In the Eastern Cape TB deaths account for 10% of registered male deaths and 7% of registered female deaths. The two provinces that have the highest HIV prevalence among women attending antenatal clinics, namely KwaZulu-Natal and North West, recorded increases in registered TB deaths of 100% and 75% respectively for males, and 130% and 74% respectively for females. TB deaths among younger women appear to have risen particularly fast in these two provinces. Nationally the proportion of extrapulmonary tuberculosis (ETB) has risen from 5.2% to 7.4% of all TB deaths, pointing to an increase in HIV-related TB deaths.

Conclusion. The deficiencies and changes in the vital registration system make it difficult to draw firm conclusions from these data, but there is an alarming increase in TB mortality that is unlikely to be an artefact of the data alone. Some of the increase in TB mortality is likely to be due to misreporting of cause of death of AIDS patients. An audit should be conducted to investigate the enormous disparities between vital registration TB mortality, and TB deaths recorded under the TB notification system.

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Tuberculosis (TB) is by far the most common notifiable disease in South Africa, with 80 000 to 90 000 cases reported annually.[1,2] Although it is not known what impact HIV infection has had on TB incidence in South Africa, it is well known that HIV constitutes the greatest risk factor for developing active TB.[3,4] The incidence of HIV infection has been rising steadily in South Africa,[5] and the increasing load on health care facilities of TB cases due to HIV infection has recently been documented for one health district.[6]

TB deaths could be seen as failures of TB control programmes. However they could also reflect the rising number of AIDS deaths, when there is a reluctance to list AIDS as the underlying cause of death. This study examines registered TB mortality patterns for the first 2 years (1994 and 1995) for which mortality data were collected under a unified albeit imperfect registration system. As occurs in many other developing countries, death registration data in South Africa show a high degree of under-coverage and inaccurate reporting of cause of death.[7] Earlier studies have noted the large proportion of all registered deaths accounted for by TB mortality, particularly in the black and coloured populations.[8] In this study we used mortality registration data from the first 2 years for which data were available for the whole of South Africa, i.e. following the incorporation into provincial administrations of the former TBVC (Transkei, Bophutatswana, Venda and Ciskei) states and semi-autonomous territories created under the apartheid system. It is likely that registration levels and procedures underwent major changes during this period. Nevertheless, we considered that it was important to analyse and report on the magnitude as well as the very sharp increase in TB mortality registration that is evident from the data for these 2 years, even though caution will have to be exercised in drawing conclusions from the changes reported.

METHODS

Age-adjusted mortality rates for registered deaths were calculated for each province for 1994 and 1995, with male and female rates calculated separately. The indirect method of standardisation was used,[9] and the population of the whole of South Africa served as a reference population. Age-adjusted rates were computed for all deaths, for deaths due to all forms of TB (ICD 9, 3-digit classification codes 010 - 018),[10] and for deaths where the cause was undetermined, the so-called 'ill-defined' category.

Registered mortality data were aggregated from unit record vital registration data. These data are based on death registration forms administered by the Department of Home Affairs. The government statistical agency, Central Statistical Service (CSS), now Statistics SA, routinely captures and processes the mortality data after coding them for cause of death. Population sizes for each province and for South Africa were taken from the preliminary release of the 1996 census

results.[11] At the time of writing no age breakdowns were available from the 1996 census, and projections from previous censuses are considered to be unreliable. Ten-year age breakdowns by province were, however, available from the post-enumeration survey. (After transition to democracy, South Africa's first census as a unified democratic country was held in October 1996. A post-enumeration survey (PES) was undertaken to determine the degree of undercount and to evaluate the quality of data collected in the census. The PES was conducted on a sample of approximately 1% of the total population, stratified by province.) Provincial age-sex counts were obtained by multiplying the proportion of persons in each 10-year age group obtained from the PES for the particular province by the provincial totals from the preliminary census figures. In order to estimate the population counts for 1994 and 1995, deflation factors of 0.9612 and 0.9804 respectively were applied to the 1996 (preliminary) census data. This was based on an approximate annual population growth rate of 2%.

A proportional mortality rate for deaths due to TB and those due to ill-defined causes was calculated for each province for 1994 and 1995. This was done in order to determine the impact of registered TB mortality in relation to overall mortality registration levels in each province, as well as to make an assessment of the quality of mortality registration in various provinces and to get an idea of provincial variation regarding completeness of cause of death recorded on death notifications.

Age distribution for TB deaths was examined by calculating age-specific rates by gender for the whole country and for those provinces where change in TB mortality between 1994 and 1995 had been particularly large. This was done in order to investigate whether changes in the TB mortality rate are associated with a shift in the age pattern of people dying from TB.

In order to explore a possible link between HIV and the TB mortality trend, extrapulmonary tuberculosis (ETB) was calculated as a proportion of all TB deaths for 1994 and 1995, HIV infection being more common in patients with ETB than in those with pulmonary tuberculosis.[12]

RESULTS

Table I shows that there was an increase in registered deaths from 1994 to 1995 in all provinces except Northern Province. For South Africa as a whole the increase in the death rate was approximately 23% for both women and men. The steepest increase in mortality registration rates occurred in KwaZulu-Natal (55% for males, 59% for females) and in North West (63% for females, 56% for males). Age-adjusted mortality rates varied considerably by province, with the Eastern Cape and Northern Province recording exceptionally low rates compared with the rest of the country.

Table I. Age-adjusted all-cause mortality rates by province and year

	Deaths per 100 000 population			
	1994		1995	
Province	Males	Females	Males	Females
Western Cape	837.6	607.7	929.5	664.3
Eastern Cape	425.0	273.1	547.4	342.3
Northern Cape	989.6	709.6	1 180.8	855.0
Free State	950.8	742.4	1 039.5	807.9
KwaZulu-Natal	708.5	422.2	1 095.3	671.6
North West	613.4	423.8	954.1	690.5
Gauteng	817.8	660.3	871.7	709.6
Mpumalanga	737.7	504.3	881.7	613.5
Northern Province	528.5	297.6	470.9	250.9
South Africa	707.4	474.3	872.4	583.5

Table II shows deaths due to unknown or ill-defined cause as a proportion of all deaths for each province for the 2 years under consideration. For the country as a whole there was a small overall increase from 16.8% to 17.4% for this category, but

Table II. Proportion of deaths due to ill-defined cause and TB respectively, by province and year

	Ill-defined (%)				TB (%)			
	1994		1995		1994		1995	
Province	Male	Female	Male	Female	Male	Female	Male	Female
Western Cape	7.2	9.2	7.3	9.9	5.4	2.8	5.2	3.1
Eastern Cape	13.4	17.6	14.1	17.5	9.7	6.4	10.0	6.8
Northern Cape	9.7	14.3	11.4	15.4	7.4	5.9	6.7	6.7
Free State	13.3	18.9	13.1	17.2	6.9	3.9	7.2	4.9
KwaZulu-Natal	10.2	14.6	17.0	23.0	5.0	2.9	6.4	4.2
North West	12.3	16.8	14.3	19.0	6.7	4.2	7.6	4.5
Gauteng	14.7	20.2	15.7	21.8	3.2	1.6	3.5	1.8
Mpumalanga	21.1	27.8	20.1	27.8	4.3	2.0	5.0	2.8
Northern Province	40.4	52.0	26.6	36.8	5.7	3.0	8.6	4.6
South Africa	14.4	19.8	15.0	20.4	5.4	3.1	6.0	3.9

cause of death was more often not reported for women than for men. KwaZulu-Natal showed the biggest increase in this category, whereas Northern Province showed the biggest decline, despite the fact that it was still the province with by far the largest percentage of deaths in this category (31% males and females combined). The Western Cape was the province with the smallest proportion of deaths due to ill-defined causes (8.3%).

Table II also shows the proportion of deaths due to TB (according to death certificates) of the total number of registered deaths for males and females respectively. For the country as a whole TB deaths constituted 6.0% of all registered male deaths, and 3.9% of registered female deaths. TB as a proportion of all registered deaths was highest in the Eastern Cape, where TB-related deaths constituted nearly 10% of all registered deaths for males, and 6.8% for females.

The total number of death registrations where TB was given as the cause of death was 9 461 for 1994 and 13 757 for 1995. Table III shows the national changes in registered TB mortality rates from 38 per 100 000 in 1994 to 53 per 100 000 in 1995 for males (an increase of 38%), and from 15 per 100 000 in 1994 to 23 per 100 000 in 1995 for females (an increase of 53%). The provincial breakdown shows dramatic increases in TB death rates in KwaZulu-Natal (100% for males, 130% for females) and North West (approximately 75% for both males and females). The highest rates were recorded by the Northern Cape, closely followed by the Free State. The rates in Gauteng were the lowest in the country, and both in Gauteng and the Western Cape the rate was fairly stable, showing an increase more or less in line with the overall increase in all-cause mortality.

Table III. Age-adjusted TB mortality rates by province and year

	Deaths per 100 000 population			
	1994		1995	
Province	Males	Females	Males	Females
Western Cape	44.9	17.2	48.1	20.4
Eastern Cape	41.1	17.5	54.6	23.5
Northern Cape	72.9	41.7	78.9	57.7
Free State	65.6	28.7	75.3	39.6
KwaZulu-Natal	35.2	12.3	70.3	28.3
North West	41.2	17.9	72.0	31.2
Gauteng	26.4	10.4	30.3	13.2
Mpumalanga	31.4	10.1	44.3	16.9
Northern Province	30.0	9.1	40.3	11.4
South Africa	38.0	14.9	52.5	22.7

Table IV. Age-specific TB mortality rates for South Africa

	Deaths per 100 000 population			
	1994		1995	
Age group (years)	Males	Females	Males	Females
0 - 9	3.3	2.9	5.7	5.1
10 - 19	1.8	2.6	2.3	4.7
20 - 29	15.3	12.3	22.2	22.1
30 - 39	47.2	18.9	68.3	32.7
40 - 49	88.5	24.4	130.4	37.8
50 - 59	129.6	35.5	180.2	45.0
60 - 69	163.9	41.1	205.9	57.3
70 and over	213.1	61.5	259.4	70.3

Tables IV and V show age-specific TB mortality rates for South Africa and for the two provinces with the largest increase in registered TB mortality between 1994 and 1995, namely KwaZulu-Natal and North West respectively. The rate ratio of male TB mortality between the 20 - 29-year-old and the 60 - 69-year-old groups was approximately 6 for KwaZulu-Natal and about 10 nationally, indicating that younger men in KwaZulu-Natal are more at risk of TB mortality than their peers in general. The age gradient for women was much less steep than it was for men and in KwaZulu-Natal much of the increase in female TB mortality was due to women under the age of 40. There was a fourfold increase in the TB mortality rate from 1994 to 1995 for women in their thirties in KwaZulu-Natal

Table V. Age-specific TB mortality rates for KwaZulu-Natal and North West

	Deaths per 100 000 population							
	KwaZulu-Natal				North West			
	1994		1995		1994		1995	
Age group (years)	Males	Females	Males	Females	Males	Females	Males	Females
0 - 9	2.7	3.3	10.0	7.1	2.5	3.1	5.7	8.0
10 - 19	1.6	2.1	3.5	6.8	0.5	3.2	4.4	8.1
20 - 29	16.9	13.0	40.7	35.5	15.8	19.9	22.1	32.0
30 - 39	55.5	11.0	104.3	44.0	50.3	22.4	95.5	56.3
40 - 49	89.0	17.4	172.0	35.5	115.2	41.5	204.4	56.8
50 - 59	109.2	27.8	203.3	48.5	140.9	38.5	260.8	57.1
60 - 69	135.9	31.6	244.6	62.5	199.3	46.8	307.4	58.5
70 and over	142.1	65.6	329.2	80.2	191.7	34.6	289.7	56.1

(from 60 to 243 cases). The pattern of TB mortality was very similar in North West province, the province with the second highest increase in TB mortality between 1994 and 1995 after KwaZulu-Natal. Among women in North West the biggest increases in TB mortality were in the younger age groups, with the rate among women in their thirties rising by 250% (46 cases in 1994 to 118 cases in 1995).

Between 1994 and 1995 the proportion of ETB rose from 5.2% to 7.4% of all TB deaths nationally ($P < 0.001$).

Discussion

The very sharp increase of 44% in the registered TB death rate must be seen against the background of an overall increase in mortality registration of 23% during the years 1994 and 1995. Some of this overall increase in mortality is likely to be due to improvements in mortality registration, particularly since 1994 was a year that saw the establishment of provincial health departments, which integrated the functions of a number of the sectional health service providers inherited from the previous dispensation. Our lack of knowledge of the extent and distribution of under-registration of deaths and of mis-reporting of cause of death makes it difficult to draw firm conclusions about trends in mortality over a 2-year period. Nevertheless, regardless of any time trends, 13 757 registered TB deaths in 1995 represents a very sizeable number of mainly avoidable deaths, caused by a largely curable disease — if TB was indeed the underlying cause of death.

There are factors suggesting that there may be over-reporting of registered TB deaths, as well as factors suggesting that there may be under-reporting. The national TB notification system[1,2] recorded only 25% and 21% of the deaths recorded under the vital registration system for 1994 and 1995 respectively. This discrepancy between registered TB mortality and deaths recorded under the TB notification system has been noted for mortality data of an earlier period,[8] and is likely to be due in part to under-reporting. It can be speculated that many of the TB deaths recorded under the vital registration system may have been reported for fatalities where there was no previous contact with the health service. Cause of death for many of these cases may be unreliable. Under the TB notification system, on the other hand, cause of death is likely to be more accurately reported, but coverage may be less complete.

The large number of deaths due to ill-defined cause[7] are a measure of the poor quality of vital registration data in general. Some of these may in fact be deaths due to TB. The proportion of ill-defined deaths is consistently higher for females than for males (Table II) and the lower number of female deaths overall indicates that undercoverage of death registrations is worse for women. Does this suggest that less effort is taken to establish the cause of death of a woman, if her death is recorded at all?

Provincial comparisons of the registered TB mortality rates (Table III) show that the Western Cape, which has the highest TB notification rate in the country,[1] has a TB mortality rate very close to the national average. This suggests a relatively low TB case fatality rate in this province.

Very low levels of registered all-cause mortality recorded in the Eastern Cape and in Northern Province (approximately 0.5 of the national rate) must indicate a large-scale failure of the registration system in these provinces (Table I). The relatively high registered TB death rate in the Eastern Cape (nearly 7% of all registered female deaths and 10% of all registered male deaths in the province; Table II) must therefore be cause for concern. The low registration levels in the province suggest that the true TB mortality rate may well be higher than the recorded rate, unless there are reasons why TB deaths are recorded more thoroughly than other deaths in the Eastern Cape. Registered deaths in the Northern Cape are the highest in the country and registered TB deaths are no exception. The rate for females in the Northern Cape is particularly high.

Table II shows that TB mortality is generally higher among males than females, and Table IV shows that this difference increases with age. A very high gradient of TB incidence with age has previously been found among South African goldminers.[13] It is possible that the excess in TB mortality of males over females and the steep gradient of male TB mortality with age may be related to a high risk of TB among older retired mineworkers.

The statistically significant increase in the proportion of ETB suggests that at least some of the increase in TB mortality is HIV-related. AIDS as an underlying cause of death was stated on 3 162 death notifications for 1994, and on 5 684 death notifications for 1995. There is evidence to suggest that there is a reluctance on the part of medical practitioners to mention AIDS on death certificates for fear of stigmatising the next of kin (submissions made to a workshop entitled 'Medical certificates in respect of HIV/AIDS related deaths', South African Law Commission, Pretoria, February 1997). It is therefore possible that a sizeable number of AIDS deaths are deliberately misreported as TB deaths. The annual HIV survey of women attending antenatal clinics[5] shows that the two provinces with the highest prevalences of HIV in 1996 were KwaZulu-Natal and North West (20% and 25% respectively in this group of the population). These two provinces also recorded the steepest increases in registered TB mortality between 1994 and 1995: 100% for males and 130% for females in KwaZulu-Natal and 75% for both males and females in North West. The very sharp increases of more than 250% in registered TB mortality among younger women in these two provinces would be consistent with an increase in AIDS mortality, with TB falsely recorded on death certificates.

Conclusion

Vital registration mortality statistics indicate a very large and growing proportion of TB mortality in South Africa. It is highly

likely that some of the increase is associated with the HIV epidemic, particularly in KwaZulu-Natal and North West. These data are, however, at variance with those recorded under the TB notification system.

We recommend that an investigation into the large disparity between TB registration and vital registration be conducted as a matter of urgency. This could be in the form of a follow-back survey of a stratified sample of registered TB mortality cases. Such a survey would determine: (*i*) whether there is large-scale under-reporting of TB deaths by the TB notification system; (*ii*) whether there is over-reporting of TB deaths in the vital registration system; (*iii*) whether the sharp increases in TB mortality in segments of the population are real or artefactual; and (*iv*) the role played by HIV/AIDS in the apparent increase in TB mortality.

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