Reducing sodium content in high salt foods: Impact on cardiovascular disease in South Africa

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Abstract:

**Background:** Intake of salt of the South African adult population is higher than recommended levels. This contributes to an increasing burden of hypertension and cardiovascular disease, especially stroke. Much of the salt eaten comes from non-discretionary intake. The highest proportion comes from bread with considerable contributions from margarine, soup mixes and gravies.

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

**Methods:** The average intake of salt (as measured by 24-h urinary Na excretion) per adult person per day in South Africa is 8.1g. Using potential sodium reduction in selected products, we calculated the expected reduction in population level systolic blood pressure. The impact of this SBP change on mortality due to CVD and stroke incidence was then calculated.

**Results:** Proposed reductions, would decrease salt intake by 0.85 grams per day. Lowering the sodium content of these foods would reduce the population distribution of systolic blood pressure, resulting in 7,400 fewer deaths due to CVD and 4,300 less non-fatal strokes per year.

**Conclusions:** Population-wide strategies have great potential for public health gains as they do not rely on either individual behaviour change or a well-functioning health system to achieve population wide health benefit. This is the first study to show the potential impact of such a policy on health in South Africa.
Background

South Africa 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 1/3rd of all DALYs in South Africa’s National Burden of Disease study in 2000 (1). Despite this, NCDs are often neglected in South African health priorities. Stroke is the third leading cause of death in South Africa behind HIV and ischaemic heart disease (1).

The South African Hypertension Guidelines recommend a maximum salt intake of 6 grams per day (2). This is the upper boundary of World Health Organization guidelines, which recommend 4-6 grams per day. (3). The South African diet is high in salt, with an average intake of 7.8 grams per day among black people, 8.5 grams per day among those of mixed race, and 9.5 grams per day among whites as measured by 24-hour urinary Na excretion (4). Salt is known to impact blood pressure (5). Between 25 and 40% of sodium intake in South Africa comes from bread for the different groups (4).

The South African health system does not function optimally. Queues, lack of continuity of care and drug stock outs are some of the factors which contribute to a lack of preventive health care in South Africa (6). Although new policies and programs to revitalize primary health care and introduce a national health insurance scheme are gaining momentum, these changes will take time and resulting health gains will not be seen immediately. Tangible health benefits can be achieved through intersectoral actions. Such actions should be explored in the South African context.

This analysis provides evidence on the number of cardiovascular disease deaths and non-fatal strokes that would likely be avoided if sodium content of bread, margarine, soups and gravies was reduced.
Methods

Baseline data

Average salt intake in South Africa in 2005 has been previously reported (4). Statistics South Africa mid-year population statistics for 2010 show 79% of the population is black, 11% mixed race and 9% white (7). Using these data we calculated the weighted average salt intake across the total South African population. Intake of bread, margarine, gravy and soup was also presented by race, and a weighted average intake for the whole population calculated (Table 1).

[Table 1 here]

A study undertaken with Sasko Milling and Baking Company found that a bread with a sodium content of 342mg/100g bread was possible, without impacting texture or taste of the bread (8). Similar work with Unilever indicated that a reduction of 61% sodium in margarine, 69% sodium in soup mix and 51% sodium in seasoning was possible (9). Using these figures, we calculate the change in total sodium intake if these reduced sodium levels were adopted in South African foods. We use a regression equation by Law et al (10) to calculate the impact on the population distribution of blood pressure that is achieved by reducing average sodium intake. Current population distributions of blood pressure, corrected for regression dilution bias are shown in Table 2(11). For each 100 mmol reduction in sodium intake, a reduction of 5-10mmHg in SBP is expected, varying by age (10).

[Table 2 here]
Using the population distribution of systolic blood pressure due to reducing sodium intake, along with relative risks adapted from the Prospective Studies Collaboration (reported in the comparative risk assessment for South Africa (Table 3,(11)), we calculate the change in potential impact fraction (PIF) that would result from the lowering of sodium intake (Equation 1)

**Equation 1: Potential Impact Fraction (PIF)**

\[
P_{IF} = \frac{\int_l^h RR(x)P(x)dx - \int_l^h RR(x)P^*(x)dx}{\int_l^h RR(x)P(x)dx}
\]

Where \(P(x)\) is the original risk factor distribution, \(P^*(x)\) the risk factor distribution after the change, \(RR(x)\) the relative risk function, \(dx\) denotes the integration is done with respect to \(x\) and \(l\) and \(h\) are integration boundaries (12).

The PIF was used in the World Health Organization Comparative Risk Assessment study to estimate the percentage reduction in disease or death that would take place if exposure to common risk factors were reduced (13). A PIF is calculated separately for each of stroke, ischaemic heart disease and hypertensive heart disease.

We use this PIF value to calculate the resulting number of CVD deaths and non-fatal strokes that could be avoided per year by reducing sodium content in these foods to the levels highlighted. The PIF is multiplied by the total number of deaths occurring due to each condition (1) and to the number of new incident cases of stroke (14).

[Table 3 here]

**Results**
The total sodium intake due to bread in South Africa is 1.6 grams per day. A reduction in sodium content from 650mg per 100g bread to 350 mg per 100g bread would lead to an average reduction per person of 0.73 g per day of sodium intake. The addition of margarine, soup and seasoning would make the reduction per person per day 0.85g. The impact of this change in sodium intake on population systolic blood pressure varies by age and sex. Projected shifts in blood pressure distributions for the youngest and oldest age groups are shown in figure 1.

[Figure 1 here]

Applying the PIF values to the total number of fatal and non-fatal incident strokes estimated in South Africa in 2007 (14), we calculate that some 7,400 deaths would be prevented each year, with 6,400 of these coming from bread alone (Figure 2). Approximately 4,300 non-fatal strokes would also be prevented. Overall, approximately 8% of all strokes, 6.5% of ischaemic heart disease and 11% of hypertensive heart disease could be prevented.

[Figure 2 here]

Discussion

Reducing the sodium content of foods has the potential for large public health impact. As well as preventing 7,400 deaths due to cardiovascular disease each year, the prevention of non-fatal stroke cases will relieve pressure on an overburdened health system. Previously published data on the direct cost of treating stroke indicates that each stroke costs 76,000 ZAR to treat (excluding follow up and rehabilitation costs) ((15) translated to 2010 ZAR). This indicates a total saving of approximately 300 million Rands (~40 million USD) each year due to the prevention of non-fatal strokes. This saving does not include household costs, such as lost income, which can be significant in those with chronic disease.
With more than 90% of cost saving coming from bread alone, reducing the sodium content of bread is of the greatest importance in South Africa.

These numbers may underestimate the true impact of reducing sodium intake on stroke, as an independent effect not mediated through blood pressure has been hypothesized (16, 17). The evidence is not yet strong enough to support an independent assessment of this impact. Information also indicates that the impact of sodium reduction on people of African origin may be greater than its effect on those of European origin (18, 19); this possibility has not been included in this analysis. The analysis assumes that consumers will not increase their consumption of other high-salt foods if the salt content of the foods targeted in the analysis are decreased. It also assumes that regulation surrounding sodium levels of foods would affect all commercially available products.

The cost of baking a regular loaf of brown bread was 92.3 cents per loaf in 2005(9). The additional cost for reducing the sodium content was estimated at 0.0891 ZAR per loaf(9), however this full amount could not be attributed solely to the sodium reduction, as other micronutrient content was simultaneously increased. An updated study of the cost implications is required.

A recent analysis of data from a small observational study, with findings showing an inverse relationship between sodium intake and cardiovascular mortality, caused controversy as it suggested that the results contradicted the previously accepted relationship (20). The analysis has come under much criticism for having large amounts of missing data, using only one measurement of sodium intake and failing to account for confounding factors (21-23). Thus we did not include this information in our analysis.

Evidence indicates that a reduced sodium diet has an equivalent impact on hypertension as first line drug treatment with a diuretic or beta blocker (24). Individual measures to reduce sodium intake, such as dietary counseling targeted at people with hypertension, can have an impact on systolic blood pressure levels. However this impact is limited as most of the salt intake is derived from pre-prepared
food produced by the food industry (25). Population-wide strategies to reduce the non-discretionary intake of salt in food products, and thus reduce the population distribution of blood pressure, are expected to have an overall larger impact on population health at lower cost (26, 27).

Voluntary measures to reduce the sodium content of packaged food have been successfully introduced in a number of countries including the United Kingdom and Finland (28). The European Union has 11 countries signed up to a salt reduction program currently underway. In the UK, the Consensus Action on Salt in Health (CASH) group is a strong advocacy group that has been successful in convincing a number of major retailers to reduce the sodium content of pre-packaged foods by 10-15% (28). In contrast a study in Australia indicated that 20 times the health gain seen through voluntary changes could be achieved through mandatory legislative changes regarding the salt content of food (26). However introducing a sodium tax, an economic (dis)incentive intended to alter food purchasing behavior and hence decrease sodium intake, was estimated to achieve a smaller reduction in intake than mandatory changes with consequent smaller health effects (29).

The moves by the South African Department of Health to engage with the appropriate consumer and industry groups to begin the process of a voluntary reduction in sodium levels in foods should be applauded. Further engagement with companies producing cereals, gravies and soup mixes, which are consumed in high quantities in sub-populations within South Africa, is needed for a comprehensive salt reduction plan for processed foods. Potential industry concerns regarding consumer acceptance of lower-sodium products are unwarranted. Evidence indicates that the palate adapts to the lower sodium foods and consumer preference will change to these food, particularly if the salt content is repeatedly reduced in small incremental steps until the desired level of salt is achieved (30, 31).
Acknowledgements

This work has provided a rare but welcome opportunity for public health researchers to engage fully in a policy debate, and provide relevant, real time evidence to support the proposed legislative changes. The close relationship with policy makers developed through the PRICELESS-SA project (www.pricelesssa.ac.za) has been a vital aspect. The project will continue to engage with the Department of Health and provide further evidence where appropriate in support of the process of voluntary or legislative change regarding sodium in processed foods.

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References


9. Charlton KE. The development of a dietary intervention to modify dietary cation content and the evaluation of its effects on blood pressure in hypertensive black South Africans: University of Cape Town; 2007.


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<table>
<thead>
<tr>
<th>Salt intake by product</th>
<th>Bread</th>
<th>Soup powder</th>
<th>Seasoning</th>
<th>Margarine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>40.5%</td>
<td>2.9%</td>
<td>1.1%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Mixed Race</td>
<td>30.7%</td>
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<td>n/a</td>
<td>1.9%</td>
</tr>
<tr>
<td>White</td>
<td>25.2%</td>
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<td>n/a</td>
<td>2.7%</td>
</tr>
<tr>
<td><strong>Weighted average intake for whole population</strong></td>
<td><strong>38.0%</strong></td>
<td><strong>2.3%</strong></td>
<td><strong>0.9%</strong></td>
<td><strong>2.8%</strong></td>
</tr>
</tbody>
</table>
Table 2: Systolic blood pressure distributions in South Africa in 2000, by age and sex, corrected for regression dilution bias (11)

<table>
<thead>
<tr>
<th>Age in years</th>
<th>30-44</th>
<th>45-59</th>
<th>60-69</th>
<th>70-79</th>
<th>80+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Mean SBP</td>
<td>122</td>
<td>130</td>
<td>138</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>11</td>
<td>13</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Female</td>
<td>Mean SBP</td>
<td>116</td>
<td>128</td>
<td>167</td>
<td>141</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

BP in mmHg
Table 3: 10 year Relative risk of cardiovascular disease due to a 20 mmHg change in systolic blood pressure by age (1111)

<table>
<thead>
<tr>
<th>Age in years</th>
<th>30-44</th>
<th>45-59</th>
<th>60-69</th>
<th>70-79</th>
<th>80+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischaemic Heart Disease</td>
<td>0.49</td>
<td>0.50</td>
<td>0.54</td>
<td>0.60</td>
<td>0.67</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.36</td>
<td>0.38</td>
<td>0.43</td>
<td>0.50</td>
<td>0.67</td>
</tr>
<tr>
<td>Hypertensive Disease</td>
<td>0.19</td>
<td>0.20</td>
<td>0.22</td>
<td>0.25</td>
<td>0.31</td>
</tr>
</tbody>
</table>
Figure 1: Expected change in population distribution of systolic blood pressure due to a reduction in sodium content of bread, soup mix and seasoning. Solid lines represent the current distribution; dashed lines represent new distribution due to the change.
Figure 2: Number of cardiovascular disease deaths prevented per year due to a reduction in the sodium content of foods in South Africa