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**Norman, Rosana**, Bradshaw, Debbie, Schneider, Michelle, Joubert, Jane, Groenewald, Pam, Lewin, Simon, Steyn, Krisela, Vos, Theo, Laubscher, Ria, Nannan, Nadine, Nojilana, Beatrice, & Pieterse, Desiree (2007)

A comparative risk assessment for South Africa in 2000: Towards promoting health and preventing disease.

*South African Medical Journal*, 97(8), pp. 637-641.

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## A comparative risk assessment for South Africa in 2000: Towards promoting health and preventing disease

Rosana Norman, Debbie Bradshaw, Michelle Schneider, Jané Joubert, Pam Groenewald, Simon Lewin, Krisela Steyn, Theo Vos, Ria Laubscher, Nadine Nannan, Beatrice Nojilana, Desirée Pieterse and the South African Comparative Risk Assessment Collaborating Group

A landmark project of the Medical Research Council, the first South African National Burden of Disease (SA NBD) study, identified the underlying causes of premature mortality and morbidity experienced in South Africa in the year 2000.<sup>1</sup> These estimates were recently revised<sup>2</sup> on the basis of additional data to estimate the disability-adjusted life years (DALYs) for single causes for the first time in South Africa. DALYs are a comprehensive measure of the disease burden combining the years of life lost (YLLs) as a result of premature mortality and years lived with disability (YLDs) related to illness or injury.<sup>3</sup> Compared with the use of mortality as a measure of disease burden, DALYs also capture the contributions of conditions that do not result in large numbers of deaths. For example, mental health disorders have a large disability component relative to the number of deaths. The SA NBD study highlighted the fact that despite levels of uncertainty there is important information to guide public health responses to improve the health of the nation.

The next step was to undertake a comparative risk assessment (CRA) to estimate the contribution made by selected risk factors, as was done globally in the *World Health Report* of 2002.<sup>4</sup> In order to protect and improve health, there is a need for much more emphasis on preventing disease and injury and on the causal determinants of health. CRA

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methodology, developed by the World Health Organization (WHO), is a standardised and systematic approach to estimate the contributions of risk factors, at various levels of causality to the burden of disease within a unified framework.<sup>5</sup> Reliable and comparable analysis of risks to health provides information on the relative contribution of individual risk factors, which can be used to guide a health sector-led response to promoting health and preventing disease and injury. Although the global assessment gives an indication of the risk factor profile that can be expected for South Africa, only a national assessment of the burden of disease and risk factor data can provide valid information for health service planning. In combination with information on the effectiveness and cost-effectiveness as well as the local applicability and appropriateness of interventions, it can contribute to the more rational use of limited resources to impact on the risk factors that determine the health of the nation.

The SA CRA followed WHO CRA methodology.<sup>4,6</sup> The selected risk factors were identified based on the burden of disease experienced in South Africa, as well as input from a range of stakeholders including the national and provincial Departments of Health. A list of 17 risk factors was chosen after consultation with stakeholders. Risk factors were selected based on the following criteria: (i) likely to be among the leading causes of burden of disease and injury; (ii) evidence of causality; (iii) being potentially modifiable; and (iv) availability of data. Our focus in this study was on proximal, physiological and environmental risks as opposed to the more distal risk factors such as poverty and inequality, which have complex relationships with health. For the selected risk factors, expert working groups carried out a review of published work to obtain local estimates of prevalence of risk factor exposure for the year 2000. With regard to hazard size (relative risks where appropriate), extensive use was made of the comprehensive reviews carried out in the global WHO CRA study.<sup>6</sup> Since diabetes and interpersonal violence were included in the SA CRA but not the global assessment, a literature search was carried out to identify the best available data sources on hazard size for these risk factors.

The burden of disease and injury attributable to various risk factors was estimated using a counterfactual approach. Categorical attribution<sup>5,7</sup> was also used in certain instances such as in the attribution of road traffic injuries to alcohol consumption where the health outcome could be directly



linked to the risk factor through available information on blood alcohol content. In counterfactual analysis, the contribution of risk factors to burden of disease and injury was estimated by comparing the current local health status with a theoretical minimum counterfactual with the lowest possible risk, irrespective of whether or not it is attainable in practice. The advantage is that the potential gain in population health by reducing risk to 'ideal' levels becomes evident when applied consistently across all risk factors.

The contribution of each risk factor was expressed as the population-attributable fraction (PAF) of related diseases and injuries attributable to exposure to this risk factor in the South African population. This was estimated by a discrete version of the generalised potential impact fraction (PIF)<sup>5</sup> for continuous exposures, or a multi-level extension of the usual attributable fraction formula when the exposure variable had several categories. PAFs were calculated and applied to revised burden

of disease estimates, deaths and DALYs from the SA NBD study for 2000<sup>8</sup> to obtain the attributable mortality and burden of disease for each selected risk factor. The methodology used for each selected risk factor is described in more detail in this supplement.<sup>9-25</sup> Monte Carlo simulation-modelling techniques were used for analysis of uncertainty around exposure and hazard size parameters.

The contribution of the 17 selected risk factors to burden of disease in the year 2000 is shown in Tables I and II. The first table shows the burden attributable to the risk factors in terms of deaths, and the second in terms of DALYs. In each case the ranking of the risk factors is shown alongside the ranking of the leading underlying causes of death and disease burden. Diabetes as a risk factor includes the excess burden resulting from the increased risk of mortality and disability from cardiovascular and renal disease in addition to burden categorically attributed to diabetes as the underlying cause.

**Table I. Deaths attributable to selected risk factors compared with the underlying causes of death**

Rank	Risk factor	% total deaths	Rank	Disease, injury or condition	% total deaths
1	Unsafe sex/STIs	26.3	1	HIV/AIDS	25.5
2	High blood pressure	9.0	2	Ischaemic heart disease	6.6
3	Tobacco smoking	8.5	3	Stroke	6.5
4	Alcohol harm	7.1	4	Tuberculosis	5.5
5	High BMI (excess body weight)	7.0	5	Interpersonal violence injury	5.3
6	Interpersonal violence (risk factor)	6.7	6	Lower respiratory infections	4.4
7	High cholesterol	4.6	7	Hypertensive disease	3.2
8	Diabetes (risk factor)	4.3	8	Diarrhoeal diseases	3.1
9	Physical inactivity	3.3	9	Road traffic injury	3.1
10	Low fruit and vegetable intake	3.2	10	Diabetes mellitus	2.6
11	Unsafe water, sanitation and hygiene	2.6	11	Chronic obstructive pulmonary disease	2.5
12	Childhood and maternal underweight	2.3	12	Low birth weight	2.2
13	Urban air pollution	0.9	13	Asthma	1.3
14	Vitamin A deficiency	0.6	14	Trachea/bronchi/lung cancer	1.3
15	Indoor air pollution	0.5	15	Nephritis/nephrosis	1.3
16	Iron deficiency anaemia	0.4	16	Septicaemia	1.2
17	Lead exposure	0.3	17	Oesophageal cancer	1.1

**Table II. DALYs attributed to selected risk factors compared with the underlying causes of DALYs**

Rank	Risk factor	% total DALYs	Rank	Disease, injury or condition	% total DALYs
1	Unsafe sex/STIs	31.5	1	HIV/AIDS	30.9
2	Interpersonal violence (risk factor)	8.4	2	Interpersonal violence injury	6.5
3	Alcohol harm	7.0	3	Tuberculosis	3.7
4	Tobacco smoking	4.0	4	Road traffic injury	3.0
5	High BMI (excess body weight)	2.9	5	Diarrhoeal diseases	2.9
6	Childhood and maternal underweight	2.7	6	Lower respiratory infections	2.8
7	Unsafe water sanitation and hygiene	2.6	7	Low birth weight	2.6
8	High blood pressure	2.4	8	Asthma	2.2
9	Diabetes (risk factor)	1.6	9	Stroke	2.2
10	High cholesterol	1.4	10	Unipolar depressive disorders	2.0
11	Low fruit and vegetable intake	1.1	11	Ischaemic heart disease	1.8
12	Physical inactivity	1.1	12	Protein-energy malnutrition	1.3
13	Iron deficiency anaemia	1.1	13	Birth asphyxia and birth trauma	1.2
14	Vitamin A deficiency	0.7	14	Diabetes mellitus	1.1
15	Indoor air pollution	0.4	15	Alcohol dependence	1.0
16	Lead exposure	0.4	16	Hearing loss, adult onset	1.0
17	Urban air pollution	0.3	17	Cataracts	0.9



Similarly, in addition to the interpersonal violence injury mortality and disability directly resulting from violence, the substantial contribution of mental health, behavioural and reproductive health consequences are also included in the estimate of burden attributable to interpersonal violence as a risk factor (Tables I and II).

The leading causes of mortality included sexually transmitted infections (STIs) from unsafe sex (accounting for 26.3% of the estimated 521 000 deaths in South Africa in 2000), followed by high blood pressure (9.0%) and tobacco smoking (8.5%) (Table I). Table II indicates that STI burden resulting from unsafe sex accounted for the highest burden (31.5% of the 16.2 million DALYs in 2000). Interpersonal violence as a risk factor ranked second accounting for 8.4% of DALYs. Alcohol harm accounted for 7.0% and tobacco smoking for 4.0% of total DALYs. It was also estimated that the diet-related risk factors such as high body mass index (BMI), high blood pressure and cholesterol, as well as childhood and maternal undernutrition (disaggregated into underweight and micronutrient deficiencies), each cause significant harm to health. These attributable burdens, however, are the independent contributions and cannot be added together for risk factors that share common causal pathways. The attributable burden for interpersonal violence, for example, includes the contribution resulting from alcohol-associated violence. Similarly, the attributable burdens of underweight and micronutrient deficiencies are not additive. For high blood pressure, cholesterol, excess body weight, physical inactivity, low fruit and vegetable intake, diabetes and smoking it would be useful to estimate a joint effect of these multiple risks on cardiovascular disease outcomes. Risk factors such as unsafe water, sanitation and hygiene and indoor air pollution from household use of solid fuels may also work synergistically with others such as undernutrition or HIV infection to increase incidence and effects of diseases such as respiratory infection and diarrhoeal diseases in children.

This is the first CRA to be done in South Africa, capturing the relative contribution of selected risk factors in the year 2000. The results of this study show that the loss of health in South Africa is dominated by STIs resulting from unsafe sex and highlights the urgency of finding ways to prevent the spread of HIV. The risk factor profile also reflects distinct types of risk factors, those related to poverty and underdevelopment, such as undernutrition, unsafe water, sanitation and hygiene and indoor smoke from solid fuels, as well as those associated with a Western lifestyle, such as alcohol, tobacco, diabetes, high blood pressure and high cholesterol. The high ranking of two extremes in nutrition, high BMI (5th) immediately followed by childhood and maternal underweight (6th), reflects the inequalities in South African society and the protracted bipolar health transition<sup>26</sup> related to uneven development. The high ranking of interpersonal violence as a risk factor is also likely to be associated with the extreme inequalities in the South African society. It is important to

acknowledge that low ranking in this study does not negate the importance of some of these health risks, particularly the environmental risks, urban air pollution, indoor air pollution and lead exposure. Sizable mortality burdens are already associated with these risks and furthermore, interventions are necessary to avoid increases in future burden.

In this cross-sectional analysis, the assumption is that the risk factor profile reflects the disease burden in 2000 resulting from past exposure to selected risks. However, the burden of disease in South Africa is increasing rapidly.<sup>27,28</sup> This is largely as a result of the spread of HIV, and implies that unsafe sex would account for a much higher proportion of the current burden than in 2000. In future, it will be important to consider attributable DALY rates as the increase in the burden attributable to unsafe sex will overshadow changes in the relative contributions of other risk factors. Seventeen risk factors were selected for inclusion in this study, but future CRA studies should also include other relevant risk factors such as illicit drug use. It would also be of interest to consider the impact on future disease burden resulting from climate change.

Although this project confronted several data inadequacies, consistent and coherent estimates of attributable burden were derived for 2000, thereby providing important local information to guide the identification and prioritisation of risk factors to be targeted for interventions and further study. Hazard ratios from the WHO CRA were used to increase international comparability, although differences in risk may exist across sub-populations. In light of various areas of uncertainty and omissions, it remains important to improve the South African epidemiological database for important conditions and their associated risk factors in follow-up CRA studies. Furthermore it is essential to conduct epidemiological research on the complex relationship between poverty and ill-health to enable the quantification of burden of disease attributable to this underlying determinant of poor health.

Despite these uncertainties and data limitations the SA CRA has highlighted the health impact of major risk factors and is key in pointing towards potential interventions for averting death and disability. Bold steps and determined action by government are now needed to develop relevant health promotion strategies. Taking definitive action is not new to our government – as the country's prominent and courageous anti-tobacco action confirms, as well as the recently adopted National Strategic Plan for HIV, AIDS and STIs. Preventing or reducing risks to health will have social value far beyond preventing death and disability, including the promotion of sustainable development, reducing inequities in society, and strengthening the trust and legitimacy with which government's actions are viewed by the citizenry.<sup>4</sup> The growing burden of disease in South Africa makes it imperative for government to take effective steps to improve the health of the nation. The SA CRA provides these first steps by developing a roadmap for evidence based interventions and recommendations.<sup>29</sup>



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