

## Conference on ‘Transforming the nutrition landscape in Africa’ Plenary Session 8: Sodium Reduction

### Assessment of salt intake: how accurate is it?

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The aims of this review paper are to provide an overview of the association of sodium intake with cardiovascular health, to identify sodium in our global food supply and to describe problems associated with assessment of dietary sodium intake. Excess sodium intake may contribute to the development of hypertension in some individuals, consequently increasing CVD risk. The average intake of sodium in populations around the world far exceeds the actual body's needs. Processed and restaurant foods contribute the most dietary sodium for Americans and other populations worldwide. There is a worldwide focus on reducing sodium content of food products in an effort to reduce health related issues associated with excessive salt and sodium intake in individuals. In several countries, regulations have been introduced to lower the sodium content of foods. Manufacturers are complying with these regulations by formulating new products to meet these standards. However, the variability in food sodium content poses challenges to researchers to accurately assess dietary sodium intakes of individuals. There are differences in sodium content of foods in databases compared with nutritional information provided by manufacturers for the same food products. Variations also exist in restaurant foods, where values differ from those available on restaurant websites. Sodium may be either underestimated or overestimated; it is not always on target. Awareness of the variability among food products is crucial but capturing sodium content of every food in the market is not feasible. Whenever possible, updating databases is critical. In conclusion, it is not feasible to capture the sodium content of every food in the marketplace but being aware of these differences is essential to assessing actual sodium consumption. Since biological determinations are burdensome and impractical, it is imperative for researchers and other health professionals to participate in the development and implementation of tools to accurately assess sodium intake in individuals.

**Sodium: Marketplace variability: Sodium variability: Dietary assessment: Food composition**

Sodium and salt intakes continue to pose a challenge in several realms worldwide. Physiologically, sodium intakes exceed need, with mean intakes  $>100$  mmol (2.3 g)/d in most adult populations and some Asian countries  $>200$  mmol (4.6 g)/d<sup>(1)</sup>. This is projected to cost US\$93.5 billion in health care services, medications and missed work days in the USA<sup>(2)</sup>. In 2011, it was estimated that 31.9% of the US population suffered from hypertension and of those, 46.7% have uncontrolled blood pressure<sup>(3)</sup>. Estimates from Canada

are that 17.1% of Canadians aged 12 and older reported suffering from high blood pressure with rates increasing with age for both males and females<sup>(4)</sup>. In Africa, it has been reported that hypertension has become an important health problem and hypertensive heart disease and failure are the most common of the CVD<sup>(5)</sup>. In four rural and Sub-Saharan African communities, it was found that hypertension was the most frequently observed risk factor contributing to CVD; the prevalence varied between

**Abbreviations:** USDA, United States Department of Agriculture.

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19 and 38%, with disturbingly low levels of hypertension control<sup>(6)</sup>.

When one reviews the need for sodium in the diet, there clearly is more consumed than required. The Centers for Disease Control in the USA has estimated the daily need for sodium to be between 180 and 500 mg/d<sup>(7)</sup>. The recommended adequate intake is 1500 mg/d and the upper tolerable level proposed at 2300 mg/d<sup>(7)</sup>. Estimates are that the average intake within the US population aged 2 years and older is just over 3400 mg/d<sup>(7)</sup>.

### Salt and sodium in the food supply

Processed and restaurant foods contribute greatly to the intakes of salt and sodium. The National Heart, Lung and Blood Institute of the National Institutes of Health in the USA has reported that as many as 150 000 lives per year would be saved if the sodium levels in processed foods and restaurant foods were cut in half<sup>(8)</sup>. Estimates from the early 1990s were that the American diet contained approximately 77% of sodium intake attributed to processed and restaurant foods, 5% added during food preparation and 6% at the table, with only 12% naturally occurring<sup>(9)</sup>. These estimates have not changed much over the years since this report.

Health authorities in Canada listed major food group contributors to sodium intake in the Canadian diet, noting that some foods, although high in sodium were consumed in lesser amounts while some lower sodium foods were eaten in higher amounts<sup>(10)</sup>. The following categories were included: 14% from breads, quick breads and other bread-like products; 9% each from processed foods and from vegetable-based dishes, tomato and vegetable juice; 7% from soups; 6% from pasta-based dishes; 5% from cheese; 4% each from milk products, red meat-based dishes, poultry-based dishes and gravies and sauces; 3% each from pizza, breakfast cereals and potato-based dishes; 2% each from fish and shellfish dishes, eggs, rice-based dishes and potato chips and salty snacks; 17% was attributed to other food types.

In the USA, current estimates are that >40% of the sodium consumed comes from the following ten types of foods<sup>(7)</sup>: (1) breads and rolls, (2) cold cuts and cured meats such as deli or packaged luncheon meats, (3) pizza, (4) fresh and processed poultry, (5) soups, (6) sandwiches such as fast food burgers, (7) cheese, (8) pasta dishes, (9) meat mixed dishes such as meat loaf with tomato sauce and (10) snacks, including chips, pretzels and popcorn. Sources of foods matter with 65% of sodium coming from foods purchased at retail stores and 25% from restaurants<sup>(7)</sup>. Recommendations are to look for lower sodium choices in retail stores since the nutrition facts label is helpful and to realise that there are differences in sodium content among different brands. In a restaurant establishment, it is difficult to determine how much sodium is in foods.

The range of sodium content for foods in the USA varies<sup>(11)</sup>. Breads can vary from 95 to 210 mg sodium per 28.4 g (ounce), whereas frozen pizzas can range from 450 to 1200 mg sodium per 113 g (4 ounce) portion. Variation in salad dressings, soups and tomato juices can also be

quite large. The magnitude of the problem within the USA becomes more evident when one considers that the average number of items carried in a US supermarket in 2010 was 38 718<sup>(12)</sup>.

Years ago the first of the major points of contention was the fat content of the diet, and manufacturers successfully reduced fats and *trans* fats. These foods remain the largest health food category in supermarkets<sup>(13)</sup>. Manufacturers reformulated products to create healthier versions acceptable to the consumer in fat content and flavour. However, sodium content was often increased to replace the flavour of the missing fat.

In 2007, Tony Clement, the Canadian Federal Health Minister, stated he wanted to wean the country off salt. He claimed that up to 15 000 Canadians were dying every year due to excessive sodium consumption<sup>(14)</sup>. Yet in 2009, there was still no plan implemented to reduce sodium consumption.

In South Africa, there is a plan to cut salt intake in half<sup>(15)</sup>. South African food manufacturers will have until June 2016 to comply with a first set of sodium targets and an additional 2 years to meet the next set of targets. It has been reported that approximately 60% of sodium consumed by South Africans comes from processed foods. Also reported was that many poor South Africans have a diet very high in salt, as their staple starch is bread and that South African bread is the saltiest in the world. In 2011, the Health Minister of Africa began a crusade to decrease the amount of salt in the South African diet. Studies show that reducing salt in bread will save close to 6500 lives per year<sup>(16)</sup>. Unlike the UK which implemented voluntary sodium reduction in 2003, the South African government plans to regulate the sodium initiatives.

The news media in South Africa quoted a health department official as indicating that hypertension affects 6.3 million South Africans and is one of the highest incidences in the world<sup>(17)</sup>. The same report indicated that studies revealed that South Africans were consuming as much as 40 g salt per day. The proposed regulations would allow a maximum of 400–750 mg/100 g of some high-sodium-containing food categories. The penalty for non-compliance by a manufacturer would be up to 2 years in prison. In May 2012, a workshop was held by the International Union of Nutritional Science and Unilever. Its aim was to generate ideas for approaches to promote salt awareness and intake in the South African public<sup>(18)</sup>.

### The need to reduce salt and sodium in the food supply

High blood pressure levels may cause arterial disease and kidney, eye or heart damage before the diagnosis of hypertension<sup>(19)</sup>. Elevated blood pressure increases risks for heart attack, congestive heart failure, stroke and end-stage renal disease<sup>(8)</sup>. Reducing dietary sodium intake can both treat and prevent hypertension and lower high blood pressure<sup>(19)</sup>. The WHO<sup>(20)</sup> has estimated that reducing dietary sodium intake by 50 mmol (1.15 g)/d would lead to 22% reduction in the number of deaths from strokes and a 16% reduction in deaths from CHD. Because decreasing sodium consumption can be accomplished by

changing the population's food supply, it represents the most practical way to combat this public health problem.

Almost half of consumers (47%) assume responsibility for ensuring the food they eat is nutritious<sup>(21)</sup>. A total of 15% of consumers hold manufacturers and food processors responsible, 15% believe that it is the government's role and 5% feel that supermarkets are responsible; nonetheless, salt and/or sodium is a top nutritional concern for only about 17% of consumers<sup>(21)</sup>. Although the majority of consumers take responsibility for choosing healthy foods, the manufacturers and supermarkets still represent areas where a small reduction of sodium in foods could yield a significant reduction in sodium intake by consumers.

A 2007 report indicated that Canadians needed to lower their salt intake in order to bring sodium consumption down to healthy levels by 2020, with the target for lowering of sodium through processed foods; and furthermore, Canada's Health Minister indicated that sodium was a bigger health threat than *trans* fats<sup>(14)</sup>. Much like the South African initiatives previously mentioned, the intent is to reduce the amount of salt consumed through regulation and an education campaign in order to improve cardiovascular health.

### Food manufacturing changes

Food manufacturers should be encouraged to reduce the sodium added to food during processing in order to increase the potential for a population-wide mean reduction in blood pressure values<sup>(22)</sup>. Food manufacturers use salt in their products not only to enhance flavour, but also to maintain the quality of the food during processing. Both the Center for Science in the Public Interest and the American Medical Administration have asked the Food and Drug Association to regulate more closely the amount of salt in processed foods and to improve education for consumers on low-sodium diets<sup>(13)</sup>. In 2011, the Center for Science in Public Interest reported that the amounts of salt used in packaged and restaurant foods make it the deadliest ingredient in the food supply, causing high blood pressure, heart disease and kidney problems<sup>(23)</sup>. Recent efforts in the USA and abroad to reduce sodium in food were outlined in an October 2010 report from a WHO and Government of Canada joint technical meeting<sup>(24)</sup>. In that report it was noted that Campbell's expanded its number of low-sodium foods from 24 in 2005 to 100 in 2009. ConAgra planned to cut overall sodium use by 20% by 2015, a reduction of more than 160 products. General Mills, with products in the African markets, also planned to cut sodium by 20% by 2015, which involved 600 products accounting for 40% of their products in ten categories. Kraft planned to reduce sodium by 10% over a 2-year period. Nestle, a worldwide company, will reduce sodium by 25% over a 5-year period. Sara Lee planned to cut sodium use by 20% over a 5-year period. Finally, Unilever was conducting a worldwide Nutrition Enhancement Programme to reduce levels of sodium and other nutrients of concern. Of course as time goes on, it is anticipated that food manufacturers will address the concern over sodium in the food supply as

effectively as total, saturated and *trans* fats were addressed. According to Cassels<sup>(25)</sup>, the war on salt will overshadow the war on *trans* fats.

### Products in supermarkets

A supermarket is any full-line, self-service grocery store generating a sales volume of US\$12 million or more annually, as reported by the Food Marketing Institute<sup>(12)</sup>. There is a large variation in the sodium content between similar foods in the supermarket. For example, private label products and name brand products may not only differ in cost but may also vary in the sodium content. When economy-minded consumers compare two identical products, they may choose the lower priced product without recognising the higher sodium levels<sup>(22)</sup>. Variation in sodium levels within food categories suggests that sodium levels can be reduced without compromising taste and shelf life.

The Center for Science in the Public Interest in the USA published a document entitled 'Salt Assault: Brand-name Comparisons of Processed Foods in 2005'<sup>(26)</sup>. This publication illustrated the variation of sodium in the food supply in the USA focusing on two sources of foods: packaged foods and restaurant foods. Wide variations were seen in sodium content among brands and in different restaurant foods. It was evident some brands may have 50–100% more sodium than competing brands. There were no consistent patterns among products tending to be lower or higher in sodium. While intended to make a case for lowering the sodium content of the US food supply, the publication effectively illustrated existing variations among products and brands at the time of its publication.

### Methods to identify sodium in the food supply

Considering the plethora of food products in supermarkets, it is not possible to capture the sodium content of every product. This variability makes it challenging to accurately assess dietary sodium intake of individuals. Nutrient data collected from US supermarkets and fast food websites were compared against the United States Department of Agriculture's (USDA) Food and Nutrient Database for Dietary Studies<sup>(27)</sup>. Several different frozen dinner brands were averaged and compared with the meal equivalent in the USDA database. Generic fast food meals from the USDA database were compared with nutrition information from popular fast food restaurants' websites. To assess the magnitude of the variation, it was necessary to evaluate the weight of the product in the food composition database with the weight of the product as packaged (in the case of the frozen dinner comparisons) or as purchased from the fast food establishments (with data from the relevant fast food website). While this procedure does not lend itself well to statistical testing, it is valuable to assess the potential variation in estimating sodium content by comparing database values with actual information provided from the manufacturer.

**Table 1.** Comparison of Nutrient Values in FNDDS (USDA Food and Nutrient Database for Dietary Studies, 2.0. 2006. Beltsville, MD: Agricultural Research Service, Food Surveys Research Group) Fast Foods with Data from Fast Food Establishments

| Description  | Portion                      | DB g | Grams actual* | Na (mg), FF web* | Na from DB wt | Diff from DB wt | Na from actual wt | Diff from actual wt |
|--|------------------------------|------|---------------|------------------|---------------|-----------------|-------------------|---------------------|
| Cheeseburger, with mayonnaise or salad dressing and tomatoes, on bun – Generic | 1 cheeseburger               | 167  |               |                  | 775           |                 |                   |                     |
| Includes:  |                              |      |               |                  |               |                 |                   |                     |
| Fast food restaurant 1   | 1 cheeseburger               | 161  | 170           | 780              | 747           | -33             | 789               | 9                   |
| Fast food restaurant 2   | 1 cheeseburger               | 194  | 184           | 970              | 900           | -70             | 854               | -116                |
| Fast food restaurant 3   | 1 cheeseburger               | 179  | 179           | 730              | 831           | 101             | 831               | 101                 |
| Cheeseburger, 1/4 lb meat, with mayonnaise or salad dressing, on bun – Generic | 1 (1/4 lb) cheeseburger      | 228  |               |                  | 1259          |                 |                   |                     |
| Includes:  |                              |      |               |                  |               |                 |                   |                     |
| Fast food restaurant 1   | '1/4 lb Double Cheeseburger' | 226  | 186           | 1120             | 1248          | 128             | 1027              | -93                 |
| Fast food restaurant 2   | 'HB Deluxe w/Cheese'         | 239  | 184           | 970              | 1320          | 350             | 1016              | 46                  |
| Fast food restaurant 3   | 'Ultimate Cheeseburger'      | 239  | 323           | 1580             | 1320          | -260            | 1784              | 204                 |

DB, database values (FNDDS); FF, fast food website information; wt, weight (g); Diff, difference; Na, sodium.

\*Indicates data obtained from the fast food website.

The comparisons between frozen dinners in the Food and Nutrient Database for Dietary Surveys with manufacturer nutrient composition information were enlightening. An item compared for sodium content was Swedish meatballs, gravy and noodles frozen meal. The generic description compared well with the marketplace products (Lean Cuisine, Michelina's Lean Gourmet and Weight Watcher's Smart Ones). The sodium levels for these were close to the values in the database (653 mg v. 660 mg). The second comparison made was for fried chicken dinner, frozen meal, large meat portion and the variations in sodium were more extreme. The generic meal in the database contained a sodium content of 1863 mg sodium per meal; Banquet Hearty Ones contained 2550 mg or 36.8 % more, Swanson's Hungry Man 2300 mg or 23 % more and Swanson Hungry Man Classic 1940 mg or only 4 % more than the generic descriptor. Depending on which product an individual ate, certainly it is evident from this data that the estimate of sodium could vary greatly. It is worthy of mentioning at this point that when one considers the many frozen dinners in the marketplace and how frequently new ones are appearing, that the dilemma for those individuals who update the food composition tables, e.g. USDA, Health Canada, West Africa and others, is overwhelming.

Fast food comparisons were made using a description of the food generically and then comparing it to those items which the USDA Food and Nutrient Database for Dietary Surveys included to fit that description. The portion of the food and the weight of that portion both within the database were compared with the actual weight as listed by the fast food restaurant. Sodium was compared in two ways: that from the fast food website and that calculated from the weight in the database. The sodium difference between actual and calculated was also compared. Sodium from the actual weight and the sodium difference from the actual weight were calculated and are presented in Table 1. In the database, a cheeseburger with mayonnaise or salad dressing and tomatoes on a bun was 167 g and the three types included in that description varied in weight, with the listed weight of fast food restaurant 2 'Hamburger Deluxe with Cheese' weighing 194 g. The website listed it as actually weighing 184 g. When the sodium content was calculated using the database weights, sodium varied from -33 to +101 mg. When the sodium content from the actual weight of the product is calculated using the actual weights, sodium varied from -116 to +101 mg, substantial differences.

The second example shown in Table 1 is a quarter pound cheeseburger with mayonnaise on a bun which was listed as containing 1259 mg sodium. Compared with an 'Ultimate Cheeseburger' from fast food restaurant 3 which had 1580 mg sodium, the difference in sodium is notable but is largely due to the actual weight of this product. Even though the products are often logical choices for the generic description, the variation between sodium based on actual v. calculated is relatively high.

Therefore, it is necessary to investigate not only the appropriateness of the description of the products but confirm that the portion sizes within the database actually reflect that consumed by participants in research studies



collecting dietary intakes. Sodium recorded in the database may reflect erroneous weights. When compared with the actual sodium information, it is easy to realise that these differences exist and need to be considered.

### Methods to identify sodium in the diet

As alluded to previously, reported intakes, regardless of methodologies used to collect them, warrant careful examination of sodium values especially if this is the outcome of interest. While extensive dietary records may be valuable, the participant burden is significant and may not be practical in African studies. Charlton *et al.*<sup>(28)</sup> developed and validated a short FFQ to assess habitual dietary salt intake among South Africans. This instrument allowed classification according to intakes above or below the maximum recommended salt intake of 6 g/d. From a practical standpoint, this may be more useful for public health perspectives and potential recommendations in the future. Assessing dietary intakes with dietary records, dietary recalls and FFQ limit exactness of the data. Biological assessments of sodium intakes using 24 h urine collections are considered the gold standard. The drawbacks to this method include the individual's willingness to complete the collections and the widespread problem of incomplete collections<sup>(29)</sup>. Gerber and Mann<sup>(30)</sup> found that when compared with 24 h urines, agreement with self-reported sodium intake was poor. They reported that overall sodium excretion exceeded 100 meq among 75% of their subjects who indicated they consumed either average or high intakes of sodium. Of even more interest, among 57% of subjects who reported that they consumed low-sodium diets, their sodium excretion also exceeded 100 meq. Gerber and Mann<sup>(30)</sup> also reported that urine collections were often incomplete; among those who reported low sodium intakes, sodium excretion exceeded 100 meq in 80% of those submitting complete collections, but only 29% of those submitting incomplete collections. They concluded that sodium intake is frequently underestimated based on incomplete urine collections.

### Conclusions

As has been reported previously, current data from supermarkets, fast food chains and restaurants confirms the variability of sodium content in foods consumed worldwide<sup>(31)</sup>. Knowing the variability of sodium content in foods is crucial; however, it does not appear to be feasible to capture the sodium content of every food in the marketplace or meals away from home. Updates to food composition tables and nutrient databases are essential if sodium intakes are to be evaluated using routine dietary assessment methodologies.

Awareness of the variability of sodium among food products is absolutely essential. Because a large proportion of the population tends to eat away from home, restaurant and processed foods are a high priority. USDA food composition tables as well as food composition tables from other countries are commonly used in dietary assessment; therefore it is crucial to recognise inconsistencies in the

foods. Intended use of the data will drive many decisions regarding whether specific foods need to be modified before sodium consumption can be characterised.

As has been proposed by WHO and the Canadian Government, there are challenges given the current supply worldwide and the behaviour of the individual<sup>(24)</sup>. Researchers and health professionals need to support and participate in continued research on sodium consumption and sources of sodium in diets of populations globally. Researchers need to participate in the development and implementation of tools to both monitor and evaluate sodium intake more effectively. Researchers need to proactively advocate for and assist in the evaluation and monitoring of evidence-based policies for sodium reduction and further monitor and support those reduction policies. Monitoring what influences sodium intakes at a population level is important, as is monitoring health related issues and trends in sodium in the food supply and in consumption.

So, in response to the question 'how accurate is the assessment of salt intake,' the answer is 'not very accurate.' However, it is clear that a worldwide focus on reducing salt in food products and initiating behaviour-change strategies to enable individuals to more effectively lower their intakes of salt will be important in creating awareness of health issues related to excessive salt intake. These are steps in the right direction and will potentially further efforts to better estimate salt and sodium intakes by researchers.

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