

A REVIEW OF METHODS TO DETERMINE THE MAIN SOURCES OF SALT IN THE DIET

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WHO/PAHO Regional Expert Group for Cardiovascular Disease
Prevention through Population-wide Dietary Salt Reduction

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Section 1: Introduction

For countries to effectively direct their policies and interventions at lowering dietary salt, they need to monitor how much salt people are eating and identify the main food sources of salt¹. To determine total salt intake, there is a Protocol for Population Level Sodium Determination in 24-hour Urine Samples, prepared by the WHO/PAHO Regional Expert Group for Cardiovascular Disease Prevention through Population-wide Dietary Salt Reduction. For the Protocol, see http://new.paho.org/hq/index.php?option=com_content&task=view&id=3072&Itemid=2376.

This Review is the companion to the Protocol, intended to assist governments and other public health agencies in determining the main sources of dietary salt, to inform their decisions on how best to reduce salt intake. The description of methods is a compilation of general information and the specific experiences of a number of nutrition science experts in North, Central and South America and the Caribbean, identified in the list of acknowledgements.

Primary aims

The Review features the combination of methods and data sources that will deliver a complete profile of the dietary sources of salt by identifying:

- foods that people eat and the amounts and frequency of consumption
- sodium content of the most commonly consumed foods
- the amount of salt added at the table and in cooking
- intake of high-sodium foods that are culturally or regionally-specific

The variety of methods employed to assess the sources of salt in the diet reflect the complexity and dynamic nature of food supplies. This Review is designed to assist countries in selecting what is appropriate to their resources and circumstances. Once baseline data on the of sources and amounts of dietary salt are determined, ongoing monitoring is needed to keep up with changes e.g. the introduction of new and reformulated food products and population shifts in eating habits.

Other factors to consider

- Data on several nutrients of concern to public health nutrition policy, in addition to sodium, can be captured with the methods described here, for example, saturated fats, trans fatty acids, fibre and total sugar.
- If the individual food products in food consumption surveys and in the food composition tables are grouped into broad categories such as breads, processed meats, etc, they can become the basis for raising awareness among consumers as to the food categories that contribute the most salt to the diet.
- Grouping food products according to common formulations, functions or processes can also serve as a useful basis for setting reduced-sodium targets with the food industry.

¹ Equivalencies: 5 gm salt (NaCl) = 2000 mg sodium (Na) = 87 mmol sodium = 87 mEq sodium

- Questions on knowledge, attitudes and behaviour (KAB) can be added to a food consumption survey to gain more information about consumers' perspectives on salt that can inform interventions and communication strategies. A sample set of KAB questions is provided in the Protocol mentioned above.
- Countries with fairly common food cultures in a particular region can explore opportunities for joint approaches or harmonized tools that may provide economies of scale to determining the main sources of salt in diets.

Intended audience

Governments, public health agencies and principle investigator(s) for studies of nutritional habits to determine the sources of sodium in the diet.

Section 2: Food Consumption Surveys

2.1 Overview

Ideally, a national food consumption survey is cross-sectional in nature, capturing food consumption data from which nutrient intakes are calculated as well as collecting height/weight measurements of respondents and sometimes their nutritional and health status. Below are considerations when designing a nutrition survey.

Who to survey	Which ages – infants, children, adolescents, adults, elderly people
What to survey	All foods consumed by the population whether at home, in restaurants, canteens, cafeterias in schools or workplaces, etc. (depends on who is being surveyed and where they eat)
Possible exclusions	People in remote locations, the military, institutions such as nursing homes, hospitals etc. (depends on who is being surveyed)
Representativeness	• Nationally (and/or state/provincially) representative, or representative sentinel sites, based on census data for each age/gender group (groups should be consistent with age groups used for national nutritional recommendations). • Where census data are lacking, different sampling methods can be applied such as convenience samples in urban and rural settings.
Other data to collect	May want to collect information on selected health conditions, socioeconomic or demographic characteristics
When and how often to survey	• Ideally continuously with national commitment for cycle repeats e.g. every 3, 5, 10 or 20 years, or • Periodically as national resources permit

General challenges with surveys

-
- Need to systematically use probing questions and if possible observe existing foods and preparations, to ensure that respondents accurately record all foods eaten and amounts
- Need to measure serving sizes, portions eaten (and frequency of consumption if applicable)
 - Need to calculate ingredients and amounts in recipes
 - Consumption of mixed dishes can make it difficult for participants to recall and assess items and amounts of food consumed during a meal
 - Store-bought versus restaurant versus home-made foods – are not always the same in terms of ingredients, serving size, or nutrients
 - Anticipate specific challenges when surveying young children and the frail elderly
 - need to question parents, daycares, care-givers
 - often not sure how much is served versus eaten
 - Households eating from a communal pot during meals can make it difficult to assess food consumption of individuals
 - Some diets may include complex stews and soups, in which water and extra ingredients are added to an existing dish over a day or more, and portions are taken as needed
 - Can be difficult to estimate sodium losses with some food preparation practices e.g. soaking or rinsing of foods prior to preparation or discarding salted cooking water [1]
 - Food terminology can vary
 - Household measures can vary
 - Foods consumed must be linked to relevant food composition databases/tables to determine sodium content (see Section 3)
-

Challenges specific to accounting for foods with salt/sodium additives

-
- Once changes and reformulations start occurring, the composition of similar food products may vary greatly between manufacturers.
 - In some circumstances, a variety of sodium additives can be used interchangeably.
-

2.2 Methods that Provide Direct or Primary Data on Food Consumption

A number of methods can provide direct or primary data on food consumption, requiring participants to provide personal information on what they typically eat and drink in a defined period of time [2,3,4]. The main methods used currently for dietary assessment are described below with examples following.

	Descriptions and considerations
24-hour food intake recall	A systematic questionnaire/survey designed to capture all foods consumed in a defined 24-hour period. • ideal method commonly used by government agencies for national surveys • foods with a certain threshold of intake and sodium content per serving can be added [15] • a number of governments have extensive experience with this survey methodology (see below the US National Health and Nutrition Examination Survey (NHANES) and the Canadian Community Health Survey (CCHS) 2.2) may be expensive • requires considerable analysis to categorize foods and extensive follow-up questions to ensure complete recalls • may not be representative of usual consumption patterns if limited to a single day recall • distribution of single day intakes shows larger variance than usual intake distribution; requires a repeat recall on a different day (ideally a week day and a weekend day) from a sub-sample of respondents to estimate usual intakes • difficult to model usual intake for episodically consumed foods e.g. seasonally available • can have large variations by geographic area e.g. rural versus urban statistical challenges: need to account for days without food consumption; allow for consumption-day amounts that are positively skewed • recent improvements include computer assisted questionnaires (see the multi-pass method below)

**Food frequency
questionnaires
(FFQ)**

Participants indicate their usual dietary intake – how frequently certain foods and food groups on a pre-defined list are consumed during a specified period of time.

- suitable for population surveys
- relatively inexpensive
- most amenable to web-based administration
- recent improvements include a number of on-line and web-based versions which are often easier and quicker to complete
- can capture intake of all nutrients of interest to national nutrition policy and can inform on overall dietary adequacy
- can be expanded or contracted to include or isolate high salt/sodium food items
- can add questions on salt added at table or in cooking
- can add questions on respondents' willingness to reduce dietary sodium
- can add questions on consumption away from home to monitor the nutrition transition
- In lower resource situations, can consider sentinel food surveillance
- usually requires validation food diaries done in a sub-sample of the same population
- represents usual nutrient intake, as diet is assessed over long periods of time (e.g. previous 12 months)
- field staff require extensive training to ensure data consistency
- are typically long because of the need to be comprehensive of common food products

**3-day, 7-day food
diaries**

Written records of all foods and beverages consumed and amounts over 3 or 7 days.

**Duplicate food
collection or
weighed food
consumption**

**The preparation of two identical plates of every food consumed one of which is sent to a laboratory for chemical analysis of nutrient content.
Accurate weighing of all foods consumed combined with analysis or calculation of nutrient composition.**

- usually used only for research projects
- very time consuming with heavy burden on participants
- relatively expensive

Example 1: US NHANES 24-hour food recall

NHANES is a program of studies designed to assess the health and nutrition status of adults and children in the United States, combining interviews with physical examinations. For survey questionnaires, examination components and laboratory components for 2009-2010, see http://www.cdc.gov/nchs/nhanes/nhanes2009-2010/questexam09_10.htm. A dietary screener module is available at http://www.cdc.gov/nchs/data/nhanes/nhanes_09_10/mi_dtq_f.pdf and a dietary data tutorial is available at <http://www.cdc.gov/nchs/tutorials/dietary/index.htm> to promote broader and more proficient use of NHANES data.

NES also includes some FFQ modules. English and Spanish versions of the NHANES FFQ are available at <http://riskfactor.cancer.gov/diet/usualintakes/ffq.html>

Example 2: CCHS 2.2 24-hour food recall

The survey provides national nutrition data about the food and nutrient intakes of Canadians and the relationship between diet and a wide range of health correlates. The 24-hour recall instrument is described at <http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=5049&lang=en&db=imdb&adm=8&dis=2>.

The last CCHS survey also included a series of short questions on health, demographics and socio-economic status, and had several targeted FFQs, for example on use of salt, supplements, fruit and vegetable consumption, etc. A guide to help with assessing and interpreting the data is available at http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/surveill/cchs-guide-escc-eng.pdf

Example 3: Automated multiple-pass method for 24-hour recall

Automated multi-pass method (AMPM) is a computerized method for systematically collecting interview-administered 24-hour dietary recalls either in person or by telephone. The field staff follow five research-based steps designed to enhance complete and accurate food recall and reduce respondent burden (see below). Information about the AMPM is available at the USDA web site – <http://www.ars.usda.gov/Services/docs.htm?docid=7710>.

Step 1	Quick List •Everything you had to eat or drink yesterday
Step 2	Forgotten Foods •List of foods often forgotten e.g. coffee, tea, soft drinks, milk, juice, water
Step 3	Time and Occasion •Breakfast, lunch, dinner, snacks
Step 4	Details •Types – e.g. bread (white, brown, rye, etc) •Amounts – number, size of unit (use pictures, models)
Step 5	Final Probe •Anything else, even small amounts at e.g. meetings, while shopping, cooking, etc.

Sample Screen Viewed by Field Staff

Diet*Calc Data Entry - C:\TQ8\CH22\INTAKE\INTAKE

Forms Answer Navigate Options Help

SANDY SMITH (35, F), N1.001.IN.01.001

Please tell me everything you had to eat and drink all day yesterday, Tuesday, from midnight to midnight. Include everything you had at home and away, even snacks, coffee, soft drinks, alcoholic beverages and water. I'll ask you for specific details and amounts of the foods in a few minutes. At this time, just tell me what you had.

[ENTER THE NAME OF EACH FOOD ON A SEPARATE LINE. USE COMMENT, TIME, AND OCCASION FIELDS ONLY IF RESPONDENT PROVIDES DETAILS.]

	RECFoodName	RECComent	RECTime	RECO	RECOccasionOS
[1]	Toast				
[2]					
[3]					
[4]					
[5]					
[6]					
[7]					

Example 4: National Cancer Institute diet history questionnaire

Diet History Questionnaire II (DHQ II) is a food frequency questionnaire developed by the US National Cancer Institute. It consists of 134 food items and includes both portion size and dietary supplement questions. It takes about one hour to complete and was designed to be easy to use. Web based versions are likely to take less time to complete. Full information about the DHQ (forms, web versions, data analysis) is available at <http://riskfactor.cancer.gov/dhq2/about/>.

The original DHQ was validated against a number of other food frequency questionnaires, with response rates varying from 70-85%, not statistically different from shorter FFQs. Diet*Calc PC software can be used to analyze DHQ data for nutrient intakes. A Dietary Assessment Resource Manual is available in Spanish, published in 2006 by the Instituto de Nutrición de Centro América y Panamá (INCAP).

2.3 Using Indirect or Secondary Data Sources

Indirect or secondary data on food consumption are typically collected by departments of finance or agriculture or by market research companies for purposes other than nutrient intakes or nutrition policy. While these data sources cannot provide precise estimates of individual food intake, they have long been used to track information on national supply and household availability of sometimes thousands of food items, summarized into broad categories of food commodities such as cereals, grains, fruits and vegetables to correspond to dietary guidelines. Estimating the intake of high salt/sodium products from secondary sources like these requires additional set of information to be included in the household budget surveys and careful setting of assumptions. For an example of sodium intake estimated from a household budget survey, refer to the experience in Brazil.[5]

Descriptions and considerations

Household income and expenditure (budget) surveys

Designed to provide information on the consumption patterns and economic conditions of private households in a specific time period, typically income, savings as well as consumption.

- With regards to food, detailed information on household level purchases of food items (including beverages) is recorded (brand information is generally not available)
- Average market prices are used to estimate the total amount acquired of each item (if not originally available)
- Inexpensive in that secondary use of budget data (to determine food consumption) is usually free
- Additional information (such as brand information or total acquired amount of each item) can be included in the study.
- Can rely on periodicity
- Is generally representative of the national population and the large sample size permits deductions for different strata (urban and rural, socio-economic levels, regions, provinces)
- Comparable methodologies applied across countries
- Household consumption is divided by the number of inhabitants
 - Individual intake is refined by estimating the proportional intake of energy by each member of the household using the adult male as the reference (i.e. the adult equivalent concept where for example an adult woman is 0.7 adult equivalents or in other words consumes 70% of the energy of an adult male). [16]
- May be able to add modules to gather data on individual food consumption with specificity for high salt/sodium products e.g. table salt, bouillon cubes, high salt condiments (see also Section 5)
- Foods purchased and consumed away from home are not usually captured, therefore may be less useful if these foods are a main source of salt/sodium
- Non-monetary food acquisitions (such as gifts, home produced foods) are considered
- Family member participation in household food consumption may be unclear

- Household food stocks at beginning and end of survey are not assessed (assumed to be equal)
- Does not account for losses or product uses for other than food preparation
- Individual food and salt intake may differ from the estimated proportion of energy intake for each household member
- Can expect to overestimate salt intake

Household food disappearance data

Estimates total salt used by the household and approximates the per capita (or per adult equivalent) intake

- Typically, direct measurement is limited to a sub-sample of a population that is participating in a national or regional survey on food consumption or is resident in a sentinel site that is being studied.
- Relatively easy to implement to capture the total salt used from additions at the table and in cooking, bouillon cubes or dried soup mixes, fish and soy sauces and other highly salt products by counting and/or weighing the disappearance of these salt sources during a specific period of time (e.g. 7 days), and dividing that amount by the number of days and by the number of inhabitants in the household. (See also Section 5.)
 - Individual intake is refined by estimating the proportional intake of energy by each member of the household using the adult male as the reference (i.e. the adult equivalent concept where for example an adult woman is 0.7 adult equivalents because she requires 70% of the energy of an adult male).
- Requires before-and-after measurement of all salt sources in the household
- Does not account for losses or product uses for other than food preparation.
- Individual food and salt intake may differ from the estimated proportion of energy intake for each household member.
- Usually overestimates salt intake [11].

National food disappearance data; food production data; food import/export data

Designed to capture production and consumption of agricultural commodities as well as import/export data.

- Do not reflect salt/sodium consumption.
 - If salt is considered a broad general commodity, usually cannot separate salt used for food from that used for other purposes e.g. animal feed, water softening, road salt for de-icing, etc.
-

**Food sales data;
scan data**

Retail sales information usually collected by private sector market researchers

- With regards to food, designed to collect detailed information on the sales of main retailers
- so brand information is likely to be available
- Information about food consumption away from home (e.g. restaurants and cafeterias) is not included
 - Market or retailer specific i.e. there is no information on who is buying the products or how much individuals are consuming
 - Expensive to purchase
 - Can provide estimates of salt in cooking ingredients or processed foods when linked to nutrient information in appropriate food composition databases
 - Geographic data and economic stratifications of households are likely available in markets where the surveys are conducted
 - Can rely on periodicity
 - Represents a large share of the sales
 - Comparable methodologies applied across countries
 - Utility increased when combined with data on food consumption patterns
-

2.4 Attaching Questions or Modules to Existing Chronic Non-communicable Disease Risk Factor Surveys

As an alternative to stand-alone food consumption surveys, it is worth considering whether questions or modules specific to salt intake can be attached to existing survey instruments that collect data on risk factors for chronic non-communicable diseases. Examples of such surveys are the WHO STEPwise approach available at <http://www.who.int/chp/steps/en/> and PanAm STEPS at <http://www.paho.org/english/ad/dpc/nc/panam-steps.htm>.

A set of standard questions is suggested in Population Level Sodium Determination in 24-hour Urine Samples, available at http://new.paho.org/hq/index.php?option=com_content&task=view&id=3072&Itemid=2376.

Section 3: Sodium Content of Foods

3.1 Overview

Food composition tables or databases provide detailed profiles of the nutritional composition of foods, usually for a particular country. They can contain information on a variety of components, among them: energy, macronutrients, minerals (such as sodium) and vitamins, and sometimes, individual fatty acids, amino acids and/or vitamin fractions [6]. They are essential to determining the sodium content of foods consumed as identified in food consumption surveys.

Countries can use a variety of methods to construct national food composition tables, using direct or indirect data. Chemical analysis of major national foods and the calculation of values using yield and nutrient retention factors provide direct or primary data. Countries can also develop national food composition database by starting with data from another country with a similar food supply and then modifying and adding data to reflect national food culture. Some adjustments to data from other countries can required to e.g. account for country-specific regulations on food fortification levels, the use of permissible sodium containing food additives and local food products. New or additional data can come from secondary sources, typically from industry, on food labels or in scientific literature.

- Given that data accuracy varies across sources, it is important to identify for each source in the food composition database, the country of origin of the data, whether it is primary or secondary data, if primary – the sample collection date, analytical methods used, number of samples and detailed food name identification, and if secondary – detailed food name identification and the original data sources. This will greatly assist the process of updating the database when new values become available.

3.2 Methods that Provide Direct or Primary Data

	Descriptions and considerations
National/regional food composition databases	Reflects food products consumed in a country or in a region whose countries have a common food culture - Usually provide averages or generic composite values for certain food categories rather than brand-specific data - Require ongoing commitment to be kept up-to-date as food supplies are dynamic in that the nutrient composition of food products changes e.g. the elimination of trans fats, reductions in sodium, discretionary addition of nutrients, new processes e.g. moisture enhancement of meats, and depending on the sales volumes of certain brands of a changed product e.g. white bread, the average sodium content for that particular food product may shift - Need to account for local traditional foods, indigenous peoples' foods and ethnic foods, foods provided by restaurants and street vendors.

**Modifying/updating
existing database
from another
country**

-
- May save resources in that a large proportion of food products may already be accounted for in existing databases (with primary and secondary data)
 - Need to supplement with some analysis of national foods to account for differences in e.g. national regulations on fortification levels and the addition of local traditional foods, indigenous peoples' foods and ethnic foods, foods provided by restaurants and street vendors
 - Can supplement with data from national secondary sources or scientific literature that reflects the national food culture
 - Need to recognise geographic variations – using values from other country databases can introduce unexpected errors
 - Within brand differences – same brand products available globally may have different formulations (e.g. added sodium) at sub-regional or country (local) levels, or have different inherent sodium content of base ingredients in various national markets, therefore it is important to note the country of origin for the product (where produced or processed)
 - Requires ongoing commitment to be kept up-to-date
-

3.3 Food Composition Tables and Databases from Selected Countries and Regions

Below are examples of national food composition databases and where they can be found. Other examples can be found through LanguaL at

http://www.languaL.org/languaL_linkcategory.asp?CategoryID=4&Category=Food+Composition and http://www.fao.org/infoods/directory_en.stm.

Argentina ARGENFOODS (Argentina Tabla de Composición de Alimentos)	http://www.unlu.edu.ar/~argenfoods/Tablas/Tabla.htm
New Zealand FSANZ (Food Standards Australia New Zealand) – Australian Food Composition Tables (NUTTAB 2006)	http://www.foodstandards.gov.au/consumerinformation/nuttab2006/
Brazil TBCAUSP (Tabela Brasileira de Composição de Alimentos)	http://www.fcf.usp.br/tabela/
Canada Canadian Nutrient File	http://webprod.hc-sc.gc.ca/cnf-fce/index-eng.jsp
Chile Tabla de Composición Química de Alimentos Chilenos	http://mazinger.sisib.uchile.cl/repositorio/lb/ciencias_quimicas_y_farmaceuticas/schmidth03/index.html
Central America INCAP – Tabla de Composición de Alimentos de Centroamérica	http://www.tabladealimentos.net/tca/TablaAlimentos/inicio.html
Costa Rica Tablas de Composición de Alimentos de Costa Rica (Macronutrientes y fibra dietética, Alimentos fortificados, Ácidos grasos)	http://devserver.paho.org/virtualcampus/costarica/drupal/
Europe EuroFIR (European Food Information Resource)	http://www.eurofir.org/eurofir_knowledge/european_databases
Latin America LATINFOODS (Tabla de Composición de Alimentos de América Latina)	http://www.into.cl/latinfoods/
United Kingdom UK Food Standards Agency - UK Nutrient Databank, Composition of Foods Integrated Dataset (CoF IDS) and The McCance and Widdowson's – The Composition of Foods (CoF) book series (6th Summary Edition, 2002)	http://www.food.gov.uk/science/dietarysurveys/dietsurveys/#h_1
United States USDA (United States Department of Agriculture) – National Nutrient Database for Standard Reference	http://www.nal.usda.gov/fnic/foodcomp/search/

3.4 Using Indirect or Secondary Data Sources

Food composition databases can be constructed or modified using secondary sources of data, a process known as data compilation. In this case, a number of factors need to be addressed, key among them discussed in the table below.

A thorough discussion of quality in the compilation of nutrient data for a food composition database is provided in Chapter 10: Quality considerations in the compilation of a food composition database. In Greenfield H and Southgate DAT. (2003). *Food Composition Data: Production, Management and Use* (pp.171-186). Rome: FAO, available at <http://books.google.co.cr/books?hl=es&lr=&id=KQRzKDr9bgcC&oi=fnd&pg=PR7&dq=Food+composition+data.+Production+management+and+use,+FAO&ots=nXTxTEoJ0c&sig=nOEjo0RB-sZ2nFrFcBqDx16FJOg#v=onepage&q=Food%20composition%20data.%20Production%20management%20and%20use%2C%20FAO&f=false>

Specific to LATINFOODS, Electronic Conferences Reports are available http://www.inta.cl/latinfoods/conferencia_electronica.html.

One on “Compilación de datos para bases de datos y tabla de composición química de alimentos” is available at <http://www.rlc.fao.org/foro/latfoods/infofinal.pdf>.

Another on “Evaluación de la calidad de los datos para bases de datos y tablas de composición química de alimentos” is available at http://www.inta.cl/latinfoods/inf_final_conferencia_esp.pdf.

Descriptions and considerations

Industry-provided data	• need to ascertain the source • determine if the data are from laboratory analysis and if so the number of samples analyzed, sample preparation procedure and analytic method used, or whether values were taken/calculated from another data source e.g. calculation software, other databases, etc. • determine age/date of the data (may need to be tagged for collection or confirmed by the food company) • data may be limited e.g. only major brands, only certain cuts of meat • label information is brand specific, need to account for all major brands • can link label information on salt/sodium content to market share weighting (using the universal product code) to identify relative contribution of products to sodium intake • should have some quantitative data to confirm the accuracy of label values in the country or the industry provided data (requires capacity to sample and analyze available data to confirm accuracy) • where certain products are typically imported, it is useful to know the origin(s) and whether imports from there are constant or not, as similar
Food label review for branded products	

products can have variable formulations depending on the producer/country of origin

- where nutrition labelling is voluntary, nutrient data may not be consistently available
- where nutrition labelling is mandatory but does not require declaration of salt/sodium content, will need to find other sources of complementary data
- need to recognize issues with labels – rounding of values, application of compliance tolerances, conservative labelling practices, label information may not keep pace with reformulations
- popular products for which nutrition labelling is not required may need chemical analysis

**Restaurant chain
nutrition information**

- Usually web based
- Generally less consistently available
- Variability in information due to customization; usually only data for standard menu items are available

**Nutrition science
literature for analyzed
values**

- Judgement is required to evaluate the relevance of the data to one's country, the sampling plan applied, the analytical and technical expertise of the laboratory and methods used before deciding on whether or not to use the published data
-

Section 4: Salt Added at the Table and during Cooking

If food consumption data indicate that processed and packaged foods are the main contributors of salt in the diet, typical in higher income countries, determining qualitatively the frequency with which salt is added at the table and in cooking in households – the discretionary use of salt – provides sufficient information on which to base consumer awareness campaigns to curb the personal use/addition of salt.

4.1 Qualitative Methods

Descriptions and considerations

Supplementary questions in national, regional or sentinel site food consumption surveys or KAB surveys

- For salt added at the table, 24-hour dietary recalls, FFQ surveys or KAB studies are supplemented with questions on “added salt” such as “what type of salt is usually added” and “how often”, with typical responses about frequency being “rarely”, “occasionally” or “very often”.
- To probe cooking practices in households, a sample question is “how often is ordinary or seasoned salt added in cooking or preparing foods in the household” and should include “don’t know if salt is added in cooking” in case others in the household are cooking.
- Also select or probe if the respondent is the cook in the household and if yes, ask about the number of people for whom he/she prepares food.

4.2 Direct Quantitative Methods

In countries, regions or sub-populations undergoing nutrition transition – where households are known to rely on home-prepared meals at the same time that consumption of commercially prepared foods is increasing – it is important to quantify the intake of discretionary salt to differentiate it from other sources.

A number of quantitative methods are available to measure the amount of salt added at the table and in cooking [7]. Typically, direct measurement is limited to a sub-sample of a population that is participating in a national or regional survey on food consumption or is resident in a sentinel area being studied. Other than the lithium tagging method, most of the methods described below require further research and validation and the resulting data represent rough estimates of discretionary salt use at the population level.

Descriptions and considerations

Lithium tagging of household salt

- a metabolic method
- normal household salt in sample households is for a specific period of time replaced by salt tagged with lithium. For each individual in the household, daily urinary excretion of lithium combined with that of sodium measures both discretionary and total salt intake [8,9,10].
- the gold standard providing the most accurate data on discretionary salt consumed

	• can be cumbersome to the extent that is not feasible • requires 24-hour urine collection from usually all members of the household (refer to the Protocol for Population Level Sodium Determination in 24-hour Urine Samples) • data have limited geographic and socio-economic strata comparability method requires review and validation for population level application
Weighed household salt (disappearance method)	• household salt is replaced by a defined quantity of salt that is measured after a specific timeframe to determine how much was used • can significantly exaggerate consumption because of the large amounts of salt discarded in cooking water [11]
Using simulated meals	• participants add salt to food models or pictures of meals which is then collected and measured • simple to measure • limited to what is assumed to be representative of typical meals • limited to research studies or targeted individuals
Observing cooking practices	• the amounts of salt added during cooking are observed • semi-quantitative in that the observer estimates the amount of salt added by the cook • difficult to generalize to large populations as household recipes can be highly variable

4.3 Indirect “Subtraction” Method

Estimating absolute and proportional intake of discretionary salt using urinary salt excretion and primary or secondary food consumption data	• estimates intake of discretionary salt as: • discretionary salt intake = 24-hour salt excretion – salt intake attributed to commercially-available foods • Requires the estimation of sodium (salt) urinary excretion for a 24-hour period. • Accuracy is highly dependent on the precision and certainty of measurements of the consumption of commercially prepared foods. • Must account for the commercially prepared foods consumed outside the home • Despite the effort to account for non-food uses and losses, the values may still overestimate discretionary salt intake.
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4.4 Secondary Sources

Both qualitative and quantitative determinations of the discretionary use of salt may be derived from or supplemented by scientific literature, with the cautions noted below.

**Nutrition science
literature**

- Judgment is required to assess whether local/regional patterns of adding salt at the table and in cooking are similar to what is published in the literature.
 - Assumptions on which to base accepting/adjusting the data may be necessary.
-

Section 5: Culturally or Regionally-specific High-sodium Foods

It is very important to account for what can be considered a sub-set of the general category of processed and packaged foods that in some countries is subject to discretionary use in the household – the high-sodium prepared foods that are specific to the national food culture or to a region or sub-population within a country. Even though used in relatively small amounts at any one time, these products can contribute very high levels of salt to the diet because they are so frequently consumed. Examples are some pickled foods, salted fish, condiments, sauces (soy sauce, fish sauce, tomato sauce, specialty local sauces), marinades, curry pastes and soup mixes. Usually there are only a few such products in a given country. The sodium level per product is usually determined from manufacturer-provided data if laboratory analysis data are not available [12,13].

	Descriptions and considerations
Supplementary questions in national, regional or sentinel site food consumption surveys, KAB surveys, household budget surveys, household food disappearance studies	Specific local products known to be popular can be: • queried in the 24-hour recall, • listed in FFQs, • added to household budget surveys, • household food disappearance studies or • included with questions about salt added at the table and in cooking, • the survey instrument is customized to reflect national, regional or even more localized food cultures.
Nutrition science literature	Unless the food product featured in the literature is known to be the same or very similar in terms of salt/sodium content and patterns of use, and whose differences can be accounted for through a set of reasonable assumptions, published data on a very specific product from another country or region are not likely to accurately reflect intake in another country or region.

Section 6: Recommendations

Knowing the main sources of salt in the diet is essential to “making the case” for reducing dietary salt in that the information points out the directions for action. With key high-salt food products identified, frequency of their consumption measured and discretionary salt use understood, national public health agencies can frame the issue with baseline information, begin raising consumer awareness and at the same time engage with the food industry to encourage reformulations to lower salt/sodium content across the food products of concern. In cases where limits on the salt content of food products are regulated, monitoring the main sources of salt in the diet and their salt levels informs the national authorities with the mandate to enforce regulations.

How the main sources of salt in the diet are determined depends on what would be most efficient, cost-effective and feasible in the context of a country’s existing national nutrition policies, the capacities and resources that support them and what is already known about food and nutrient consumption. So as not to assume what countries may have in hand, the recommendations in this Section are presented in a sequence that begins with a fundamental question and progresses as information is accumulated. An overarching recommendation applying to any aspect of the sequence is for countries to use as much as possible existing processes and instruments that are known to be reliable and valid, and in the case of surveys, for them to have the required periodicity and representativeness, to which questions or modules specific to salt intake can be added at marginal cost.

While the recommendations here are based on the methods reviewed in the previous sections, the preferred approach uses as much as possible validated methods, some with training materials and/or software. Nevertheless, it may be necessary to use approaches that require further validation, and where this is the case, investigators are encouraged to design their studies such that they can inform the refinement of the methods and to plan for dissemination of findings.

6.1 Determining Baseline Data on the Major Contributors to Salt Intake

Step 1: What is the overall use of discretionary salt?

In low and middle income countries and where there is evidence of nutrition transition, it is important to assess at the outset the overall discretionary use of salt in the household – salt added at the table and in cooking and the use of specific high sodium products – as this may be the most significant source of sodium in the diet. And since the quantities of salt and high sodium products added cannot be measured through 24-hour recalls, a combination of direct and indirect methods is needed.

- KAB surveys can be designed to give preliminary qualitative information on discretionary salt
- Local food/nutrition experts can provide qualitative insights based on their experience in the area. These preliminary findings can be then further refined through e.g. focus groups.

- Household food disappearance studies can isolate the use of table salt and specific high sodium food products at the table and in cooking.
- If data on 24-hour sodium excretion are available as well as estimates of salt intake from commercially prepared foods, subtract one from the other for an estimate of discretionary use. *(Note that if salt from commercially prepared foods is negligible, salt intake estimated by food disappearance together with changes in urinary sodium excretion may be sufficient to set intake baselines and subsequent monitoring.)*
- To differentiate at the population level the personal use of table salt (added at the table and in cooking) from all other sources, the lithium-tagged salt method can be considered with results potentially contributing to further validation of this method.

Step 2: What are the food consumption patterns?

- Investigate whether established survey instruments with reliable periodicity and appropriate representativeness e.g. household income and expenditure surveys, food disappearance surveys or risk factor surveys, can be vehicles for questions or modules on food consumption that specifically investigate salt intake.
- If there is a possibility of administering 24-hour recalls or FFQS, conduct small sentinel site surveys e.g. one urban and one rural, to collect initial data on sources of dietary salt to confirm protocols and determine the expertise and resources (financial and personnel) needed to scale up to a systematic national survey.
- Conduct national surveys using 24-hour recalls or FFQs applying/adapting as much as possible the tools that are validated and supported.

Step 3: What is the proportional importance of discretionary sources versus commercially prepared foods?

- Combine data on discretionary sources with salt intake from commercially prepared foods to get the proportion of each
- If data on 24-hour sodium excretion are available as well as estimates of salt intake from commercially prepared foods, subtract one from the other and calculate the relative proportion of discretionary sources.

6.2 Establishing and maintaining food composition databases and tables

Regardless of the methods chosen to determine baseline data on the main sources of dietary salt, using national or international food composition databases is essential to ascertain salt/sodium intakes from food. National investments are therefore required to establish food composition tables from primary or secondary sources, and then to verify and maintain the quality of data given their importance to nearly all activities in nutrition and food quality and safety [14].

Key questions to ask are:

- is there a national food composition database with nutrient data including sodium that are reliable, up-to-date and available for local foods and processed and packaged foods
- is there a food composition database in another country that can be adapted to national food products
- is there an international or regional food composition database to which a country can contribute for the benefit of all countries using the database
- if adjustments need to be made to a national or international database, what are the resources and expertise at hand, and in what timeframe is information needed

The outcome being sought is determining the amount of salt consumed and identifying the main contributors of salt in the national diet in a manner that allows for setting targets, monitoring change in these sources and capturing new sources on an ongoing basis.

6.3 Deciding on Targets and Interventions

Based on knowledge about the main contributors to salt intake in a country, targets can be set for either the food groups that contribute the most to salt intake, for the full food chain, and/or for reductions in discretionary use, both table/cooking salt and high sodium food products. Targets can be set as averages, as maximums (upper limits) or sales weighted means per food category (see the examples below).

If targets are to apply to processed and pre-prepared food products, they should be set jointly with the food industry. A recommended first step is engaging with the sector of the food industry that accounts for high volume products that contribute a significant proportion to salt intake. Several countries have begun with the bread sector, working with associations of small independent bakers and in some cases also supermarket chains that have in-store bakeries. Other countries have started with the producers of bread products and processed meats. Still others have approached several food producers to address salt levels in a full range of categories of packaged processed foods that are the main sources of dietary salt. Depending on resources and capacities available, subsequent or concurrent interventions can deal with food retailers, restaurants and street food vendors.

Examples of targets and descriptions of how specific countries have negotiated with the food industry are shown below:

- For the United Kingdom, see <http://www.food.gov.uk/healthiereating/salt/saltreduction> [check if works]
 - For the [US] National Sodium Reduction Initiative, packaged food targets are at <http://www.nyc.gov/html/doh/downloads/pdf/cardio/cardio-salt-nsri-packaged.pdf> and restaurant food targets are at <http://www.nyc.gov/html/doh/downloads/pdf/cardio/cardio-salt-nsri-restaurant.pdf>.
 - For the Canadian sodium reduction targets, see <http://www.hc-sc.gc.ca/fn-an/nutrition/sodium/sodium-reduction-targets-cibles-eng.php>.
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6.4 Monitoring and Evaluation

Monitoring food consumption and the main sources of salt in the diet also requires collecting primary and/or secondary data as is the case with setting the baseline. It can be limited to the same food groups that determined the baseline to optimize resources, or just the targeted foods, or can include reassessing food consumption and updating food composition tables for new sources and levels of salt.

The ultimate impact analysis or evaluation of dietary salt reduction policies and interventions can include food product analysis, food consumption patterns, health status (mean blood pressure), and sodium intake measured through urine samples.

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Appendix – Case Studies

Barbados

The Barbados National Commission for Chronic Non-Communicable Disease is spearheading a country-wide nutrition intervention and improvement programme aiming to reduce chronic diseases (in particular, heart disease, stroke and diabetes). The prevalence of hypertension, the principal risk factor for cardiovascular disease, exceeds 50% in the 40 to 80 age group, making the Barbadian high salt diet a target for intervention.

In 2010, the Barbados Ministry of Health sent out a request for proposals to develop a Salt Intake Study with two components to:

- determine a baseline of actual sodium intake (through 24-hour urine sampling)
- identify the main sources of dietary sodium in the population.

By 2005, a quantitative food frequency questionnaire (QFFQ) had been developed and was in use in the Barbados National Cancer Study through a collaboration between Stony Brook University in New York, the University of the West Indies and the Cancer Research Center of Hawaii. The list of foods in this QFFQ instrument had been derived from food intake data collected in 2000 through the Barbados Food Consumption and Anthropometric Survey (BFCAS). For the BFCAS, 1600 respondents 18 years of age and over completed a single 24-hour dietary recall, and 50 (of 63) randomly selected residents gave additional updated information on foods that they consumed. All foods, beverages and supplements reported by at least two BFCAS participants were included in the draft QFFQ. This instrument was piloted in a random sample of individuals (n=50) selected from the nationwide electoral register. Participants completed a 24 hour dietary recall followed by an interviewer-administered QFFQ. Foods with minimal contribution to nutrient intake were excluded, and the final QFFQ contained 148 food and drink items.

There was evidence of some secular changes in the Barbadian diet between 2005 and 2010, and the current QFFQ, will therefore have to be amended for use in the Salt Intake Study. To this end ongoing work to date has entailed:

- Phase 1 – a pre-pilot in April 2010:
 - to update and amend the existing QFFQ by the inclusion of additional food items and to create a more comprehensive QFFQ to allow the evaluation of salt consumption;
- Phase 2 – a pilot of the amended QFFQ in May 2010;
- Phase 3 – administration of the updated QFFQ to a nationally representative sample of the population.

It is anticipated that these new dietary data will provide information on nutrient intake and cooking practices to be targeted for a nutritional intervention aimed at reducing salt intake.

The first step of Phase 1 began with the selection of a random sample of participants from the electoral register who were mailed a letter of invitation to participate in the study, followed by telephone or personal contact by study staff to make appointments for recall interviews. Nutritionists were trained to conduct a series of three non-consecutive 24 hour dietary recalls with each participant. These recalls also included questions probing for additions to the diet such as salt, sugar, seasonings and condiments. Information on

portion size (using food models, standard units or household utensils, later converted to standardized weights), specific types of foods and drink including brand names, cooking methods (boiled, fried, baked, “lime and salt”) and food sources were also recorded.

Twenty-five men and 27 women (aged 25 to 90 years; mean ages were 46 and 55, respectively) participated in Step 1 (83% response rate). Data represented 148 days of dietary recall. Preliminary results showed that the mean daily sodium intake among men aged 27-50 years and 51-73 years was 4,313 mg and 2,653 mg, respectively, while women 25-50 years and 51-90 years consumed 2,897 mg and 2,126 mg of sodium per day, respectively. The leading dietary sources of sodium were rice and peas (5.4%), fried flying fish (4.4%), and macaroni pie (3.2%). Bread, fish, rice, poultry, and sweets were major food group sources of sodium, contributing a combined 50% to total sodium consumption. Mean sodium intake levels exceeded Adequate Intake recommendations across all gender-age groups.

In Step 2, a focus group with Barbadian nurses, a dietitian and researchers facilitated the draft of the QFFQ with the addition of new food items reported more than once by participants in Step 1, with particular attention paid to items rich in sodium e.g. condiments and preserved foods. Of note, questions about the practice of adding salt at the table and others asking about participants’ willingness to reduce dietary sodium were included. The new draft QFFQ was initially piloted in May 2010 with 25 respondents who added other foods they frequently consumed. Final updates were completed by July 2010.

The Salt Intake Study has now been approved by the funding agency and the start of data collection is anticipated in mid-2011.

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Brazil

The National Household Budget Survey (HBS – *Pesquisa de Orçamentos Familiares*) administered between July 2002 and June 2003 by the Brazilian Institute of Geography and Statistics (IBGE, *Instituto Brasileiro de Geografia e Estatística*) provided the data from which the main sources of sodium in the Brazilian diet were derived [4]. The HBS is designed to obtain information on the earnings and expenditures of families in order to adjust the structure of the national consumer price index.

The 2002/03 version of the HBS surveyed a probabilistic sample representative of all Brazilian households as well as each of the country's five macro-regions (according to the urban/rural status of the household) or 26 states. Sampling was based on a complex (two-stage) strategy involving 443 previously defined socio-geographic strata of census tracts (aiming to assure high representativeness with a minimum sample size). Subsequently, census tracts were selected from within each stratum and households were selected from within each tract. Finally, in order to make data collection uniform across the four trimesters of the year, the interviews carried out within each stratum were spread out

across the 12 months of the survey. A total of 48,470 households participated in the survey.

With regards to diet, the HBS collects detailed information on all food and drink purchases made by households during a period of seven consecutive days, including the name and specification of each item, its price and where it was acquired (i.e. grocery store, bakery). The 48,470 households contributed a total of 969,989 records. Data were collected electronically with the help of portable computers and specially developed software.

Since the seven-day reference period is not sufficient to characterize the food-purchase pattern of each household, the survey unit was adapted to be groups of households (rather than individual households) corresponding to the 443 HBS strata.

The household units in each stratum are homogeneous in terms of territorial domain and family socioeconomic status and they were surveyed uniformly throughout the trimesters of the year.

Initial data analysis excluded any non-edible fraction from each of the purchases using correction factors recommended by IBGE. The edible fraction of each food item was then converted into energy (kcal) and sodium (grams) using version 1 of the Brazilian Food Composition Table (TACO – *Tabela Brasileira de Composição dos Alimentos*), or where an item was not in TACO, using the United States official food composition table version 15. (An extension to the statistical package Stata – AQUINUT – was developed for this purpose [5].) In the specific case of foods preserved in salt such as salted/dried beef and salted fish, an additional adjustment allowed the sodium concentration of these items to refer to the desalted product. Thus for each survey unit (household stratum), the daily *per capita* availability of energy and sodium was calculated.

Given that meals eaten outside the home and the fraction of food purchases not consumed are unknown, the household sodium availability to actual intake was estimated by considering the sodium content per 2,000 kcal of total energy consumed – the Brazilian recommendation for daily *per capita* energy intake. Food and beverages were then classified into four groups: 1) salt and salt-based condiments; 2) processed foods with added salt; 3) *in natura* foods, or processed foods without added salt; and 4) ready-made meals. The proportion that each food group contributes to total household sodium availability was described for the country as a whole and according to quintiles of *per capita* income distribution.

The results indicate that the amount of sodium available for consumption in Brazilian households was 4.7 g/person/day, more than two times the maximum internationally recommended intake level of 2 g/person/day. Excessive consumption was identified in all regions, in both rural and urban settings, and across all income strata. Although most of the available sodium in all income strata originates from discretionary salt (added at the table and in cooking) and salt-based condiments, the proportion derived from processed foods has a strong and growing importance as household purchasing power increases in Brazil. The complete set of results was published in the journal “Revista de Saúde Pública” [6].

Canada

In 2004, Statistics Canada carried out the Canadian Community Health Survey (CCHS) 2.2 – Nutrition using a 24-hour food recall instrument to which a statistically representative sample (based on census data) of over 35,000 people responded from all provinces (the survey excluded members of the armed forces, residents of the three northern territories, people living on native reserves, in institutions and some remote locations). A subset of respondents (>10,000) completed a repeat recall three to 10 days later (to assess day-to-day variation, which was used for determining usual intakes). The response rate was 76.5% and 72.85% respectively. The survey provided information on the then current intakes of dietary sodium by the Canadian population, which is the baseline against which the effectiveness of strategies to reduce salt consumption would be measured.

Respondents were asked to list all foods and beverages consumed during the 24 hours (from midnight to midnight) before the day of their interview. Interviewers used a Canadianized version of the USDA Automated Multi-pass Method with five steps to help respondents remember what they had had to eat and drink:

- a quick list (respondents reported all items in whatever order they wished)
- questions about specific food categories and frequently forgotten foods
- questions about the time and type of meal
- questions seeking more detailed, precise descriptions of foods/beverages and quantities consumed
- a final review

An additional salt questionnaire was administered. People who replied “None” when asked “What type of salt do you usually add to your food at the table?” were classified as “never adding salt at the table”. Otherwise, respondents were asked how often they added salt to their food, with the answer options of rarely, occasionally, or very often. Respondents were also asked about certain health conditions that were expected to last or had already lasted six months or more that had been diagnosed by a health professional. Those who answered “yes” to “Do you have high blood pressure?” were defined as having hypertension [7; 8].

The nutrient values, including sodium levels for foods that respondents consumed were obtained from Health Canada’s Canadian Nutrient File (version 2001b) [9]. The average daily intakes of sodium, as well as percentages of the population who exceed the Upper Level (UL) were reported for each DRI age and sex group for age 1 up [7]. Proportions of the population who reported adding salt to food at the table or in cooking as well as the 10 main sources of sodium were provided. Additional analyses were done by province and by frequency of high blood pressure (adults aged 31 and older).

The CCHS survey were used for a further detailed analysis of food sources of sodium for four age groups derived by regrouping the Dietary Reference Intakes (DRI) age–sex groups according to expected similarities in sodium intake patterns [8]. The child DRI age–sex groups were divided by age into two groups: young people aged 1 to 8 years and those aged 9 to 18 years. The adult DRI age–sex groups were divided by sex into two groups: males aged 19 years and older, and females aged 19 years and older.

The food groups used in this study were based on an established classification system developed in the Food Directorate of Health Canada and used in previous nutrition surveys. Some of the food groups were altered for sodium modeling purposes e.g. by separating them into

canned, pickled, smoked, or dried foods, usually higher in sodium than the rest of the group.

The analyses focused on estimating the sources of sodium by food group, with a number of parameters being reported for each food group:

- food intake per person, in grams per day, calculated as the total grams of the foods reported within the group divided by the total population;
- the sodium amount in foods, in milligrams per 100 g, calculated from the total sodium consumed, divided by the total grams of the foods consumed within the group;
- the percent of total sodium intake, calculated from the total sodium consumed within the group divided by the total sodium consumed by the population;
- the daily sodium intake per person in milligrams per day, calculated as the total sodium intake within the group divided by the total population;
- the percent of the population consuming the food, calculated from the number of consumers having reported eating at least one of the foods within the group divided by the total population; and
- the daily sodium per consumer in milligrams per day, calculated as the total sodium intake within the group divided by the number of consumers having reported eating at least one of the foods within the group.

In addition, the average daily energy provided by each food group was calculated by multiplying the energy density in kcal per gram by the per capita food intake for each food group. The amount of sodium provided by the quantity of food supplying 100 kcal of energy was determined by dividing the daily per capita sodium intake from each food group by the per capita energy intake for that group.

The analyses conducted in this study [8] were based on first-day recalls only. Usually a repeat recall is used to adjust for intra-individual variability to estimate the usual intake distribution. However, for the food groups considered in the sodium modeling, the frequency of their consumption did not meet the requirements for estimating a usual intake distribution from the CCHS 2.2 sample.

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