Estimating the burden of disease attributable to smoking in South Africa in 2000

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Objectives. To quantify the burden of disease attributable to smoking in South Africa for 2000.

Design. The absolute difference between observed lung cancer death rate and the level in non-smokers, adjusted for occupational and indoor exposure to lung carcinogens, was used to estimate the proportion of lung cancer deaths attributable to smoking and the smoking impact ratio (SIR). The SIR was substituted for smoking prevalence in the attributable fraction formula for chronic obstructive pulmonary disease (COPD) and cancers to allow for the long lag between exposure and outcome. Assuming a shorter lag between exposure and disease, the current prevalence of smoking was used to estimate the population-attributable fractions (PAF) for the other outcomes. Relative risks (RR) from the American Cancer Society cancer prevention study (CPS-II) were used to calculate PAF.

Setting. South Africa.

Outcome measures. Deaths and disability-adjusted life years (DALYs) due to lung and other cancers, COPD, cardiovascular conditions, respiratory tuberculosis, and other respiratory and medical conditions.

Results. Smoking caused between 41 632 and 46 656 deaths in South Africa, accounting for 8.0 - 9.0% of deaths and 3.7 - 4.3% of DALYs in 2000. Smoking ranked third (after unsafe sex/sexually transmitted disease and high blood pressure) in terms of mortality among 17 risk factors evaluated. Three times as many males as females died from smoking. Lung cancer had the largest attributable fraction due to smoking. However, cardiovascular diseases accounted for the largest proportion of deaths attributed to smoking.

Conclusion. Cigarette smoking accounts for a large burden of preventable disease in South Africa. While the government has taken bold legislative action to discourage tobacco use since 1994, it still remains a major public health priority.

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Smoking tobacco is responsible for a large burden of premature mortality, causing about 4.8 million adult deaths worldwide in 2000.[1] This is expected to increase to about 10 million by 2025.[2] Smoking causes many diseases, including lung cancer, other cancers, chronic obstructive pulmonary disease (COPD) and cardiovascular disease (CVD), with lung cancer having the strongest association and CVD accounting for the majority of tobacco-attributable deaths in developed countries.[3] Recent studies in developing countries such as China,[4,5] India[6,7] and South Africa[8,9] suggest that the causes of tobacco-attributable mortality may differ in developing countries, with chronic respiratory diseases accounting for a larger proportion of deaths than in developed countries, and tuberculosis (largely eradicated in developed countries) accounting for a significant number of deaths.

After increasing steadily during the 20th century, and especially after World War II, annual per capita consumption of cigarettes peaked in South Africa at around 1 650 cigarettes per adult in the 1980s. Government has taken bold steps to discourage tobacco use, to protect non-smokers from environmental tobacco smoke, and to protect children from pro-smoking advertising messages.[10] Comprehensive legislation passed in 1999[10] included the printing of warnings on cigarette packaging and advertising material, banning of tobacco advertising, sponsorships and promotions, restriction of smoking in enclosed public places, and setting maximum limits on nicotine and tar yields of cigarettes. Rapid increases in the excise tax on cigarettes increased the average retail price from R2.55 in 1993 to around R12.50 per pack in 2005, and has contributed to the precipitous drop in annual per capita cigarette consumption to current levels of less than 800 cigarettes per adult through significant reductions in smoking prevalence and a reduction in cigarette consumption among remaining smokers.[11,12] The overall prevalence of smoking has declined from 32% in 1992 to 24% in 2003.[11,12]

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Smoking prevalence varies by population group and gender. (The population group classification is used in this article to demonstrate differences in the risk factor profile and the subsequent burden. Data are based on self-reported categories according to the population group categories used by Statistics South Africa. Such mentioning of differences allows for a more accurate estimate of the overall burden and may assist in higher effectiveness of future interventions. The authors do not subscribe to this classification for any other purpose.) Rates are highest among coloured males and females, rates for black African females are much lower than those for black African males, and the white community has intermediate rates.[13,14] Prevalence has decreased most rapidly among males, black Africans, coloureds, young people aged 16 - 24, and low income earners.[11,12] Groups that experienced moderate or no decreases in smoking prevalence include women, whites, Indians and people aged 50 years and older.

Consistent mortality trend data are not available, with little information for blacks before 1999. Data from 1949 to 1985 for the other population groups show that lung cancer mortality rates have increased markedly among males, with the rates among whites increasing almost threefold – and even more for coloured males.[15] Smaller increases occurred among females. In 1984 - 1986 the age-standardised mortality for lung cancer was highest among urban coloured males (88.4/100 000), followed by white urban males (48.7/100 000), urban black African males (27.9/100 000) and urban Indian males (21.8/100 000).[15] A similar pattern is seen in the national age-standardised death rates for 2000, with coloured males (77.1 per 100 000) having the highest rates followed by white males (52.3), coloured females (38.8), black males (31.1), white females (30.1), Indian males (27.5), black African females (6.3), and lastly Indian females (5.6).[16] Importantly, lung cancer rates in younger black African males aged 35 - 44 years and 45 - 54 years were higher than for white males in the same age groups, but much lower in older age groups. This suggests that occurrence of lung cancer in black Africans may exceed that in whites as the cohort of black African smokers ages. In 1988 Yach and Joubert[17] identified the potential for a rise in mortality from smoking-related conditions among coloureds and black Africans with increased tobacco use.

Given the high exposure to smoking and large burden due to lung cancer, it is likely that tobacco accounts for a large proportion of premature mortality in the South African population, and will continue to do so in the future. Sitas *et al.*[8] used a case-control analysis of death notification forms in 1998 which included the smoking status of the deceased to estimate the increased risk of mortality associated with tobacco in South Africa. Using direct calculations it was estimated that about 8% of adult deaths (> 25 years) could be attributed to smoking. However, this study was subject to the limitations of a case-control study and could not adjust for all confounding factors.

The comparative risk assessment (CRA) methodology developed by the World Health Organization for the global burden of tobacco-attributed mortality used an indirect approach, developed by Peto *et al.*,[3] that allows for an adjustment for the maturity of the tobacco epidemic through a smoking impact ratio (SIR). This method has been refined for use in developing countries to take into account the role of indoor air pollution from coal smoke in lung cancer mortality.[1] The present study applied an indirect technique to quantify the burden of disease attributed to smoking among adults for South Africa in 2000, taking into account the variations between population groups.

Methods

Smoking prevalence data were obtained from the 1998 Demographic and Health Survey.[18] A fourth-order polynomial was used to smooth the age-specific prevalence observed for each race and gender group. For Indian women the combination of a small sample and low smoking prevalence (9%) resulted in extremely erratic estimates. Since the lifestyle of Indians is more similar to that of whites than other population groups, the smoking prevalence percentage by age among Indian women was scaled to the age pattern of white women, such that the average smoking prevalence among Indian women remained at 9.0 %.

Adverse health outcomes related to tobacco use have been well described in the literature, and are summarised in Table I.[3,19] Outcomes likely to be causal, but not quantified in this study because of a lack of sufficient evidence on prevalence or hazard size (or both), include maternal and perinatal conditions and fire injuries.

There are several sources of relative risk estimates for cause-specific mortality related to tobacco use, including: (*i*) the American Cancer Society Cancer Prevention Study, Phase II (CPS-II) as used by Peto *et al.*;[3] (*ii*) a retrospective case control study of 1 million deaths in urban and rural China;[4] (*iii*) a similar case-control study of 43 000 adult male deaths in India;[6] and (*iv*) a case-control analysis to estimate tobacco-attributed mortality in South Africa from 5 340 death notification forms which included information on smoking status.[8] The CPS-II study is a prospective cohort study of smoking and death in more than 1 million Americans aged above 30 years in which most current smokers were lifelong cigarette smokers with a mean consumption of about 20 cigarettes per day.[3] The relative risks from the CPS-II study as used by Peto *et al.*[3] and Ezzati and Lopez[1] were selected as the best point estimates to calculate population-attributable fractions (PAF) as these were considered to be the most robust. The relative risk (RR) estimates, after adjustment for excess risk due to confounding, and their 95% confidence intervals (CIs), based on those estimated by Thun *et al.*,[21] are set out in Table II.

Table I. Disease outcomes related to tobacco use

Outcomes	ICD-10 codes[20]
Respiratory tuberculosis	A15, A16, A19
Other respiratory diseases	J00-J22, H65-H66, J30-J39, J45-J47, J60-J80, J82-J89, J91-J98
Chronic obstructive pulmonary disease	I27, J40-J44
Lung cancer	C33-C34
Upper aero-digestive cancers (oral, pharynx, larynx, oesophagus, sinus cancer)	C00-C14, C15, C30-C32
Digestive, urinary, cervical cancer	C16-C26, C53, C64-C68
Other cancers	C37-C45, C47-C52, C54-C63, C69-C97
Ischaemic heart disease	I20-I25
Stroke and other vascular conditions	I10-I15, I26, I28, I47-I49, I60-I84, I86-I89
Other medical conditions*	D50-D89, E00-E90, Rest of I00-I99, K00-K93, L00-L99, M00-M99, N00-N99

*Excluded: Infectious and parasitic conditions with the exception of the above (rest of A00-B99, N70-N73), maternal and perinatal conditions (O00-O99), neuropsychiatric conditions (F00-F99, G00-G99), cirrhosis of the liver (K70, K74), congenital anomalies (Q00-Q99), and injuries (V01-Y98).
ICD-10 = *International Classification of Diseases.*[20]

Table II. Relative risk estimates for tobacco-attributable mortality, after adjustment for confounding*

Disease outcome	Male (95% CI)	Female (95% CI)
Lung cancer†	24.2	12.5
Upper aero-digestive cancer	5.81 (4.2 - 8.23)	5.17 (3.75 - 7.26)
Other cancer	1.48 (1.26 - 1.79)	1.14 (1.05 -1.31)
Chronic obstructive pulmonary disease	9.97 (7.77 - 12.81)	10.25 (7.76 - 12.62)
Other respiratory		
35 - 59 yrs	2.44 (1.80 - 3.24)	2.18 (1.69 - 2.77)
60 - 69 yrs	1.84 (1.47 - 2.31)	2.12 (1.65 - 2.68)
70 - 79 yrs	1.7 (1.39 - 2.09)	1.7 (1.41 - 2.05)
80+ yrs	1.38 (1.21 -1.59)	1.31 (1.18 - 1.47)
Respiratory tuberculosis		
35 - 59 yrs	2.44 (1.80 - 3.24)	2.18 (1.69 - 2.77)
60 - 69 yrs	1.84 (1.47 - 2.31)	2.12 (1.65 - 2.68)
70 - 79 yrs	1.7 (1.39 - 2.09)	1.7 (1.41 - 2.05)
80+ yrs	1.38 (1.21 -1.59)	1.31 (1.18 - 1.47)
Ischaemic heart disease		
35 - 59 yrs	2.44 (2.26 - 2.71)	2.18 (1.97 - 2.39)
60 - 69 yrs	1.84 (1.74 - 2.00)	2.12 (1.92 - 2.32)
70 - 79 yrs	1.7 (1.42 - 1.84)	1.7 (1.6 -1.9)
80+ yrs	1.38 (1.23 - 1.46)	1.31 (1.27 - 1.40)
Stroke		
35 - 59 yrs	2.44 (2.26 - 2.71)	2.18 (1.97 - 2.39)
60 - 69 yrs	1.84 (1.74 - 2.00)	2.12 (1.92 - 2.32)
70 - 79 yrs	1.7 (1.42 - 1.84)	1.7 (1.6 - 1.9)
80+ yrs	1.38 (1.23 - 1.46)	1.31 (1.27 - 1.40)
Other medical conditions		
35 - 59 yrs	2.03 (1.57 - 2.60)	1.85 (1.5 - 2.28)
60 - 69 yrs	1.6 (1.33 - 1.93)	1.8 (1.47 - 2.2)
70 - 79 yrs	1.5 (1.28 - 1.78)	1.5 (1.29 - 1.75)
80+ yrs	1.27 (1.15 - 1.42)	1.22 (1.13 - 1.33)

Source: CPS-II relative risk estimates used by Peto *et al*.[3]
*A correction factor of 30% was used to reduce excess risk due to confounding for all cause-specific relative risks, except 'other medical conditions' where a correction factor of 50% was used.[1]
†For lung cancer the PAF was obtained by subtracting the non-smoker lung cancer mortality from the lung cancer mortality of the population, therefore no correction factor was applied to the relative risk.
CI = confidence interval.

The method to estimate the PAF used by Ezzati *et al*.[1] has been adapted and applied to South African data. The proportion of lung cancer attributable to smoking for each population group is estimated as the absolute difference between the observed lung cancer death rate and the level among non-smokers from the CPS-II study population, once the observed rate has been adjusted for occupational and indoor exposure to lung carcinogens.[22,23] The proportion of lung cancer estimated to be attributable to occupational and indoor exposure to lung carcinogens is subtracted from the

observed age-specific lung cancer mortality rate by gender and population group.

The observed lung cancer mortality rates for each of the 4 population groups in South Africa were estimated from a sample of the official death data for 2000.[24] These rates were adjusted so that the total of the 4 population groups matched the national lung cancer rates from the revised South African National Burden of Disease Study estimates for 2000,[16] where no information was available on race, in order to maintain consistency with estimates used for the health outcomes for other risk factors studied.

Since the current prevalence of smoking is a poor proxy for the cumulative hazards of smoking, Peto *et al*.[3] proposed the SIR, which estimates excess lung cancer, as a marker for accumulated smoking risk. In contrast to the global study,[1] the SIR is substituted for smoking prevalence in the classic PAF formula:

$$PAF = \frac{P\,(RR - 1)}{P\,(RR - 1) + 1}$$

(where P is the prevalence of exposure and RR is the relative risk of disease given exposure) only for conditions with a long lag between exposure and outcome such as COPD and other cancers. The SIR was calculated for all 4 population groups as follows:

$$SIR = \frac{C_{LC} - N_{LC}}{S^*_{LC} - N^*_{LC}}$$

where C_{LC} is the observed lung cancer rate in a given age group in a population, N_{LC} is the non-smoker lung cancer rate in the study population, and S^*_{LC} and N^*_{LC} are the smoker and non-smoker lung cancer rates in a reference population from the CPS-II study population.[3] The SIR point estimates were smoothed using appropriate polynomials with a maximum value set to 1, to avoid potential overestimation of risk.

The current prevalence of smoking was used to estimate PAF for the other smoking-related outcomes with a short lag between exposure and outcome, including cardiovascular conditions, respiratory tuberculosis and other respiratory conditions. The justification for this is that the lag between exposure to tobacco smoke and CVD is shorter than the lag for cancers and COPD. This is also reflected in the estimates of risk reversal after smoking cessation from the CPS-II study as estimated by Ezzati *et al*.[1] – within 2 years after quitting smoking the risk of CVD was halved, while halving the risks for COPD and lung cancer occurred between 5 and 10 years after cessation.

That means that the relative contribution of ex-smokers to the overall population risk of disease is greater for lung cancer and COPD than it is for CVD, since the SIR is derived from lung cancer rates and therefore reflects the same mix of current and ex-smokers contributing to disease as is relevant for lung cancer but not for CVD. Hence, the current prevalence of smoking (or the prevalence for a few years before the year of estimation) may be a better reflection of the relevant exposure for CVD, particularly if prevalence has been relatively stable over the recent past.

We assume that the PAF for morbidity was the same as for mortality for cancers and COPD. For all other causes it was assumed to be half of the latter,[1] arguing that tobacco influences not only incidence but also case fatality of these diseases.

Monte Carlo simulation-modelling was used to present uncertainty ranges around point estimates reflecting the main

Table III. Smoking prevalence by age group, gender and population group, South Africa, 2000 (adapted from 1998 Demographic and Health Survey[18])

	Smoothed smoking prevalence (%) in South Africa, DHS 1998									
	Indian/Asian		Black African		Coloured		White		Total	
Age group (yrs)	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
15 - 19	28.7	10.9	11.7	0.2	26.1	20.9	31.2	36.9	15.1	5.3
20 - 24	46.4	10.9	35.7	1.2	51.6	34.5	44.6	36.8	37.9	6.8
25 - 29	58.7	10.6	49.3	3.3	64.5	43.1	50.3	35.5	51.0	10.0
30 - 34	66.1	10.0	55.3	5.7	68.9	47.8	51.1	33.7	56.4	12.8
35 - 39	69.2	9.4	56.4	7.8	68.3	49.6	48.9	31.6	56.9	14.7
40 - 44	68.6	8.8	54.4	9.4	65.5	49.5	45.3	29.5	54.5	15.7
45 - 49	65.2	8.2	51.1	10.0	62.4	47.9	41.4	27.5	50.9	15.8
50 - 54	59.7	7.6	47.6	9.7	60.4	45.4	37.9	25.6	47.2	15.4
55 - 59	52.9	7.0	44.7	8.5	60.1	42.2	35.0	23.6	44.1	13.9
60 - 64	45.8	6.3	42.5	6.7	61.2	38.4	32.5	21.2	41.8	12.1
65 - 69	39.3	5.4	41.1	4.6	63.0	33.8	29.7	18.1	40.1	10.1
70 - 74	34.5	4.0	39.8	3.0	63.8	28.2	25.3	13.6	37.3	7.8
75 - 79	32.4	2.1	37.7	2.5	61.4	21.0	17.8	7.1	33.2	5.3
80+	34.2	0.0	33.2	4.0	52.7	11.5	4.9	0.0	24.9	3.0
15+	54.8	9.0	42.4	5.0	57.2	40.0	40.4	27.7	43.7	11.1

Table IV. Population-attributable fractions and burden attributable to smoking tobacco in males and females, South Africa, 2000

	Males			Females			Persons		
	PAF (%)	Deaths	DALYs	PAF (%)	Deaths	DALYs	PAF (%)	Deaths	DALYs
Lung cancer	78	3 629	37 422	67	1 481	14 966	75	5 110	52 388
Upper aero-digestive cancer	58	2 981	36 536	25	624	6 568	47	3 605	43 014
Other cancers	15	1 598	15 889	4	557	5 652	8	2 156	21 541
Chronic obstructive pulmonary disease	69	5 387	60 642	51	2 444	23 267	62	7 831	83 910
Respiratory tuberculosis	32	4 460	75 900	8	490	8 874	24	4 950	84 775
Other respiratory	27	3 296	63 177	5	612	21 080	17	3 908	84 258
Cardiovascular	24	10 006	126 242	6	3 183	41 979	14	13 189	168 220
Other medical	22	2 752	87 955	5	914	29 734	12	3 666	117 689
Total burden		**34 108**	**503 763**		**10 306**	**152 122**		**44 415**	**655 885**
95% uncertainty interval		31 566 - 36 292	455 720 - 545 532		9 421 - 11 089	134 598 - 169 796		41 632 - 46 656	603 654 - 702 707
% of total burden		**12.4%**	**5.9%**		**4.2%**	**2.0%**		**8.5%**	**4.0%**
95% of uncertainty interval		11.5 - 13.2%	5.4 - 6.4%		3.8 - 4.5%	1.7 - 2.2%		8.0 - 9.0%	3.7 - 4.3%

PAF = population-attributable fraction; DALYs = disability-adjusted life years.

sources of uncertainty in the calculations. The @RISK software version 4.5 for Excel[25] allows multiple recalculations of a spreadsheet, each time choosing a value from distributions defined for the input variables. The probability distributions around the input variables were based on standard errors of the smoking prevalence specifying a normal distribution. For the RR input variables we specified a normal distribution around the natural logarithm of the CPS-II RR estimates. For each of the output variables (namely attributable burden as a percentage of total burden in South Africa 2000), 95% uncertainty intervals were calculated bounded by the 2.5th and 97.5th percentiles of the 2000 iteration values generated.

Results

Smoking prevalence was highest among coloured and Indian males followed by black African males (Table III). White males and coloured females, with a similar smoking prevalence, were next. Among 15 - 19-year-olds the prevalence was highest among white females. The prevalence increased dramatically in the 20 - 24-year age group across all population groups. Although white males started smoking at younger ages than black Africans, from 30 years and older black African men had a higher smoking prevalence than white men. With the exception of the 15 - 19-year age group, the rates for coloureds were highest across all age groups.

Table IV shows the estimated attributable fractions for all the conditions included in the study. Lung cancer was the outcome with the highest attributable fraction – 78% in males and 67% in females. This was followed by COPD and then upper aero-digestive cancer. Twenty-four per cent of tuberculosis deaths were attributed to smoking tobacco. Overall, the attributable fraction was 3 times higher in males than females.

Tobacco smoking caused an estimated 34 108 deaths in males (12.4% of all male deaths) and 10 306 deaths in females (4.2% of all female deaths) in South Africa in 2000 (Table IV). Since most deaths attributable to tobacco occurred in middle and old age, the proportion of DALYs attributable to tobacco was lower than the proportion of deaths (5.9% for males and 2.0% for females).

Fig. 1 shows age and sex distribution for the deaths attributable to tobacco smoking. The deaths attributable to smoking peaked in the 45 - 59-year age group, and at all ages there were more male than female deaths. Cardiovascular deaths account for the majority of tobacco-attributable deaths, followed by COPD and then lung cancer (Fig. 2). The cause distribution of tobacco-attributable mortality differs between males and females; males have a larger proportion of deaths due to respiratory tuberculosis and upper aero-digestive cancers than females, while females have a larger proportion of deaths from cardiovascular conditions and COPD.

The age-standardised tobacco-attributable mortality rates varied markedly between population groups and gender (Fig. 3). Coloured males had the highest age-standardised tobacco-attributable mortality rates, followed by black African and Indian males, and then white males. The rates for coloured females were almost as high as for white males. Rates for white females were about half those for coloured females. Rates for black African and Indian females were similar, at about one-third of the rates for white females.

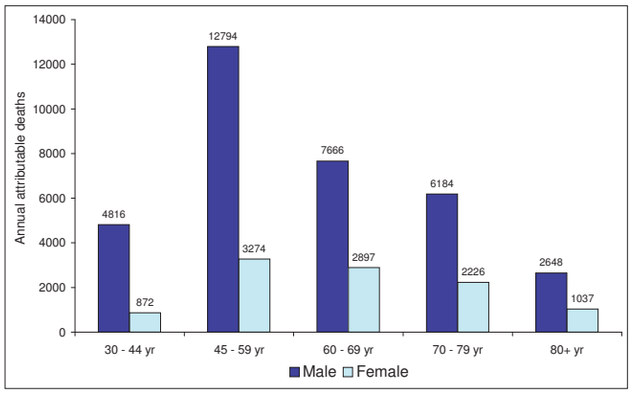

Fig. 1. Tobacco-attributable deaths in adults by age and sex, South Africa, 2000.

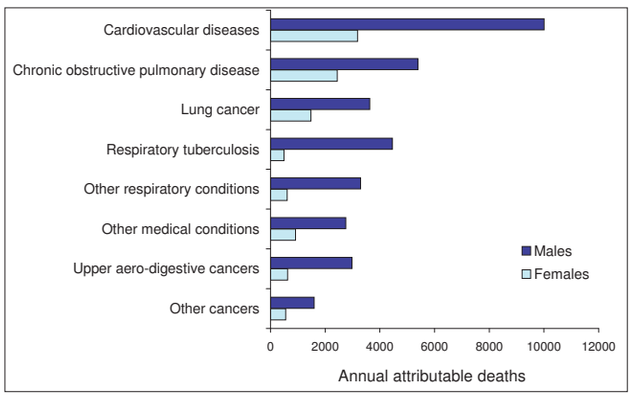

Fig. 2. Tobacco-attributable deaths by cause for adult males and females, South Africa, 2000.

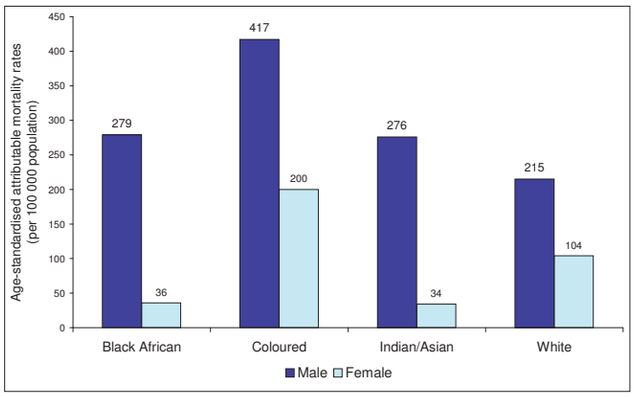

Fig. 3. Age-standardised tobacco-attributable mortality rates by population group and gender, South Africa, 2000.

The uncertainty analysis revealed that between 41 632 and 46 656 deaths were attributable to smoking in South Africa in 2000 (Table IV).

Discussion

The results of this study suggest that about 8.5% of all deaths and 13% of deaths in adults (> 35 years) can be attributed to smoking, with a large proportion of deaths (49%) occurring in the economically productive age groups (35 - 69 years). Sitas *et al*.[8] estimated that about 8% of all adult deaths (> 25 years) were caused by smoking in 1998, using a direct method of estimating tobacco-attributable mortality. This would translate to 34 481 smoking-attributable deaths, if the attributable fractions for adults > 30 years (re-estimated from Sitas *et al*.) were applied to the revised burden estimates for 2000.[16] This is remarkably similar to our indirect estimates of 36 841 smoking-attributable deaths, after excluding 'other medical causes' and 'other respiratory diseases' to be consistent with the South African case-control study.[8] We included 'other medical conditions' in line with the WHO CRA study,[1] although evidence of an association with smoking is considered sufficient for only certain of these conditions by other researchers.[26,27] This study confirms the high fraction of tuberculosis deaths attributed to smoking tobacco found by Sitas *et al*.[8] (24% v. 20%).

The cause distribution of mortality due to smoking in South Africa is similar to that found in developing countries, with the exception of respiratory conditions. In South Africa COPD accounts for a smaller proportion of tobacco-attributable mortality (18%) than in developing countries (27%), and other respiratory diseases and respiratory tuberculosis account for a larger proportion (20% v. 13%).[1]

There are marked differences in the age-standardised smoking-attributable mortality rates between population groups and genders, reflecting the differences in smoking prevalence between subgroups. The coloured population is particularly badly affected, with extremely high rates compared with other population groups. Of particular concern is the high prevalence of smoking (46%) among pregnant coloured women.[28] Although this study did not attempt to measure the attributable burden due to smoking for perinatal conditions such as low birth weight (due to a lack of data on hazard size), this is likely to be substantial among coloured women, who have among the highest low-birth-weight rates in the world.

There are clearly a number of limitations pertaining to indirect methods of estimating tobacco-attributed mortality. These include the fact that the risks of smoking in relation to disease increase over time, and updating the risk estimates using published literature depends on the availability of the most recent studies. Extrapolating overall risks from the USA to a country such as South Africa, which contains subpopulations that may be at different levels of the tobacco epidemic, may provide misleading information.[29] There is also the risk of overestimating the hazard if there has been a sharp decline in smoking rates in recent years.

There is clearly some uncertainty around these estimates, mainly because of the lack of reliable estimates of the RRs for South Africa. The CPS-II RRs as used by Peto *et al*.[3] have the

potential to overestimate the burden since they reflect a mature epidemic. It is difficult to apply the RRs from South Africa,[8] India[6] and China[4] to the South African data since there are differences in inclusion and exclusion categories, for example, differences in aggregations of causes and age groups. However, crude estimates of the tobacco-attributable deaths using these RRs show a wide range of results (19 000 - 44 000 smoking-attributable deaths). This may be explained by the different stages of the epidemic or the limitations of case-control studies. However, it highlights the need for more South African data to improve RR estimates.

Conclusion and recommendations

This study shows that tobacco smoking accounts for between 12% and 15% of deaths in adults over 35 years of age in South Africa, from preventable disease, with at least half a million DALYs lost per annum. The indirect method used here yields very similar results to those derived from direct estimates of the burden of tobacco-attributed mortality in South Africa based on the question on a death notification form regarding smoking status.

Despite some uncertainty with regard to the precise number of deaths attributable to smoking in South Africa, from a public health policy perspective these results enable tobacco-attributable mortality to be ranked against other risk factors, thus providing information for priority setting. In terms of mortality, tobacco ranked third (after unsafe sex/sexually transmitted disease and high blood pressure) out of 17 risk factors evaluated in the South African CRA study.[30] Recent success in reducing smoking prevalence is likely to lower the burden of tobacco-attributable mortality in future decades. However, even at current prevalence rates, the tobacco burden will continue to be a large part of the burden of disease in South Africa. Therefore, ongoing tobacco control remains an important health priority in South Africa.

Stringent tobacco control legislation and sharp increases in the excise tax on cigarettes illustrate the government's commitment to improving tobacco control in South Africa. Despite increases in excise tax, the current tax burden of 52% of the retail price is low compared with the European Union minimum (57%) and the tax burdens on cigarettes sold in the UK and Scandinavia (more than 75%). Econometric studies have shown that tax and price increases, more than any other intervention, have decreased cigarette consumption.[12]

Tobacco-control legislation is important because it affects the social acceptability of smoking. It changes people's attitudes and rights. Whereas the right to smoke-free air was previously contested, the legislation has unambiguously given the right to smoke-free air to non-smokers.

Currently the government is debating amendments to the 1999 legislation.[10] These entail closing some loopholes, increasing penalties for contravention of the existing legislation, banning point-of-sale adverts and introduction of pictorial warnings. Pictorial warnings have been introduced in countries like Australia, Canada and Brazil.[31] These are likely to reach people with lower levels of education more effectively than written warnings.

Other than increasing the excise tax and imposing stronger tobacco-control legislation, the government can reduce tobacco consumption through continued public education, including encouraging and supporting smokers to quit. Programmes aimed at preventing schoolchildren from starting to smoke need to be greatly strengthened.

Many people still grossly underestimate the health risks associated with tobacco use. Quitting smoking reduces these risks substantially.[2] Initiatives that assist smokers to quit are considered to be essential components of a comprehensive tobacco-control programme. The use of nicotine replacement therapies has been shown to improve the effectiveness of individual or group cessation efforts.[32] However, the cost-effectiveness of smoking cessation programmes and nicotine replacement therapies in the South African public health sector need to be investigated. This is an important consideration for the tuberculosis control programme, given that 24% of tuberculosis deaths can be attributed to smoking. In addition, it is essential that the public antenatal services develop and implement tobacco-cessation programmes targeted at pregnant women. This is particularly important for coloured women in view of their high smoking rates.[28] In the public health sector health providers could support patients in making healthy lifestyle choices, such as quitting smoking, by providing a patient-centred care approach (Professor Krisela Steyn, South African Medical Research Council, 2006 – personal communication).

As a signatory to the Framework Convention on Tobacco Control,[33] South Africa is well placed to support international tobacco-control activities in other developing countries and neighbouring states. Routine surveillance is required to monitor tobacco-control efforts, in particular the economic impact thereof. Increased cigarette smuggling could undermine the consumption and tax revenue impact of higher excise taxes, and the government needs to put measures in place to counteract possible smuggling. With strong tobacco-control measures currently in place, communities and the authorities should ensure that these regulations are properly monitored and complied with.

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