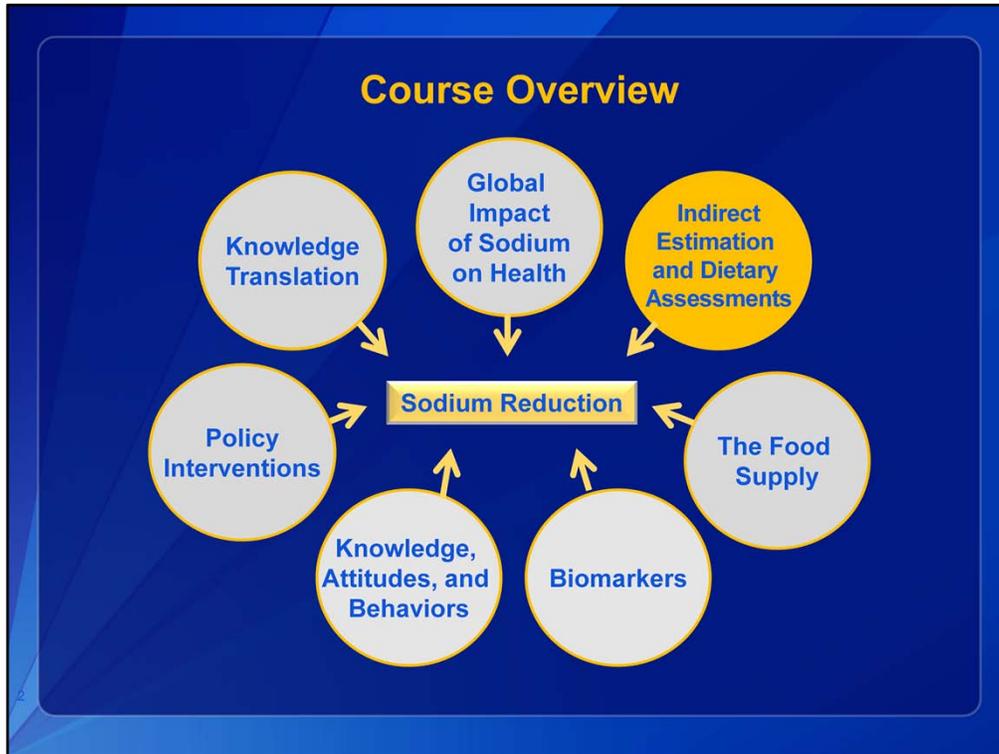


This module is part of the Centers for Disease Control and Prevention’s Sodium Reduction Toolkit: A Global Opportunity to Reduce Population-Level Sodium Intake. The toolkit is designed to provide government agencies, international organizations, and other stakeholders with a brief overview, tools, and information necessary to inform strategies to reduce population-level sodium intake.

*“Salt intake exceeding biologically adequate levels has a causal and direct relationship with greater-than-optimum levels of blood pressure.”<sup>1</sup>*



This module in the Sodium Reduction Toolkit covers methods to evaluate sodium intake through indirect estimation and dietary assessments. Other modules in the toolkit provide information about the global impact of sodium on health; methods to evaluate sodium intake through biomarkers; analysis of sodium in the food supply; knowledge, attitudes, and behaviors related to sodium intake and health; strategies for using sodium-reduction policy interventions to reduce sodium intake; and the process of translating and sharing evidence-based research. Each module also includes examples and a list of top 10 resources.

Please note that throughout this module, the term “salt,” also known as sodium chloride, is not synonymous with the term “sodium.” Modules in this series use the term “salt” when referring to sodium chloride and sodium when referring to sodium. A list of conversions for salt and sodium is available on the toolkit web page.

## Objectives

1. Describe various methods for estimating sodium intake
2. Discuss the benefits and limitations of each method
3. Provide examples of how these methods can be used to estimate sodium intake

The objectives of the Indirect Estimation and Dietary Assessments module are to:

1. Describe various methods for estimating sodium intake.
2. Discuss the benefits and limitations of each method.
3. Provide examples of how these methods can be used to estimate sodium intake.

Please note that the examples and recommendations provided should be used for training purposes only and do not necessarily imply that they are appropriate for use in your country.

## Background

- ❑ **Excessive sodium intake**
  - Increases blood pressure
  - Is a health risk
- ❑ **Sodium intake**
  - Biomarkers
  - Dietary assessments and indirect estimation



Excessive sodium intake, through high blood pressure, is a major cause of cardiovascular disease death and disability worldwide. Reducing population-level sodium intake can reduce blood pressure levels as well as health care costs.<sup>2,3</sup>

One strategy to reduce excessive sodium intake is to monitor the amount of sodium people consume. There are two ways to monitor sodium intake: The first method involves biomarkers, and the second employs dietary assessments and indirect estimation.

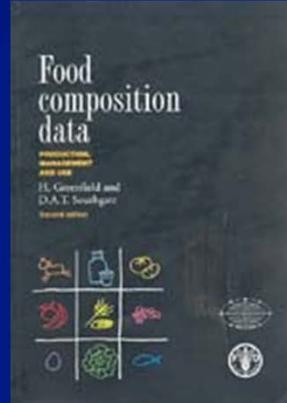
Biomarker data provide an estimate of sodium intake through urine collections. Although biomarkers, such as 24-hour urine collections, are considered the “gold standard” for assessing sodium intake, they do not provide information about how much sodium people consume from specific food categories and sources.<sup>4</sup>

On the other hand, dietary assessments and indirect estimation—which encompass food and nutrient consumption at the individual, household, and national levels—do provide information about the amount of sodium individuals consume and from which specific food categories and sources. These methods also can provide information about discretionary salt use at the table and in cooking.

This module focuses on dietary assessment and indirect estimation methods. It is divided into three sections with a different scope: individual, household, and national. Each section reviews methods, their benefits and limitations, and examples of their use. We will begin at the individual level.

## Food Composition Data

- **Provide nutrient values of foods**
  - Energy
  - Macronutrients
  - Micronutrients
  - Other dietary components
- **Assess nutrient intakes (sodium)**



It is important to acknowledge that a food composition database or other compositional data source is necessary to monitor sodium intake. Food composition data provide nutrient values of foods, including but not limited to energy, macronutrients, minerals such as sodium, vitamins, fiber, fatty acids, amino acids, and other dietary components such as caffeine and carotenoids.<sup>5,6</sup>

In general, food composition data are used to estimate the nutrient content of foods; compare different foods for their nutrient composition; and assess nutrient intakes at the individual, group, and population levels. For example, food composition data are necessary to convert food intake data reported in dietary assessment surveys into nutrient intake data.

For more information about food composition data, please see the Food Supply module. Next, we will briefly review the terms and definitions used in this module.

## Terms and Definitions

- ❑ **Individual**
  - Food record
  - 24-hour dietary recall
  - Food frequency questionnaire
- ❑ **Household**
  - Food sales data
  - Expenditure survey
- ❑ **National**
  - Food balance sheet
  - Disappearance data
  - Market basket survey



The terms and definitions on this slide are for educational purposes only.

Beginning at the individual level, food records, 24-hour dietary recalls, and food frequency questionnaires often are used to monitor intake. A food record is a written record of all foods and beverages and the amounts of each consumed over one or more days.<sup>7</sup> A 24-hour dietary recall collects information on all food and beverage intake by an individual from the previous day or 24 hours.<sup>7</sup> A food frequency questionnaire is a report of the usual frequency of consumption from a list of foods over a specific period of time.<sup>7</sup>

Food sales data and expenditure surveys are methods used to monitor food intake at the household level. Food sales data record all food and beverage purchases by a household.<sup>8</sup> An expenditure survey collects information about food expenditures, household income, and other characteristics related to spending habits.

Food balance sheets, disappearance data, and market basket surveys are methods used to monitor intake at the national level. A food balance sheet provides a comprehensive picture of the pattern of a country's available food supply during a specified time period.<sup>9</sup> Disappearance data refers to the amount of food and nutrients that "disappears" from the food supply and can be used to determine food and nutrient availability for a population.<sup>4</sup> A market basket survey analyzes a group of foods that reflect the average food consumption patterns of a population and can be used to estimate intake of nutrients from those foods.<sup>10,11</sup>

## Section One: Individual Level

- ❑ Food Record
- ❑ 24-Hour Dietary Recall
- ❑ Food Frequency Questionnaire



We will now begin our review at the individual level with food records, 24-hour dietary recalls, and food frequency questionnaires.

## Food Record

- ❑ **Written record of all foods and beverages and the amounts of each consumed over 1 or more days**
- ❑ **Nutrient intake**
  - Sum of each  $\frac{(\text{Portion Size [g]} \times \text{Frequency} \times \text{Nutrient Content})}{\text{Number of days}}$
- ❑ **Benefit: may provide more accurate information**
- ❑ **Limitations:**
  - Literacy often required
  - May provide inaccurate records
  - May be burdensome

A food record is a written record of all foods and beverages and the amounts of each consumed over one or more days.<sup>7</sup> The record also collects information on food preparation and any additions to food, such as salt or condiments. The amounts consumed can be measured using a food scale or household tools such as cups and tablespoons, or it can be estimated using food models and pictures.<sup>7</sup>

Nutrient intakes can be estimated by summing the total amount of each food portion consumed, converting it to a gram weight, and multiplying it by the nutrient composition obtained from a food composition database or other data source. This method can be conducted using a paper and pencil, computer, voice recorder, or other tool.

Because foods and beverages are measured and recorded at each occasion, the food record method has the potential to provide accurate information.<sup>7</sup> However, food records have limitations.

First, literacy, if using paper and pencil, and a basic knowledge about types of food, serving sizes, and preparation techniques often are necessary. Because respondents are asked to record all foods and beverages as they are consumed, some respondents may falsify the type and/or amount of food they consumed.

Lastly, this method can be burdensome to participants, especially when they are asked to record intake for several days. For example, research shows a significant increase in incomplete records as more days of food records are kept.<sup>12</sup>

Twenty-four-hour dietary recalls are discussed next.

## 24-Hour Dietary Recall

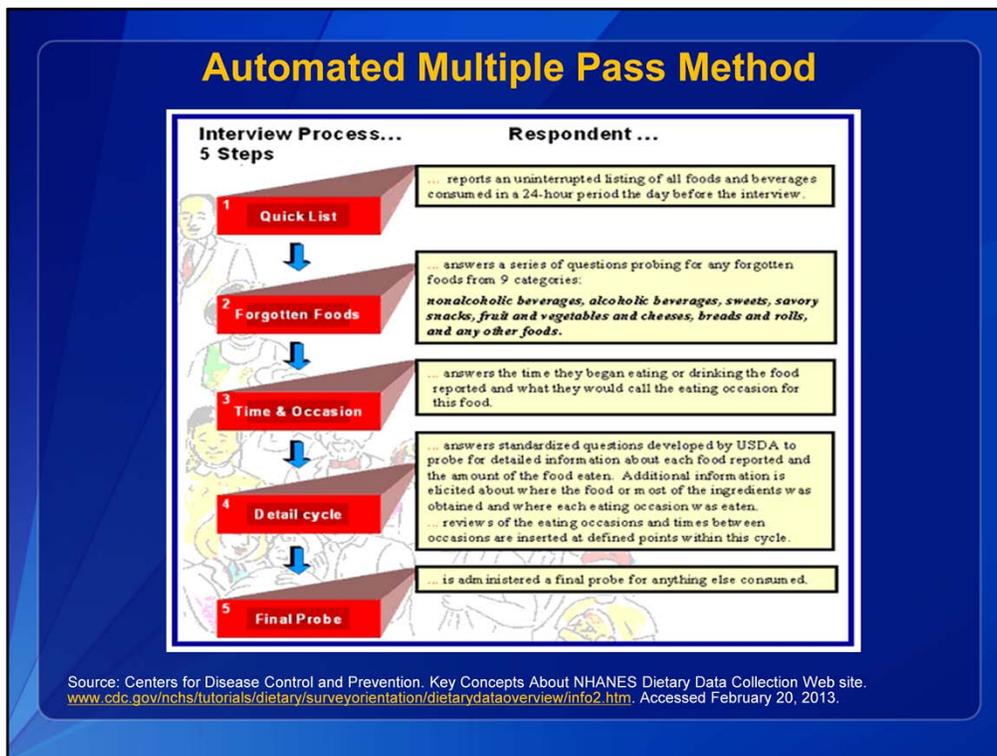
- ❑ **Food and beverage intake from the previous day**
- ❑ **Nutrient intake**
  - Sum of each  $\frac{(\text{Portion Size [g]} \times \text{Frequency} \times \text{Nutrient Content})}{\text{Number of days}}$
- ❑ **Benefits:**
  - Literacy often not required
  - Generally low participant burden
  - Less potential for participants to change their eating behavior

A 24-hour dietary recall obtains information on all food and beverage intake from the previous day or previous 24 hours.<sup>7</sup> This method is commonly used by governments for national surveys and has been validated by several population-based studies.<sup>13</sup>

The recall is often conducted by a trained interviewer, either in person or by telephone. It can also be conducted via computer. Through food models or other specific techniques, the interview is designed to prompt participants to remember all foods and beverages consumed. It is also useful for collecting other details, such as how foods were prepared or whether any additions to foods were made, such as added salt.

There are many benefits to 24-hour recalls. Literacy is typically not required because an interviewer records the responses. Because the interview is conducted in person, by phone, or via computer, there is relatively little burden to participants. Lastly, compared to food records, dietary recalls occur after food has already been consumed, which means a lower potential for participants to provide inaccurate dietary intake information.

The current tool used by the United States to improve the accuracy of 24-hour recalls is the Automated Multiple Pass Method.<sup>14</sup> This tool is described next.



The Automated Multiple Pass Method is a computerized method for collecting 24-hour dietary recalls in person or by telephone. This method is used in the United States for the National Health and Nutrition Examination Survey to estimate sodium intake from specific food categories and sources among U.S. participants aged 2 years and older.<sup>15,16</sup>

The process usually takes 30 to 45 minutes and consists of the following five steps:

1. A “quick list,” for which the respondent reports all foods and beverages consumed in a 24-hour period the day before the interview,
2. “Forgotten foods,” for which a respondent answers a series of probing questions for any forgotten foods from nine categories,
3. Time and occasion, for which the respondent answers the time they began eating or drinking the food reported and the occasion,
4. A “detail cycle,” during which the respondent is probed for more detail about each food and the portion size, and
5. The “final probe” for anything else the respondent consumed.

Limitations of 24-hour dietary recalls are discussed next.

## 24-Hour Dietary Recall: Limitations

- ❑ May result in inaccurate reporting
- ❑ Relies on food models or other prompts
- ❑ Relies on more than one recall to estimate usual intake



Twenty-four-hour dietary recalls have limitations. First, some participants may not accurately report their food and beverage intake.<sup>7</sup> This lack of reporting may be related to knowledge, memory, age, gender, or other conditions affecting the respondent.<sup>7,17-21</sup>

In addition, food models or other prompts are necessary to help individuals during the interview. Without these prompts, some individuals may have difficulty recalling the portion size or use of condiments, such as added salt.<sup>13</sup> Lastly, due to day-to-day variation in individual dietary intakes, more than one recall is often necessary to estimate usual intakes.<sup>7</sup>

Food frequency questionnaires are discussed next.

## Food Frequency Questionnaire

- ❑ **A report of the usual frequency of consumption from a list of foods during a specific period of time**
- ❑ **Benefits:**
  - Assess overall dietary intakes in a population
  - Suitable for population-based studies
  - Can be modified (sodium-specific categories)



In general, a food frequency questionnaire contains a list of 20 to 200 food and beverage categories for which participants record their usual frequency of consumption, such as how many times per day, week, or month they consume that food, and the portion size.<sup>7,13</sup>

Food frequency questionnaires are used to assess overall dietary intakes in a population and are usually conducted once every 3, 6, or 12 months. They have been widely used in epidemiological studies to identify relationships between diet and disease. Therefore, data are often used to categorize and rank individuals relative to others in the population, such as low, medium, or high intake groups or as quintiles. Generally, this grouping is more helpful than estimating actual intake.

Food frequency questionnaires are relatively inexpensive and appropriate for population-based dietary surveys. They can be conducted in person or online and can be modified to accommodate different populations. For example, you can add foods to the list that are typically high in sodium and add questions about salt use at the table or in cooking.<sup>7,13</sup>

The next slide provides an example of a food frequency questionnaire used in Barbados.

## Barbados Salt Intake Survey

Food	Portion	Never <1/mo	Once a month	2-3x a month	Once a week	2-3x a week
<b>Breads, cakes and cereals</b>						
1. Salt bread, white	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Salt bread, whole wheat	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Turnover, white/whole wheat	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Buns, hot dog buns, rolls	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Other white bread	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Other whole wheat bread	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Crackers, white/whole wheat	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Coconut bread	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Cake, any kind	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Doughnuts, currant slices, jam puffs	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. Sweet biscuits	<input type="checkbox"/> <input type="checkbox"/> . <input type="checkbox"/> <input type="checkbox"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adapted from: Sharma S. Development and use of FFQ among adults in diverse settings across the globe. *Proc Nutr Soc.* 2011;70(23-51).

In Barbados, cardiovascular disease is the leading cause of death.<sup>22,23</sup> More than half of the African-origin population aged 40 years and older has high blood pressure.<sup>24</sup>

To reduce the burden of disease, the Barbados Salt Intake Survey food frequency questionnaire was developed to assess baseline sodium intakes and food consumption patterns over time. Three 24-hour dietary recalls were used to identify the major contributors of sodium and salt intakes in the Barbadian population. Local recipes and composite dishes were analyzed and included in the survey.

The example on this slide comes from the quantitative food frequency questionnaire developed for the adult population of Barbados. Participants were asked to indicate their usual frequency of intake for these foods during the previous 12 months.

For example, if a participant consumed white bread containing sodium two to three times per week, he or she would mark the relevant box. The participant would continue down the list, providing the usual frequency of consumption for each food or food group listed.

The limitations of food frequency questionnaires are discussed next.

## **Food Frequency Questionnaire: Limitations**

- ❑ **Do not use visual aids**
- ❑ **Do not provide a comprehensive list of all foods consumed in a population**
- ❑ **Changes in dietary patterns make it difficult to record usual intake**

Food frequency questionnaires have limitations. Unlike 24-hour dietary recalls, this method does not use visual aids or other mnemonic devices; instead, it relies on a respondent to accurately record the types and amounts of food consumed, often over a long period of time.

Because food frequency questionnaires do not provide a comprehensive list of all foods consumed in a population, information on individual brands and categories may be excluded. Further, changes in dietary patterns due to illness, pregnancy, or economic situations may make it more difficult for participants to record usual intake within the requested time frame.<sup>7,13</sup>

This concludes our review of Section One at the individual level. For additional information about these methods, please refer to the references available for download from this module.

## Section Two: Household Level

- ❑ Food Sales Data
- ❑ Expenditure Survey



We will now begin our review at the household level with food sales data and expenditure surveys.

## Food Sales Data

- **Provide detailed food-purchase information for household members**
- **Benefits:**
  - Assess changes in food purchases relative to public health nutrition initiatives
  - Monitor changes in sodium of individual-brand food products and categories
  - Proxy for sodium intake at the household level
  - Identify differences in household purchasing trends and consumption patterns over time

Food sales data provide detailed food-purchasing information for household members.<sup>25</sup> Data often are used to study patterns in food consumption, food pricing, and changes in the retail food market.<sup>25</sup>

For example, food sales data can be used to monitor changes in the sodium content of food products and categories from individual brands.<sup>4,13,26</sup> Data can also be used to assess changes in the food-purchasing behavior of households relative to public health nutrition initiatives, such as mandatory nutrition labeling.<sup>4,26,27</sup>

A unique benefit of this method is that it collects demographic, socioeconomic, and geographic information of households. These data can be used to identify differences in household purchasing trends and consumption patterns over time.

The next slide describes how to collect food sales data.

## Collecting Food Sales Data

- ❑ Scan UPC-containing foods
- ❑ Merge food sales with nutrient data
- ❑ Estimate total household and individual intakes
  - Adult male equivalent



Figure 1.



Figure 2.

To collect food sales data, first a panel of households are randomly selected. Household members use a laser scanner, shown in Figure 1, to scan food products that contain a Universal Product Code, or UPC, as shown in Figure 2. A UPC is a series of vertical black bars on processed and packaged food products that, when scanned, can provide sales and nutrition information. For foods that do not contain a UPC, such as fresh produce or meat, participants are asked to record the type of food, the weight, and price.

Second, information about these food purchases are merged with nutrient information found on food labels or in a food composition database. Third, data are analyzed to estimate total household consumption of sodium and other nutrients.<sup>4,25</sup> Individual intake can also be estimated by dividing the total household consumption of a nutrient by the number of household members.<sup>13</sup>

Because household members may have different levels of food and nutrient intakes, some researchers use “the adult male equivalent” or other reference point to estimate intakes of household members.<sup>13,28</sup> This reference point can be helpful when estimating intakes for different population subgroups, including women, children, and the elderly. For example, if the adult male equivalent for sodium intake is set at 1, and an adult female is 0.7 equivalents, then she is estimated to consume 70 percent of the sodium of an adult male.

Please note that adult male and female equivalents are only averages. Some men may not consume as much sodium as other men, and some females may consume more sodium than other females.

The next slide gives an example of how food sales data were used to monitor sodium intake in the United Kingdom.



In the United Kingdom, more than 21,000 households were randomly selected and asked to participate in a 4-week scanner survey.<sup>29</sup> Household members collectively purchased and scanned more than 44,000 different food products for home consumption. Scanner data were linked to nutrient data, including sodium.

Results show that approximately 5,400 milligrams of sodium were purchased and available for daily household consumption, not including sodium in any foods purchased away from home. More than one-third of the top contributors to household sodium purchases were table salt at 23 percent, processed meat at 18 percent, bread and bakery products at 13 percent, dairy products at 12 percent, and sauces and spreads at 11 percent.

Limitations of food sales data are discussed next.

## Food Sales Data: Limitations

- ❑ Do not provide information on actual intake
- ❑ Exclude food purchased away from home
- ❑ May be burdensome
- ❑ Associated cost



Food sales data have limitations.<sup>8,13,30</sup> Because information is based on food purchases, food sales data do not provide information on actual intake. Further, because this method only scans food purchases for home consumption, it excludes other foods purchased outside the home, such as restaurant food.

The food sales data method can be burdensome to participants because they must remember to scan all food purchases every time they go shopping. As a result, some participants may forget to scan their purchases or they may inaccurately record details of the trip, such as the store location. Lastly, there is often an associated cost to access food sales data.

Household expenditure surveys are discussed next.

## Expenditure Survey

- ❑ Provide household-level information on food expenditures and purchasing trends over time
- ❑ Benefits:
  - Identify trends in household sodium purchases
  - Provide a gross estimate of sodium intake
  - Provide demographic, socioeconomic, and geographic data
- ❑ Individual intake =  $\frac{\text{Total Household Consumption}}{\text{Household Members}}$

Household expenditure or budget surveys provide information on food expenditures, purchasing trends, and income information for households over a specified period of time. They are typically conducted every year.

Market research companies use these data to identify household purchasing trends of products and services over time. Governments, public health organizations, and researchers can use these data to assess the economic conditions of a population or to identify market baskets, which are described in Section Three.

Unlike food sales data, expenditure surveys do not use laser scanners. These surveys can be used to identify trends in food purchases at home *and* away from home.

Demographic, socioeconomic and geographic data of households are often collected as part of the survey and can be used to identify differences in purchasing trends and consumption patterns. Using information from the survey and food label data, sodium intake for the household or individual can be estimated.<sup>13,28,31,32</sup>

The next slide provides an example of how a household expenditure survey was used to monitor population-level sodium intake in Brazil.

## Expenditure Survey: Brazil

Approximately 4,500 mg of sodium per person per day were available for consumption

Food Group	Fifth of <i>per capita</i> income distribution					
	Brazil	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>
Salt and salt-based condiments	76.2	83.8	81.9	77.8	70.2	62.5
Processed foods with added salts	15.8	9.7	11.8	15.2	21.0	25.0
In natura foods or processed foods without added salt	6.6	6.1	5.6	6.0	7.3	8.8
Ready-made meals	1.4	0.4	0.7	1.0	1.5	3.7
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Adapted from: Sarno F, Claro RM, Levy RB, Bandoni DH, Ferreira SR, Monteiro CA. Estimated sodium intake by the Brazilian population, 2002–2003. *Rev Saude Publica*. 2009;43:219–25.

In Brazil, data from a household expenditure survey were analyzed to estimate individual-level sodium intake.<sup>33</sup> Almost 970,000 food purchase records were collected from 48,000 households. The table on this slide shows the percent distribution of household sodium intake based on food purchases according to increasing fifths of the per capita income distribution, by food group.

Approximately 4,500 milligrams of sodium per person per day were available for consumption, according to the survey. More than 75 percent of household purchases were from salt and salt-based condiments, rather than from processed foods with added sodium or ready-made meals. However, as income increased, household purchases of processed foods also increased.

Limitations of household expenditure surveys are discussed next.

## Expenditure Survey: Limitations

- ❑ Does not provide information on actual intake
- ❑ May not provide individual-brand products and subcategories
- ❑ May misreport food purchases

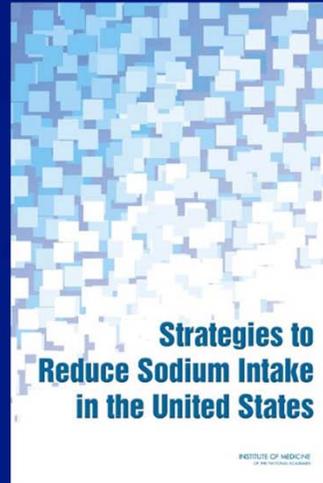


Household expenditure surveys have some limitations. Because information is based on food purchases, this method does not provide information on actual intake. Second, because food purchases are generally categorized by major food groups, information on individual-brand food products and categories may be limited. Lastly, some participants may forget to record all items they purchase during the study time frame.<sup>13,25,34</sup>

This concludes our review of Section Two.

### Section Three: National Level

- ❑ Food Balance Sheet
- ❑ Disappearance Data
- ❑ Market Basket Survey



Compared to the methods in Sections One and Two, the methods discussed in Section Three do not use information obtained from individuals or household members. Rather, these methods rely on information obtained from national-level data, such as food balance sheets, disappearance data, and market baskets.

## Food Balance Sheets

- ❑ Provide a comprehensive pattern of a country's available food supply during a specified time
- ❑ Based on the supply and disappearance of food commodities produced for human consumption
- ❑ Individual food intake =

$$\begin{array}{rcc}
 & \text{Total Food Availability} & \\
 \text{Supply} & - & \text{Disappearance} \\
 \text{(Production + Imports} & & \text{(Exports + Feed + Seed + Industrial} \\
 \text{+ Beginning Stocks)} & & \text{+ Spoil/Waste + Non-Food Use)} \\
 \hline
 & \text{Population} & 
 \end{array}$$

Food balance sheets provide a comprehensive picture of the pattern of a country's available food supply during a specified time period in a given year.<sup>35</sup> Food balance sheet data are published online by the Food and Agriculture Organization of the United Nations.<sup>35</sup>

Food balance sheets are based on the supply and disappearance of food commodities produced for human consumption. Supply includes production, imports, and beginning stocks, and disappearance includes exports, feed to livestock, seed use, industrial use, food spoilage or waste, and non-food use. By subtracting disappearance from supply, the remaining quantity represents the amount and type of food available for human consumption.

Food availability data also refer to the "disappearance" of food from the food supply.<sup>4</sup> They can be used to estimate individual food intake by dividing the total amount of available food during a specified time period by the total population in a given year.<sup>13,36</sup>

The benefits of using food balance sheet data are discussed next.

## Food Balance Sheets: Benefits

- ❑ Estimate food availability/intake
- ❑ Assess the adequacy of the food supply
- ❑ Assess changes in food intake relative to public health nutrition initiatives

FORMAT II  
FOOD BALANCE SHEET  
YEAR \_\_\_\_\_  
POPULATION \_\_\_\_\_ (thousands)  
COUNTRY \_\_\_\_\_  
(Use metric tons, unless otherwise specified)

COMMODITY	PRODUCTION		Change in STOCKS	Gross IMPORT	SUPPLY	Gross EXPORT	DOMESTIC UTILIZATION				PER CAPUT CONSUMPTION								
	Input	Output					TOTAL	FEED	SEED	MANUFACTURE for Food	Industrial Use	WASTE	FOOD	Kilo-grams /yr	Grams /day	Cal. /day	Prot. /day	Fat /day	

There are several benefits of using food balance sheets. They can be used to estimate population and individual food availability as well as intake.<sup>35</sup> This method can be used to assess the adequacy of the available food supply, such as whether there is enough food to feed an entire population.<sup>13,36</sup>

Further, these data can be used to assess changes in food availability relative to public health nutrition initiatives.<sup>13,36</sup> Lastly, food balance data can be used to determine nutrient intakes, including sodium.

The limitations of food balance sheets are discussed next.

## Food Balance Sheets: Limitations

- ❑ Do not provide information on actual intakes
- ❑ Cannot be used to identify differences in the diet by different population groups
- ❑ Do not account for foods produced, discarded, or spoiled



Food balance sheets have limitations.<sup>13,35,36</sup> First, because they are based on the supply and disappearance of food commodities, they cannot provide information on actual food intakes. Second, data cannot be used to identify differences in diet across different population groups, such as differences in age, gender, socioeconomic status, or geographic residence.

Lastly, food balance sheet data do not account for foods produced and discarded in the home or for food spoilage and waste that occurs during the manufacturing process. To obtain a better estimate of intake, food balance sheet data can be combined with the methods discussed in Sections One and Two.

Sodium disappearance data are described next.

## Sodium Disappearance Data

- **Amount of sodium that “disappears” from the food supply**
- **Benefits:**
  - Estimate time trends in the availability of sodium for human consumption
  - Assess changes in household food purchases relative to public health nutrition initiatives, such as mandatory nutrition labeling

For the purposes of this module, the term “disappearance data” refers to the amount of sodium that “disappears” from the food supply due to some foods being re-directed for export, livestock feed, seed use, or industrial use or due to food spoilage or waste.<sup>36</sup>

Disappearance data provide a snapshot of the amount of sodium in the food supply.<sup>36</sup> These data can be used to estimate time trends in the availability of sodium for human consumption and may be used as a proxy for sodium intake.<sup>36</sup> Furthermore, data may be used to monitor changes in sodium intake relative to public health nutrition initiatives.

There are two ways to estimate individual sodium intake from sodium disappearance data. The first method uses a food composition database<sup>36</sup> or other data source; the second method uses food-grade salt sales.<sup>4</sup> These methods are described next.

## Estimating Per Capita Sodium Intake

### ❑ Method 1: Food Composition Data

$$\frac{\text{Annual Per Capita Food Availability (lb)} \times \text{Sodium (g/lb)}}{365 \text{ Days}} \times 1,000 \text{ mg}$$

### ❑ Method 2: Food Grade Salt Sales

- Salt tonnage  $\times$  40% = sodium tonnage
- Convert sodium tonnage to sodium milligrams
- $\frac{\text{Sodium (mg)}}{\text{Population}} = \text{Sodium per person per year}$
- $\frac{\text{Sodium (per person per year)}}{365 \text{ Days}} = \text{Sodium per person per day}$

Two methods for estimating individual sodium intake are displayed on this slide.

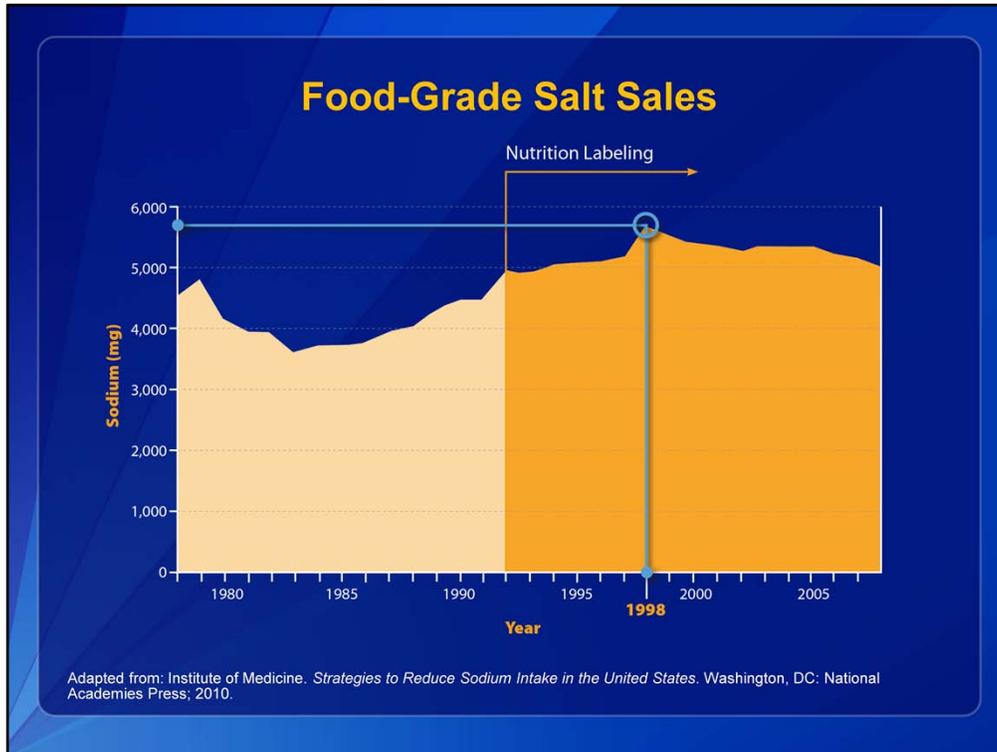
When using Method 1, food balance sheet data and an up-to-date food composition database or other data source are necessary. To estimate per capita sodium intake, multiply the annual per capita food availability from food balance sheet data for a specific food category, such as chicken, by the sodium content obtained from the food composition database. Then divide that number by 365 and multiply by 1,000.

For example, if the annual per capita food availability for chicken in Country X is approximately 4.5 million pounds, and one pound of chicken contains approximately 150 grams of sodium, multiply 4.5 million by 150 grams to get 675 million grams. Divide that number by 365 and multiply by 1,000 to get approximately 1,850 milligrams of sodium per person per day. In other words, the per capita sodium availability from chicken is approximately 1,850 milligrams per day.<sup>36</sup>

Unlike Method 1, the second method uses food-grade salt sales to estimate per capita sodium intake. Convert the quantity of food-grade salt sales, usually reported in metric tons, by 40 percent to get metric tons of sodium. Then, convert tonnage of sodium into milligrams of sodium. Divide milligrams of sodium by the total population and then divide by 365 days.

For additional information about food-grade salt sales, refer to the Institute of Medicine's *Strategies to Reduce Sodium Intake in the United States* report.

The following slide illustrates how Method 2 was used to monitor changes in sodium intake relative to public health nutrition initiatives.<sup>4</sup>



Based on food-grade salt sales data, this graph shows the amount of sodium that “disappeared” from the U.S. food supply from 1978 to 2008.<sup>4</sup> These data reveal how much sodium was available for consumption.

In addition, data were used to assess changes in Americans’ daily sodium intake relative to public health nutrition initiatives, such as the implementation of the 1993 mandatory food-labeling regulations.

The graph shows that in 1998, about 5,700 milligrams of sodium were available for consumption per person per day. This amount is higher than the sodium availability in 1993 and more than double the recommended limit for daily sodium intake set by the *Dietary Guidelines for Americans*. The graph suggests that mandatory food labeling did not result in decreased sodium consumption.

The limitations of sodium disappearance data are discussed next.

## Sodium Disappearance Data: Limitations

- ❑ Do not provide information on actual intake
- ❑ May overestimate intake
- ❑ Do not account for differences of population subgroups



Sodium disappearance data have limitations. First, data do not provide information on actual intake of sodium, only what was available in the food supply.<sup>13,35</sup> Second, because data do not account for losses due to cooking, food spoilage, and waste, intakes may be overestimated.<sup>36</sup> Third, data do not account for differences in intakes across population subgroups, including by gender, age, and race or ethnicity.<sup>13</sup>

Market basket surveys are described next.

## Market Basket Survey

- **Analyze a group of foods that reflect the average food consumption patterns of a given population**
- **Steps**
  - Select foods based on dietary assessment data
  - Develop “typical” diet
  - Purchase and prepare foods
  - Analyze foods
- **Benefit: foods are prepared as they would be consumed**

A market basket survey is a tool used to assess nutrient levels in a group of foods that reflect the average consumption patterns and portion sizes of a population, as identified by dietary assessment surveys.<sup>10</sup> Market basket surveys can be conducted several times each year, annually, or when resources are available.

A market basket survey involves selecting foods based on dietary assessment survey data, for which individuals are asked to report what and how much they have eaten, and from retail sales data. Usually, the most frequently consumed foods are selected to be analyzed. Therefore, only 100 to 200 foods are tested, rather than the thousands reported in dietary assessment data.

A “typical” diet is developed based on the food list for each of the population groups identified. Foods to be analyzed can be purchased from retail outlets, including but not limited to a supermarket, butcher, café, or fast food restaurant. This approach helps to ensure variety.

Prior to nutrient analysis, food purchases are prepared as they would be consumed, so the nutrient values provided can be used to estimate actual nutrient intakes in a population, such as for sodium. To estimate sodium intake, multiply the nutrient content of a specific food category or type by the average intake for that food.

The next slide provides an example of a market basket survey.



Food consumption data from Italy's nationwide dietary survey on individuals was used to select a list of market basket foods that reflected the Italian total diet.<sup>37</sup> About 191 foods were selected, purchased, prepared, and analyzed for nutrient content.

Food items were categorized by main food group, for example, milk and dairy, cereals and cereal products, meat and meat products, fish, fruit, vegetables, sweet products, beverages, and other products. Based on average dietary intake data, the average daily intake of sodium and other nutrients in the total diet and in individual food groups were estimated.

The average sodium intake from the total diet, including discretionary salt use, was about 3,800 milligrams per person per day. The major sources of sodium were cereals (18 percent) and meat and meat products (13 percent). Compared with the Italian recommended dietary allowances, average daily intake of sodium was above the upper limit.

Limitations of market basket surveys are discussed next.

## **Market Basket Study: Limitations**

- ❑ **Market basket is determined by food consumption data**
- ❑ **Data do not account for individual intakes**
- ❑ **Resource-intensive method**
- ❑ **Differences in procedures can result in different nutrient values**

There are several limitations of market basket surveys. First, dietary assessment data or other national consumption data often are necessary for selecting market basket foods because market baskets are chosen according to the foods that are most frequently consumed, as reported in dietary assessment surveys.

Second, nutrient intake values are averaged for the entire population and therefore do not account for individual intakes. Market studies also can be resource intensive because qualified researchers are needed to develop a valid food sampling, preparation, and analytic plan. Lastly, differences in food selection, food preparation, and laboratory techniques may result in different nutrient values.<sup>13,38</sup>

This concludes our review of Section Three at the national level.

## Considerations

- ❑ Use various methods to monitor sodium intake
- ❑ Provide assistance and resources
- ❑ Maintain a food composition database
- ❑ Work with the food industry



A modest reduction in population sodium intake is one of the most cost-effective strategies to reduce the burden of high blood pressure and related cardiovascular disease death and disability worldwide.

In summary, national data are useful for assessing food and nutrient consumption patterns over time. However, they do not provide a direct measure of consumption. Household data can show patterns of food-purchasing trends, but similar to national data, they do not provide a direct measure of consumption. Dietary assessment data, on the other hand, can be used to estimate individual sodium intake.

Using a combination of the methods just described, countries can monitor sodium intake over time. Countries also can choose to provide assistance and resources to other countries to help monitor sodium intake. Additionally, maintaining an up-to-date food composition database will help monitor sodium intake as reported in dietary assessment surveys.

Lastly, countries may choose to work with the food industry to obtain current nutrient information for packaged foods, which will help monitor sodium intake from these sources.

## Top 10 Resources

1. World Health Organization and Pan American Health Organization. *A Review of Methods Used to Determine the Main Sources of Salt in the Diet*. Pan American Health Organization Web site. 2010.  
[http://new.paho.org/hq/index.php?option=com\\_content&task=view&id=3072&Itemid=2376](http://new.paho.org/hq/index.php?option=com_content&task=view&id=3072&Itemid=2376). Accessed February 7, 2013.
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3. Institute of Medicine. *Strategies to Reduce Sodium Intake in the United States*. Washington, DC: National Academies Press; 2010.
4. Food and Agricultural Organization of the United Nations. Historical background of food balance sheets. In: *Food Balance Sheet: A Hand Book*. Food and Agricultural Organization of the United Nations Web site. 2001. [www.fao.org/DOCREP/003/X9892E/X9892e01.htm](http://www.fao.org/DOCREP/003/X9892E/X9892e01.htm). Accessed February 7, 2013.
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[http://riskfactor.cancer.gov/diet/adi/thompson\\_subar\\_dietary\\_assessment\\_methodology.pdf](http://riskfactor.cancer.gov/diet/adi/thompson_subar_dietary_assessment_methodology.pdf). Accessed February 7, 2013.

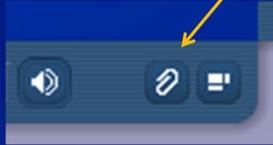
The resources included here provide additional background about indirect estimation and dietary assessments.

## Top 10 Resources

6. U.S. Department of Agriculture, Agricultural Research Service. Welcome to the Food Surveys Research Group Web site. [www.ars.usda.gov/Main/site\\_main.htm?modecode=12-35-50-00](http://www.ars.usda.gov/Main/site_main.htm?modecode=12-35-50-00). Accessed February 7, 2013.
7. U.S. Department of Agriculture, Economic Research Service. Food Availability (Per Capita) Data System Web site. [www.ers.usda.gov/data-products/food-availability-\(per-capita\)-data-system/food-availability-documentation.aspx](http://www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system/food-availability-documentation.aspx). Accessed February 7, 2013.
8. U.S. Food and Drug Administration. FDA's Total Diet Study: Monitoring U.S. Food Supply Safety Web site. [www.fda.gov/Food/FoodSafety/FoodContaminantsAdulteration/TotalDietStudy/ucm186140.htm](http://www.fda.gov/Food/FoodSafety/FoodContaminantsAdulteration/TotalDietStudy/ucm186140.htm). Accessed February 7, 2013.
9. European Commission. *Household Budget Surveys in the EC: Methodology and Recommendations for Harmonisation*. European Commission Web site. 2011. <http://ec.europa.eu/eurostat/ramon/statmanuals/files/KS-BF-03-003--N-EN.pdf>. Accessed February 7, 2013.
10. McCarthy ME, Garner TI, Passero WD, Johnson DS, Paulin GD. *Consumer Expenditure Survey: Construction and Research Use of the Consumer Expenditure Survey*. Bureau of Labor Statistics Web site. 1998. [www.bls.gov/cex/food\\_princeton\\_1998.pdf](http://www.bls.gov/cex/food_princeton_1998.pdf). Accessed February 7, 2013.

## References

References for the information presented in this module are available for download. Click on the paperclip icon below.



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## Module Evaluation

We are interested in hearing your feedback on this module. Your feedback and comments will be used to make training improvements and better meet the needs of participants. Please click on the link below to provide your feedback.

[www.surveymonkey.com/s/GlobalSodiumReductionFoodIntake](http://www.surveymonkey.com/s/GlobalSodiumReductionFoodIntake)

This concludes the Indirect Estimation and Dietary Assessments module. Please review the other modules to learn more about strategies for reducing sodium intake in your country.

We are interested in hearing your feedback on this module. Your feedback and comments will be used to make training improvements and better meet the needs of participants. Please click on the link below to provide your feedback.

## **Sodium Reduction Toolkit: A Global Opportunity to Reduce Population-Level Sodium Intake**

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### **Indirect Estimation and Dietary Assessments: References**

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