

Vital Signs: Food Categories Contributing the Most to Sodium Consumption — United States, 2007–2008

Abstract

Background: Most of the U.S. population consumes sodium in excess of daily guidelines (<2,300 mg overall and 1,500 mg for specific populations). Excessive sodium consumption raises blood pressure, which is a major risk factor for heart disease and stroke, the nation's first and fourth leading causes of death. Identifying food categories contributing the most to daily sodium consumption can help reduction.

Methods: Population proportions of sodium consumption from specific food categories and sources were estimated among 7,227 participants aged ≥ 2 years in the *What We Eat in America*, National Health and Nutrition Examination Survey, 2007–2008.

Results: Mean daily sodium consumption was 3,266 mg, excluding salt added at the table. Forty-four percent of sodium consumed came from 10 food categories: bread and rolls, cold cuts/cured meats, pizza, poultry, soups, sandwiches, cheese, pasta mixed dishes, meat mixed dishes, and savory snacks. For most of these categories, >70% of the sodium consumed came from foods obtained at a store. For pizza and poultry, respectively, 51% and 27% of sodium consumed came from foods obtained at fast food/pizza restaurants. Mean sodium consumption per calorie consumed was significantly greater for foods and beverages obtained from fast food/pizza or other restaurants versus stores.

Implications for Public Health Practice: Average sodium consumption is too high, reinforcing the importance of implementing strategies to reduce U.S. sodium intake. Nationwide, food manufacturers and restaurants can strive to reduce excess sodium added to foods before purchase. States and localities can implement policies to reduce sodium in foods served in institutional settings (e.g., schools, child care settings, and government cafeterias). Clinicians can counsel most patients to check food labels and select foods lower in sodium.

Introduction

High sodium consumption is related to high blood pressure, or hypertension, which in 2008 was reported as a primary or contributing cause of approximately 348,000 U.S. deaths (1). Thirty-one percent of adults in the United States have hypertension, and fewer than half of them have their blood pressure under control (2). Reducing the average daily population sodium consumption by about one third is projected to reduce blood pressure and decrease the number of new and recurrent cases of heart attack and stroke, averting up to 81,000 deaths, and saving \$20 billion health-care dollars annually (3).

Excess sodium consumption is common and can be reduced through modifications to the food environment (4). Average daily sodium consumption during 2007–2008 was 3,266 mg among persons aged ≥ 2 years in the United States, well above the current *Dietary Guidelines for Americans* recommendations of <2,300 mg overall and 1,500 mg for specific at-risk populations comprising about half of the population (5). Approximately 88% of persons aged ≥ 2 years who should consume <2,300 mg daily and 99% of persons who should consume 1,500 mg daily consume more than these levels (6). Meeting these recommendations might be challenging, because >75% of



sodium consumed is estimated to come from sodium added to restaurant and processed foods before purchase, whereas only 5%–6% is added at home during cooking and 5%–6% at the table (4,7). The Institute of Medicine (IOM) recently recommended populationwide strategies, including mandatory reductions in sodium in processed and restaurant foods with interim voluntary reductions from food manufacturers (4).

Identifying the major food sources of sodium is important to reducing sodium consumption. This report describes the sources of dietary sodium consumption, both specific food categories and where they were obtained among the U.S. population aged ≥ 2 years, overall, and by age and other demographic characteristics.

Methods

Data were analyzed from the 2007–2008 *What We Eat in America* (WWEIA), National Health and Nutrition Examination Survey (NHANES), a multistage probability sample of the U.S. noninstitutionalized population, with oversampling of specific population subgroups including, but not limited to, non-Hispanic blacks, and Mexican-Americans.* During this period, 9,013 participants aged ≥ 2 years were interviewed and examined (response rate: approximately 75%). Of these, 7,227 completed two 24-hour dietary recalls. Compared with the 1,786 who did not complete both recalls, persons in the analytic sample did not differ by race-ethnicity, but were older (mean difference: 4 years, $p < 0.001$), and a higher percentage were female (52% vs. 46%, $p = 0.017$).

The initial 24-hour dietary recall was administered in the NHANES Mobile Examination Center, and the second recall was administered 3–10 days later by telephone.† The 24-hour dietary recall was collected by trained interviewers using USDA's Automated Multi-Pass Method, a 5-step fully computerized recall method with food models.§ For each person, on each of the 2 days, nutrient intakes (e.g., sodium) were estimated by summing the amount of the nutrient consumed from each food or beverage reported for that day. Estimates of sodium in some foods were adjusted downward for those who reported not using salt in cooking; estimates also excluded salt added at the table and consumed from supplements and medicines. Using the detailed information from the 24-hour dietary recall, each food was assigned to a food code in the U.S. Department of Agriculture (USDA) Food and Nutrient Database for Dietary Studies (FNDDS) version 4.1. Nutrient values for each FNDDS 4.1 food code are based on the National Nutrient Database for Standard Reference, release 22.¶

* Additional information available at <http://www.cdc.gov/nchs/nhanes.htm>.

† Additional information available at http://www.cdc.gov/nchs/nhanes/nhanes2007-2008/drxdoc_e.htm.

§ Additional information available at <http://www.ars.usda.gov/ba/bhnrc/fsrg>.

¶ Additional information available at <http://www.ars.usda.gov/nutrientdata>.

To identify the top 10 ranked food categories contributing to sodium consumption, each of the approximately 7,000 food codes in FNDDS was assigned to one of approximately 100 food categories, based on the customary use and consumption of foods in the diet.** The food categories were ranked based on population proportion, defined as the sum of the amount of sodium from foods within a specific category (or obtained from a specific source) for all persons, divided by the sum of sodium from all foods for all persons and multiplied by 100 (8,9). Sodium density, a measure that accounts for differences in the amount of calories consumed from foods obtained from each food source (e.g., store or restaurant), was defined as mg of sodium per 1,000 kcal. The population proportion (%) of sodium consumed from a food source within a food category (e.g., pizza) was estimated from the sum of the amount of sodium from the food and source category divided by the sum of sodium consumption from all foods consumed within the specific food category.

Population proportions and other percentages, means, and standard errors were estimated using software that accounts for the complex survey design. For all estimates, the sums of two 24-hour recalls per person and 2-day dietary sample weights were used. Sample weights accounted for the probability of selection, survey nonresponse, and the proportion of weekend/weekday combinations of the two 24-hour dietary recalls.

Results

Mean daily sodium consumption was 3,266 mg. Approximately 44% of sodium consumption came from foods in the following 10 categories: bread and rolls (7.4%), cold cuts/cured meats (5.1%), pizza (4.9%), fresh and processed poultry (4.5%), soups (4.3%), sandwiches like cheeseburgers (4.0%),†† cheese (3.8%), pasta mixed dishes (e.g., spaghetti with meat sauce) (3.3%), meat mixed dishes (e.g., meat loaf with tomato sauce) (3.2%), and savory snacks (e.g., chips and pretzels) (3.1%) (Table 1). Whether analyzed by age group, sex, or racial-ethnic population, the five leading food categories contributing to sodium consumption almost always were among the top 10 ranked categories (Table 1 and Table 2). Exceptions included frankfurters and sausages, which were the third highest contributor among children aged 2–5 years (5.4% of sodium consumption) and the fifth highest among non-Hispanic blacks (5.0%). Among Mexican-Americans, burritos, tacos, and tamales were the top contributor (6.8%), and tortillas were the fifth contributor (4.7%).

Most sodium consumed (65.2%) came from foods obtained from a store (e.g., supermarket or convenience store). Restaurants

** Additional information available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6105-table.htm>.

†† Sandwiches as identified by a single code in WWEIA.

TABLE 1. Ranked population proportions of sodium consumed,* by selected food categories and age groups — *What We Eat in America (WWEIA)*, National Health and Nutrition Examination Survey, United States, 2007–2008

Rank [†]	Food category [§]	Age group (yrs)								
		≥2	2–19	2–5	6–11	12–19	≥20	20–50	51–70	≥71
1	Breads and rolls	7.4 (0.2)	6.9 (0.4)	6.5 (0.5)	7.8 (0.6)	6.5 (0.4)	7.5 (0.2)	7.2 (0.3)	7.8 (0.4)	9.6 (0.3)
2	Cold cuts/cured meats	5.1 (0.3)	4.4 (0.4)	3.4 (0.5)	4.3 (0.4)	4.9 (0.7)	5.3 (0.3)	5.5 (0.5)	4.6 (0.2)	6.0 (0.5)
3	Pizza	4.9 (0.2)	7.3 (0.4)	4.8 (0.7)	7.2 (0.6)	8.2 (0.7)	4.1 (0.2)	5.0 (0.4)	3.0 (0.4)	1.7 (0.2)
4	Poultry	4.5 (0.2)	5.5 (0.4)	5.5 (0.4)	4.7 (0.4)	6.0 (0.6)	4.2 (0.3)	4.5 (0.3)	3.9 (0.3)	2.7 (0.3)
5	Soups	4.3 (0.3)	4.0 (0.2)	5.3 (0.9)	3.6 (0.4)	3.9 (0.4)	4.4 (0.4)	4.2 (0.4)	4.6 (0.7)	5.7 (0.7)
6	Sandwiches [¶]	4.0 (0.3)	4.4 (0.3)	3.5 (0.3)	3.9 (0.3)	5.0 (0.5)	3.9 (0.3)	4.5 (0.3)	3.2 (0.6)	3.7 (0.5)
7	Cheese ^{**}	3.8 (0.2)	3.8 (0.3)	4.2 (0.4)	3.7 (0.3)	3.9 (0.4)	3.8 (0.2)	3.9 (0.2)	3.5 (0.2)	1.8 (0.3)
8	Pasta mixed dishes ^{††}	3.3 (0.2)	3.8 (0.4)	4.0 (0.6)	4.0 (0.5)	3.7 (0.4)	3.1 (0.2)	3.4 (0.4)	2.4 (0.5)	2.9 (0.3)
9	Meat mixed dishes	3.2 (0.3)	2.1 (0.4)	— ^{§§}	2.2 (0.5)	1.9 (0.4)	3.6 (0.3)	3.5 (0.3)	3.6 (0.7)	4.2 (0.7)
10	Savory snacks ^{¶¶}	3.1 (0.2)	4.4 (0.3)	3.4 (0.2)	4.6 (0.4)	4.6 (0.6)	2.8 (0.2)	2.8 (0.2)	3.0 (0.4)	1.6 (0.2)
Mean daily sodium consumption (mg) (SE)		3,266(40)	2,957 (53)	2,245 (54)	2,944 (72)	3,310 (70)	3,372 (48)	3,568 (58)	3,239 (73)	2,658 (77)
Unweighted no. of participants in sample		7,227	2,544	662	901	981	4,683	2,280	1,549	854

Abbreviation: SE = standard error.

* The population proportion (%) of sodium consumed is defined as the sum of the amount of sodium consumed from each specific food category for all participants divided by the sum of sodium consumed from all food categories for all participants multiplied by 100. All estimates use two observations per person, take into account the complex sampling design, and use 2-day diet sample weights to account for nonresponse and weekend/weekday recalls. Standard errors of the estimates are in parentheses.

[†] Rank based on population proportions of sodium consumed for overall U.S. population aged ≥ 2 years. Columns for other age groups are ordered by this ranking. Additional information regarding food categorization is available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6105-table.htm>.

[§] Food categories contributing ≥ 3% to overall sodium consumption within specific age groups but not listed among the top 10 contributors were as follows: persons aged 2–19 years, frankfurters and sausages (3.7%) and ready-to-eat cereal (3.2%); 2–5 years, frankfurters and sausages (5.4%), whole and reduced fat milk (4.7%), and ready-to-eat cereal (3.7%); 6–11 years, frankfurters and sausages (4.1%), and ready-to-eat cereals (3.4%); 12–19 years, burritos, tacos, and tamales (4.0%); 20–50 years, burritos, tacos, tamales (3.4%); 51–70 years, salad dressings and vegetable oils (3.5%); ≥71 years, biscuits, muffins, quick breads (3.2%).

[¶] Sandwiches as identified by a single WWEIA code.

^{**} Natural and processed cheese.

^{††} Pasta mixed dishes category does not include macaroni and cheese, which is its own category.

^{§§} Data are statistically unreliable; relative standard error ≥ 30%.

^{¶¶} Includes snacks such as chips, puffs, popcorn, and pretzels.

were the source of 24.8% of the sodium consumed, including 13.6% from restaurants with fast food/pizza and 11.2% from restaurants with service by a waiter/waitress. The remaining 10.0% was from other specific sources (Table 3). Among children aged 2–19 years, 8.1% of sodium consumed came from foods obtained from school cafeterias or child care centers. Among both persons aged 2–19 years and ≥20 years, mean sodium density was significantly greater for foods and beverages obtained from fast food/pizza or other restaurants versus stores (Table 3).

A large percentage of participants ate foods from one or more of the 10 ranked food categories during at least one of the two 24-hour dietary recall days; 79.9% reported eating bread and rolls, 56.2% ate cheese, 50.7% ate savory snacks, and 48.3% ate poultry (Table 4). Among the other six food categories, the percentage that ate foods from those ranged from 17.6% to 33.9%. Among food sources, fast food/pizza restaurants accounted for 51.2% of the sodium consumed from pizza, 26.6% from poultry, and 84.5% from sandwiches.

Conclusions and Comments

The results from this study indicated that the top 10 ranked food categories contributed 44% of the overall sodium

consumption among persons aged ≥2 years in the United States. Most of the sodium was in foods obtained at stores; however, 25% of sodium consumption came from restaurants. Foods obtained at restaurants tend to have more sodium per calorie compared with foods obtained at stores. Additionally, two leading contributors to sodium consumption (pizza and poultry) are more often obtained from restaurants and locations other than stores. Although the results show this also is true for sandwiches, that is because sandwiches assigned single codes primarily represented sandwiches prepared at fast food/pizza restaurants. Together, these results suggest a comprehensive approach is needed that includes reductions in the sodium content in processed foods from stores, restaurants and other food service locations.

These analyses are the most current regarding the top food contributors of sodium consumption in the United States and further our understanding of sodium consumption by source. The results are consistent with previous analyses of sodium consumption per capita based on 2005–2006 or older data and somewhat different food categories, suggesting the leading food sources of sodium consumption include both frequently consumed processed foods containing moderate

TABLE 2. Ranked population proportions of sodium consumed* by persons aged ≥ 2 years, by selected food categories, sex, and selected race/ethnicities — *What We Eat in America (WWEIA)*, National Health and Nutrition Examination Survey, United States, 2007–2008

Rank [†]	Food category [‡]	Sex		Race/Ethnicity		
		Male % (SE)	Female % (SE)	non-Hispanic white % (SE)	non-Hispanic black % (SE)	Mexican-American % (SE)
1	Breads and rolls	7.4 (0.3)	7.4 (0.2)	7.9 (0.3)	6.7 (0.3)	5.2 (0.2)
2	Cold cuts/cured meats	5.8 (0.5)	4.3 (0.2)	5.5 (0.4)	4.6 (0.4)	4.1 (0.3)
3	Pizza	5.7 (0.3)	4.0 (0.3)	4.9 (0.2)	5.6 (0.6)	5.2 (0.2)
4	Poultry	4.5 (0.3)	4.5 (0.2)	4.1 (0.3)	7.2 (0.5)	4.5 (0.3)
5	Soups	4.3 (0.4)	4.4 (0.3)	3.6 (0.3)	3.2 (0.5)	6.2 (0.8)
6	Sandwiches [¶]	4.3 (0.4)	3.7 (0.3)	3.7 (0.4)	6.0 (0.7)	4.1 (0.4)
7	Cheese ^{**}	3.7 (0.1)	3.9 (0.3)	4.1 (0.2)	3.0 (0.2)	3.2 (0.2)
8	Pasta mixed dishes ^{††}	3.2 (0.2)	3.4 (0.3)	3.5 (0.2)	3.1 (0.2)	1.8 (0.2)
9	Meat mixed dishes	3.1 (0.2)	3.4 (0.5)	3.6 (0.3)	2.3 (0.2)	2.0 (0.2)
10	Savory snacks ^{§§}	2.9 (0.2)	3.4 (0.2)	3.3 (0.2)	3.2 (0.2)	2.8 (0.2)
Mean daily sodium consumption (mg) (SE)		3,760 (57)	2,828 (36)	3,324 (49)	3,116 (51)	3,037 (49)
Unweighted no. of participants in sample		3,557	3,670	3,115	1,600	1,407

Abbreviation: SE = standard error.

* The population proportion (%) of sodium consumed is defined as the sum of the amount of sodium consumed from each specific food category for all participants divided by the sum of sodium consumed from all food categories for all participants multiplied by 100. All estimates use two observations per person, take into account the complex sampling design, and use 2-day diet sample weights to account for nonresponse and weekend/weekday recalls. Standard errors of the estimates are in parentheses.

[†] Rank based on population proportions of sodium consumed for overall U.S. population aged ≥ 2 years. Columns for other age groups are ordered by this ranking. Additional information regarding food categorization is available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6105-table.htm>.

[‡] Food categories contributing $\geq 3\%$ to overall sodium consumption within specific age groups but not listed among the top 10 contributors were as follows: males, frankfurters and sausages (3.3%), and burritos, tacos, and tamales (3.2%); females, frankfurters and sausages (3.3%), burritos, tacos, and tamales (3.2%); non-Hispanic blacks, frankfurters and sausages (5.0%), salad dressings and vegetable oils (2.4%); Mexican-Americans, burritos, tacos, and tamales (6.8%), tortillas (4.7%), and eggs and eggs mixed dishes (3.8%).

[¶] Sandwiches as identified by a single WWEIA code.

^{**} Natural and processed cheese.

^{††} Pasta mixed dishes category does not include macaroni and cheese, which is its own category.

^{§§} Includes snacks such as chips, puffs, popcorn, and pretzels.

TABLE 3. Population proportions of sodium consumed* and mean sodium density,[†] by food source category and age group — *What We Eat in America*, National Health and Nutrition Examination Survey, United States, 2007–2008

Age group (yrs)	Food source category [‡]				
	Store	Restaurant with fast food/pizza	Restaurant with waiter/waitress	Cafeteria at school/child care center	Other
≥ 2					
Population proportion, % (SE)	65.2 (1.0)	13.6 (0.7)	11.2 (0.7)	—	10.0 (0.5)
Sodium density, mg/1,000 kcal	1,519 (10)	1,848 (16)	2,090 (32)	—	1,676 (21)
2–19					
Population proportion, % (SE)	65.5 (1.1)	13.7 (0.6)	6.3 (0.7)	8.1 (1.2)	6.3 (0.5)
Sodium density, mg/1,000 kcal	1,509 (14)	1,745 (20)	1,970 (63)	1,701 (22)	1,501 (58)
≥ 20					
Population proportion, % (SE)	65.1 (1.3)	13.6 (0.8)	12.7 (0.8)	—	8.6 (0.4)
Sodium density, mg/1,000 kcal	1,522 (12)	1,882 (23)	2,110 (29)	—	1,712 (24)

Abbreviation: SE = standard error.

* The population proportion (%) of sodium consumed is defined as the sum of the amount of sodium consumed from each specific food source category for all participants divided by the sum of sodium consumed from all food source categories for all participants multiplied by 100. All estimates use two observations per person, take into account the complex sampling design, and use 2-day diet sample weights to account for nonresponse and weekend/weekday recalls. Standard errors of the estimates are in parentheses. The unweighted number of participants in each sample was 7,227 (2,554 children and 4,683 adults).

[†] A measure that accounts for differences in the amount of calories consumed from foods obtained from each source, defined as mg of sodium per 1,000 kcal.

[‡] Food source categories were analyzed from responses to the question, "Where did you get this (most of the ingredients for this) [food name]?" "Cafeteria at school" and "child care center" were combined in one category. Sources other than those shown were combined under "other" and included "from someone else/gift" (3.9% population proportion among those aged ≥ 2 years), cafeteria at school/child care center (2.1%), and 19 other sources (e.g., vending machine), including "missing," "do not know," and "other/specify" (<1%). For persons not aged 2–19 years, "cafeteria at school" and "child care center" were grouped in the "other" category because <1% reported consumption of sodium from foods obtained at these locations.

TABLE 4. Percent of persons aged ≥ 2 years who consumed the food from the specified food category* and among those persons, the proportion who obtained the food from stores, restaurants, or other sources — *What We Eat in America (WWEIA)*, National Health and Nutrition Examination Survey, United States, 2007–2008

Rank	Food category	No. of consumers [§]	% (SE) [¶]	Food source category [†]			
				Store % (SE)	Restaurant with fast food/pizza % (SE)	Restaurant with waiter/waitress % (SE)	Other % (SE)
1	Breads and rolls	5,672	79.9 (0.9)	76.4 (1.3)	6.7 (0.8)	8.7 (0.6)	8.2 (0.7)
2	Cold cuts/cured meats	2,469	33.9 (1.2)	78.8 (1.1)	6.5 (1.0)	5.4 (0.9)	9.3 (1.2)
3	Pizza	1,569	21.9 (0.7)	27.2 (3.1)	51.2 (3.5)	13.2 (2.1)	8.4 (1.1)
4	Poultry	3,659	48.3 (1.3)	46.0 (2.4)	26.6 (1.9)	16.7 (1.2)	10.7 (1.3)
5	Soups	1,670	22.0 (1.3)	77.4 (4.3)	—**	12.5 (3.6)	7.5 (1.1)
6	Sandwiches ^{††}	1,480	20.6 (1.1)	11.9 (1.2)	84.5 (1.4)	—	3.0 (0.8)
7	Cheese ^{§§}	3,833	56.2 (1.9)	72.4 (1.2)	10.5 (1.0)	8.2 (0.6)	8.9 (0.9)
8	Pasta mixed dishes ^{¶¶}	1,183	17.6 (0.9)	82.2 (3.2)	—	7.4 (1.6)	8.8 (1.5)
9	Meat mixed dishes	1,417	21.8 (1.4)	76.7 (3.5)	5.4 (1.2)	9.2 (2.3)	8.7 (2.0)
10	Savory snacks ^{***}	3,599	50.7 (1.5)	81.7 (1.5)	3.6 (1.0)	2.5 (0.4)	12.2 (1.2)

* Ranked by population proportions (%) of sodium consumed by persons aged ≥ 2 years. The population proportion (%) of sodium consumed is defined as the sum of the amount of sodium consumed from each specific food source category for all participants who consumed foods within the specified food category divided by the sum of sodium consumed from all food source categories for all participants who consumed foods within the specified food category multiplied by 100. All estimates use two observations per person, take into account the complex sampling design, and use 2-day diet sample weights to account for nonresponse and weekend/weekday recalls. Standard errors of the estimates are in parentheses. Data were limited to the food categories ranked in the top 10 in population proportion of sodium consumed by persons aged ≥ 2 years.

† Food source categories were analyzed from responses to the question, "Where did you get this (most of the ingredients for this) [food name]?" Sources other than those shown were combined under "other" and included "from someone else/gift" (3.9% population proportion among those aged ≥ 2 years), cafeteria at school/child care center (2.1%), and 19 other sources (e.g., vending machine), including "missing," "do not know," and "other/specify" (<1%).

§ No. of participants aged ≥ 2 who reported consumption of at least one food within the selected food category on either day of the two 24-hour dietary recall.

¶ Percentage of participants aged ≥ 2 years who reported consumption of at least one food within the selected food category on either day of the two 24-hour dietary recalls.

** Data are statistically unreliable, relative standard error $\geq 30\%$.

†† Sandwiches as identified by a single WWEIA code.

§§ Natural and processed cheese.

¶¶ Pasta mixed dishes category does not include macaroni and cheese, which is its own category.

*** Includes snacks such as chips, puffs, popcorn, and pretzels.

amounts of sodium (e.g., breads and rolls and chicken) and less frequently consumed foods containing higher amounts of sodium (e.g., cold cuts/cured meats and pizza) (4,5,10–12). Given that sodium and energy intake are highly correlated, the proportion of sodium obtained at schools is consistent with 1994–1996 analyses among children aged 2–18 years indicating that 8.7% of calories consumed came from schools (13). Although not directly comparable, the results in this report are generally consistent with previous studies suggesting persons eat more sodium per calorie from food and beverages obtained at restaurants than eaten at home (4,14,15). Some of the population sodium contribution from restaurants might be attributable to larger portion sizes as well as the food types consumed and the amount of sodium in the foods.

This analysis is subject to at least six limitations. First, institutionalized populations were excluded. Second, some persons did not complete two 24-hour diet recalls, but estimates were weighted to account for nonresponse. Third, ranking of food categories by contribution to sodium consumption is greatly influenced by methods of categorizing. Depending on the categorization of specific foods and the portion sizes and frequency of their consumption, the contribution to sodium consumption and ranking of foods can vary (9,16). The food

categories represent how foods and beverages are consumed and should be useful to dietitians, nutritionists, and public health professionals in developing strategies and educational materials to reduce sodium consumption. Fourth, although multiple 24-hour diet recalls collected using a rigorous method were used to assess dietary consumption, the data are still subject to errors in self-reporting and food coding and composition and lack a biomarker of total sodium consumption, such as 24-hour urine collection. Fifth, nutrient information on specific brands is limited in FNDDS. Finally, the sodium contribution of foods and beverages excluded sodium consumed from salt added at the table (an estimated 5%–6% of total consumption) and from supplements and medicines (<1% of total consumption), resulting in underestimate of total sodium consumption (4,17).

The high average U.S. sodium intake reinforces the importance of the IOM recommendations to set phased targets to reduce the sodium content of processed, restaurant, and other foods (4). The Food and Drug Administration and USDA's Food Safety Inspection Service recently solicited public comments on this and other strategies. §§ The IOM also recommended that the food

§§ Additional information available at <http://www.regulations.gov/#!documentDetail;D=FDA-2011-N-0400-0001>.

Key Points

- Approximately nine of 10 persons in the United States consume more sodium than recommended.
- Recommended daily sodium consumption for all persons is <2,300 mg, and is 1,500 mg for specific groups, including non-Hispanic blacks, persons aged ≥51 years, and persons with hypertension, diabetes, and chronic kidney disease.
- Dietary sodium, excluding sodium added at the table, averages 3,266 mg/day, far greater than recommendations. The leading sources of overall sodium consumption are bread and rolls, cold cuts/cured meats, pizza, poultry, soups, sandwiches such as cheeseburgers, cheese, pasta mixed dishes such as spaghetti with meat sauce, meat mixed dishes such as meatloaf with tomato sauce, and savory snacks like chips and pretzels. Together, these account for more than 40% of sodium consumption.
- Two thirds of dietary sodium from foods and drinks comes from supermarkets, convenience stores, or other stores. One fourth comes from restaurant food, which has the highest per-calorie dietary sodium.
- Reducing the sodium content of the 10 leading sources by one fourth would reduce total dietary sodium by more than 10%. This could prevent an estimated 28,000 deaths and \$7 billion in health-care expenditures annually. In particular, sustained manufacturer and restaurant reductions in sodium in foods are recommended.
- Additional information is available at <http://www.cdc.gov/vitalsigns>.

industry voluntarily reduce the sodium content of foods (4). Several food manufacturers and restaurants have committed to voluntary reductions in some of their food products, some as part of the New York City-led National Salt Reduction Initiative.^{¶¶} In addition, to support national initiatives, IOM recommended more widespread implementation of state and local policies to reduce the amount of sodium in foods served in local restaurants and other food services (4). Programs such as those being piloted by CDC's *Sodium Reduction in Communities*^{***} might complement these efforts. In addition, health-care providers can counsel patients to choose low sodium foods, consistent with IOM recommendations (4) and those in the *Dietary Approaches to Stop Hypertension* eating pattern (4).^{†††}

^{¶¶} Additional information available at <http://www.nyc.gov/html/doh/html/cardio/cardio-salt-initiative.shtml>.

^{***} Additional information available at http://www.cdc.gov/dhdsr/programs/sodium_reduction.htm.

^{†††} Additional information available at http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf.

A reduction of 25% in sodium content across the top 10 food category contributors to sodium consumption could result in an 11% reduction (approximately 360 mg) in total daily mean sodium consumption in the United States. Reducing the mean population sodium consumption by 400 mg has been projected to avert up to 28,000 deaths from any cause and save \$7 billion in health-care expenditures annually (3). Sodium reduction is an important component of the U.S. Department of Health and Human Services' *Million Hearts* initiative, which is co-led by CDC and the Centers for Medicare and Medicaid Services and aims to improve cardiovascular disease prevention through clinical and community interventions to prevent 1 million heart attacks and strokes over the next 5 years.^{§§§}

^{§§§} Additional information available at <http://millionhearts.hhs.gov>.

Reported by

Alanna J. Moshfegh, MS, Food Surveys Research Group, Joanne M. Holden, MS, Nutrient Data Laboratory, Agricultural Research Svc, U.S. Department of Agriculture. Mary E. Cogswell, DrPH, Elena V. Kuklina, MD, PhD, Sheena M. Patel, MPH, Janelle P. Gunn, MPH, Cathleen Gillespie, MS, Yuling Hong, MD, PhD, Robert Merritt, MS, Div for Heart Disease and Stroke Prevention; Deborah A. Galuska, Div of Nutrition, Physical Activity and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC. **Corresponding contributor:** Mary E. Cogswell, mcogswell@cdc.gov, 770-488-8053.

Acknowledgments

Catherine M. Loria, PhD, Div of Cardiovascular Sciences, National Heart, Lung, and Blood Institute, Jill Reedy, MPH, PhD, Div of Cancer Control and Population Sciences, National Cancer Institute, National Institutes of Health. Donna Rhodes, MS, Food Surveys Research Group, Agricultural Research Svc, U.S. Department of Agriculture. Edward Gregg, PhD, Judy Hannan, MS, Keming Yuan, MS, Div for Heart Disease and Stroke Prevention; Barbara A. Bowman, PhD, Peter Briss, MD, National Center for Chronic Disease Prevention and Health Promotion; Chia-Yih Wang, PhD, National Center for Health Statistics, CDC.

References

1. Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics—2012 update: a report from the American Heart Association. *Circulation* 2012;125:e2–220.
2. CDC. Vital Signs: Prevalence, treatment, and control of hypertension—United States, 1999–2002 and 2005–2008. *MMWR* 2011;60:103–8.
3. Bibbins-Domingo K, Chertow GM, Coxson PG, et al. Projected effect of dietary salt reductions on future cardiovascular disease. *N Engl J Med* 2010;362:590–9.
4. Institute of Medicine. Strategies to reduce sodium intake in the United States. Washington, DC: The National Academies Press; 2010. Available at <http://www.iom.edu/reports/2010/strategies-to-reduce-sodium-intake-in-the-united-states.aspx>. Accessed December 5, 2011.

5. US Department of Health and Human Services, US Department of Agriculture. Dietary guidelines for Americans, 2010. 7th ed. Washington DC: US Department of Health and Human Services, US Department of Agriculture; 2011. Available at <http://health.gov/dietaryguidelines/2010.asp>. Accessed December 5, 2011.
6. CDC. Usual sodium intakes compared with dietary guidelines, United States, 2005–2008. *MMWR* 2011;60:1413–7.
7. Mattes RD, Donnelly D. Relative contributions of dietary sodium sources. *J Am Coll Nutr* 1991;10:383–93.
8. Krebs-Smith SM, Kott PS, Guenther PM. Mean proportion and population proportion: two answers to the same question? *J Am Diet Assoc* 1989;89:671–6.
9. Subar AF, Krebs-Smith SM, Cook A, Kahle LL. Dietary sources of nutrients among US adults, 1989 to 1991. *J Am Diet Assoc* 1998;98:537–47.
10. CDC. Sodium intake among adults—United States, 2005–2006. *MMWR* 2010;59:746–9.
11. National Institutes of Health, National Cancer Institute. Risk factor monitoring and methods. sources of sodium among the US population, 2005–06. Available at <http://riskfactor.cancer.gov/diet/foodsources/sodium>. Accessed December 5, 2011.
12. Anderson CA, Appel LJ, Okuda N, et al. Dietary sources of sodium in China, Japan, the United Kingdom, and the United States, women and men aged 40 to 59 years: The INTERMAP study. *J Am Diet Assoc* 2010;110:736–45.
13. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. *Obesity Res* 2002;10:370–8.
14. Guthrie JF, Lin B-H, Frazao E. Role of food prepared away from home in the American diet, 1977–78 versus 1994–96: changes and consequences. *J Nutr Educ Behav* 2002;34:140–50.
15. Zeigler P, Briefel R, Ponza M, Novak T, Hendricks K. Nutrient intakes and food patterns of toddlers' lunches and snacks: influence of location. *J Am Diet Assoc* 2006;106(1 Suppl 1):s124–34.
16. US Department of Agriculture, Agricultural Research Service, Beltsville Human Nutrition Research Center, Food Surveys Research Group, 2011. Sodium intake of the US population: What we eat in America, NHANES 2007–2008. Food Surveys Research Group dietary data brief no. 8. Available at http://www.ars.usda.gov/sp2userfiles/place/12355000/pdf/dbrief/sodium_intake_0708.pdf. Accessed December 6, 2011.
17. Espeland MA, Kumanyika S, Wilson AC, et al. Statistical issues in analyzing 24-hour dietary recall and 24-hour urine collection data for sodium and potassium intakes. *Am J Epidemiol* 2001;153:996–1006.