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Using Food Composition Tables to Estimate Decreases in Sodium Intake Due to the Reformulation of Packaged and Ultra-Processed Foods in a Young Population in South Africa

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Abstract

Objective: In response to increasing hypertension rates, South Africa implemented a regulation which set a maximum total sodium content for certain packaged food categories. We assess changes in reported sodium intake among 18-39 year old adults living in one township in the Western Cape as a result of the implementation of the regulation in 2016.

Design: By linking one set of 24 hour dietary recall data to two versions of the South Africa Food Composition Database which reflect the pre-regulation and post-regulation periods, we calculated changes in sodium intake due to reformulation of food products, not behavior change. We statistically tested differences in mean consumption in this sample with paired t-tests.

Setting: Langa, Western Cape, South Africa

Participants: Surveyed participants were residents of Langa between 18-39 years old (n=2,148)

Results: Before and after the implementation of the regulation there was a statistically significant decrease in the estimated sodium intake among adults of 189.4 mg (137.5, 241.4; p=0.00). Reported sodium from cured meat (such as Russians) and certain types of soup powder, cereals, and salted peanuts had a 9 to 33 percent lower calculated sodium consumption.

Conclusions: Our conclusions show that independent of any behavioral changes on the part of consumers, it is possible to lower sodium intake by using regulations to induce food manufacturers to lower the sodium levels in their products. As countries explore similar regulatory strategies, this work can add to that body of evidence to inform policies to improve the food system.

Keywords: Sodium; Hypertension; Regulation; Policy; Food composition tables

Introduction

Excessive consumption of sodium can lead to the development of hypertension and subsequent risk for cardiovascular disease, stroke, and other metabolic conditions.[1-4] South Africa has high hypertension rates, and trends over time revealed this prevalence is increasing, with higher risk among males, those that identify as black, live in an urban area, and those with self-reported high blood cholesterol.[5, 6] These increasing hypertension rates in South Africa have resulted in increased stroke and cardiovascular disease, adding a major strain to the healthcare system and to the government health budget.[7]

As most dietary sodium in South Africa comes from packaged and prepared foods such as breads, dried and processed meats, and ultra-processed snack foods, the reduction of sodium in these products can be an effective strategy to reduce overall consumption of sodium and risk of cardiovascular disease. Thus, in response to the increasing concern over consumption of these foods, in 2013 the South African National Department of Health passed new mandatory regulation limits on the quantity of sodium used in selected processed foods to be implemented starting in 2016.[8, 9] This regulation, called the *Reduction of Sodium in Certain Foodstuffs and Related Matters*, set a maximum total sodium content for certain packaged food products, for 13 food categories (**Table 1**). The sodium reduction goals were targeted across several industrially-produced food categories that utilized high sodium levels in their products. Mandatory guidelines for sodium levels limited specific foods with high consumption rates in South Africa, including bread, margarine, and soup mixes. It had a phased approach whereby the food manufacturers were instructed to reduce sodium levels in two waves by end of June 2016 and end of June 2019. For certain processed meat products, the limits were revised and the implementation date was amended to 30 April 2020.

By implementing this sodium reduction, South Africa is one of the first countries in the world (followed by Argentina in December 2013) to regulate sodium consumption at the manufacturing level for several commonly-consumed industrially-produced foods.[10] The food environment within South Africa is rapidly changing, with cheaper, energy-dense, ultra-processed and unhealthy food options becoming the food of choice for many.[11-14] A recent study by Charlton et al. reported that the population sodium intake of South Africans reduced by

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1.16 g salt per day between 2015 and 2018/early 2019, with the median salt intake in their sample group being 6.1 g of salt per day after the first phase of the sodium reduction strategy.[15] The same study found that younger people had substantially higher salt intakes than older adults, with a median salt intake of those aged 18 – 49 years estimated to be 7.8 g/day.[15] However, no studies have shown how the reformulation of these food products changed sodium consumption, without the influence of behavior change due to increased awareness of the regulation or rising cardiovascular disease rates. Furthermore, studies should consider the potential for these reformulations among younger, low-income, high packaged and processed food consumers, as the regulation may have a higher impact on the sodium consumption and subsequent health implications in these populations.

To bridge the existing research gaps regarding the effects of sodium regulations on low-income subpopulations, the objective of this study is to evaluate the changes in sodium intake among young adults aged 18-39 residing in a low-income township in the Western Cape, both before and after the sodium regulation was implemented in 2016. By applying food composition tables reflecting formulation of packaged and ultra-processed foods, we estimated how the sodium regulation resulted in reformulation of foods and thus changes in sodium intake, not accounting for changes in knowledge and subsequent nutrition-related behaviors. Given the anticipated reformulation of products containing an excessive amount of sodium that are known to be highly consumed in this population, we hypothesized that there will be a significant reduction in the consumption of sodium in this population due to the reformulation of packaged foods.

Methods

Updating Sodium Content in Food Composition Tables (FCTs)

Previous work has found that an estimated two-thirds of packaged foods in the South African Food Composition Database were reformulated to comply with the maximums set in the first phase of the regulation.[16-18] To update the food composition tables for the country and assess the sodium contents of foods, The South African Food Data System (SAFOODS) division of the South African Medical Research Council (SAMRC) directly sourced nutrient data via food company representatives. Locally accredited food laboratories chemically analyzed data, was

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used for updating the FCT with newer sodium values and other components. Standardized food compilation data quality assurance methods were applied to these data prior to updating the values in the FCTs used in this analysis: the 2017 Food Composition Tables which represents the sodium content of foods pre-regulation which were finalized prior to the 2016 regulation implementation date, and the 2021 version which represents the sodium content of foods post-regulation.[19,20] Data from nutrient facts panels or labels were not used to update the nutrient information in either version of the FCT.

24 Hour Recall Collection

We analyzed single-day 24-hour dietary recalls from a cross-sectional survey of young township adults aged 18–39 years living in the lower income Langa township near Cape Town, South Africa. Data for this analysis were collected in February–March 2018 (n=2,148). All participants gave written, informed consent to participate in the dietary recalls, which were collected as part of an evaluation of another policy change. Systematic door-to-door sampling was conducted and one randomly selected consenting adult between the ages of 18–39-year-olds per household was included in the study. The interviewer-administered household questionnaire was completed digitally using android phones and included a geolocation. For the diet assessment, 24-hour diet recalls were conducted by interviewers with nutrition training. Individual participants reported what foods and drinks were eaten, how foods and beverages were prepared, whether anything was added, and the quantity consumed. Data collectors did not prompt about addition of salt in meals at the table or in the cooking process. A multiple-pass approach, including detailed prompting, was used to enhance completeness. Only one diet assessment was completed for one individual within a given household.

Dietary recalls were coded by trained data capturers with high levels of previous nutrition experience. The SAMRC Food Quantities Manual and Composition Tables were used for coding. An extensive assumptions manual was developed to ensure coding decisions were made in a standardized manner.

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Analytical Approach

All analyses were conducted in Stata, version 16. Our key outcome variable was change in mg of sodium for all foods reported in the 24 hour recalls. By linking 2018 dietary intake data only to food composition tables created to reflect the pre-regulation period and then separately to the post-regulation period, we are able to calculate changes in sodium intake due to reformulation, not behavior change (since we are keeping the diet data consistent). Specifically, sodium content of foods reported were compared to sodium contents using the two versions of the South African Food Composition Database. Differences in nutrient values were statistically tested with paired t-tests to compare the mean sodium values of this sample between the two timepoints. Subgroup analyses were performed to look at changes in sodium consumption specifically among participants that were identified as "high" consumers of sodium in the pre-regulation period. High consumers were defined as those that consume more than the WHO recommended 2000 mg of sodium per day. [21]

Results

Changes in Reported Intake

Using the 2021 food composition table values (representing sodium values post-regulation), the mean estimated sodium intake was 1780 mg per day for men and 1515 mg per day for women. This is a decrease from the 1866 mg/day for men and 1620 mg/day for women when applying the pre-regulation food composition table values (representing sodium values pre-regulation). The mean estimated sodium intake measured using pre-regulation and post-regulation values was under the recommended maximum intake of 2000 mg per day set by the World Health Organization and the South African government for both men and women (**Table 2**). Between pre-regulation and post-regulation there was a statistically significant decrease in the estimated sodium intake among adults of 93.6 mg (76.5, 110.7; p=0.00).

Thirty percent of respondents reported consuming more than the recommended 2000mg before the implementation of the regulation. Among this population of high sodium consumers, the mean estimated sodium intake was 3188 mg per day for men and 2989 mg per day for women, as opposed to pre-regulation values of 3374 mg/day for men and 3260 mg/day for women. Between pre-regulation and post-regulation there was a statistically significant decrease

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in the estimated sodium intake among high sodium consumers of 189.4 mg (137.5, 241.4; p=0.00).

Changes by Food Category

In our study population, the food sub-categories that contributed the most amount of sodium in the diet were Russians, instant noodles, soup from powder mixes, grilled sausages, and brown bread (**Table 3**).

In comparing the values from the pre- and post-regulation food composition tables, the sodium content from salami meat and in certain types of soup powder was on average nine to ten percent lower, and nuts and seeds had a ten to thirty-three percent lower sodium content (given that they were classified as a savory snack under the regulation). We found that cereal products overall had a 16% reduction in sodium values driven by vast reduction in certain branded products. As an example, Rice Crispies in the pre-regulation FCT reported 1323 mg per 100 grams whist newer reference values listed in the 2021 FCT reports 330mg per 100g, which is approximately four times more sodium in earlier years reported by the manufacturer. Sodium content in other categories of foods had not changed significantly.

Discussion

When we applied sodium values from food composition tables reflecting the pre- and post-sodium regulation period to dietary intake data from a low-income adult population, we observed a statistically significant difference in estimated sodium intakes due to reformulation of packaged and ultra-processed foods. This study was done as a theoretical assessment to postulate effects of the regulation on sodium intake, so there are limitations in interpretation. Awareness of the sodium regulation could change food choice and consumption behaviors, which could be assessed with diet recalls performed before and after the implementation of the regulation on the same individuals. Our conclusions show that independent of any behavioral changes on the part of consumers, it is possible to lower sodium intake by using regulations to induce food manufacturers to lower the sodium levels in their products. We also showed that a policy such as this regulation may have a greater impact for high sodium consumers.

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A modeling study that informed the design of the sodium legislation in South Africa estimated that reducing current daily sodium intake by 850 mg per person, per day was a clinically relevant amount to show a decrease in cardiovascular mortality on a population level.[22] Although we observed a decrease between 93.6 and 189 mg of sodium, the values we saw represent an *underestimation* of the true sodium intake in this population because addition of table salt was not prompted during the collection of the 24 hour dietary recalls. For the 2017 Food Composition Table representing pre-implementation values, most values were updated after 2013 when the regulation was announced. The comparisons may underestimate the true level of change as "early adopted" companies may have reformulated shortly after the publishing of the draft regulations. Many food composition table codes represent composite values of many foods – including some that are a mix of regulated (ex. grilled sausage) and unregulated products (boerewors) which limits our ability to observe accurate changes in sodium. Additionally, updates to the sodium contents of the 2021 food composition table excludes recipes and foods prepared outside the home, which include highly consumed items such as chips (French fries). Furthermore, because differences in behavior were not assessed, we cannot tell if participants in the post-regulation period might have made up for the loss of sodium in packaged foods by adding salt at the table. However, the differences in sodium intake observed specifically from the consumption of packaged and ultra-processed food intake (93.6 overall and 189.4 in high consumers) will likely be similar if these behavior changes were introduced.

Conclusion

Subsequent to South Africa becoming the first Sub-Saharan African country to implement such a sodium regulation, other countries around the world are exploring similar strategies to reduce the growing rates of hypertension and cardiovascular disease. Our findings suggest that regulatory approaches to induce manufacturers to reduce sodium in their products can be a useful tool for improving population health. This work can add to that body of evidence, to inform policies to improve this imbalance in the food system in similar contexts.

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Table 1. Food groups and sodium targets under Regulations Relating to Reduction of Sodium in Certain Foodstuffs and Related Matters of 2013 (R.214) and Amendments (No.989 of 2016; No.1071 of 2017; No.812 of 2019) in South Africa

Food Category	**Max total Na per 100g as sold** **Phase 1 Target: 2016**	**Max total Na per 100g as sold** **Phase 2 Target: 2019**
Bread	400 mg Na	380 mg Na
All breakfast cereals and porridges, whether ready -to -eat, instant or cook up, hot or cold	500 mg Na	400 mg Na
All fat spreads and butter spreads	550 mg Na	450 mg Na
Ready-to-eat savory snacks, excluding salt-and -vinegar flavored savory snacks	800 mg Na	700 mg Na
Flavored potato crisps, excluding salt -and-vinegar flavored potato crisps	650 mg Na	550 mg Na
Flavored, ready-to-eat, savory snacks and potato crisps - salted and salt-and-vinegar only	1000 mg Na	850 mg Na
Processed meats – Cured	1300 mg Na* 30 Mar 2017	1150 mg Na* 30 Apr 2020
Processed meats – Uncured	850 mg Na	650 mg Na* 30 Apr 2020
Raw -processed meat sausages (all types) and similar products	800 mg Na	600 mg Na* 30 Apr 2020
Dry savory powders (not the instant type)	5500 mg Na	3500 mg Na
Dry gravy powders and savory sauce powders	3500 mg Na	2000 mg Na
Dry savory powders with dry instant noodles to be mixed with a liquid	1500 mg Na	800 mg Na
Stock cubes, Stock powders, stock granules, stock emulsions, stock pastes or stock jellies	18000 mg Na	15000 mg Na

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Table 2. Mean change in sodium intake values (mg) for men and women in one township in Western Cape, South Africa

	Men	Women	Total	Difference
All Participants (n=2162)				
Pre-regulation	1866.3	1619.9	1703.8	93.6 (76.5, 110.7)*
Post-regulation	1779.7	1515.0	1610.1	
High Consumers (> WHO recommended 2000mg/day) (n=651)				
Pre-regulation	3373.8	3259.6	3305.8	189.4 (137.5, 241.4)*
Post-regulation	3187.8	2989.4	3116.4	

*Indicates statistical significance ($p<0.05$)

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Table 3. Difference in Sodium Consumption (mg) by Applying Pre- and Post-regulation Food Composition Table Sodium Values to Same Dietary Intake Data

Food Category	**Average grams reported as consumed**	**Average Na Consumed per Meal using pre-regulation sodium values (mg)**	**Average Na Consumed per Meal using post-regulation sodium values (mg)**	**% difference**
Cereals and cereal products	201.5	358.68	302.01	-16%
Breakfast cereal - Corn flakes, plain	104.3	1355.95	515.47	-62%
Breakfast cereal - Rice Crispies	178.6	2362.50	580.36	-75%
Bread/Rolls, brown (fortified)	130.17	856.18	843.50	-1%
Bread/Rolls, white (fortified)	126.85	824.02	828.37	1%
Vegetables	63.7	33.97	33.92	0%
Fruits	152.7	5.03	5.01	0%
Legumes and legume products	91.2	170.47	158.97	-7%
Nuts and seeds	43.7	105.41	70.53	-33%
Salted peanuts	71.0	307.43	227.2	-29%
Milk and milk products	158.2	127.68	131.84	3%
Eggs	116.7	142.05	139.78	-2%
Meat and meat products	67.1	219.10	212.23	-3%
Salami, beef/pork, including Russians	91.8	1769.36	1612.42	-9%
Sausage, beef, grilled	154.1	1858.47	1848.96	-1%
Sausage, beef, dry, including droë wors	130.9	2114.74	2114.74	0%
Sausage, beef and pork, grilled, including boerewors	143.1	1322.10	1329.27	1%
Fish and seafood	120.6	349.66	356.10	2%
Fats and oils	20.5	126.61	118.85	-6%
Sugar, syrups and sweets	180.8	14.24	15.89	12%
Soups, sauces, seasonings and flavourings	57.1	418.78	377.24	-10%
Soup, powder, onion	41.4	3708.20	3324.83	-10%

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