

## Reducing the sodium content of high-salt foods: Effect on cardiovascular disease in South Africa

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**Background.** Average salt intake in South African (SA) adults, 8.1 g/day, is higher than the 4 - 6 g/day recommended by the World Health Organization. Much salt consumption arises from non-discretionary intake (the highest proportion from bread, with contributions from margarine, soup mixes and gravies). This contributes to an increasing burden of hypertension and cardiovascular disease (CVD).

**Objectives.** To provide SA-specific information on the number of fatal CVD events (stroke, ischaemic heart disease and hypertensive heart disease) and non-fatal strokes that would be prevented each year following a reduction in the sodium content of bread, soup mix, seasoning and margarine.

**Methods.** Based on the potential sodium reduction in selected products, we calculated the expected change in population-level

systolic blood pressure (SBP) and mortality due to CVD and stroke.

**Results.** Proposed reductions would decrease the average salt intake by 0.85 g/person/day. This would result in 7 400 fewer CVD deaths and 4 300 less non-fatal strokes per year compared with 2008. Cost savings of up to R300 million would also occur.

**Conclusion.** Population-wide strategies have great potential to achieve public health gains as they do not rely on individual behaviour or a well-functioning health system. This is the first study to show the potential effect of a salt reduction policy on health in SA.

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South Africa (SA) confronts a quadruple burden of disease, with the chronic non-communicable disease (NCD) burden increasing in the face of high levels of HIV, injuries and maternal and child health issues. Chronic diseases contributed nearly one-third of all disability-adjusted life years (DALYs) in SA in 2000.<sup>1</sup> Despite this, NCDs are often neglected in health priorities. Stroke is the third-leading cause of death in SA, after HIV and ischaemic heart disease.<sup>1</sup>

The SA Hypertension Guidelines recommend a maximum salt intake of 6 g/day;<sup>2</sup> this is the upper boundary of the 4 - 6 g/day recommended by the World Health Organization (WHO).<sup>3</sup> SA diet is high in salt, with bread contributing to 25 - 40% of sodium intake.<sup>4</sup> Average daily intake, measured by 24-hour urinary sodium excretion, is 7.8 g in black persons, 8.5 g in mixed-race persons, and 9.5 g in white persons in SA.<sup>4</sup>

The SA health system functions poorly; queues, lack of care continuity and drug stock-outs contribute to a lack of preventive healthcare.<sup>5</sup> Although new policies and programmes to revitalise

primary healthcare and a national health insurance scheme are gaining momentum, these changes will take time and health gains will not be immediate. Tangible health benefits can be achieved through intersectoral actions, i.e. collaboration between the Department of Health (DoH) and other government departments to shape food policy, road safety and alcohol taxation. This should be investigated in the SA context.

Salt is known to affect blood pressure (BP) via a linear association.<sup>6</sup> This analysis provides evidence on the number of cardiovascular disease (CVD) deaths and non-fatal strokes likely to be avoided if the sodium content of bread, margarine, soups and gravies was reduced.

### Methods

Average salt intake in SA was previously reported in 2005.<sup>4</sup> Statistics SA 2010 mid-year population statistics showed that the SA population was 79% black, 11% mixed race and 9% white.<sup>7</sup> Using these data, we calculated the weighted average salt intake across the population. Consumption and weighted average intake of bread, margarine, gravy and soup was determined according to race (Table 1).

A study undertaken with Sasko Milling and Baking found that it was possible to produce bread with a sodium content of 342 mg/100 g, without affecting texture or taste.<sup>8</sup> Similar work with Unilever indicated that it was possible to reduce the sodium content of margarine by 61%, soup mix by 69% and seasoning by 51%.<sup>9</sup> We calculated the change in sodium intake if these reductions were adopted in SA and used a regression equation<sup>10</sup> to calculate the effect on the population distribution of BP. For each 100 mmol reduction in sodium intake, an SBP reduction of 5 - 10 mmHg is expected, with variation according to age.<sup>10</sup> Norman *et al.*<sup>11</sup> published current population distributions of BP, corrected for regression dilution bias.

The potential impact fraction (PIF) (Equation 1), employed in the South African and WHO comparative risk assessments, estimates the reduction in morbidity and mortality anticipated if exposure to common risk factors were to be reduced.<sup>11</sup> We used the PIF to estimate the percentage reduction in CVD that would result from reducing the sodium content of the described foods to the levels highlighted, considering the altered population distribution of SBP and relative risks adapted from the Prospective Studies Collaboration.<sup>11</sup> The PIF

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**Table 1. Intake of high-salt foods in SA in 2005<sup>4</sup>**

	Salt intake per product (%)			
	Bread	Soup powder	Seasoning	Margarine
Black	40.5	2.9	1.1	2.9
Mixed race	30.7	N/A	N/A	1.9
White	25.2	N/A	N/A	2.7
Weighted average intake (population)	38.0	2.3	0.9	2.8

N/A= not applicable.

was calculated separately for stroke, ischaemic heart disease and hypertensive heart disease. The PIF values were used to calculate the consequent number of CVD deaths and non-fatal strokes that could be avoided annually. The PIF was multiplied by the total number of deaths due to each condition<sup>1</sup> and the number of new incident strokes.<sup>13</sup>

$$PIF = \frac{\int_l^h RR(x)P(x)dx - \int_l^h RR(x)P^*(x)dx}{\int_l^h RR(x)P(x)dx}$$

Equation 1. Potential impact fraction (PIF). P(x) is the original risk factor distribution, P\*(x) is the risk factor distribution after the change, RR(x) is the relative risk function, dx denotes that the integration is performed with respect to x, and l and h are integration boundaries.<sup>12</sup>

**Results**

The average sodium intake from bread in SA is 1.6 g/person/day; a reduction of 0.73 g/person/day would result from a decrease in the sodium content of bread from 650 mg/100 g to 350 mg/100 g. This reduction would increase to 0.85 g/person/day if the sodium content of margarine, soup and seasoning was lowered as well. The effect of this sodium intake on population SBP varies by age and sex. Fig. 1 shows the projected shift in BP distribution for the youngest and oldest age groups.

Applying the PIF values to the total number of fatal and non-fatal incident strokes estimated in 2008,<sup>13</sup> we estimated that 7 400 deaths would be prevented in SA each year – 6 400 from reducing the sodium content of bread alone (Fig. 2). This includes deaths related to stroke (2 900), ischaemic heart disease (2 500) and hypertensive heart disease (2 000). Furthermore, approximately 4 300 non-fatal strokes would be prevented. Overall, 8% of strokes, 6.5% of ischaemic heart disease and 11% of hypertensive heart disease could be prevented.

**Discussion**

Reducing the sodium content of food has the potential for large public health effects. As well as preventing 7 400 CVD deaths per year, the prevention of non-fatal strokes will relieve pressure on the overburdened health system. Data indicate that the direct costs of treating a stroke amount to R76 000 (excluding follow-up and rehabilitation costs;<sup>14</sup> translated to 2010 ZAR). This amounts to a total annual saving of R300 million (40 million USD) due to the prevention of non-fatal strokes. This does not include household costs, such as lost income, which can be significant. Reducing the sodium content of bread is of greatest importance, with 80% of estimated cost savings stemming from this alone.

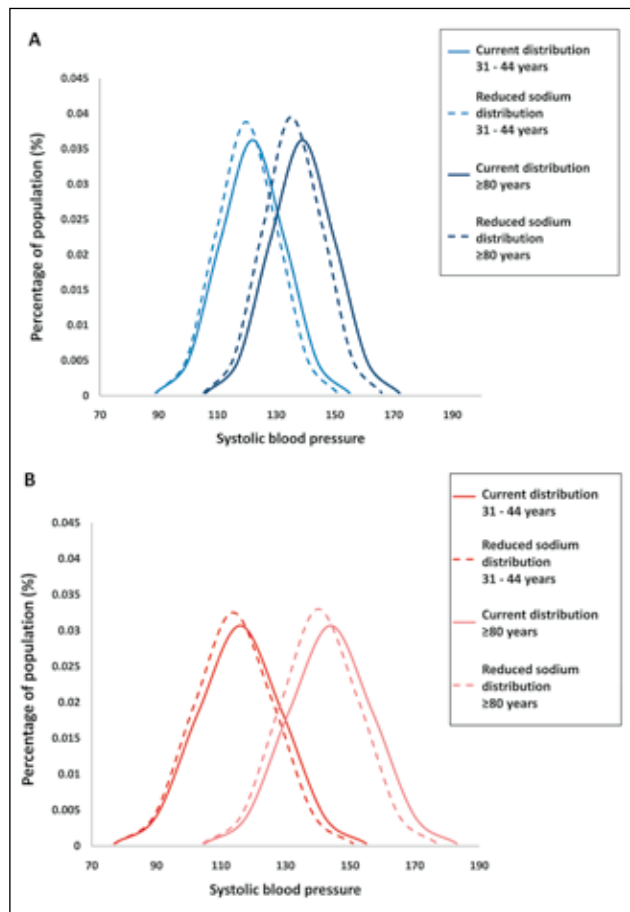


Fig. 1. Expected change in population distribution of SBP due to a sodium content reduction of bread, soup mix and seasoning, in (A) males and (B) females. Solid lines represent the current distribution; dashed lines represent new distribution due to the change.

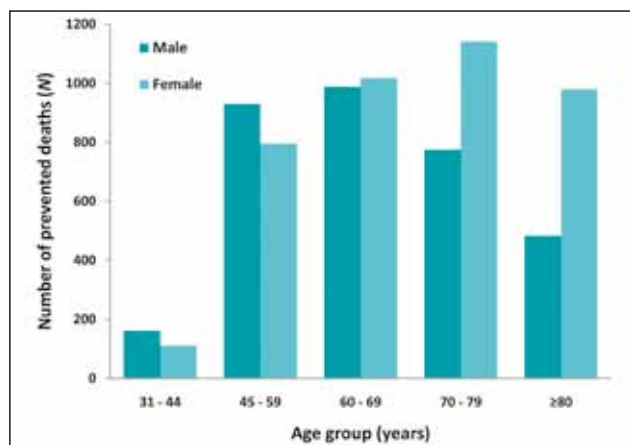


Fig. 2. Number of CVD deaths prevented per year due to a reduction in the sodium content of foods in SA.

These values may underestimate the true effect of reduced sodium intake on stroke, as an independent effect not mediated via BP has been hypothesised;<sup>15</sup> the evidence is not yet strong enough to support an independent assessment of this effect. Our analysis did not account for the possibility that the effect of sodium reduction may be greater in black individuals than in white individuals.<sup>16</sup> Furthermore, our analysis assumed that the consumption of other high-salt foods would not increase if the salt content of targeted foods was decreased. A previous

randomised trial showed no change in bread consumption or choice of sandwich fillings following a reduction in the bread's sodium content.<sup>17</sup> Our study also assumes that regulations concerning sodium levels would affect all commercially available products.

The cost of baking a regular loaf of brown bread was 92.3 cents per loaf in 2005.<sup>9</sup> The additional cost of reducing sodium content was estimated at 8.91 cents per loaf;<sup>9</sup> this amount could not be attributed solely to sodium reduction, however, as other micronutrient content was simultaneously increased. An updated study of the cost implications is required.

We excluded from our analysis a controversial observational study<sup>18</sup> that showed an inverse relationship between sodium intake and cardiovascular mortality – contradicting the previously accepted relationship. Furthermore, the study was criticised for missing data, employing only one measurement of sodium intake and failing to account for confounding factors.<sup>19</sup>

Evidence indicates that a reduced sodium diet has an effect on hypertension equivalent to first-line drug treatment with a diuretic or beta-blocker.<sup>20</sup> Individual measures to reduce sodium intake, such as dietary counselling, can affect SBP levels, although to a limited degree because most salt intake is derived from pre-prepared food.<sup>21</sup> Population-wide strategies to reduce non-discretionary salt intake, and thereby reduce the population distribution of BP, are expected to have an overall larger effect on population health at lower cost.<sup>22</sup>

Voluntary measures to reduce the sodium content of packaged food have been introduced successfully in several countries.<sup>23</sup> The European Union currently has 11 countries signed up to a salt reduction programme. The Consensus Action on Salt in Health (CASH) group in the United Kingdom has been successful in convincing a number of major retailers to reduce the sodium content of pre-packaged foods by 10 - 15%.<sup>23</sup> In contrast, an Australian study indicated that 20 times the health gain seen through voluntary changes regarding salt content could be achieved through mandatory legislative changes.<sup>22</sup> However, sodium tax – an economic (dis)incentive intended to alter food-purchasing behaviour and thereby decrease sodium intake – was estimated to achieve a smaller reduction in intake than mandatory changes, with consequently smaller health effects.<sup>24</sup>

We applaud the efforts of the DoH to engage with the appropriate consumer and industry groups to begin the process of a voluntary reduction in food sodium levels. Engagement with companies producing cereals, gravies and soup mixes, consumed in high quantities in SA, is needed for a comprehensive salt reduction plan. Industry concerns regarding consumer acceptance of lower-sodium products are unwarranted. Evidence indicates that the palate adapts to lower-sodium foods, particularly if the salt content is reduced incrementally in small steps to a desired level,<sup>25</sup> allowing for taste adaptation. The DoH intends to implement appropriate policy using multiple targets over a number of years, with a concurrent monitoring and evaluation programme to ensure regulation compliance.

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